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JEE Main 2026 Session 2

Chemistry
Solutions companion

300 questions / NCERT chapter navigation
Answers and available source solutions, in paper order.

Use the question numbers from the companion question paper. Brief source answers are identified wherever a detailed solution is unavailable.

Solutions on your phone

Scan to choose a chapter or question. You can also download all three solutions PDFs together.

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Open the PDF bookmarks panel on the left to jump between chapters. The chapter links in the guide are clickable too.

YOUR PRACTICE ROADMAP

Chapter & topic priorities

For this Session 2 collection, begin with **Hydrocarbons; Alcohols, Phenols and Ethers; Equilibrium**. These chapters have the largest share of the selected questions.

Practice weight = questions selected from a chapter / 300. Topic percentages use that chapter's question count. These are practice priorities from the prediction output, not guaranteed exam marks or probabilities.

NCERT chapter / leading topics	Priority	Questions	Weight
Some Basic Concepts of Chemistry Mole concept and stoichiometry: 3 (50.0%) / Mole concept: 2 (33.3%) / Solution preparation: 1 (16.7%)	Next	1-6 (6)	2.0%
Structure of Atom Quantum numbers: 2 (100.0%)	Consolidate	7-8 (2)	0.7%
Classification of Elements and Periodicity in Properties Classification of Elements and Periodicity in Properties: 3 (37.5%) / Ionisation enthalpy trend: 2 (25.0%) / Periodic trends: 2 (25.0%) / More topics in chapter guide	Next	9-16 (8)	2.7%
Chemical Bonding and Molecular Structure Chemical bonding: 4 (44.4%) / Molecular orbital theory: 3 (33.3%) / Hybridisation: 1 (11.1%) / More topics in chapter guide	Next	17-25 (9)	3.0%
Thermodynamics Thermodynamics: 4 (40.0%) / Thermodynamic energy and spontaneity: 2 (20.0%) / Enthalpy change: 1 (10.0%) / More topics in chapter guide	Focus first	26-35 (10)	3.3%
Equilibrium Chemical and ionic equilibrium: 10 (55.6%) / Acid-base equilibrium: 1 (5.6%) / Basic buffer: 1 (5.6%) / More topics in chapter guide	Focus first	36-53 (18)	6.0%
Redox Reactions Redox Reactions: 2 (50.0%) / Oxidation states and redox reactions: 1 (25.0%) / Oxidation-reduction principles: 1 (25.0%)	Consolidate	54-57 (4)	1.3%
Organic Chemistry - Some Basic Principles and Techniques Organic reaction mechanisms: 4 (40.0%) / Organic Chemistry - Some Basic Principles and Techniques: 2 (20.0%) / Organic reaction principles: 1 (10.0%) / More topics in chapter guide	Next	58-67 (10)	3.3%
Hydrocarbons Reactions of hydrocarbons: 117 (95.9%) / Aromaticity: 2 (1.6%) / Alkyne reduction and alkene oxidation: 1 (0.8%) / More topics in chapter guide	Focus first	68-189 (122)	40.7%
Solutions Boiling point elevation: 1 (20.0%) / Concentration of solutions: 1 (20.0%) / Freezing point depression: 1 (20.0%) / More topics in chapter guide	Consolidate	190-194 (5)	1.7%

NCERT chapter / leading topics	Priority	Questions	Weight
Electrochemistry Electrochemical cells: 1 (50.0%) / Electrode potentials and electrolysis: 1 (50.0%)	Consolidate	195-196 (2)	0.7%
Chemical Kinetics Initial-rate method: 1 (50.0%) / Reaction stoichiometry from a concentration-time graph: 1 (50.0%)	Consolidate	197-198 (2)	0.7%
The p-Block Elements Main group element chemistry: 4 (66.7%) / Acidic, basic and amphoteric oxides of group 14 elements: 1 (16.7%) / Gas-evolution reactions: 1 (16.7%)	Next	199-204 (6)	2.0%
The d- and f-Block Elements The d- and f- Block Elements: 6 (60.0%) / Properties of transition elements: 3 (30.0%) / Magnetic properties of transition ions: 1 (10.0%)	Next	205-214 (10)	3.3%
Coordination Compounds Coordination chemistry: 9 (60.0%) / Coordination Compounds: 2 (13.3%) / Coordination number and geometry: 1 (6.7%) / More topics in chapter guide	Focus first	215-229 (15)	5.0%
Haloalkanes and Haloarenes Nucleophilic substitution: 10 (76.9%) / Haloalkanes and Haloarenes: 1 (7.7%) / Reactivity of aryl halides: 1 (7.7%) / More topics in chapter guide	Focus first	230-242 (13)	4.3%
Alcohols, Phenols and Ethers Reactions of alcohols, phenols and ethers: 15 (71.4%) / Reactions of alcohols and phenols: 3 (14.3%) / Acid-catalysed dehydration: 2 (9.5%) / More topics in chapter guide	Focus first	243-263 (21)	7.0%
Aldehydes, Ketones and Carboxylic Acids Reactivity of the carbonyl group: 2 (50.0%) / Aldehydes, Ketones and Carboxylic Acids: 1 (25.0%) / Cyanohydrin reaction sequence: 1 (25.0%)	Consolidate	264-267 (4)	1.3%
Amines Amines: 3 (42.9%) / Reactions of amines: 2 (28.6%) / Amines and diazonium salts: 1 (14.3%) / More topics in chapter guide	Next	268-274 (7)	2.3%
Biomolecules Carbohydrates: 6 (54.5%) / Biomolecules: 3 (27.3%) / Proteins and amino acids: 1 (9.1%) / More topics in chapter guide	Focus first	275-285 (11)	3.7%
Practical Chemistry (NCERT Laboratory Manual) Practical and qualitative chemistry: 3 (75.0%) / Qualitative chemical analysis: 1 (25.0%)	Consolidate	286-289 (4)	1.3%
States of Matter Historical appendix / omitted source chapter Gas laws: 2 (66.7%) / Omitted Chapter : States of Matter: 1 (33.3%)	Historical appendix	290-292 (3)	1.0%
Hydrogen Historical appendix / omitted source chapter Hydrogen and its compounds: 2 (66.7%) / Hydrogen and water chemistry: 1 (33.3%)	Historical appendix	293-295 (3)	1.0%

NCERT chapter / leading topics	Priority	Questions	Weight
The s-Block Elements Historical appendix / omitted source chapter s-Block Elements: 1 (100.0%)	Historical appendix	296-296 (1)	0.3%
Surface Chemistry Historical appendix / omitted source chapter Adsorption: 1 (50.0%) / Adsorption isotherms: 1 (50.0%)	Historical appendix	297-298 (2)	0.7%
General Principles and Processes of Isolation of Elements Historical appendix / omitted source chapter Extraction and purification of metals: 1 (50.0%) / Metallurgy: 1 (50.0%)	Historical appendix	299-300 (2)	0.7%

How to use the priorities

1. Rank chapters by their selected question counts. Ties follow NCERT book order.
2. Focus first: chapters starting within the first 70% of selected, non-historical questions. Next: the following 20%. Consolidate: the remainder. A chapter crossing a threshold stays together.
3. Topic counts use the question's existing core concept, falling back to topic and then chapter. Each question is counted once. Full topic lists begin each chapter.
4. Historical/omitted chapters stay in a separate appendix. Their presence is not a recommendation that they are in the target examination syllabus.

Names follow NCERT Classes XI and XII. Practical chemistry is identified as a laboratory-manual section. Percentages are rounded and may not add to exactly 100.0%. Chapters with no selected questions are not listed; this does not mean they have no exam importance.

Chapter naming references: NCERT textbooks.

Some Basic Concepts of Chemistry

Question 1

Aqueous HCl reacts with $\mathbf{MnO_2(s)}$ to form $\mathbf{MnCl_2(aq)}$, $\mathbf{Cl_2(g)}$ and $\mathbf{H_2O(l)}$. What is the weight (in g) of $\mathbf{Cl_2}$ liberated when 8.7 g of $\mathbf{MnO_2(s)}$ is reacted with excess aqueous HCl solution ? (Given Molar mass in $\mathbf{gmol^{-1}Mn = 55, Cl = 35.5, O = 16, H = 1}$)

A. 7.1

B. 71

C. 21.3

D. 14.2

Correct answer: A

Source solution

$$\mathbf{MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O}$$

$$\frac{\mathbf{8.7}}{\mathbf{87}}\ \mathbf{Excess}\ \mathbf{0.1\ mole}$$
$$\mathbf{= 0.1\ mole}$$

Wt. of $\mathbf{Cl_2}$ obtained $= \mathbf{0.1 \times 71 = 7.1\ g}$

Question 2

The molarity of the solution prepared by dissolving 6.3 g of oxalic acid $(\mathbf{H_2C_2O_4 \cdot 2H_2O})$ in 250 mL of water in $\mathbf{molL^{-1}}$ is $\mathbf{x \times 10^{-2}}$. The value of x is

. (Nearest integer)

[Atomic mass : $\mathbf{H : 1.0, C : 12.0, O : 16.0}$]

Numerical answer: _____

Enter the requested integer (0 decimal places).

Correct answer: 20

Source solution

$$[\mathbf{H_2C_2O_4 \cdot 2H_2O}] = \frac{\mathbf{weight\ /M_w}}{\mathbf{V(L)}}$$

$$\Rightarrow \mathbf{x \times 10^{-2}} = \frac{\mathbf{6.3/126}}{\mathbf{250/1000}}$$

$$\mathbf{x = 20}$$

Question 3

Quantitative analysis of an organic compound (X) shows following % composition.

C : 14.5%

Cl : 64.46%

H : 1.8%

(Empirical formula mass of the compound $(\mathbf{X})$ is

$\times 10^{-1}$

(Given molar mass in $\mathbf{gmol}^{-1}$ of $\mathbf{C : 12, H : 1, O : 16, Cl : 35.5}$)

Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 1655

Source solution

	C	Cl	H	O
\%mass	14.5	64.46	1.8	19.24
Molar ratio	$\frac{14.5}{12}$	$\frac{64.46}{35.5}$	$\frac{1.8}{1}$	$\frac{19.24}{16}$
	1.2	1.8	1.8	1.2
Minimum integral ratio	2	3	3	2

Empiricial formula $= \mathrm{C_2H_3Cl_3O_2}$

Mass $= 165.5$

Mass $= 1655 \times 10^{-1}$

Question 4

For the given reaction;

$$\mathrm{CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2}$$

If $\mathbf{90\ g CaCO_3}$ is added to 300 mL of HCl which
contains 38.55% HCl by mass and has density $\mathbf{1.13\ g\ mL^{-1}}$, then which of the following option is correct?
Given molar mass of H, Cl, Ca and O are 1, 35.5, 40 and $\mathbf{16\ g\ mol^{-1}}$ respectively.

A. 64.97 g of HCl remains unreacted

B. 32.85 g of $\mathbf{CaCO_3}$ remains unreacted

C. 97.30 g of HCl reacted

D. 60.32 g of HCl reamains unreacted

Correct answer: A

Source solution

Density of HCl solution $\mathbf{(d) = 1.13\ g/ml}$

$$\mathbf{V = 300ml}$$

Wt. of HCl solution $= \mathbf{339\ g}$
Wt. of $\mathbf{HCl = 339 \times \frac{38.55}{100} = 130.68\ g}$
(LR)

$\mathrm{CaCO_3}+$	$\mathrm{2HCl \rightarrow CaCl_2 + H_2O + CO_2}$
$\frac{90}{100}$	$\frac{130.68}{36.5}$
$= 0.90$ mole	$= 3.58$ mole

Moles of HCl remained = 1.78 mole.
Mass of HCl remained $= \mathbf{64.97\ g}$.

Question 5

A solution containing 2 g of a non-volatile solute in 20 g of water boils at 373.52 K . The molecular mass of the solute is $\mathbf{gmol^{-1}}$. (Nearest integer)
Given, water boils at $\mathbf{373\ K,\ K_b}$ for water $= \mathbf{0.52\ K\ kg\ mol^{-1}}$

Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 100

Source solution

100
$\mathbf{\Delta T_b = 373.52 - 373 = 0.52}$
$\mathbf{\Delta T_b = iK_bm \quad i = 1}$
$\mathbf{0.52 = 0.52 \times \frac{2/x}{20} \times 1000}$
$\mathbf{x = 100 gm/mol}$

Question 6

Match List I with List II

LIST I (molecules/ions)		LIST II (No. of lone pairs of e^- on central atom)	
A.	IF_7	I.	Three
B.	ICl_4^-	II.	One
C.	XeF_6	III.	Two
D.	XeF_2	IV.	Zero

Choose the correct answer from the options given below:

A. A - II, B - III, C - IV, D - I

B. A - II, B - I, C - IV, D - III

C. A - IV, B - I, C - II, D - III

D. A - IV, B - III, C - II, D - I

Correct answer: D

Source solution

Molecule
IF_7
\href{http://l.pe}{l.pe} $^-$of C.M.
ICl_4^-
0
XeF_6
2
XeF_2
1
3

Structure of Atom

Questions 7-8 / 2 selected / 0.7% practice weight / Consolidate

Question 7

According to Bohr's atomic theory :
(A) Kinetic energy of electron is $\propto \frac{Z^2}{n^2}$
(B) The product of velocity (v) of electron and principal quantum number (n). ' vn ' $\propto \mathbf{Z^2}$.
(C) Frequency of revolution of electron in an orbit is $\propto \frac{Z^3}{n^3}$.
(D) Coulombic force of attraction on the electron is $\propto \frac{z^3}{n^4}$.

Choose the most appropriate answer from the options given below:

A. (C) only

B. (A) and (D) only

C. (A) only

D. (A), (C) and (D) only

Correct answer: B

Source solution

Sol. (A) $\mathbf{KE} = -\mathbf{TE} = 13.6 \times \frac{\mathbf{Z^2}}{\mathbf{n^2}}\mathbf{eV}$
$\mathbf{KE} \propto \frac{\mathbf{Z^2}}{\mathbf{n^2}}$
(B) $V = 2.188 \times 10^6 \times \frac{Z}{n}\ \mathbf{m/sec}.$

So, $Vn \propto Z$
(C) Frequency $= \frac{V}{2\pi r}$

So, $\mathbf{F} \propto \frac{\mathbf{Z^2}}{\mathbf{n^3}}$ $\left[\because \mathbf{r} \propto \frac{\mathbf{n^2}}{\mathbf{z}} \text{ and } \mathbf{v} \propto \frac{\mathbf{Z}}{\mathbf{n}}\right]$
(D) Force $\propto \frac{\mathbf{z}}{\mathbf{r^2}}$

So, $\mathbf{F} \propto \frac{\mathbf{Z^3}}{\mathbf{n^4}}$
So, only statement (A) is correct

Question 8

In a multielectron atom, which of the following orbitals described by three quantum numbers with have same energy in absence of electric and magnetic fields?

A. $\mathbf{n = 1, 1 = 0,\ m_1 = 0}$

B. $\mathbf{n = 2, 1 = 0,\ m_1 = 0}$

C. $\mathbf{n = 2, 1 = 1,\ m_1 = 1}$

D. $\mathbf{n = 3, 1 = 2,\ m_1 = 1}$

E. $\mathbf{n = 3, 1 = 2,\ m_1 = 0}$

Choose the correct answer from the options given below:

A. A and B only

B. B and C only

C. C and D only

D. D and E only

Correct answer: D

Source solution

Sol.

orbital

$\mathbf{A : n = 1, \ell = 0,\ m_\ell = 0}$ 1s

$\mathbf{B : n = 2, \ell = 0,\ m_\ell = 0}$

$\mathbf{C : n = 3, \ell = 1,\ m_\ell = 1}$

$\mathbf{D : n = 3, \ell = 2,\ m_\ell = 1}$ 3d

$\mathbf{E : n = 3, \ell = 2,\ m_\ell = 0}$

In absence of electric and magnetic fields, all orbitals of 3d are degenerate

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Classification of Elements and Periodicity in Properties

Question 9

Which of the following reaction is correct?

A. $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 2\ N_2O_4 + O_2$

B. $2LiNO_3 \xrightarrow{\Delta} 2NaNO_2 + O_2$

C. $2LiNO_3 \rightarrow 2Li + 2NO_2 + O_2$

D. $4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$

Correct answer: D

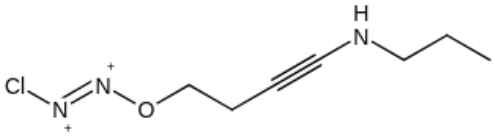
Source solution

$4LiNO_3 \xrightarrow{\Delta} 2Li_2O + 4NO_2 + O_2$

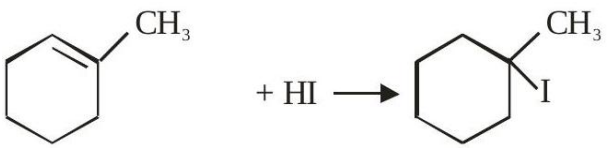
Question 10

Which of the following reaction is correct ?

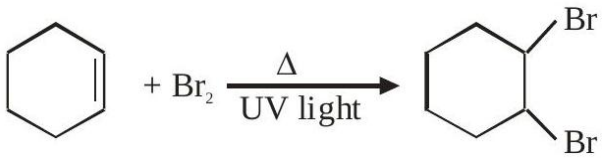
A.



B.



C.

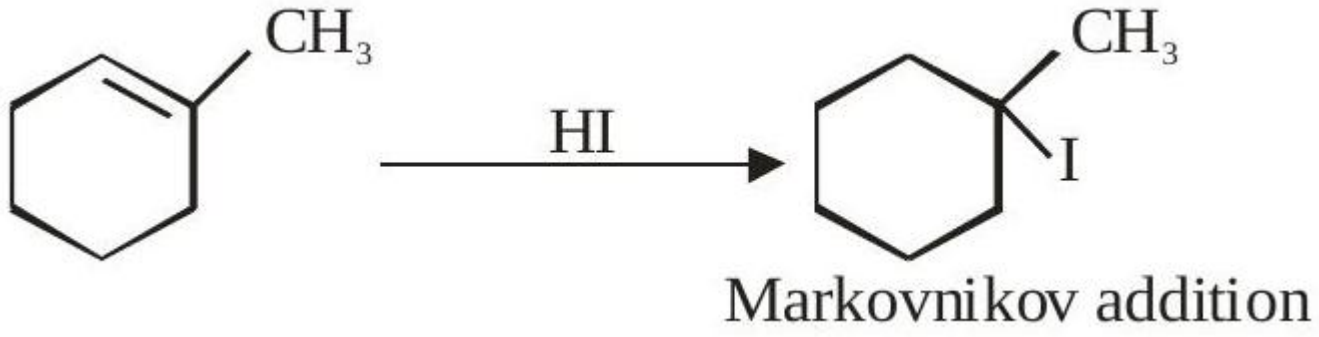


D.

$$C_2H_5CONH_2 + Br_2 + NaOH \rightarrow C_2H_5CH_2NH_2 + Na_2CO_3 + NaBr + H_2O$$

Correct answer: B

Source solution



Question 11

Match the LIST-I with LIST-II.

LIST-I	Family	LIST-II	Symbol
A.	Pnictogen (Group 15)	I.	Ts
B.	Chalcogen	II.	Og
C.	Halogen	III.	Lv
D.	Noble Gas	IV.	Mc

Choose the correct answer from the options given below.

A. A-IV, B-I, C-II, D-III

B. A-IV, B-III, C-I, D-II

C. A-III, B-I, C-IV, D-II

D. A-II, B-III, C-IV, D-I

Correct answer: B

Source solution

Sol.

$$A \rightarrow \text{Mc (115)}$$
$$B \rightarrow \text{Lv (116)}$$
$$C \rightarrow \text{Ts (117)}$$
$$D \rightarrow \text{Og (118)}$$

$$A - \text{IV}, \quad B - \text{III}, \quad C - \text{I}, \quad D - \text{II}$$

$$\text{Correct Answer : (2)}$$

Question 12

Which of the following statements are correct?

A. The process of the addition an electron to a neutral gaseous atom is always exothermic

B. The process of removing an electron from an isolated gaseous atom is always endothermic

C. The 1st ionization energy of the boron is less than that of the beryllium

D. The electronegativity of C is 2.5 in CH_4 and CCl_4

E. Li is the most electropositive among elements of group I

Choose the correct answer from the options gives below

A. B and C only

B. A, C and D only

C. B and D only

D. B, C and E only

Correct answer: A

Source solution

Sol. (A) The process of adding an e^- to a neutral gaseous atom is not always exothermic it may be exothermic or endothermic.

(C) Be

B

$1s^2 2s^2 \quad 1s^2 2s^2 2p^1$

In Be 2s subshell in fully filled

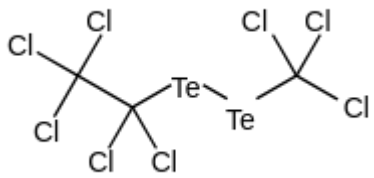
So, need high energy to remove e^- as compared to B .

(D)

due to partially positive charge $z_{eff} \uparrow, EN \uparrow$

So, EN of $C \Rightarrow CCl_4 > CH_4$

(E) Cs is most electropositive.



Question 13

Given below are two statements :

Statement (I) : The first ionisation enthalpy of group 14 elements is higher than the corresponding elements of group 13.
Statement (II) : Melting points and boiling points of group 13 elements are in general much higher than those the corresponding elements of group 14. In the light of the above statements, choose the most appropriate answer from the options given below :

A. Statement I is correct but Statement II is incorrect

B. Statement I is incorrect but Statement II is correct

C. Both Statement I and Statement II are incorrect

D. Both Statement I and Statement II are correct

Correct answer: A

Source solution

Sol. Statement 1 is correct since left to right 1E increases in general in periodic table.
Statement 2 is incorrect since M.P. of group 14 elements is more than group 13 elements.

Question 14

Which of the following statements are correct?

A. The M^{3+}/M^{2+} reduction potential for iron is greater than manganese

B. The higher oxidation states of first row dblock elements get stabilized by oxide ion.

C. Aqueous solution of Cr^{2+} can liberate hydrogen from dilute acid.

D. Magnetic moment of V^{2+} is observed between $4.4 - 5.2BM$

Choose the correct answer from the options given below:

(1) (B), (C) only

(C), (D) only

(2) (A), (B), (D) only

(A), (B) only

Correct answer: A

Source solution

(A) The M^{3+}/M^{2+} reduction potential for manganese is greater than iron

(B) $E^0_{Fe^{+3}/Fe^{+2}} = +0.77$

$$E^0_{Mn^{+3}/Mn^{+2}} = +1.57$$

(C) $E^0_{Cr^{+3}/Cr^{+2}} = -0.26$

$\therefore \quad Cr^{2\oplus} + H^{\oplus} \longrightarrow Cr^{3\oplus} + \frac{1}{2}H_2$

(D) $V^{2\oplus} = 3$ unpaired electron

Magnetic Moment = 3.87 B.M

Question 15

Select the correct statements among the following:

A. B, C, D

B. A, B, C, D

C. A, B, C

D. C, D

Correct answer: A

Source solution

}
Only LiCl amongst the first group chlorides dissolve in pyridine because the solvation energy of lithium is higher than the other salts of the same group.
Lithium does not react with ethyne to form ethynilide due to its small size and high polarizability. Lithium and Magnesium both have very small sizes and very high ionization potentials so, they react slowly with water.
Amongst all the alkali metals, Li has the smallest size hence, the hydration energy for Li is maximum.

Question 16

Match List-I with List-II.

List-I	Elements
A	Cl, S
B	Ge, As
C	Fr, Ra
D	F, O

List-II	Properties
I	Highest electronegativity
II	Largest atomic size
III	Properties of both metals and non-metals
IV	Highest negative electron gain enthalpy

Choose the correct answer from the options given below.

A. A-II, B-III, C-IV, D-I

B. A-III, B-II, C-I, D-IV

C. A-IV, B-III, C-II, D-I

D. A-II, B-I, C-IV, D-III

Correct answer: C

Source solution

Sol.

$$\begin{aligned} \mathrm{F, O} &\\ &\rightarrow \text{Highest electronegativity} \\ \mathrm{Fr, Ra} &\\ &\rightarrow \text{Largest atomic size} \\ \mathrm{Ge, As} &\\ &\rightarrow \text{Metalloids} \\ \mathrm{Cl, S} &\\ &\rightarrow \text{Highest negative electron gain enthalpy} \end{aligned}$$

Therefore,

$$A \rightarrow IV$$

$$B \rightarrow III$$

$$C \rightarrow II$$

$$D \rightarrow I$$

$$\boxed{A - IV,\ B - III,\ C - II,\ D - I}$$

Correct Answer: (3)

Chemical Bonding and Molecular Structure

Question 17

An element ' E ' has the ionisation enthalpy value of $374\ \mathrm{kJ\ mol^{-1}}$. 'E' reacts with elements A, B, C and D with electron gain enthalpy values of $-328, -349$, -325 and $-295\ \mathrm{kJ\ mol^{-1}}$, respectively.

The correct order of the products EA, EB, EC and ED in terms of ionic character is :

A. $\mathrm{EB} > \mathrm{EA} > \mathrm{EC} > \mathrm{ED}$

B. $\mathrm{ED} > \mathrm{EC} > \mathrm{EA} > \mathrm{EB}$

C. $\mathrm{EA} > \mathrm{EB} > \mathrm{EC} > \mathrm{ED}$

D. $\mathrm{ED} > \mathrm{EC} > \mathrm{EB} > \mathrm{EA}$

Correct answer: A

Source solution

$$\text{Solution}$$

$$\text{Ionisation enthalpy of } E = 374\ \mathrm{kJ\ mol^{-1}}$$

$$\text{Electron gain enthalpies are}$$

$$A = -328, \quad B = -349$$

$$C = -325, \quad D = -295$$

$$\mathrm{kJ\ mol^{-1}}$$

Greater the difference between

I.E. of cation-forming atom

and E.G.E. of anion-forming atom,

greater is the ionic character.

$$\Delta_A = 374 - 328 = 46$$

$$\Delta_B = 374 - 349 = 25$$

$$\Delta_C = 374 - 325 = 49$$

$$\Delta_D = 374 - 295 = 79$$

Smaller the value of $(I.E. - |E.G.E.|)$,

greater is the tendency

for ionic bond formation.

$$25 < 46 < 49 < 79$$

$$\therefore$$

$$EB > EA > EC > ED$$

$$\boxed{EB > EA > EC > ED}$$

$$\boxed{\text{Correct Option : (1)}}$$

Question 18

The bond order and magnetic behaviour of O_2^- ion are, respectively :

A. 1.5 and paramagnetic

B. 1.5 and diamagnetic

C. 2 and diamagnetic

D. 1 and paramagnetic

Correct answer: A

Source solution

Sol. $O_2^- = (\sigma_{1s})^2(\sigma_{1s}^*)^2(\sigma_{2s})^2(\sigma_{2s}^*)^2(\sigma_{2p_z})^2$
$\left(\pi_{2p_x}^2 = \pi_{2p_y}^2\right)\left(\pi_{2p_x}^{*2} = \pi_{2p_y}^{*1}\right)$
Bond order $= \frac{10-7}{2} = 1.5$
and paramagnetic

Question 19

Match List-I with List-II

List-I (Molecule/Ion)	List-II (Hybridisation)
$A.\ PF_5$	$I.\ dsp^2$
$B.\ SF_6$	$II.\ sp^3d$
$C.\ Ni(CO)_4$	$III.\ sp^3d^2$
$D.\ [PtCl_4]^{2-}$	$IV.\ sp^3$

Choose the correct answer from the options given below.

A. A-II, B-III, C-IV, D-I

B. A-IV, B-I, C-II, D-III

C. A-I, B-II, C-III, D-IV

D. A-III, B-I, C-IV, D-II

Correct answer: A

Source solution

Solution:

$$PF_5$$

$$5 \text{ bond pairs } + 0 \text{ lone pair}$$

$$\Rightarrow sp^3d$$

$$A \rightarrow II$$

$$SF_6$$

$$6 \text{ bond pairs } + 0 \text{ lone pair}$$

$$\Rightarrow sp^3d^2$$

$$B \rightarrow III$$

$$Ni(CO)_4$$

Tetrahedral complex

$$\Rightarrow sp^3$$

$$C \rightarrow IV$$

$$[PtCl_4]^{2-}$$

Square planar complex

$$\Rightarrow dsp^2$$

$$D \rightarrow I$$

$$\boxed{A-II,\ B-III,\ C-IV,\ D-I}$$

Correct Option (1)

Question 20

Match List-I with List-II

List-I	List-II
$A.\ SO_2Cl_2$	$I.$ Paramagnetic
$B.\ NO$	$II.$ Diamagnetic
$C.\ NO_2^-$	$III.$ Tetrahedral
$D.\ I_3^-$	$IV.$ Linear

Choose the correct answer from the options given below :

A. A-IV, B-I, C-III, D-II

B. A-III, B-I, C-II, D-IV

C. A-II, B-III, C-I, D-IV

D. A-III, B-IV, C-II, D-I

Correct answer: B

Source solution

Solution

$$SO_2Cl_2 \Rightarrow \text{Tetrahedral} \Rightarrow (\text{III})$$

$$NO \Rightarrow \text{One unpaired electron} \Rightarrow \text{Paramagnetic} \Rightarrow (\text{I})$$

$$NO_2^- \Rightarrow \text{All electrons paired} \Rightarrow \text{Diamagnetic} \Rightarrow (\text{II})$$

$$I_3^- \Rightarrow \text{Linear} \Rightarrow (\text{IV})$$

$$\therefore A - \text{III}, \quad B - \text{I}, \quad C - \text{II}, \quad D - \text{IV}$$

Correct Answer : (2)

Question 21

Match List-I with List-II

List-I	List-II
A. Molecules obeying octet rule	*I*. NO, NO_2
B. Molecules with incomplete octet	*II*. BCl_3, $AlCl_3$
C. Molecules with odd electron	*III*. H_2SO_4, PCl_5
D. Molecules with expanded octet	*IV*. CCl_4, CO_2

Choose the correct answer from the options given below :

A. A-IV, B-II, C-I, D-III

B. A-III, B-II, C-I, D-IV

C. A-IV, B-I, C-III, D-II

D. A-II, B-IV, C-III, D-I

Correct answer: A

Source solution

Solution

A. Molecules obeying octet rule

CCl_4, CO_2

$\Rightarrow$ (IV)

B. Molecules with incomplete octet

$$BCl_3,\ AlCl_3$$

$$\Rightarrow (II)$$

C. Molecules with odd electron

$$NO,\ NO_2$$

$$\Rightarrow (I)$$

D. Molecules with expanded octet

$$H_2SO_4,\ PCl_5$$

$$\Rightarrow (III)$$

$$\therefore$$

$$A-IV,\quad B-II,\quad C-I,\quad D-III$$

Correct Answer : (1)

Question 22

Match List-I with List-II

	List-I (Species)		List-II (Hybrid Orbitals)
(a)	SF_4	(i)	$sp^3\ d^2$
(b)	IF_5	(ii)	d^2sp^3
\multirow[t]{2}{*}{(c)}	\multirow[t]{2}{*}{NO_2^+}	(iii)	$sp^3\ d$
		(iv)	sp^3
(d)	NO_4^+	(v)	sp

Choose the correct answer from the options given below :

A. (a)-(i), (b)-(ii), (c)-(v) and (d)-(iii)

B. (a)-(ii), (b)-(i), (c)-(iv) and (d)-(v)

C. (a)-(iii), (b)-(i), (c)-(v) and (d)-(iv)

D. (a)-(iv), (b)-(iii), (c)-(ii) and (d)-(v)

Correct answer: C

Source solution

(a) $SF_4 - SP^3\ d$ hybridisation $IF_5 - sp^3\ d^2$ hybridisation $NO_2^+ - sp$ hybridisation $NO_4^+ - sp^3$ hybridisation

Question 23

Match List-I with List-II

List-I	List-II (B.P. : L.P.)
$A.\ ICl_2^-$	$I.\ 4:2$
$B.\ H_2O$	$II.\ 4:1$
$C.\ SO_2$	$III.\ 2:3$
$D.\ XeF_4$	$IV.\ 2:2$

Choose the correct answer from the options given below :

A. A-IV, B-III, C-II, D-I

B. A-III, B-IV, C-II, D-I

C. A-III, B-IV, C-I, D-II

D. A-II, B-I, C-IV, D-III

Correct answer: B

Source solution

Solution

$$ICl_2^-$$

$$\text{Central atom} = I$$

$$\text{B.P.} : \text{L.P.} = 2:3$$

$$\Rightarrow (III)$$

$$H_2O$$

$$\text{Central atom} = O$$

$$\text{B.P.} : \text{L.P.} = 2 : 2$$

$$\Rightarrow (IV)$$

$$SO_2$$

$$\text{Central atom} = S$$

$$\text{B.P.} : \text{L.P.} = 2 : 1$$

$$\text{Steric number} = 3$$

$$\Rightarrow (II)$$

$$XeF_4$$

$$\text{Central atom} = Xe$$

$$\text{B.P.} : \text{L.P.} = 4 : 2$$

$$\Rightarrow (\text{I})$$

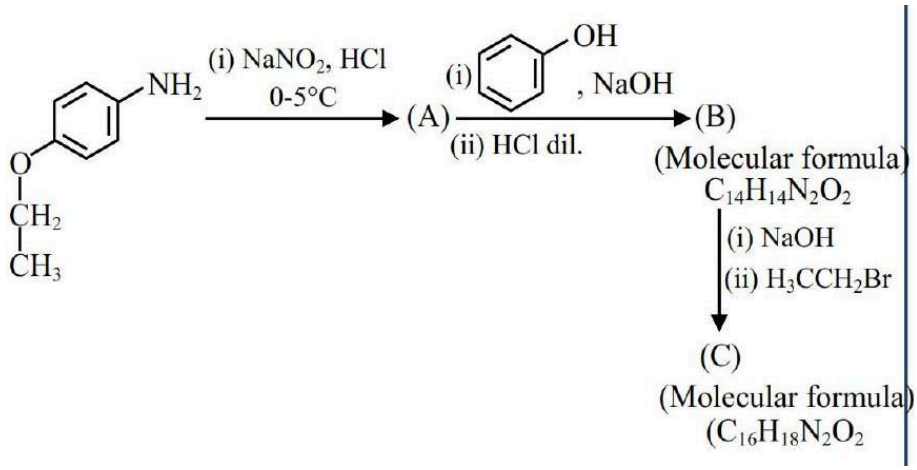
$$\therefore$$

$$A - \text{III}, \quad B - \text{IV}, \quad C - \text{II}, \quad D - \text{I}$$

$$\boxed{\text{Correct Answer : (2)}}$$

Question 24

Consider the following sequence of reactions.



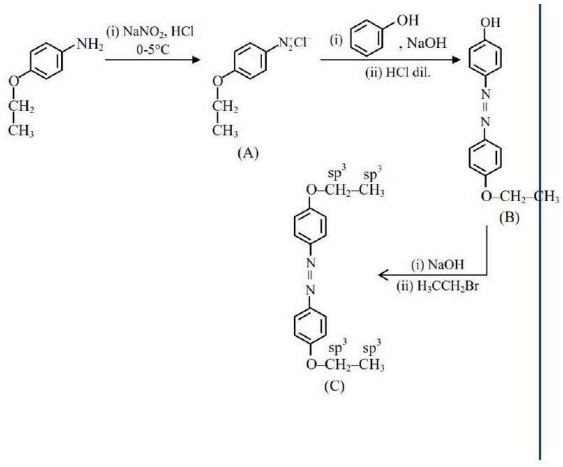
Total number of $\mathbf{sp^3}$ hybridised carbon atoms in the major product C formed is .

Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 4

Source solution



Question 25

Match List - I with List - II

List - I	List - II
(A) $\Psi_{MO} = \Psi_A - \Psi_B$	(I) Dipole moment
(B) $\mu = Q \times r$	(II) Bonding molecular orbital
(C) $\frac{N_b - N_a}{2}$	(III) Anti-bonding molecular orbital
(D) $\Psi_{MO} = \Psi_A + \Psi_B$	(IV) Bond order

A. (A)-(II), (B-(I), (C)-(IV), (D)-(III)

B. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

C. (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

D. (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Correct answer: C

Source solution

Solution:

In molecular orbital (MO) theory:

$$\Psi_{MO} = \Psi_A + \Psi_B \Rightarrow \text{Bonding molecular orbital}$$

$$\Psi_{MO} = \Psi_A - \Psi_B \Rightarrow \text{Anti-bonding molecular orbital}$$

$$\mu = Q \times r \Rightarrow \text{Dipole moment}$$

$$\text{Bond order} = \frac{N_b - N_a}{2}$$

where N_b is the number of electrons in bonding orbitals and N_a is the number of electrons in anti-bonding orbitals.

Therefore, the correct matching is:

$$(\text{A}) \rightarrow (\text{III}), \quad (\text{B}) \rightarrow (\text{I}), \quad (\text{C}) \rightarrow (\text{IV}), \quad (\text{D}) \rightarrow (\text{II})$$

Thermodynamics

Questions 26-35 / 10 selected / 3.3% practice weight / Focus first

Question 26

For the reaction $2NO_2(g) \rightleftharpoons N_2O_4(g)$, when $\Delta S = -176.0 JK^{-1}$ and $\Delta H = -57.8\ kJ\ mol^{-1}$, the magnitude of ΔG at 298 K for the reaction is ___ $kJmol^{-1}$. (Nearest integer)

Numerical answer: _____

Enter the requested integer (0 decimal places).

Correct answer: 5

Source solution

$$\Delta G = \Delta H - T\Delta S$$

$$\Delta G = 57.8 - \frac{298(-176)}{1000}$$

$$\Delta G = -5.352\ kJ/mol$$

$|$ Nearest integer value $| = 5$

Question 27

Use the following data :

Substance	$\frac{\Delta_f H^{\ominus}(500\ K)}{kJmol^{-1}}$	$\frac{S^{\ominus}(500\ K)}{JK^{-1}\ mol^{-1}}$
AB(g)	32	222
$A_2(g)$	6	146
$B_2(g)$	X	280

One mole each of $A_2(g)$ and $B_2(g)$ are taken in a 1L closed flask and allowed to establish the equilibrium at 500K.

$$A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$$

The value of x (in $kJmol^{-1}$) is

_____

(Nearest integer)

(Given: $\log K = 2.2R = 8.3JK^{-1}\ mol^{-1}$)

Numerical answer: _____

Enter an integer. Use the units and scaling requested in the question.

Correct answer: 70

Source solution

$$A_2 + B_2 \xrightarrow{500\ K} 2AB \log K = 2.2$$

$$\Delta H^\circ = (2 \times 32) - (6 + x) = (58 - x) kJ$$
$$\Delta\ S^\circ = (2 \times 222) - (146 + 280) = 18 Joule$$
$$\Delta G^\circ = -RTlnK$$
$$\Delta G^\circ = -\frac{8.314 \times 500 \times 2.2 \times 2.303}{1000}$$
$$\Delta G^\circ = -21.06$$
$$\Delta H^\circ - T\Delta\ S^\circ = -21.06$$
$$58 - x - 500\left(\frac{18}{1000}\right) = -21.06$$
$$x = 70.06 KJ/mol$$

Question 28

The value of $\log K$ for the reaction $A \leftrightharpoons B$ at 298 K is ..... (Nearest integer)

Given: $\Delta H^0 = -54.07\ kJ\ mol^{-1}$
$\Delta S^\circ = 10 JK^{-1}\ mol^{-1}$
(Take $2.303 \times 8.314 \times 298 = 5705$)

Numerical answer: _____

Enter the requested value or coefficient rounded to the nearest integer (0 decimal places).

Correct answer: 10

Source solution

$\Delta G^0 = \Delta H^0 - T\Delta S$
$\Rightarrow \Delta G^0 = (-54070 - 10 \times 298)$
Also, $\Delta G^0 = (-2.303 RT \log K)$
$\Rightarrow (-54070 - 10 \times 298)$
$= (-2.303 \times 8.134 \times 298 \log\ K)$
$\Rightarrow \log K = 10$ Ans: 10

Question 29

Match List - I with List - II.

List -I

(Processes/Reactions)
(A) $\mathbf{2SO_2(\ g) + O_2(\ g) \rightarrow 2SO_3(\ g)}$
(B) $\mathbf{4NH_3(\ g) + 5O_2(\ g) \rightarrow 4NO(g) + 6H_2O(g)}$
(C) $\mathbf{N_2(\ g) + 3H_2(\ g) \rightarrow 2NH_3(\ g)}$
(D) Vegetable oil $\mathbf{(\mathit{l}) + H_2}$ $\rightarrow$ Vegetable ghee(s)

List - II
(Catalyst)
(I) $\mathbf{Fe(s)}$
(II) $\mathbf{Pt(s) - Rh(s)}$
(III) $\mathbf{V_2O_5}$
(IV) $\mathbf{Ni(s)}$

Choose the correct answer from the options given below:

A. - (III), (B) - (I), (C) - (II), (D) - (IV)

B. (A) - (III), (B) - (II), (C) - (I), (D) - (IV)

C. (A) - (IV), (B) - (III), (C) - (I), (D) - (II)

D. (A) - (IV), (B) - (II), (C) - (III), (D) - (I)

Correct answer: B

Source solution

$\mathbf{2SO_2(\ g) + O_2(\ g) \xrightarrow{V_2O_5} 2SO_3(\ g)}$:
contact process

$$\mathbf{4NH_3(\ g) + 5O_2(\ g) \xrightarrow{Pt(\ s)-Rh(\ s)} 4NO(\ g) + 6H_2O(\ g)}:$$

Ostwald's process

$\mathrm{N_2(g) + 3H_2(g) \xrightarrow{Fe(s)} 2NH_3(g)}$; Haber's process

Vegetable oil $(l) + \mathrm{H_2(g)} \xrightarrow{\mathrm{Ni(s)}}$ vegetable ghee : Hydrogenation

---

Question 30

28.0 L of CO_2 is produced on complete combustion of 16.8 L gaseous mixture of ethene and methane at $25°C$ and 1 atm . Heat evolved during the combustion process is kJ .

Given : $\Delta H_c\,(CH_4) = -900 kJ mol^{-1}$
$\Delta H_c\,(C_2H_4) = -1400\ kJ\ mol^{-1}$

Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 847

Source solution

847
Moles of mixture $= \frac{Pv}{RT} = \frac{1\times16.8}{0.0821\times298} = 0.6866 moles$
Moles of $CO_2 = \frac{1\times28}{0.0821\times298} = 1.144\ mole$
$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
X X
$C_2H_4 + 3O_2 \longrightarrow 2CO_2 + 2H_2O$
$(0.6866 - x)$ $2(0.686 - x)$
Total CO_2 produced $= 1.144$
$x + 2(0.6866 - x) = 1.144$
$x = 1.3732 - 1.144$
$= 0.2292$
Moles of $CH_4 = 0.2292$
Moles of $C_2H_4 = 0.6866 - 0.2292$

$$= 0.4574$$

Total Heat produced
$= (900 \times 0.2292) + (0.4574 \times 1400)$
$= 206.28 + 640.36 = 846.64$

Question 31

Enthalpies of formation of $\mathrm{CCl_4(g), H_2O(g), CO_2(g)}$ and $\mathrm{HCl(g)}$ are $-105, -242, -394$ and $92\ \mathrm{kJ\ mol^{-1}}$ respectively. The magnitude of enthalpy of the reaction given below is $\mathrm{kJmol^{-1}}$. (nearest integer)

$$\mathrm{CCl_4(g) + 2H_2O(g) \rightarrow CO_2(g) + 4HCl(g)}$$

Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 173

Source solution

173

$\mathrm{\Delta H_r = (\Delta H_f)CO_2 + (\Delta H_f)_{HCl} - (\Delta H_f)_{CCl_4} - 2\,(\Delta H_f)H_2O}$

$= -173$

Question 32

The group 14 elements A and B have the first ionisation enthalpy values of 708 and $715\ \mathrm{kJ\ mol^{-1}}$ respectively. The above values are lowest among their group members. The nature of their ions $\mathrm{A^{2+}}$ $\mathrm{B^{4+}}$ respectively is

A. both reducing

B. both oxidising

C. reducing and oxidising

D. oxidising and reducing

Correct answer: C

Source solution

As per given information of ionisation energy

$$\mathrm{A = Sn \& \ B = Pb}$$

$\mathrm{A^{+2} = Sn^{2+}}$ = Reducing agent
$\mathrm{B^{+4} = Pb^{+4}}$ = Oxidising agent

Question 33

Which of the following is not correct?

A. ΔG is negative for a spontaneous reaction

B. ΔG is positive for a spontaneous reaction

C. $\mathrm{\Delta G}$ is zero for a reversible reaction

D. $\mathrm{\Delta G}$ is positive for a non-spontaneous reaction

---

Correct answer: B

Source solution

Sol. $\mathrm{(\Delta G)_{P,T} = (+)}$ ve for non-spontaneous process

---

Question 34

Which of the following statement is incorrect?

A. Low solubility of LiF in water is due to its small hydration enthalpy.

B. KO_2 is paramagnetic.

C. Sol of sodium in liquid ammonia is conducting in nature.

D. Sodium metal has higher density than potassium metal

Correct answer: A

Source solution

Sol. Low solubility of LiF in water is due to high lattice enthalpy

Question 35

Match List-I with List-II.
List-I
List-II
Alkali Metal
Emission Wavelength in nm
(A) Li
(I) 589.2
(B) Na
(II) 455.5
(C) Rb
(III) 670.8
(D) Cs
(IV) 780.0

Choose the correct answer from the options given below:

A. -(I), (B)-(IV), (C)-(III), (D)-(II)

B. (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

C. (A)-(IV), (B)-(II), (C)-(I), (D)-(III)

D. (A)-(II), (B)-(IV), (C)-(III), (D)-(I)

Correct answer: B

The source provides a brief answer only. A detailed worked solution is not available for this question.

Source solution

Fact Based

Equilibrium

Questions 36-53 / 18 selected / 6.0% practice weight / Focus first

Question 36

For the reaction,
$\mathbf{2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)}$,
$\mathbf{\Delta H = -57.2\ kJ\ mol^{-1}}$ and $\mathbf{K_c = 1.7 \times 10^{16}}$.
Which of the following statement is INCORRECT?

A. The equilibrium constant is large suggestive of reaction going to completion and so no catalyst is required.

B. The addition of inert gas at constant volume will not affect the equilibrium constant.

C. The equilibrium will shift in forward direction as the pressure increases.

D. The equilibrium constant decreases as the temperature increases.

Correct answer: A

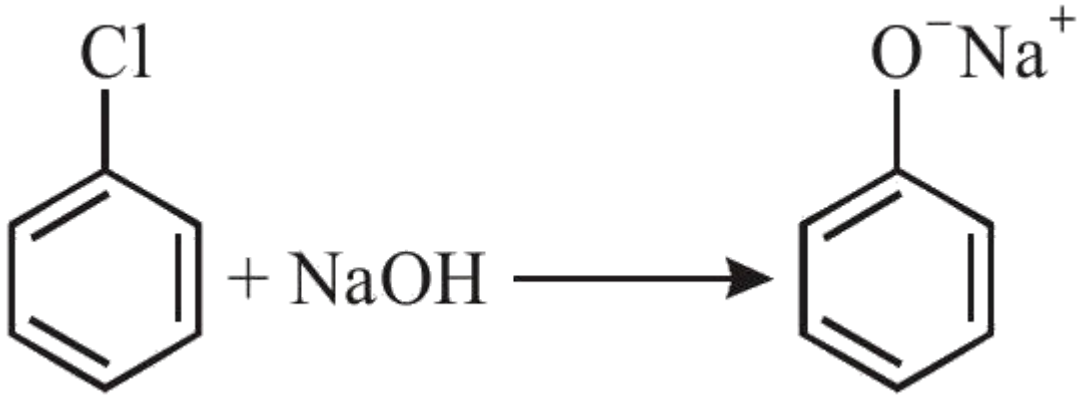
Source solution

Sol. $\mathbf{2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)}$
$\boldsymbol{K_c = 1.7 \times 10^{16}}$ i.e. reaction goes to completion. Equilibrium constant has no relation with catalyst. Catalyst only affects the rate with which a reaction proceeds.

For the given reaction, catalyst $\mathbf{V_2O_5}$ is used to speed up the reaction (Contact process).

Question 37

The above reaction requires which of the following reaction conditions?



A. $573\ K, Cu, 300\ atm$

B. $623\ K, Cu, 300\ atm$

C. $573\ K, 300\ atm$

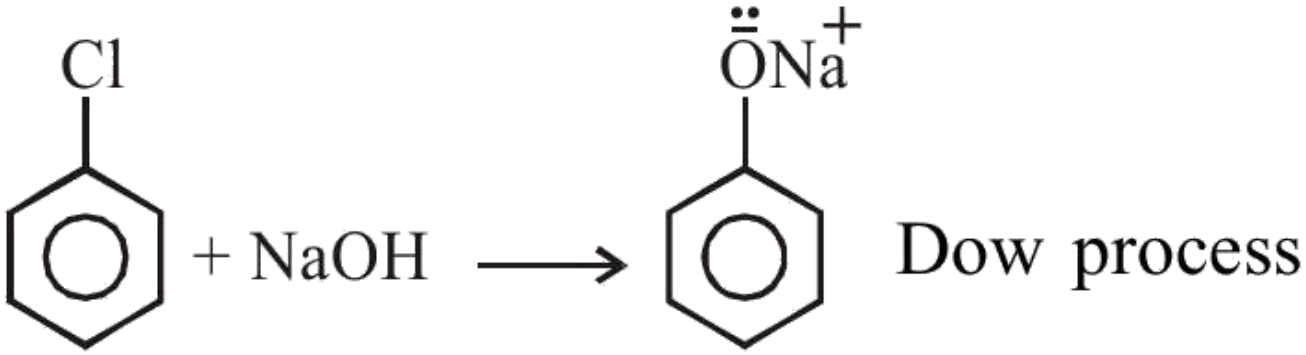
D. $623\ K, 300\ atm$

Correct answer: D

Source solution

Sol.

Temperature = $623\ K$
Pressure = $300\ atm$



Question 38

When 5.1 g of solid $\mathbf{NH_4HS}$ is introduced into a two litre evacuated flask at $\mathbf{27^\circ C, 20\%}$ of the solid decomposes into gaseous ammonia and hydrogen sulphide. The $\mathbf{K_p}$ for the reaction at $\mathbf{27^\circ C}$ is $\mathbf{x \times 10^{-2}}$. The value of $\boldsymbol{x}$ is . (Integer answer)
[Given $\mathbf{R = 0.082\ L\ atm\ K^{-1}\ mol^{-1}}$]

Numerical answer: _____

Enter the requested integer (0 decimal places).

Correct answer: 6

Source solution

moles of $\mathbf{NH_4HS}$ initially taken $= \frac{5.1\ g}{51\ g/mol}$

$$= 0.1\ mol$$

volume of vessel $= 2\ell$

	$\mathbf{NH_4HS_{(s)} \rightleftharpoons}$	$\mathbf{NH_{3(g)} + H_2S_{(g)}}$	
$\mathbf{t = 0}$	0.1 mol		
$\mathbf{t = \infty}$	$\mathbf{0.1(1 - 0.2)}$	$\mathbf{0.1 \times 0.2}$	$\mathbf{0.1 \times 0.2}$

$\Rightarrow$ partial pressure of each component
$\mathbf{P = \frac{nRT}{V} = \frac{0.1 \times 0.2 \times 0.082 \times 300}{2}}$
$\mathbf{= 0.246\ atm}$
$\mathbf{\Rightarrow k_P = P_{NH_3} \times P_{H_2S} = (0.246)^2 = 0.060516}$
$\mathbf{= 6.05 \times 10^{-2}}$
$\mathbf{\Rightarrow 6}$

Question 39

Dissociation of a gas $\mathbf{A_2}$ takes place according to the following chemical reactions. At equilibrium, the total pressure is 1 bar at 300K.

$$\mathbf{A_2(\,g) \rightleftharpoons 2\,A(\,g)}$$

The standard Gibbs energy of formation of the involved substances has been provided below:

Substance	$\Delta G_t^\circ / \mathrm{kJmol^{-1}}$
$\mathbf{A_2}$	-100.00
A	-50.832

The degree of dissociation of $\mathbf{A_2(\,g)}$ is given by $\left(\mathbf{x} \times 10^{-2}\right)^{1/2}$ where $\mathbf{x} =$

_____

.

(Nearest integer).

[Given : $\mathbf{R = 8\ J\ mol^{-1}\ K^{-1}, \log 2 = 0.3010}$, $\mathbf{\log 3 = 0.48}$]

Numerical answer: _____

Enter an integer. Use the units and scaling requested in the question.

Correct answer: 33

Source solution

$$\mathbf{-1.664 \times 10^3 = -8.3 \times 300 \ln K_p}$$

$$\mathbf{\ln K_p = 0.693}$$

$$\mathbf{K_p = 2}$$

$$2 = \frac{4\alpha^2 P_0}{1-\alpha^2}$$

$$\alpha = \frac{1}{\sqrt{3}}$$

$$\alpha = \left(\frac{100}{3} \times 10^{-2}\right)^{1/2}$$
$$= \left(33.33 \times 10^{-2}\right)^{1/2}$$

Question 40

Consider the general reaction given below at 400 K

$$\mathbf{xA(\,g) \rightleftharpoons yB(\,g)}$$

The values of $\mathbf{K_p}$ and $\mathbf{K_c}$ are studied under the same condition of temperature but variation in x and y.
(i) $\mathbf{K_p = 85.87}$ and $\mathbf{K_c = 2.586}$ appropriate units
(ii) $\mathbf{K_p = 0.862}$ and $\mathbf{K_c = 28.62}$ appropriate units
The value of $\boldsymbol{x}$ and $\boldsymbol{y}$ in (i) and (ii) respectively are:

A. (i) 3, 1 ; (ii) 3, 1

B. (i) 4, 1 ; (ii) 4, 1

C. (i) 1, 3 ; (ii) 2, 1

D. (i) 1, 2 ; (ii) 2, 1

Correct answer: D

Source solution

For reaction (i): $\mathbf{K_p > K_c}$

$$\mathbf{\Delta n_g > 0}$$
$$\mathbf{y - x > 0.}$$
$$\mathbf{85.87 = 2.586(0.0821 \times 400)^{y-x}}$$

Solving $\mathbf{y - x \simeq 1}$
For reaction (ii) : $\mathbf{K_p < K_c}$
$\mathbf{y - x < 0}$.
SECTION-B

Question 41

The OH^- concentration in a mixture of 5.0 mL of $0.0504 M NH_4Cl$ and 2 mL of $0.0210 M NH_3$ solution is $x \times 10^{-6} M$. The value of x is .
(Nearest integer)
[Given $K_w = 1 \times 10^{-14}$ and $K_b = 1.8 \times 10^{-5}$]

Numerical answer: _____

Enter the requested integer (0 decimal places).

Correct answer: 3

Source solution

$[NH_4^+] = 0.0504 \& [NH_3] = 0.0210$
So $K_b = \frac{[NH_4^+][HO^-]}{[NH_3]}$
$[HO^-] = \frac{K_b \times [NH_3]}{[NH_4^+]} = 1.8 \times 10^{-5} \times \frac{2}{5} \times \frac{210}{504} = 3 \times 10^{-6}$

Question 42

The equilibrium composition for the reaction $PCl_3 + Cl_2 \rightleftharpoons PCl_5$ at 298 K is given below.
$[PCl_3]_{eq} = 0.2\ mol\ L^{-1}$ $[Cl_2]_{eq} = 0.1\ mol\ L^{-1}$, $[PCl_5]_{eq} = 0.40\ mol\ L^{-1}$

If 0.2 mol of Cl_2 is added at the same temperature, the equilibrium concentrations of PCl_5 is $\times 10^{-2}\ mol\ L^{-1}$.

Given : K_c for the reaction at 298 K is 20

Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 48

Source solution

$$PCl_3 + Cl_2 \rightleftharpoons PCl_5$$

0.2 M & $(0.1 + 0.2)M$ & 0.4 M $Eq^m \cdot 0.2 - x$ & $0.3 - x$ & $0.4 + x$	
$\frac{(0.4+x)}{(0.2-x)(0.3-x)} = 20$	
$\Rightarrow x \simeq 0.086$	

$[PCl_5]_{eq} = 0.486M = 48.6 \times 10^{-2}M$

Question 43

$37.8\ g\ N_2O_5$ was taken in a 1 L reaction vessel and allowed to undergo the following reaction at 500 K

$2\ N_2O_{5(g)} \rightarrow 2\ N_2O_{4(g)} + O_{2(g)}$

The total pressure at equilibrium was found to be 18.65 bar.

Then, $Kp =$ $\times 10^{-2}$ [nearest integer]

Assume N_2O_5 to behave ideally under these conditions

Given : $R = 0.082$ bar $Lmol^{-1}\ K^{-1}$

Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 962

Source solution

Initial pressure of N_2O_5

$$= \frac{\frac{37.8}{108} \times 0.082 \times 500}{1} = 14.35 \text{ bar}$$

$$2\ N_2O_5 \rightleftharpoons 2\ N_2O_4 + O_2$$

$t = 0 \quad 14.35$

$t = \text{ eq} \quad 14.35 - 2P \quad 2P \quad P$

$P_{Total} \text{ at eqb } = 14.35 + P = 18.65$

$P = 4.3$

$P_{N_2O_5} = 5.75 \text{ bar}$

$P_{N_2O_4} = 8.6 \text{ bar}$

$P_{O_2} = 4.3 \text{ bar}$

$$k_p = \frac{(8.6)^2 \times (4.3)}{(5.75)^2} = 9.619 = x \times 10^{-2}$$

$x = 961.9 \approx 962$

Ans. 962

Question 44

For complete combustion of ethene.
$\mathrm{C_2H_4(g) + 3O_2(g) \rightarrow 2CO_2(g) + 2H_2O(l)}$ the amount of heat produced as measured in bomb calorimeter is $\mathbf{1406\ kJ\ mol^{-1}}$ at 300 K . The minimum value of $\mathbf{T\Delta S}$ needed to reach equilibrium is $(-)$ kJ. (Nearest integer)

Given : $\mathbf{R = 8.3 JK^{-1}\ mol^{-1}}$

Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 1411

Source solution

$$\mathrm{C_2H_4(g) + 3O_2(g) \longrightarrow 2CO_2(g) + 2H_2O(\ell)}$$
$$\Delta U = -1406 KJmol^{-1},\ T = 300\ K$$
$$\Delta H = \Delta U + \Delta n_g RT$$
$$\Delta H = -1406 + (-2) \times 8.3 \times 300 = -1406 - 4.98$$
$$= -1410.98 KJmol^{-1} \approx -1411$$
$$\Delta H = T\Delta S = -1411 KJmol^{-1}$$

Question 45

Assuming that $\mathbf{Ba(OH)_2}$ is completely ionised in aqueous solution under the given conditions the concentration of $\mathbf{H_3O^+}$ions in 0.005 M aqueous solution of $\mathbf{Ba(OH)_2}$ at 298 K is ___ $\times \mathbf{10^{-12}}$ $\mathbf{mol\ L^{-1}}$. (Nearest integer)

Numerical answer: _____

Enter the requested integer (0 decimal places).

Correct answer: 1

Source solution

$$\mathbf{Ba(OH)_2 \rightarrow Ba^{+2} + 2OH}$$

$$\mathbf{2 \times \overset{\downarrow}{0.005} = 0.01 = 10^{-2}}$$

At 298 K : in aq. solution $\mathbf{\left[H_3O^+\right]\left[OH^-\right] = 10^{-14}}$

$$\mathbf{\left[H_3O^+\right] = \frac{10^{-14}}{10^{-2}} = 10^{-12}}$$

Question 46

Consider the following reaction approaching equilibrium at $27^{\circ}C$ and 1 atm pressure

$$A + B \underset{k_r=10^2}{\overset{k_f=10^3}{\rightleftharpoons}} C + D$$

The standard Gibb's energy change ($\Delta_r G^{\theta}$) at $27^{\circ}C$ is (-) $\quad KJmol^{-1}$

(Nearest integer).

(Given: $R = 8.3\ J\ K^{-1}\ mol^{-1}$ and $\ln 10 = 2.3$)

Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 6

Source solution

6

$K_{eq} = \frac{K_f}{K_b} = \frac{10^3}{10^2} = 10$

$\Delta G^0 = -RT \ln K_{eq}$

$= -8.3 \times 300 \ln 10$

$= -8.3 \times 300 \times 2.3$

$= -5.72 \times 10^{+3}\ J$

$= 5.72KJ$

Question 47

Match List I with List II

LIST I		LIST II	
A.	Chlorophyll	I.	Na_2CO_3
B.	Soda ash	II.	$CaSO_4$
C.	Dentistry, Ornamental work	III.	Mg^{2+}
D.	Used in white washing	IV.	$Ca(OH)_2$

Choose the correct answer from the options given below:

A. A-II, B-I, C-III, D-IV

B. A-III, B-I, C-II, D-IV

C. A-II, B-III, C-IV, D-I

D. A-III, B-IV, C-I, D-II

Correct answer: B

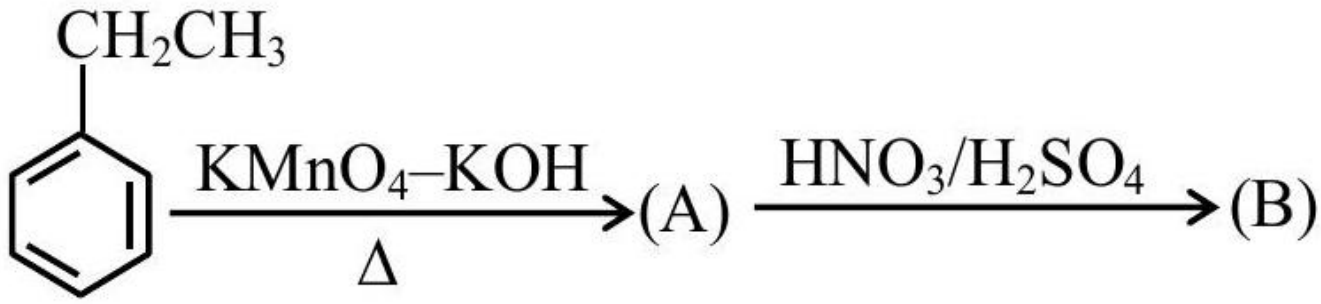
Source solution

Chlrophyl $\rightarrow Mg^{2+}$
Sodaash $\rightarrow Na_2CO_3$
Destistry &
ornamental work $\rightarrow CaSO_4$
White washing $\rightarrow Ca(OH)_2$

Question 48

Major product B of the following reaction has

π-bond.



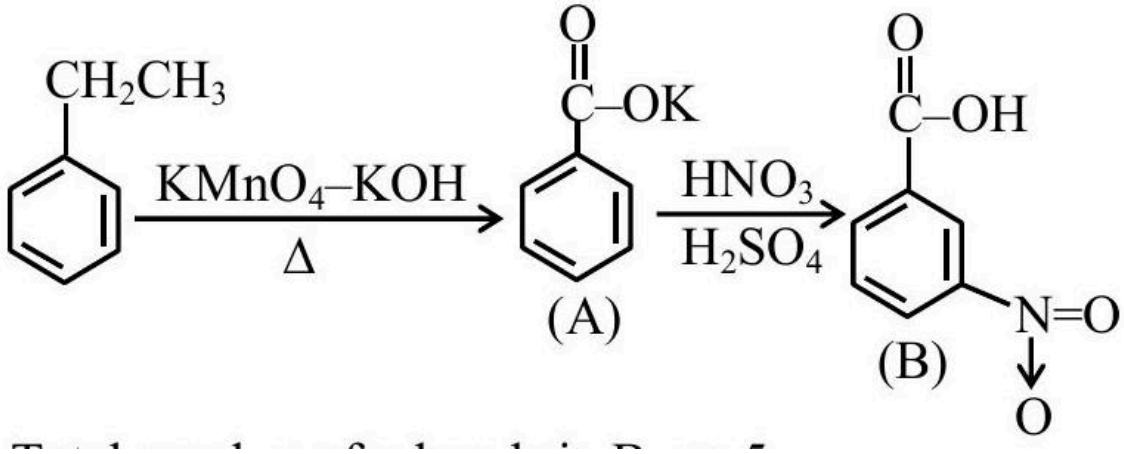
Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 5

Source solution

Major product B is $\rightarrow$



Total number of π bonds in B are 5

Question 49

Match List-I with List-II

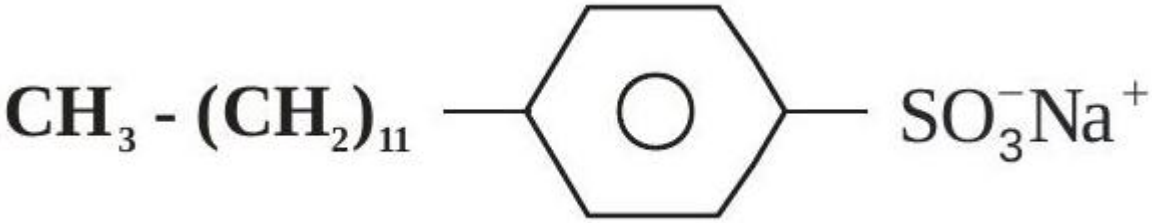
List-I

(A)



Br^-

(B)



(C) $C_{17}H_{35}COO^-Na^+ + Na_2CO_3 +$ Rosinate

(D) $CH_3(CH_2)_{16}COO(CH_2CH_2O)_nCH_2CH_2OH$

List-II

(I) Dishwashing powder
(II) Toothpaste
(III) Laundry soap
(IV) Hair conditioner

A. - (III), (B) - (II), (C) - (IV), (D) - (I)

B. (A) - (IV), (B) - (II), (C) - (III), (D) - (I)

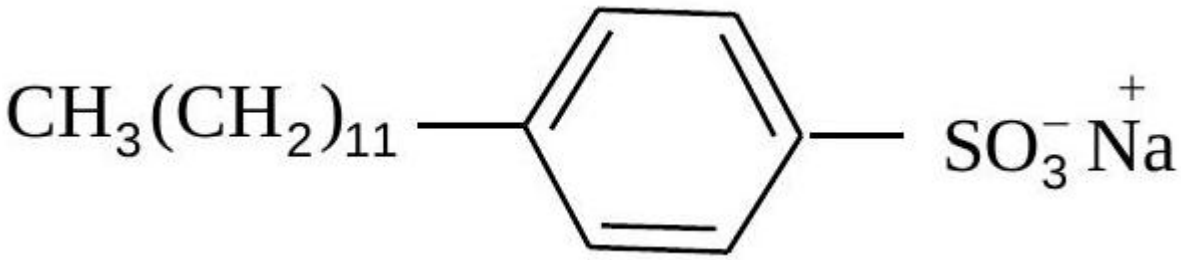
C. (A) - (IV), (B) - (III), (C) - (II), (D) - (I)

D. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct answer: B

Source solution

(A) $[CH_3(CH_2)_{15} - N(CH_3)_3]^+Br^-$
is cationic detergents used in hair conditioner
(B)



Is anionic detergent used in tooth pastes
(C) $C_{17}H_{35}COO^-Na^+ + Na_2CO_3 +$ Rosinate is used as laundary soap
(D) $CH_3(CH_2)_{16}COO(CH_2CH_2O)_NCH_2CH_2OH$ is non-ionic detergents formed from stearic acid and poly ethylene glycol used as liquid dishwashing detergents

Question 50

Match List - I with List II :

List - I		List - II	
(a)	Li	(i)	photoelectric cell
(b)	Na	(ii)	absorbent of CO_2
(c)	K	(iii)	coolant in fast breeder nuclear reactor
(d)	Cs	(iv)	treatment of cancer
		(v)	bearings for motor engines

Choose the correct answer from the options given below:

TEST PAPER WITH ANSWER

A. (a) - (v), (b) - (i), (c) - (ii), (d) - (iv)

B. (a) - (v), (b) - (ii), (c) - (iv), (d) - (i)

C. (a) - (iv), (b) - (iii), (c) - (i), (d) - (ii)

D. (a) - (v), (b) - (iii), (c) - (ii), (d) - (i)

Correct answer: D

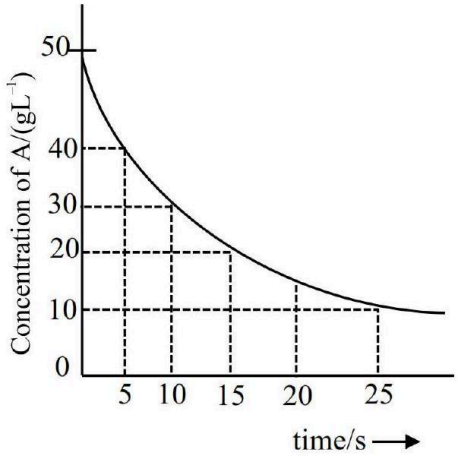
The source provides a brief answer only. A detailed worked solution is not available for this question.

Source solution

Question 51

For the reaction $\mathbf{A} \rightarrow \mathbf{B}$ the following graph was obtained. The time required (in seconds) for the concentration of A to reduce to $\mathbf{2.5\ g\ L^{-1}}$ (if the initial concentration of A was $\mathbf{50\ g\ L^{-1}}$) is (Nearest integer)

Given : $\log 2 = 0.3010$



Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 43

Source solution

As it is difficult to predict order using data provided in graph.
For specific time interval $\mathbf{0-5sec, 5-10sec}$ and $\mathbf{10-15sec}$. order comes to be zero, but graph is not a straight line.
Assuming $\mathbf{1^{st}}$ order kinetics
$\mathbf{K = \frac{1}{t} \ln \frac{A_0}{A_t}}$
$\mathbf{K = \frac{1}{10} \ln \frac{40}{20}}$
Time required to reduce to $\mathbf{2.5\ g/L}$
$\mathbf{K = \frac{1}{t} \ln \frac{50}{2.5}}$
$\mathbf{\frac{1}{10} \ln 2 = \frac{1}{t} \ln 20}$
$\mathbf{t = \frac{1.3010 \times 10}{0.3010} = 43.3 sec.}$

Question 52

Match List I with List II.

List-I		List-II	
A.	Sulphate	I.	Pesticide
B.	Fluoride	II.	Bending of bones
C.	Nicotine	III.	Laxative effect
D.	Sodium arsinite	IV.	Herbicide

Choose the correct answer from the options given below:

A. A-II, B-III. C-IV, D-I

B. A-IV, B-III, C-II, D-I

C. A-III, B-II, C-I, D-IV

D. A-III, B-II, C-IV, D-I

Correct answer: C

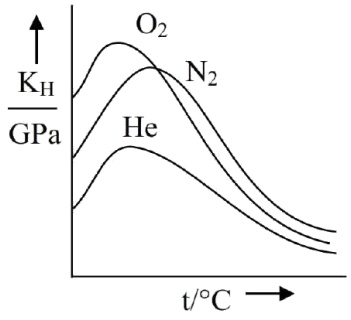
Source solution

A-Sulphate - III (Laxative effect)
B-Fluoride - II (Bending of bones)
C-Nictoine - I (pesticides)
D-Sodium Arsinite - IV (herbicide)

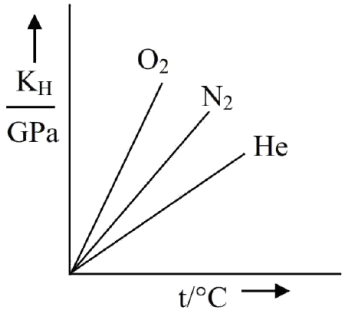
Question 53

Which of the following graph correctly represents the plots of $\mathbf{K_H}$ at 1 bar gases in water versus temperature?

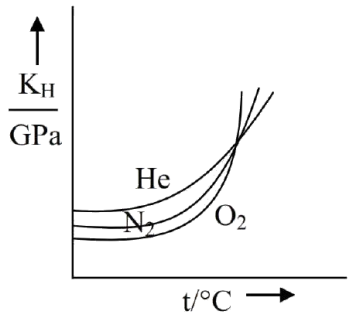
A.



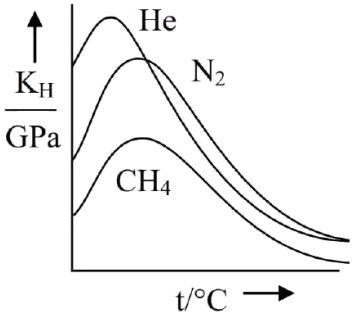
B.



C.



D.



Correct answer: D

Source solution

Sol.

Henry's law:

$$p = K_H x$$

Gas ki solubility aur K_H inversely related hote hain.

Temperature badhne par gas ki solubility pani mein kam ho jati hai, isliye

$$K_H \uparrow$$

Different gases ke liye hydration tendency:

$$\mathbf{He < N_2 < CH_4}$$

Isliye Henry's constant ka order hota hai:

$$K_H(\mathbf{He}) > K_H(\mathbf{N_2}) > K_H(\mathbf{CH_4})$$

Aur temperature ke saath K_H ka maan badhta hai.

Atah jo graph $\mathbf{He > N_2 > CH_4}$ dikhata hai wahi sahi hai.

$$\boxed{\textbf{Option (D)}}$$

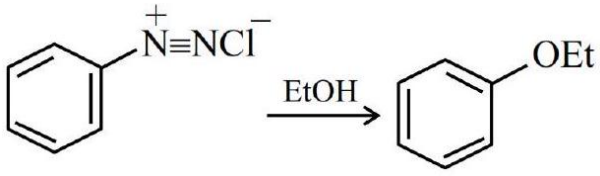
Redox Reactions

Questions 54-57 / 4 selected / 1.3% practice weight / Consolidate

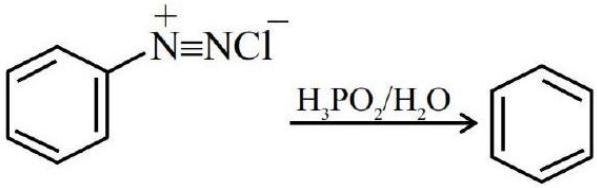
Question 54

In the following reactions, which one is NOT correct?

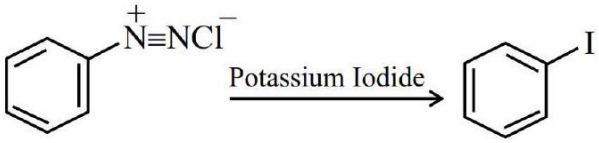
A.



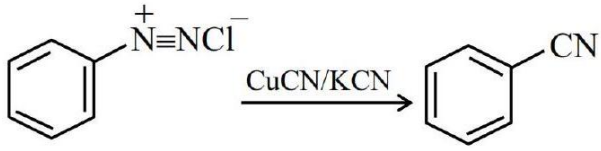
B.



C.

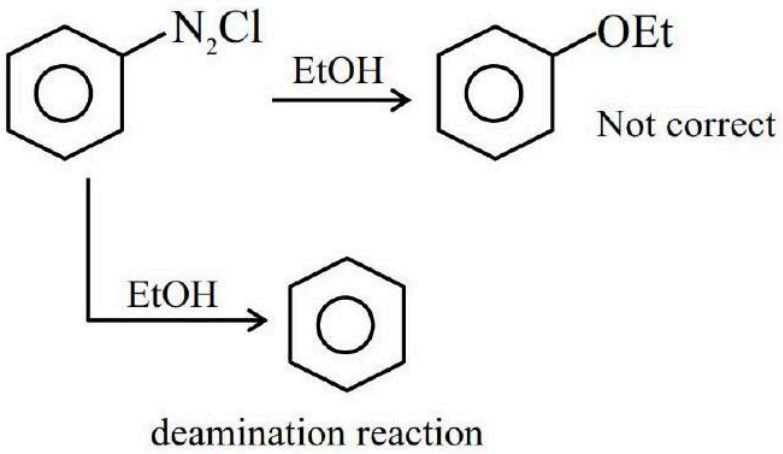


D.



Correct answer: A

Source solution



Question 55

Consider the following elements $\mathbf{In, Tl, Al, Pb, Sn}$ and Ge .
The most stable oxidation states of elements with highest and lowest first ionisation enthalpies, respectively, are

A. +2 and +3

B. +4 and +3

C. +4 and +1

D. +1 and +4

Correct answer: C

Source solution

Among Al, In, Tl, Ge, Sn, Pb, the metal having highest $\mathbf{IE_1}$ is Ge and lowest $\mathbf{IE_1}$ is In .
Most stable oxidation state of Ge is +4 and In is +3 .

Question 56

Given below are two statements :

Statements : $SbCl_5$ is more covalent than $SbCl_3$
Statements : The higher oxides of halogens also tend to be more stable than the lower ones.
In the light of the above statements, choose the most appropriate answer from the options given below

A. Both statement I and Statement II are correct

B. Both statement I and Statement II are incorrect

C. Statement I is correct but Statement II is incorrect

D. Statement I is incorrect but Statement II is correct

Correct answer: A

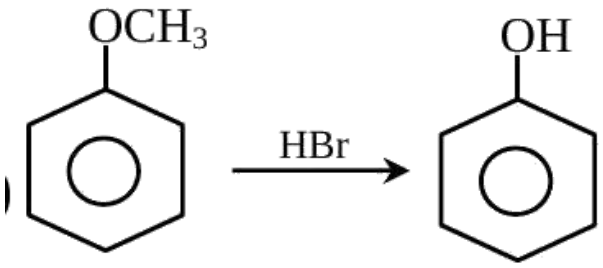
Source solution

Statement I : Is correct according to Fajan's rule Sb^{+5} more polarising power than Sb^{+3}.
Statement II : Stability of higher oxides of halogen is primarily due to
a) Higher oxidation state
b) More EN halogen
c) Resonance stabilization

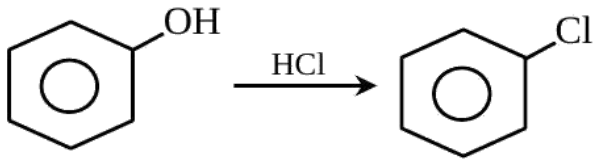
Question 57

Which one of the following reactions is NOT possible?

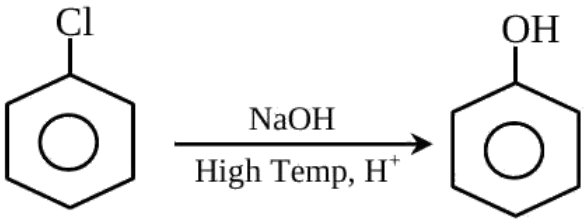
A.



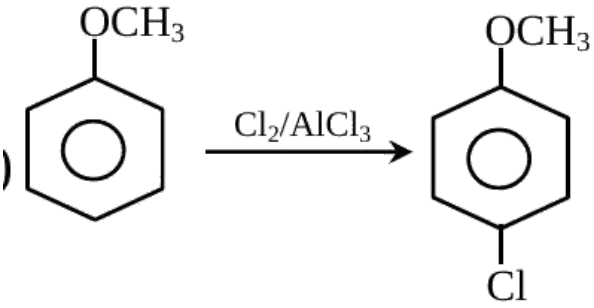
B.



C.



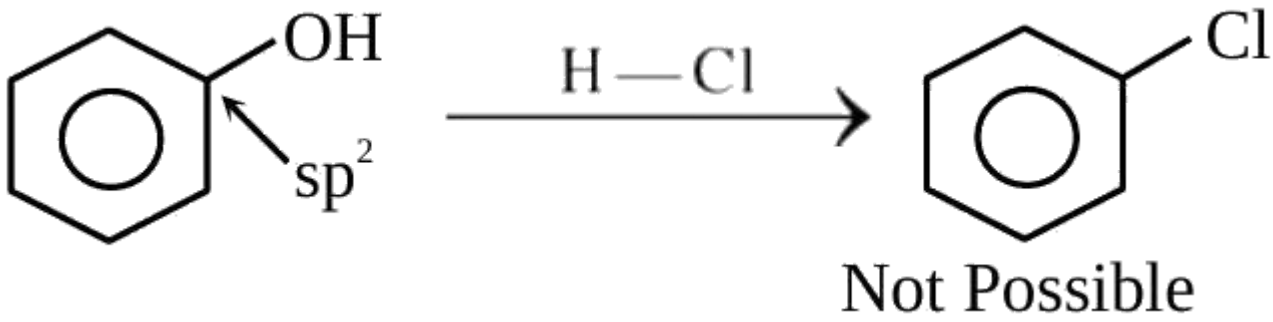
D.



Correct answer: B

Source solution

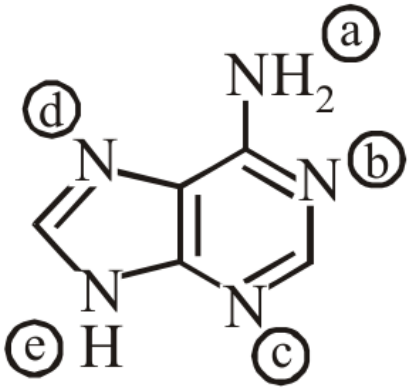
Sol.



Organic Chemistry - Some Basic Principles and Techniques

Question 58

In the following compound,
the favourable site/s for protonation is/are :-



A. (b), (c) and (d)

B. (a)

C. (a) and (e)

D. (a) and (d)

Correct answer: A

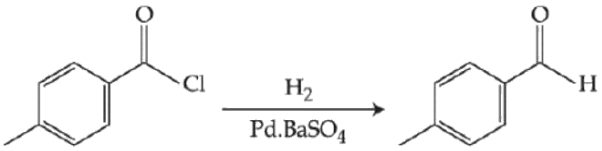
Source solution

Sol. Localised lone pair e^-.

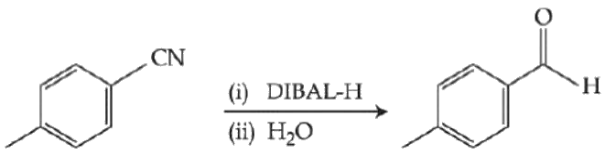
Question 59

Which one of the following reactions does not represent correct combination of substrate and product under the given conditions ?

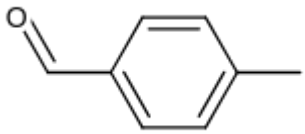
A.



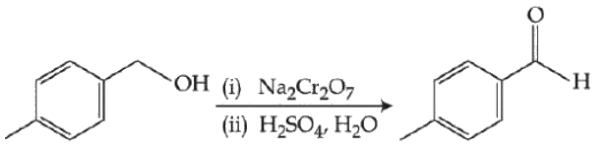
B.



C.



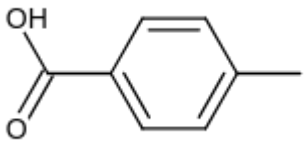
D.



Correct answer: D

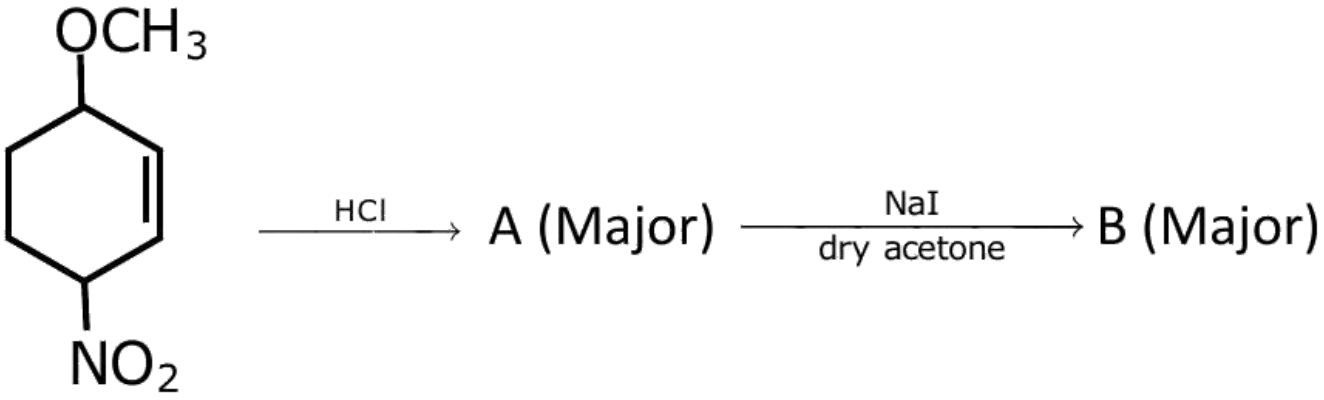
Source solution

Sol.



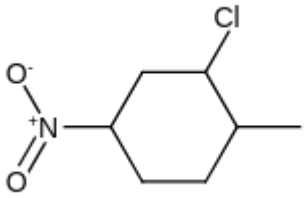
Question 60

Identify A and B in the chemical reaction.

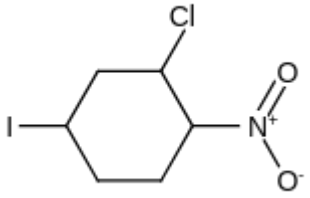


A. $A =$

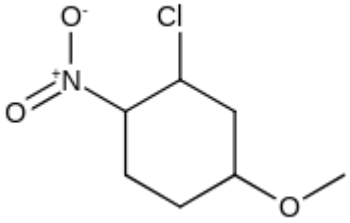
$B =$



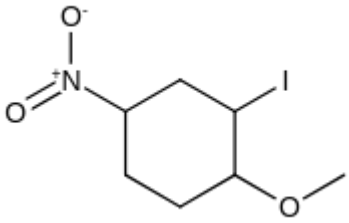
B. $B =$



C. $B =$



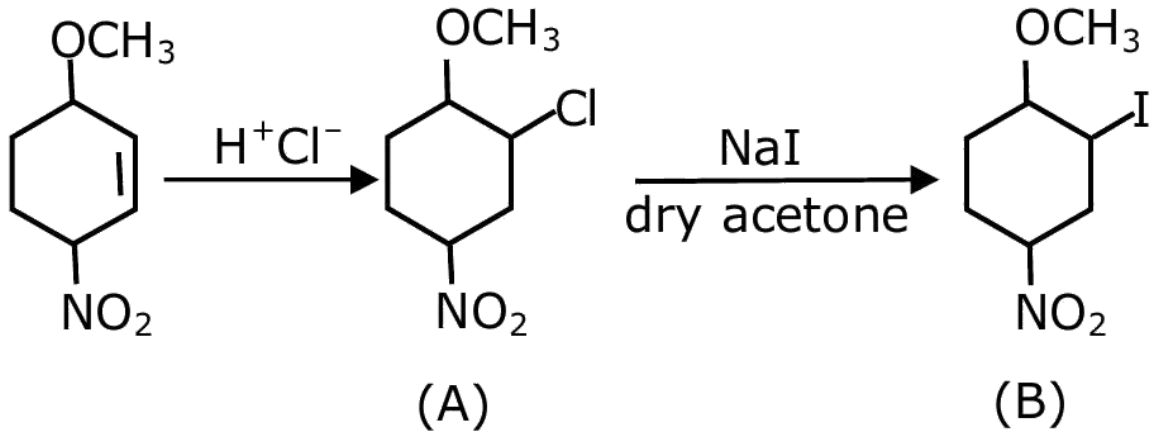
D. $B =$



Correct answer: D

Source solution

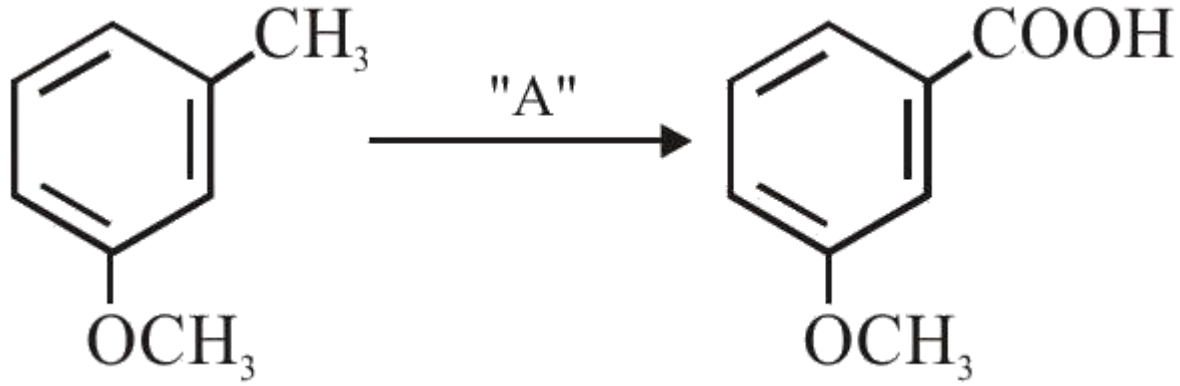
Sol. (4)



(A) (B)

Question 61

In the above reaction, the reagent " A " is :



A. $NaBH_4, H_3O^+$

B. $LiAlH_4$

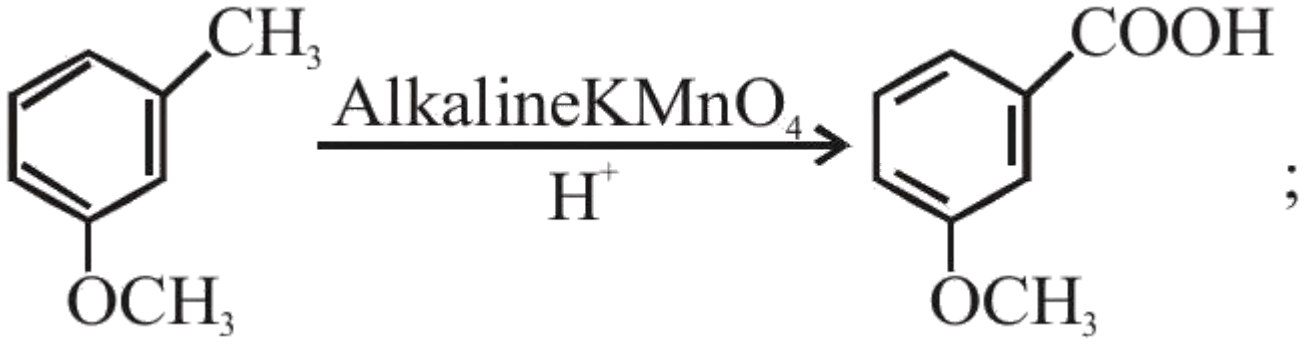
C. Alkaline $KMnO_4, H^+$

D. $HCl, Zn - Hg$

Correct answer: C

Source solution

Sol.



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Question 62

Match the LIST-I with LIST-II

LIST-I		LIST-II	
A.	Carbocation	I.	Species that can supply a pair of electrons.
B.	C-Free radical	II.	Species that can receive a pair of electrons.
C.	Nucleophile	III.	sp^2 hybridized carbon with empty p-orbital.
D.	Electrophile	IV	sp^2/sp^3 hybridized carbon with one unpaired electron.

Choose the correct answer from the options given below:

A. A-IV, B-II, C-III, D-I

B. A-II, B-III, C-I, D-IV

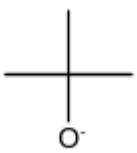
C. A-III, B-IV, C-II, D-I

D. A-III, B-IV, C-I, D-II

Correct answer: D

Source solution

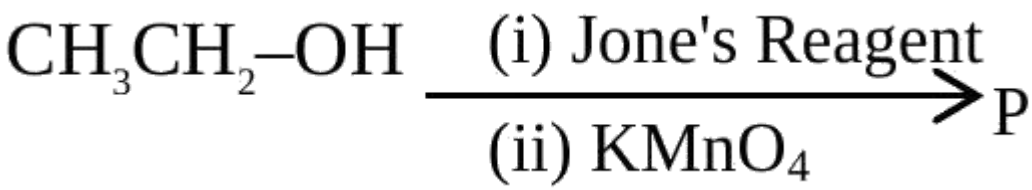
Sol. (A) Carbocation $\rightarrow$ sp^2 hybridised carbon with empty P-orbital
(B) Carbon free radical $\rightarrow$ sp^2/sp^3 hybridised carbon with one unpaired electron.
(C) Nuecleophile $\rightarrow$ species of that can supply a pair of electron.
(D) Electrophile $\rightarrow$ species that can receive a pair of electron.



Question 63

(iii) **NaOH, CaO, Δ**

Consider the above reaction sequence and identify the major product P .



A. Methane

B. Methanal

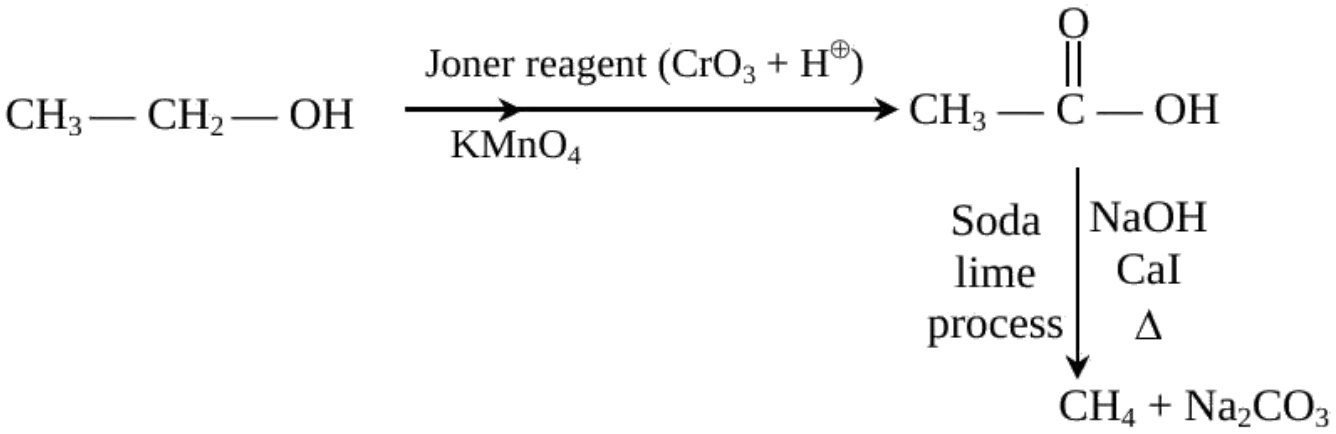
C. Methoxymethane

D. Methanoic acid

Correct answer: A

Source solution

Sol.



Question 64

Match List - I with List - II

	List - I	
(A)	$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$	(I)
(B)	$CO(g) + 3H_2(g) \rightarrow CH_4(g) + H_2O(g)$	(II) $Cu/ZnO - Cr_2O_3$
(C) $CO(g) + H_2(g) \rightarrow HCHO(g)$	(III) $Fe_xO_y + K_2O + Al_2O_3$	
(D) $CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$	(IV) Ni	

Choose the correct answer from the options given below:

A. - (II), (B) - (IV), (C) - (I), (D) - (III)

B. (A) - (II), (B) - (I), (C) - (IV), (D) - (III)

C. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

D. (A) - (III), (B) - (I), (C) - (IV), (D) - (II)

Correct answer: C

The source provides a brief answer only. A detailed worked solution is not available for this question.

Source solution

Factual

Question 65

Match List I with List II :

LIST I (Precipitating reagent and conditions)		LIST II (Cation)	
A.	$NH_4Cl + NH_4OH$	I.	Mn^{2+}
B.	$NH_4OH + Na_2CO_3$	II.	Pb^{2+}
C.	$NH_4OH + NH_4Cl + H_2S$ gas	III.	Al^{3+}
D.	dilute HCl	IV.	Sr^{2+}

Choose the correct answer from the options given below:

A. A-IV, B-III, C-II, D-I

B. A-IV, B-III, C-I, D-II

C. A-III, B-IV, C-I, D-II

D. A-III, B-IV, C-II, D-I

Correct answer: C

Source solution

Theory based question

Question 66

Match List-I with List-II :

List-I

(a) $[Co(NH_3)_6]\,[Cr(CN)_6]$
(b) $[Co(NH_3)_3(NO_2)_3]$
(c) $[Cr(H_2O)_6]Cl_3$
(d) cis $-[CrCl_2(ox)_2]^{3-}$

List-II

(i) Linkage isomerism
(ii) Solvate isomerism
(iii) Co-ordination isomerism
(iv) Optical isomerism Choose the correct answer from the options given below :

A. (a)-(iii), (b)-(i), (c)-(ii), (d)-(iv)

B. (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)

C. (a)-(ii), (b)-(i), (c)-(iii), (d)-(iv)

D. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

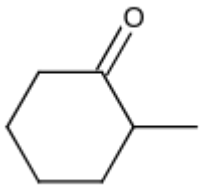
Correct answer: A

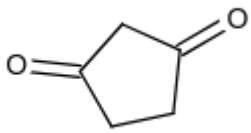
Source solution

Complex
(a) $[Co(NH_3)_6]\,[Cr(CN)_6]$
(b) $[Co(NH_3)_3(NO_2)_3]$
(c) $[Cr(H_2O)_6]Cl_3$
(d) cis $-[CrCl_2(ox)_2]^{3-}$

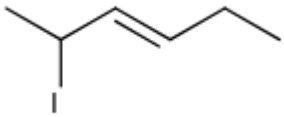
Question 67

Total number of compounds with Chiral carbon atoms from following is .





$CH_3 - CH_2 - CH(NO_2) - COOH$
$CH_3 - CH_2 - CHBr - CH_2 - CH_3$
$CH_3 - CH(I) - CH_2 - NO_2$
$CH_3 - CH_2 - CH(OH) - CH_2OH$



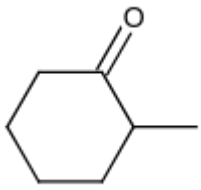
Numerical answer: _____

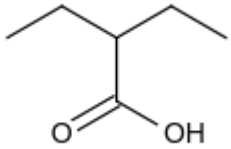
Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

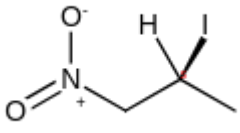
Correct answer: 5

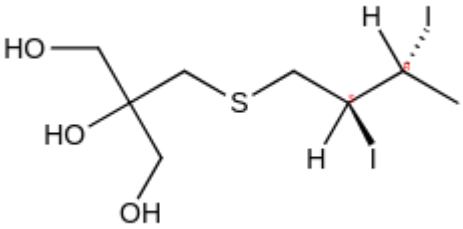
Source solution

Chiral carbons are marked by.


O


O
OH


O-
N
+
O
H
I


HO
HO
OH
S
H
I
H
I

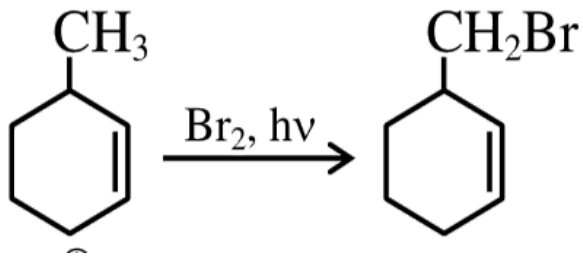
Hydrocarbons

Questions 68-189 / 122 selected / 40.7% practice weight / Focus first

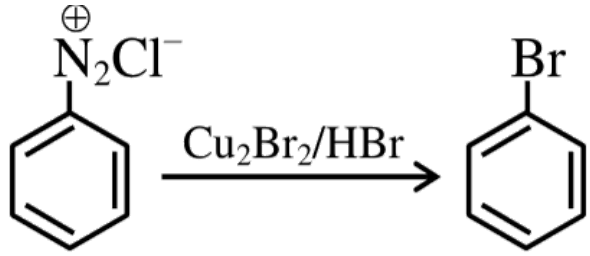
Question 68

Which of the following reaction is NOT correctly represented?

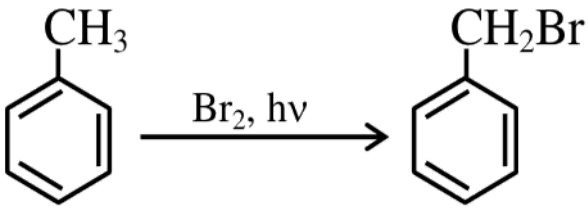
A.



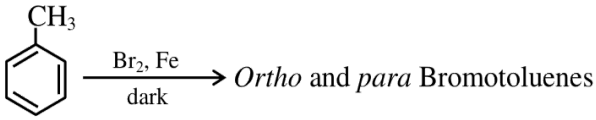
B.



C.



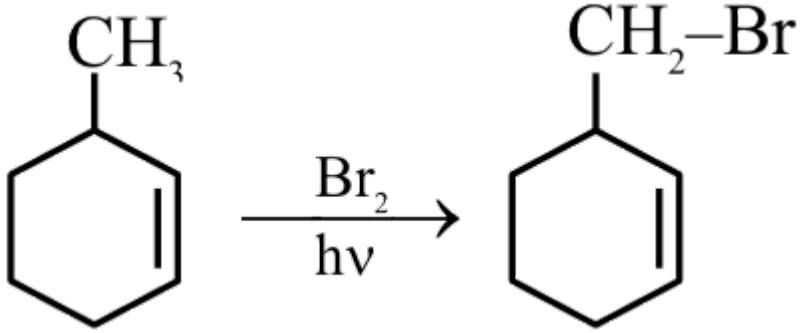
D.

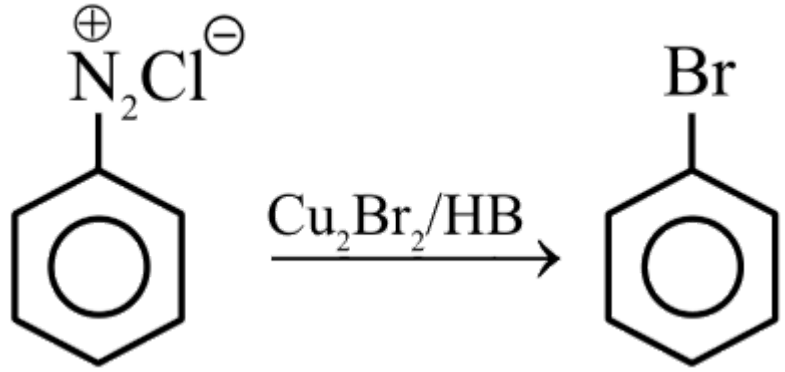


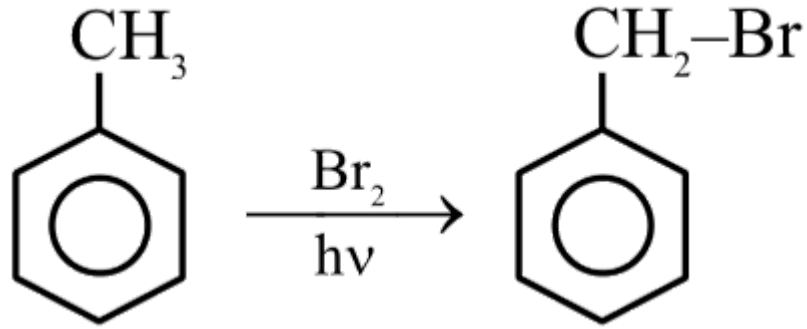
Correct answer: A

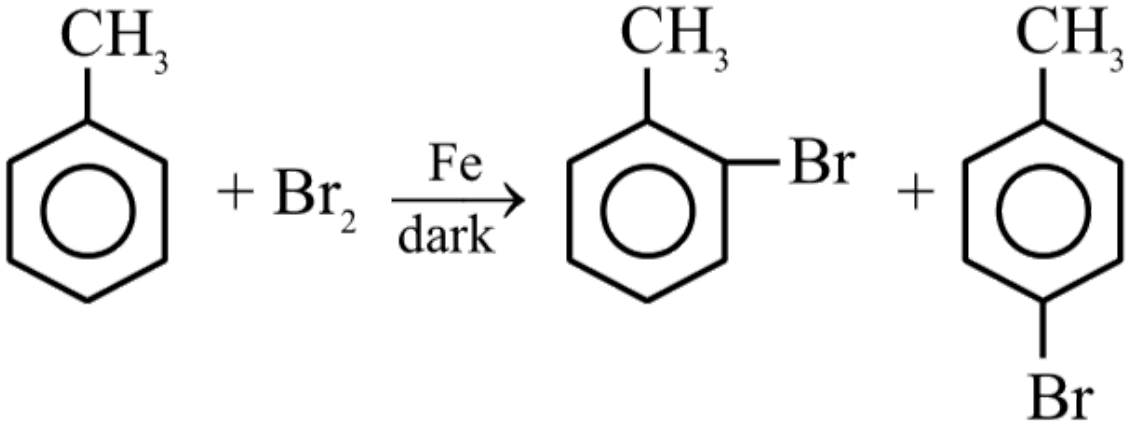
Source solution

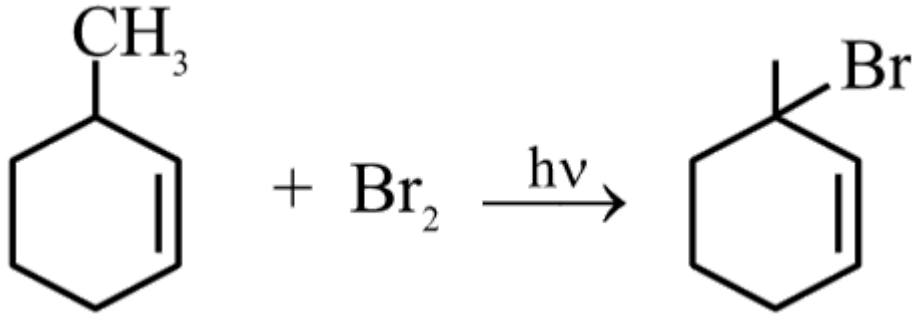
Major product of reaction (1) will be As 3° radical more stable




$\oplus$
$N_2Cl^{\ominus}$
Cu_2Br_2/HB
Br


CH_3
Br_2
$h\nu$
$CH_2–Br$


CH_3
$+ Br_2$
Fe
dark
CH_3
Br
+
CH_3
Br


CH_3
$+ Br_2$
$h\nu$
Br

Question 69

Match List I with List II.

	List I	List II
	Reaction	Reagents
	(A) Hoffmann Degradation	(I) Conc.KOH, Δ
	(B) Clemenson reduction	(II) $CHCl_3, NaOH/H_3O^{\oplus}$
	(C) Cannizaro reaction	(III) $Br_2, NaOH$
	(D) Reimer-Tiemann Reaction	(IV) $Zn - Hg/HCl$

Choose the correct answer from the options given below:

A. (A) -III , (B) -IV , (C) -I , (D) -II

B. (A) - II, (B) -I, (C) - III, (D) - IV

C. (A) - III, (B) - IV, (C) - II, (D) - I

D. (A) -II , (B) -IV , (C) -I , (D) -III

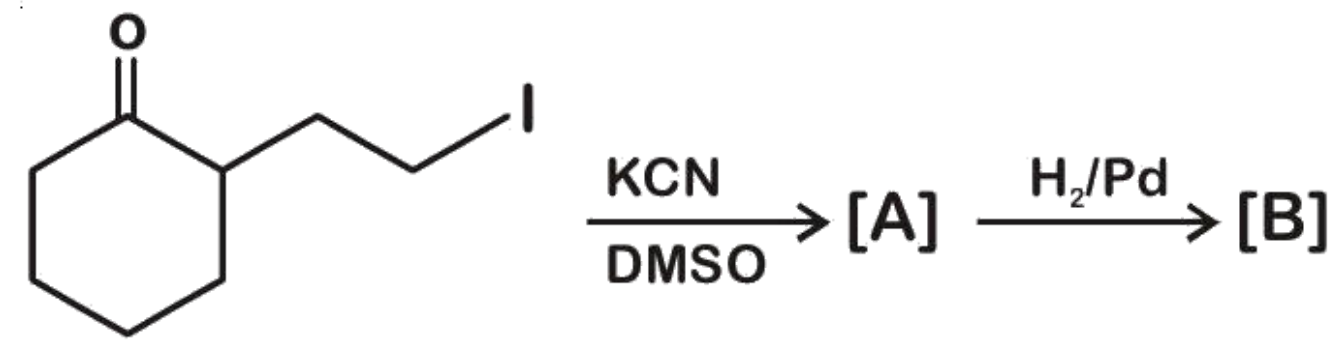
Correct answer: A

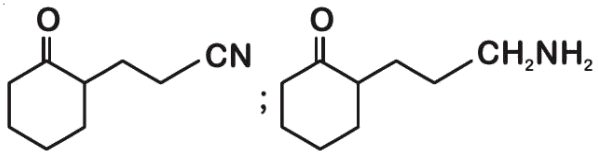
Source solution

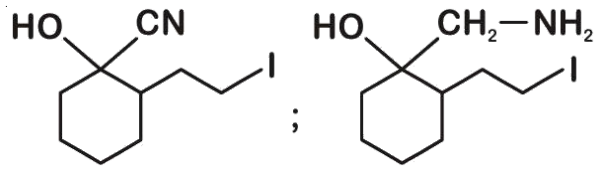
Sol. 1
Hoffmann degradation $\rightarrow Br_2$, NaOH
Clemenson reduction $\rightarrow Zn - Hg/HCl$
Cannizaro reaction $\rightarrow$ Conc. KOH, Δ
Reimer-Tiemann reaction $\rightarrow CuCl_3, NaOH/H_3O^{\oplus}$

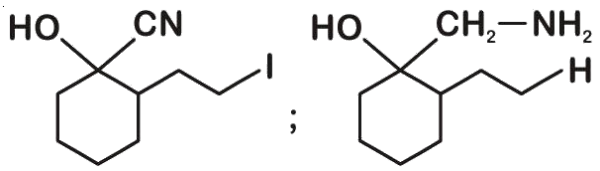
Question 70

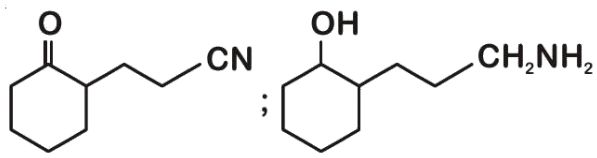
The major products A and B for the following reactions are, respectively



A. 

B. 

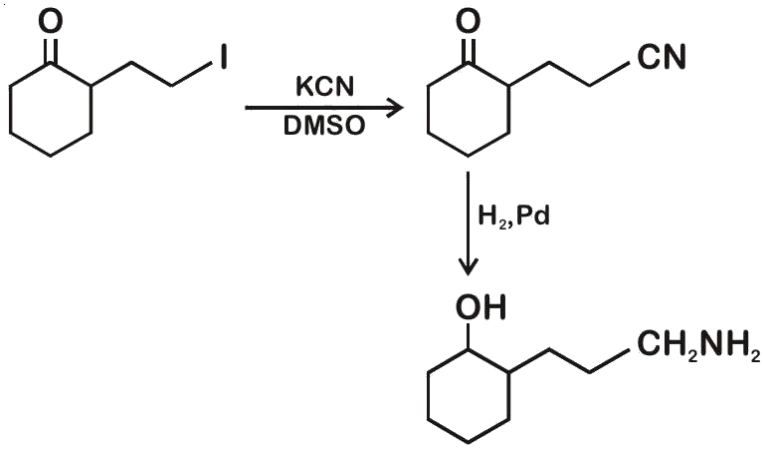
C. 

D. 

Correct answer: D

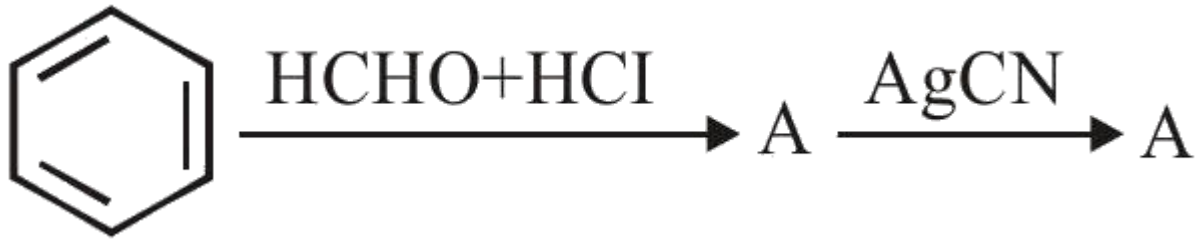
Source solution

Sol.



Question 71

The compounds A and B in the following reaction are, respectively:



A. $\mathbf{A}$ = Benzyl alcohol, $\mathbf{B}$ = Benzyl isocyanide

B. $\mathbf{A}$ = Benzyl alcohol, $\mathbf{B}$ = Benzyl cyanide

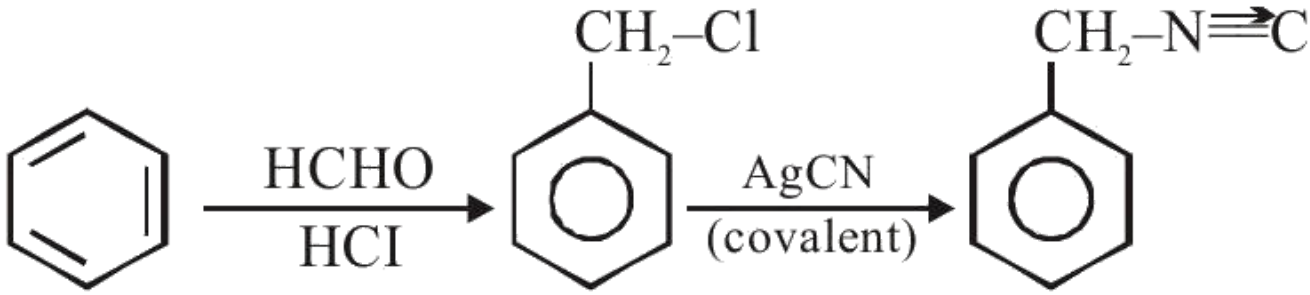
C. $\mathbf{A}$ = Benzyl chloride, $\mathbf{B}$ = Benzyl cyanide

D. A = Benzyl chloride, B = Benzyl isocyanide

Correct answer: D

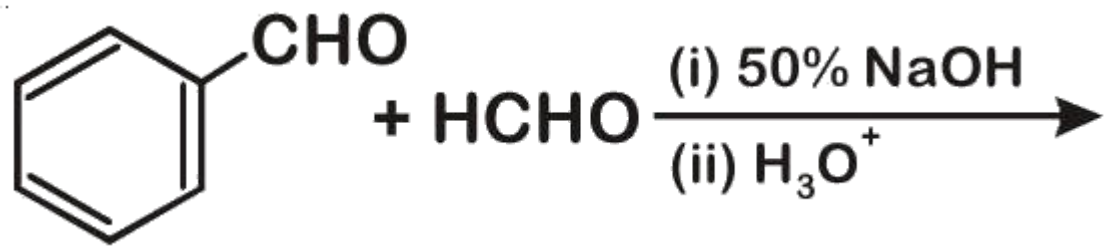
Source solution

Sol.

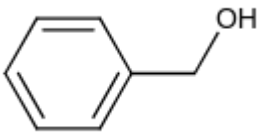


Question 72

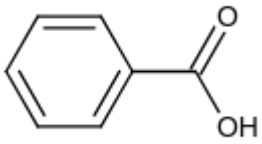
Major products of the following reaction are :



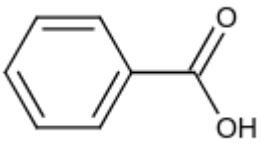
A. HCOOH and



B.



C. CH_3OH and

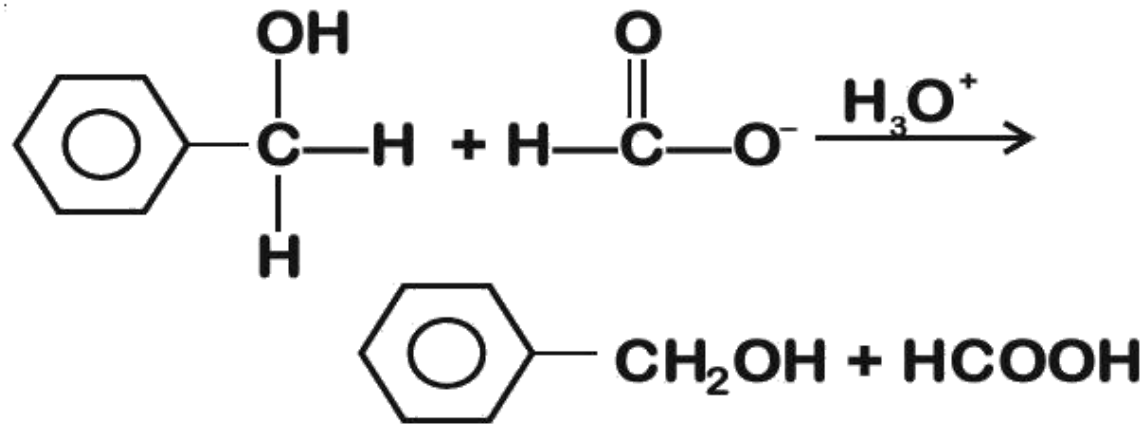


D. CH_3OH and HCO_2H

Correct answer: A

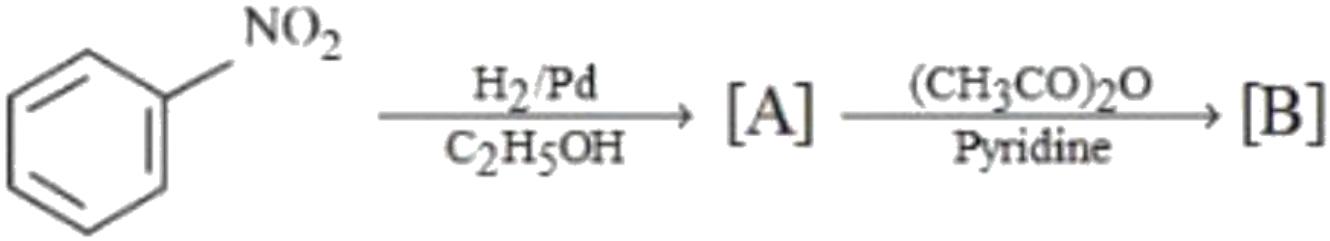
Source solution

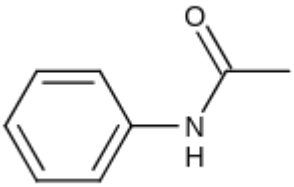
Sol.



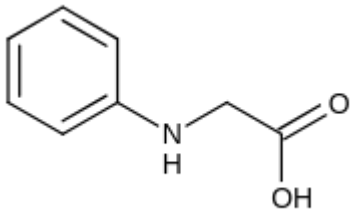
Question 73

Consider the above reaction and identify the product B. Options

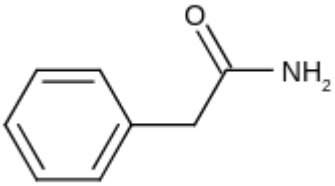




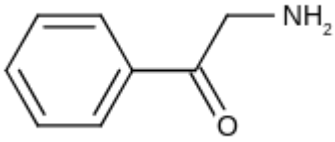
A.



B.



C.

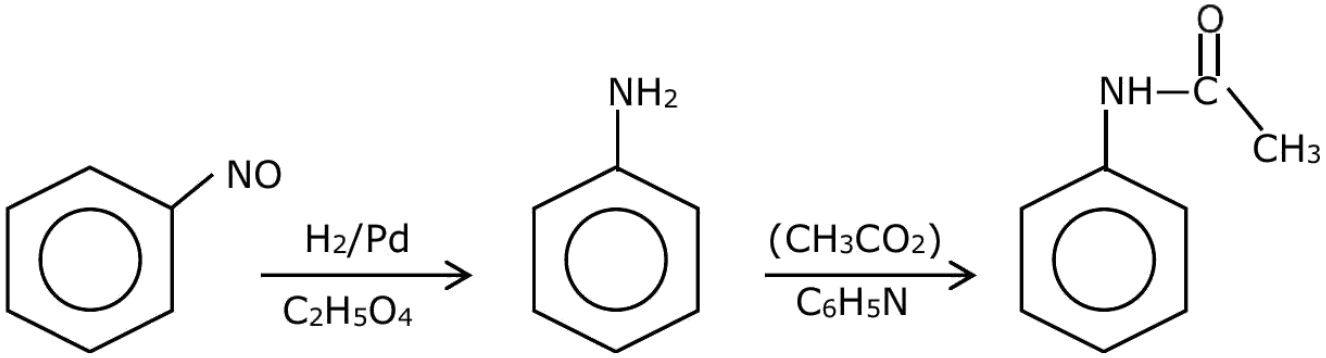


D.

Correct answer: A

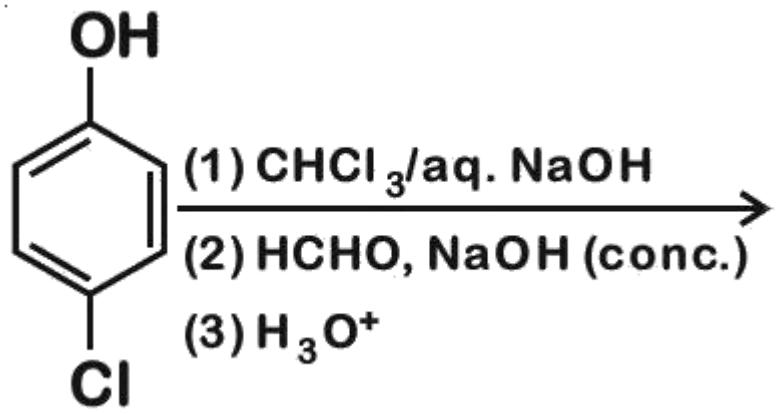
Source solution

Sol. 1

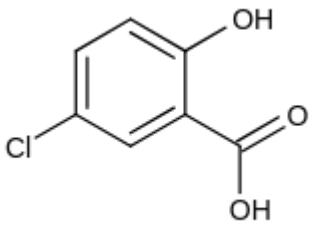


Question 74

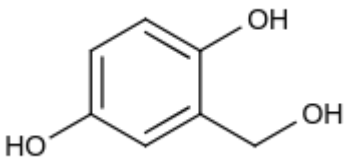
The major products of the following reaction are :



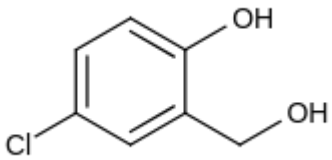
A.



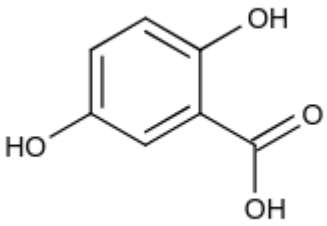
B.



C.



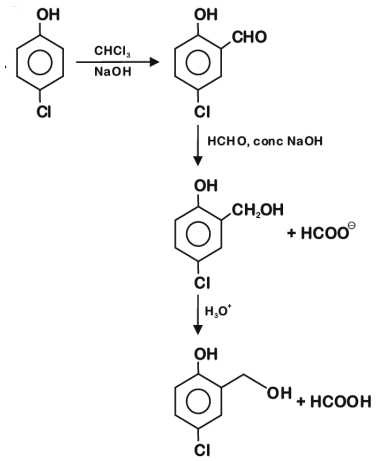
D.



Correct answer: C

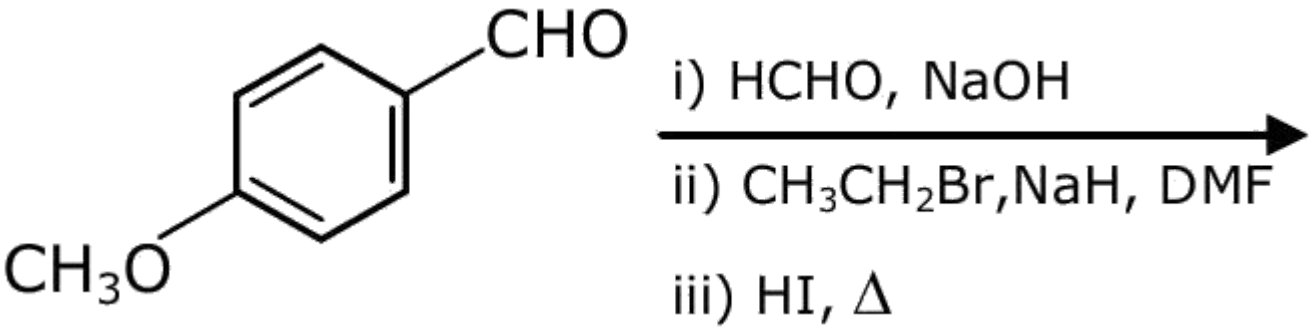
Source solution

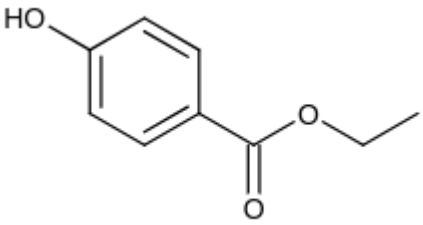
Sol.


OH
Cl
CHCl3
NaOH
OH
CHO
Cl
HCHO, conc NaOH
OH
CH2OH
+ HCOO⊖
Cl
H3O⊕
OH
OH
+ HCOOH
Cl

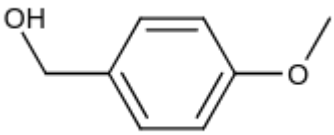
Question 75

Identify A in the following chemical reaction.

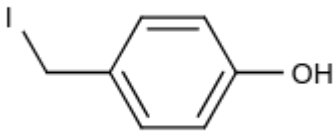




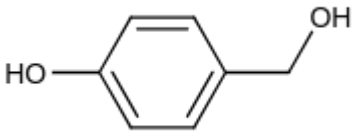
A.



B.



C.

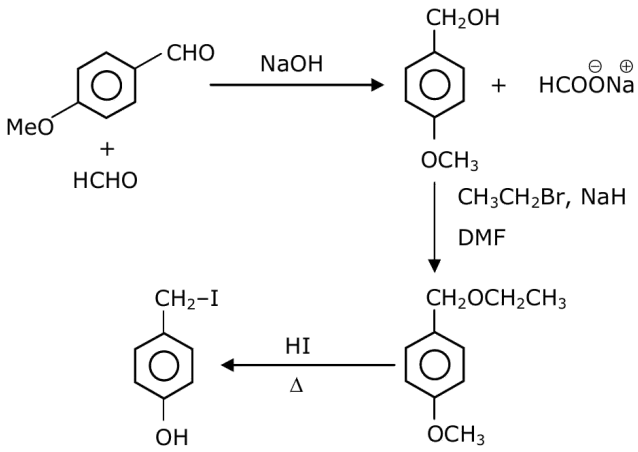


D.

Correct answer: C

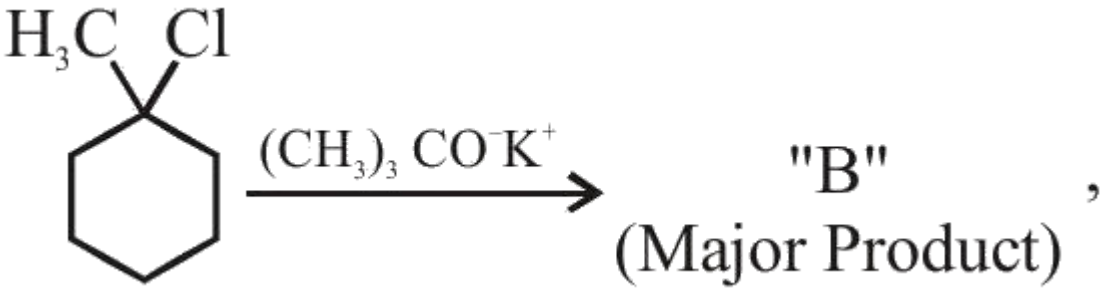
Source solution

Sol.

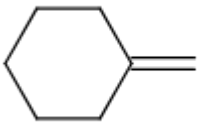

CHO
MeO
+
HCHO
NaOH
CH2OH
OCH3
+
HCOONa
CH3CH2Br, NaH
DMF
CH2OCH2CH3
OCH3
HI
Δ
CH2–I
OH

Question 76

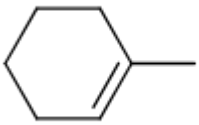
The product " A " and " B " formed in above reactions are :



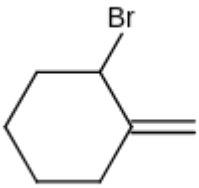
A. B-



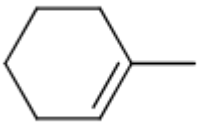
B. B-



C.



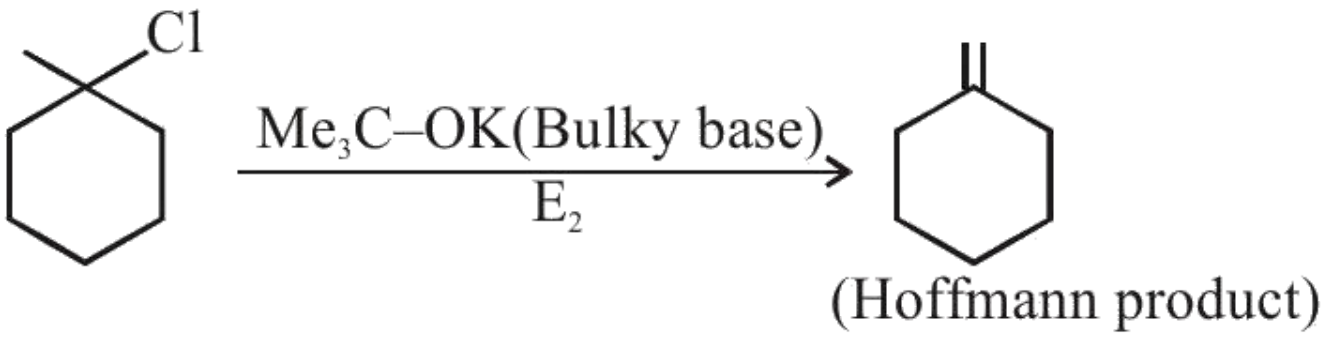
D.



Correct answer: C

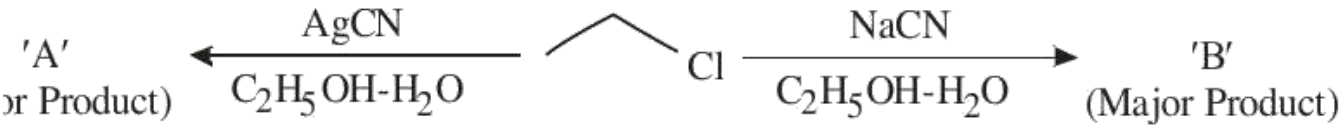
Source solution

Sol.

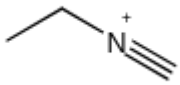


Question 77

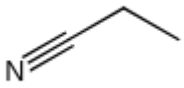
Considering the above reactions, the compound ' A ' and compound ' B ' respectively are :



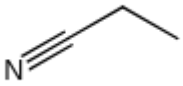
A.



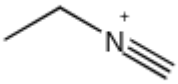
B.



C.



D.

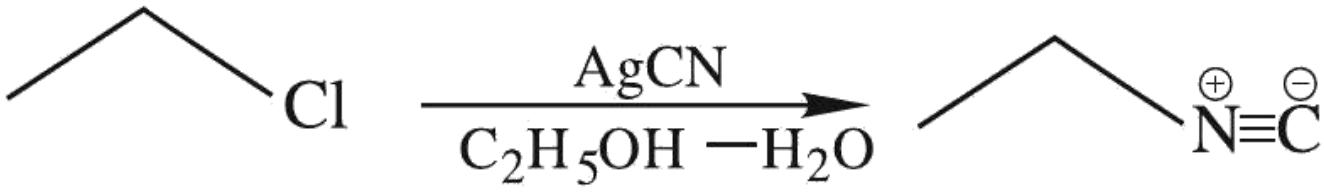


Correct answer: C

Source solution

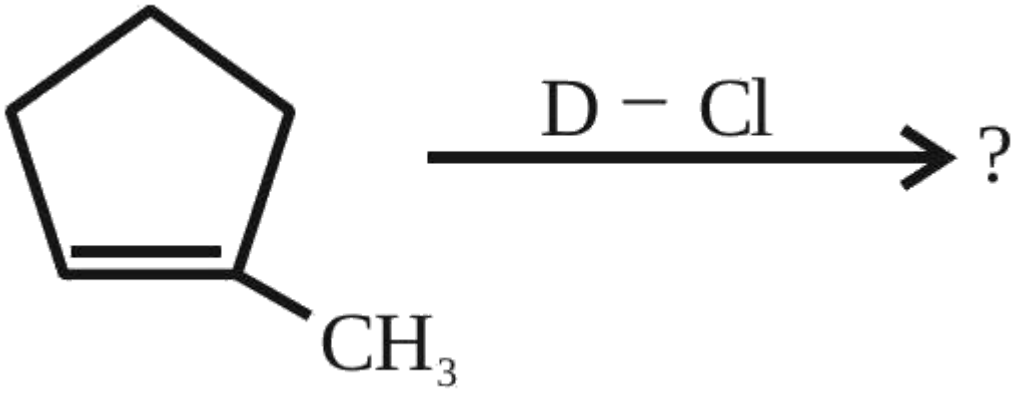
Sol.

In NaCN ; carbon is more nucleophilic atom.
Whereas in $\mathbf{AgCN;\ Ag-C}$ has covalent bond.

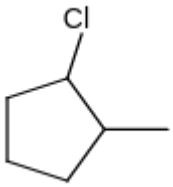


Question 78

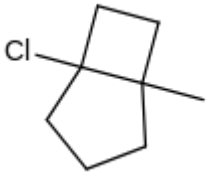
Major product of the following reaction is -



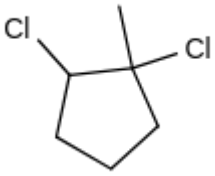
A.



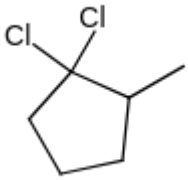
B.



C.



D.



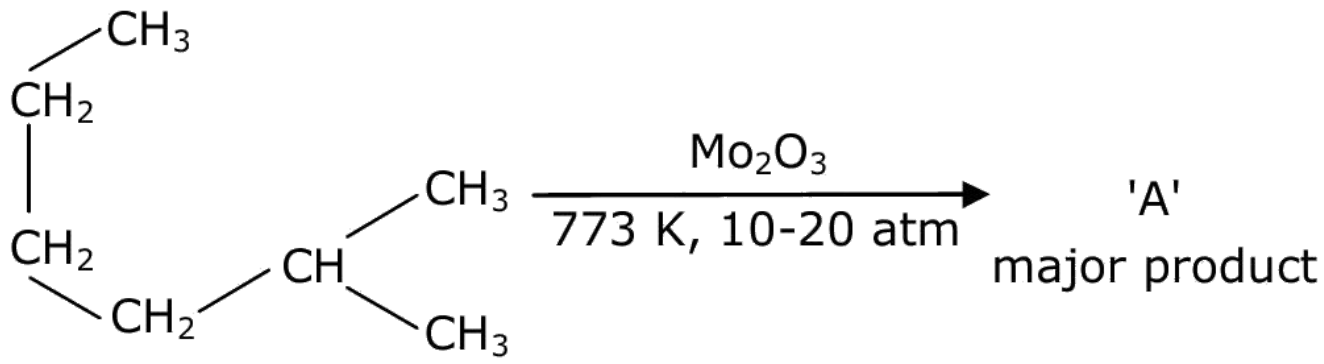
Correct answer: A

The source provides a brief answer only. A detailed worked solution is not available for this question.

Source solution

Question 79

Identify A in the given chemical reaction.



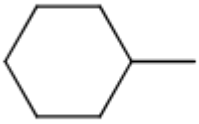
A.



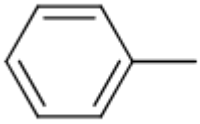
B.



C.



D.

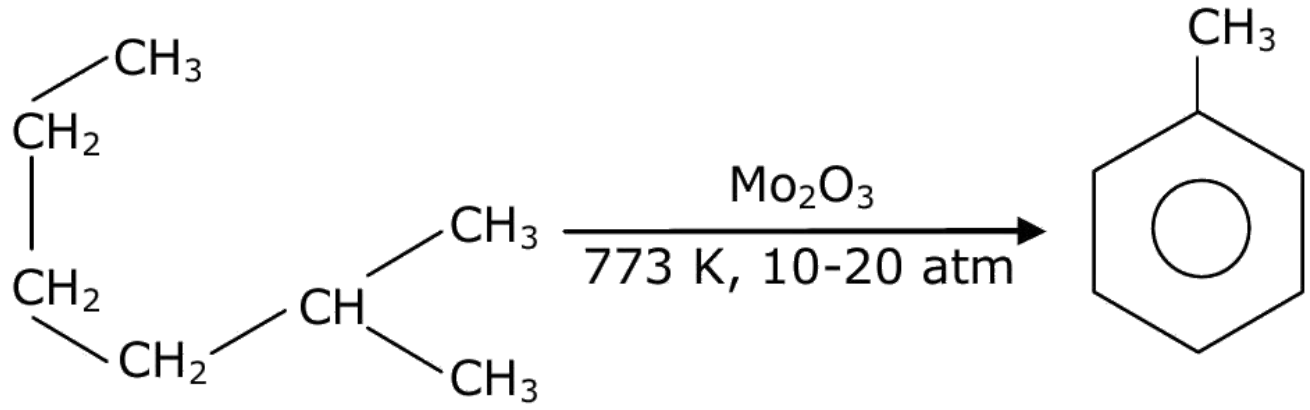


Correct answer: D

Source solution

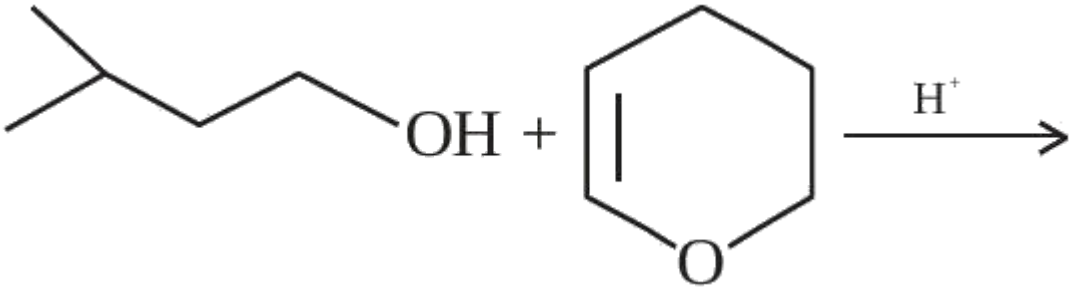
Sol. (4)}

Aromatization reaction or hydroforming reaction.

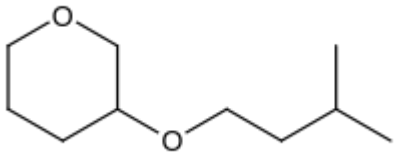

CH3
CH2
CH2
CH2
CH
CH3
CH3
Mo2O3
773 K, 10-20 atm
CH3

Question 80

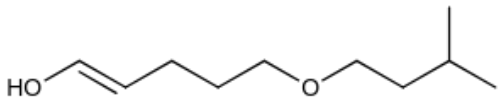
The major product formed in the following reaction, is



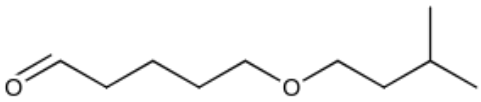
A.



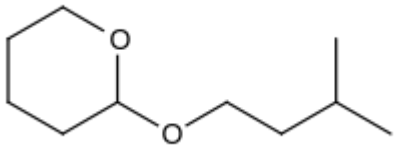
B.



C.



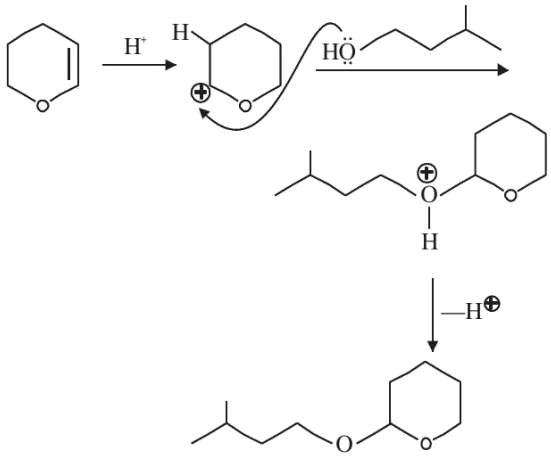
D.



Correct answer: D

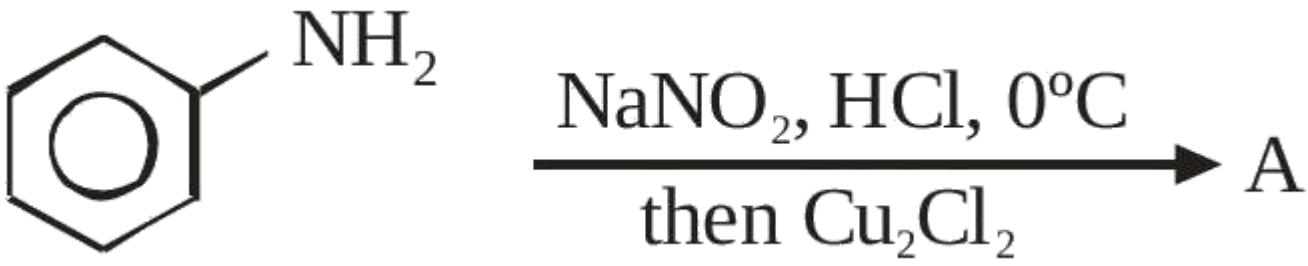
Source solution

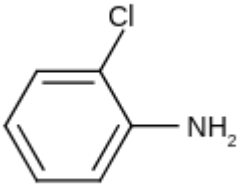
Sol.



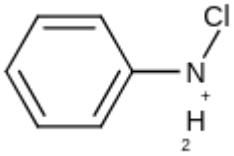
Question 81

The product A formed in the following reaction is:

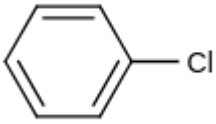




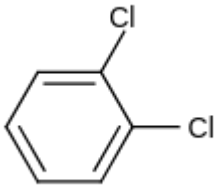
A.



B.



C.

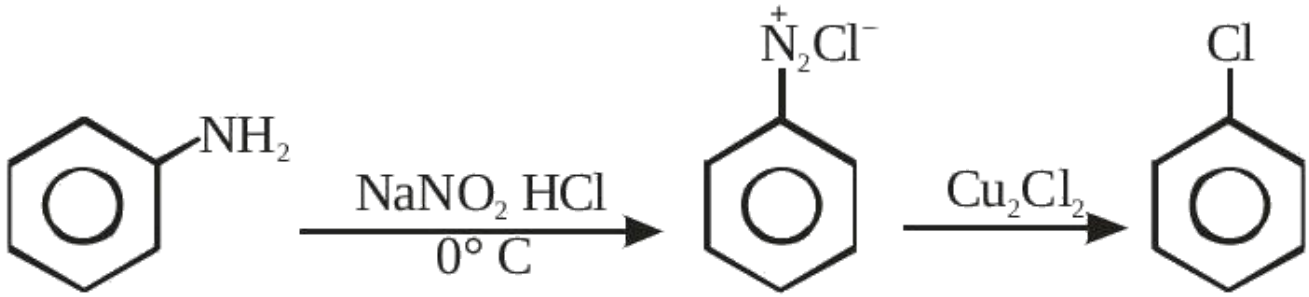


D.

Correct answer: C

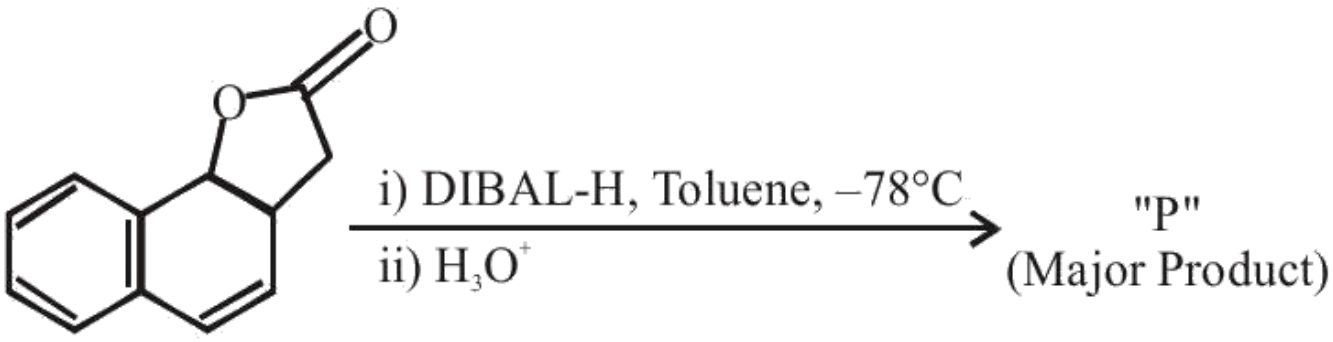
Source solution

Sol.

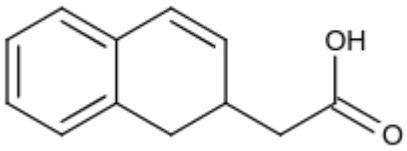


Question 82

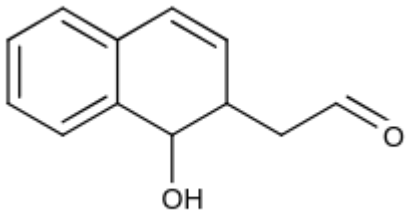
The product " P " in the above reaction is :



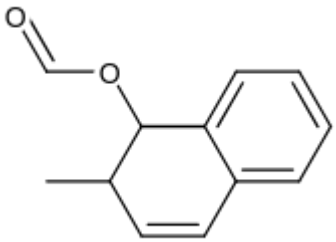
A.



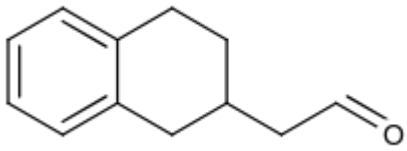
B.



C.



D.



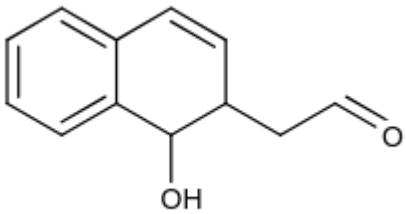
Correct answer: B

Source solution

Sol.

$\xrightarrow{\text{(i) DIBAL-H}}$

DIBAL can not reduce double bond It can reduce cyclic ester.



Question 83

The major product of the following reaction is :

$$CH_3CH_2CH{=}CH_2 \xrightarrow[\text{Rh catalyst}]{H_2/CO}$$

A. $CH_3CH_2CH_2CHO$

B. $CH_3CH_2CH = CH - CHO$

C. $CH_3CH_2CH_2CH_2CHO$

D. $CH_3CH_2C = CH_2$

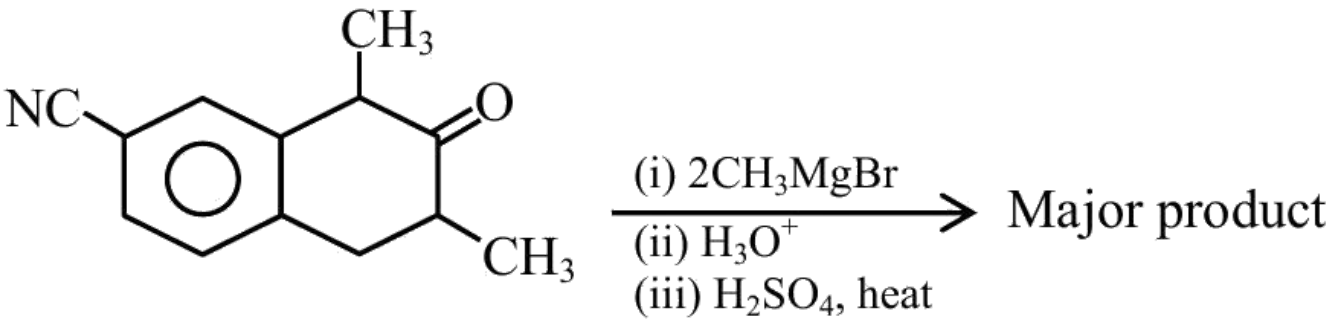
Correct answer: C

Source solution

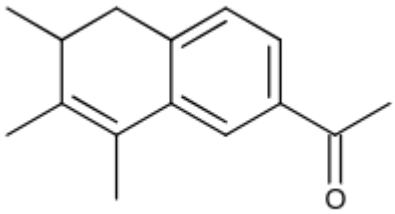
Sol. $CH_3 - CH_2 - CH = CH_2 \xrightarrow[Rh\ \text{catalyst}]{H_2/CO} CH_3CH_2CH_2CHO$

Question 84

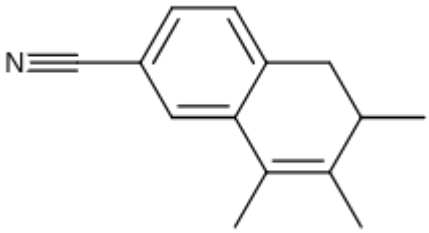
Which one of the following is the major product of the given reaction?



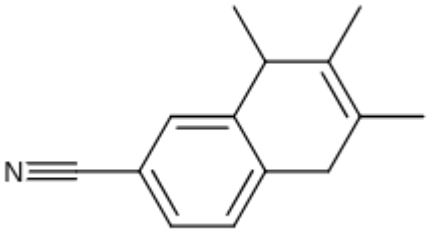
A.



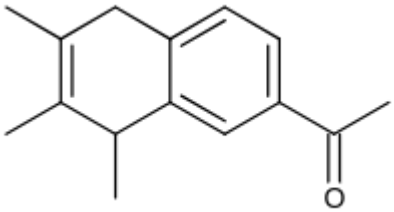
B.



C.



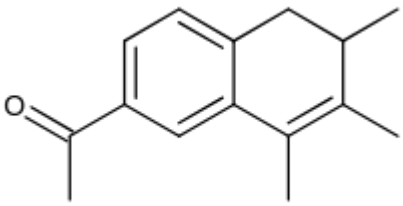
D.



Correct answer: A

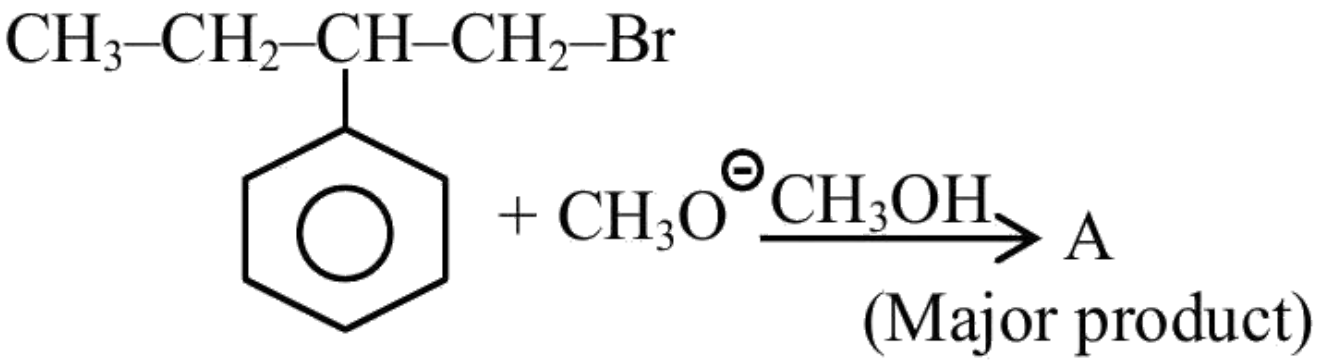
Source solution

Sol.

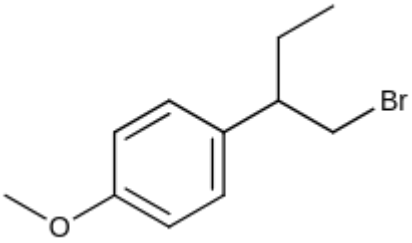


Question 85

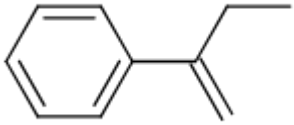
The major product (A) formed in the reaction given below is :



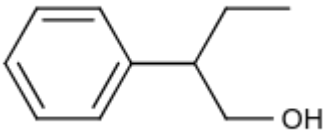
A.



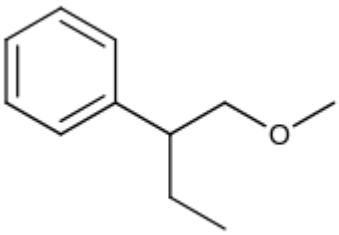
B.



C.



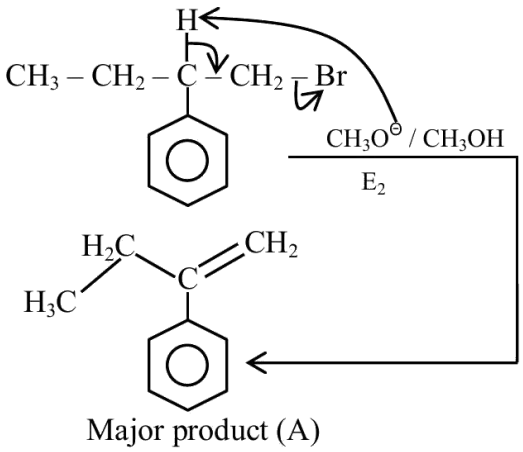
D.



Correct answer: B

Source solution

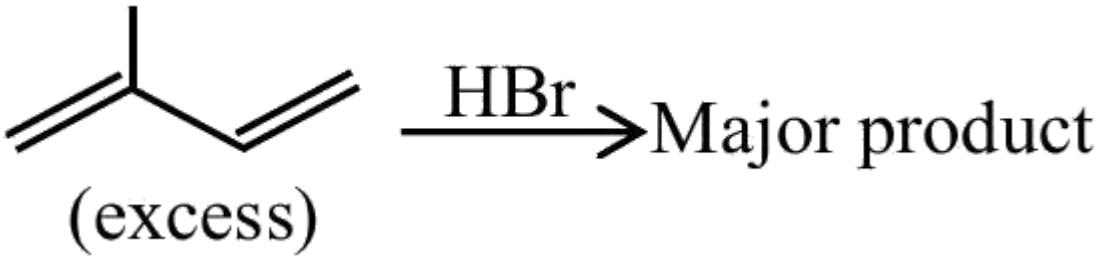
Sol.



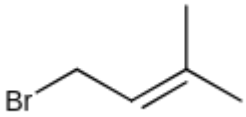
Major product (A)

Question 86

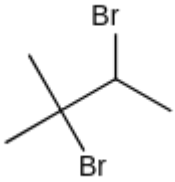
The major product formed in the following reaction is :



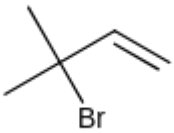
A.



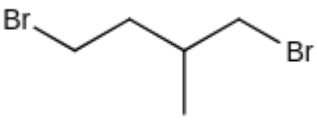
B.



C.



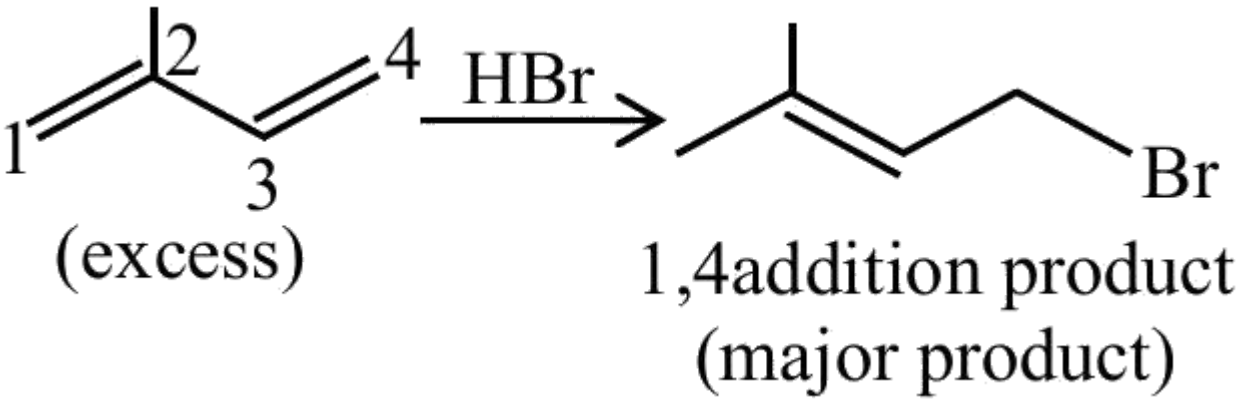
D.



Correct answer: A

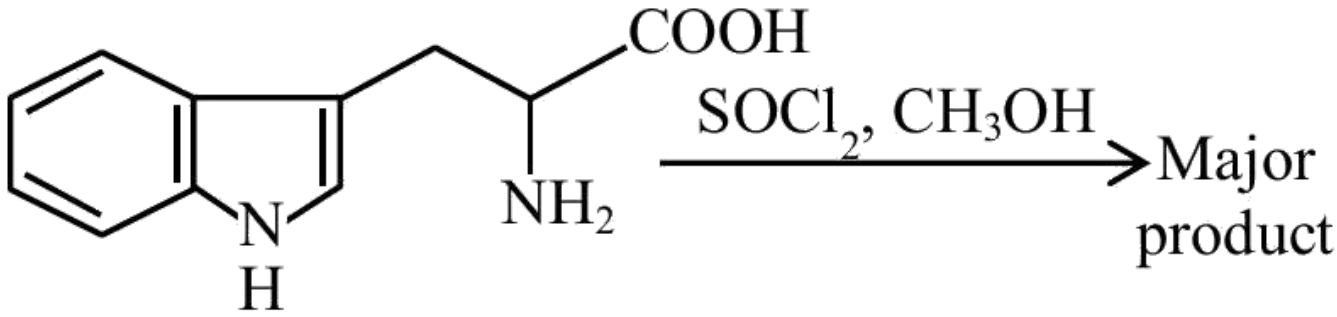
Source solution

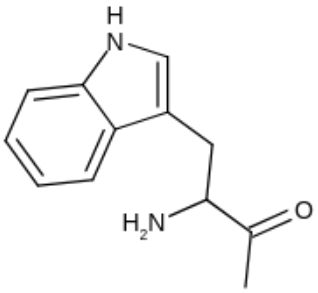
Sol.



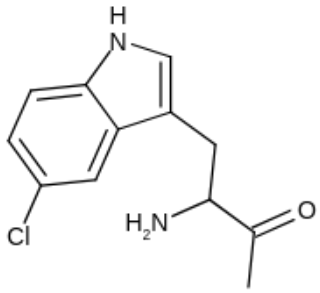
Question 87

The major product formed in the following reaction is :

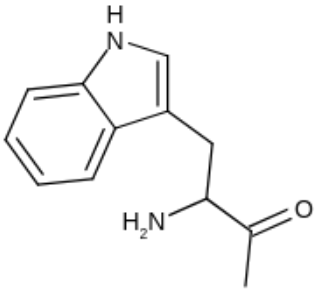




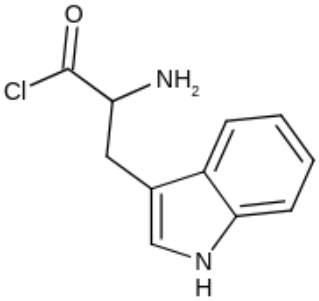
A.



B.



C.

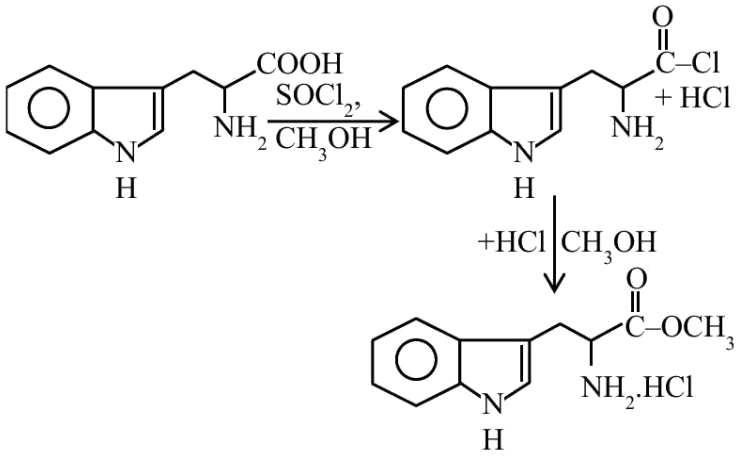


D.

Correct answer: C

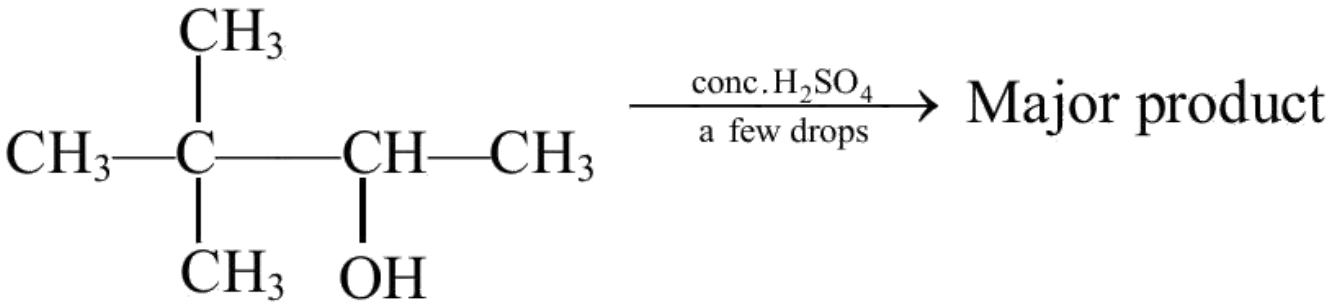
Source solution

Sol.

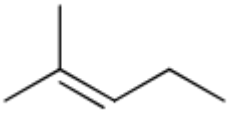

COOH
SOCl2,
CH3OH
NH2
N
H
O
C–Cl
+ HCl
NH2
+HCl
CH3OH
O
C–OCH3
NH2.HCl

Question 88

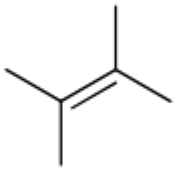
The major product formed in the following reaction is :



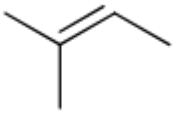
A.



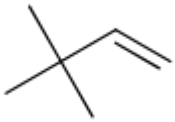
B.



C.



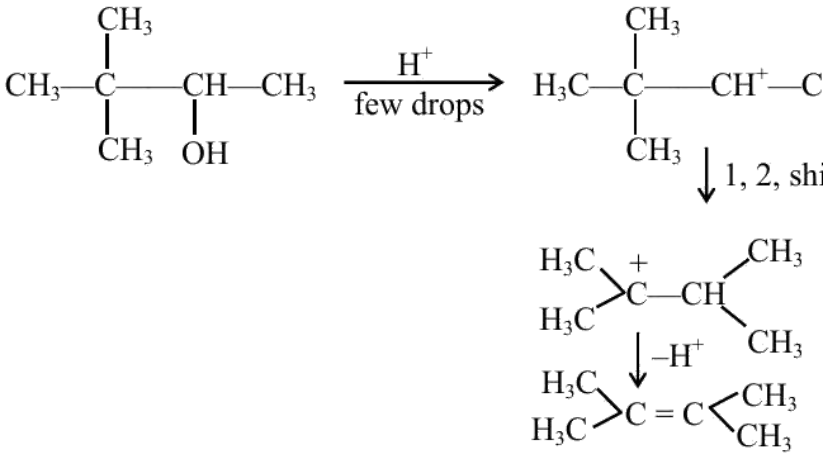
D.



Correct answer: B

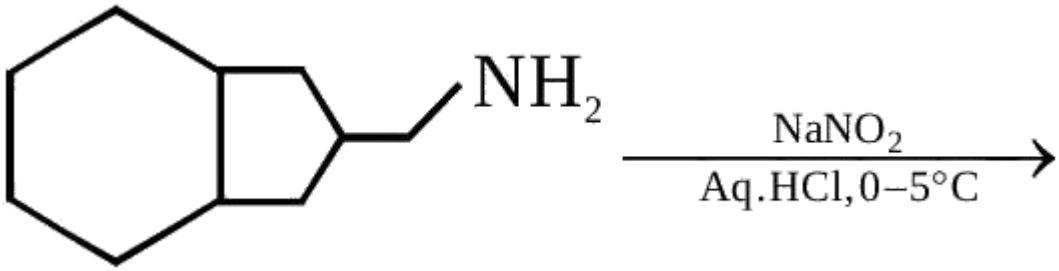
Source solution

Sol.

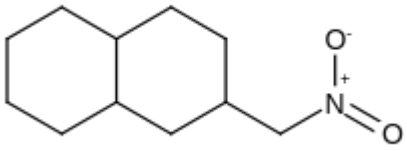


Question 89

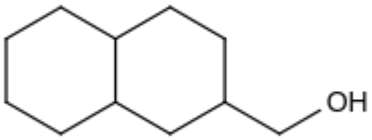
The major product formed in the reaction given below will be :



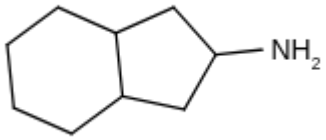
A.



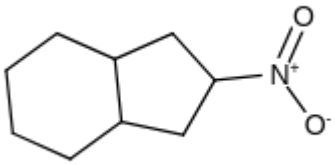
B.



C.



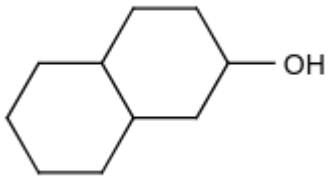
D.



Correct answer: A

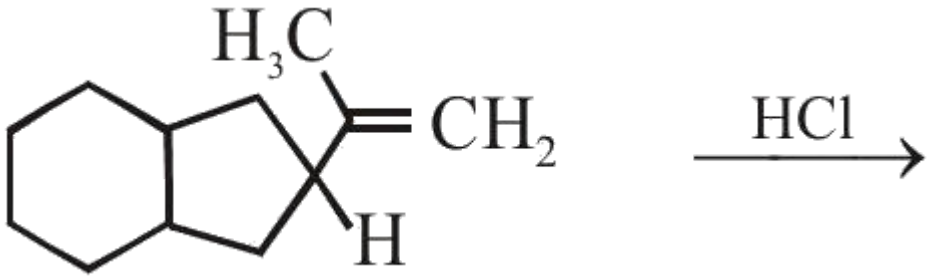
Source solution

Sol. Answer should be

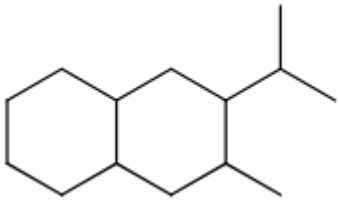


Question 90

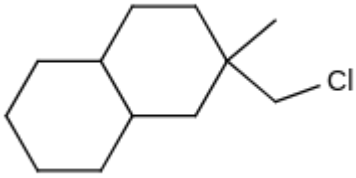
The major product of the following reaction is:



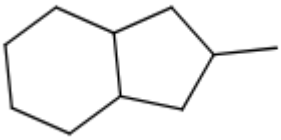
A.



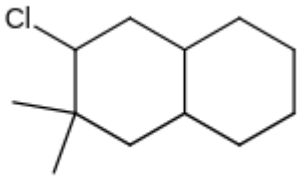
B.



C.



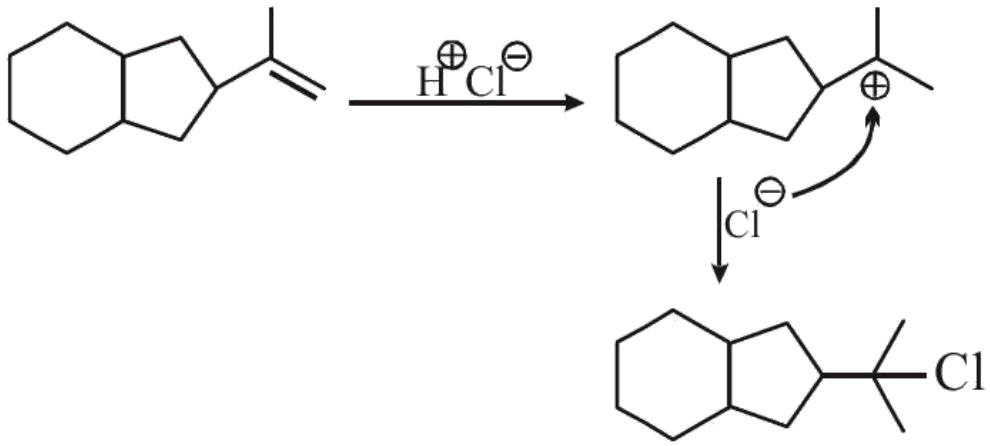
D.



Correct answer: A

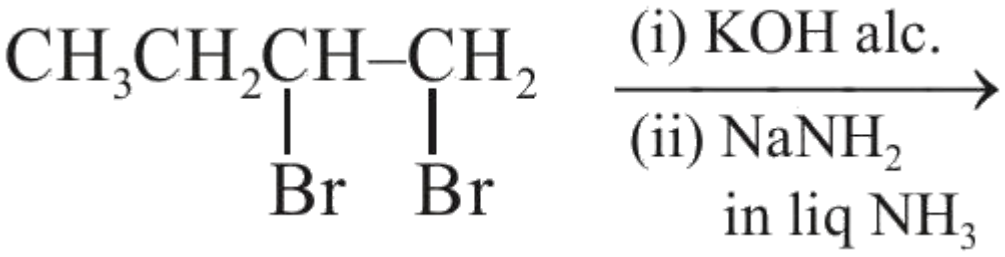
Source solution

Sol.

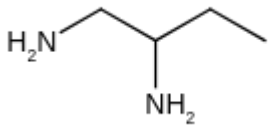


Question 91

The major product of the following reaction is:



A. $CH_3CH_2C \equiv CH$

B.


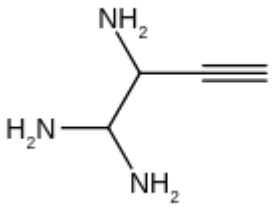
C. $CH_3CH = C = CH_2$

D. $CH_3CH = CHCH_2NH_2$

Correct answer: A

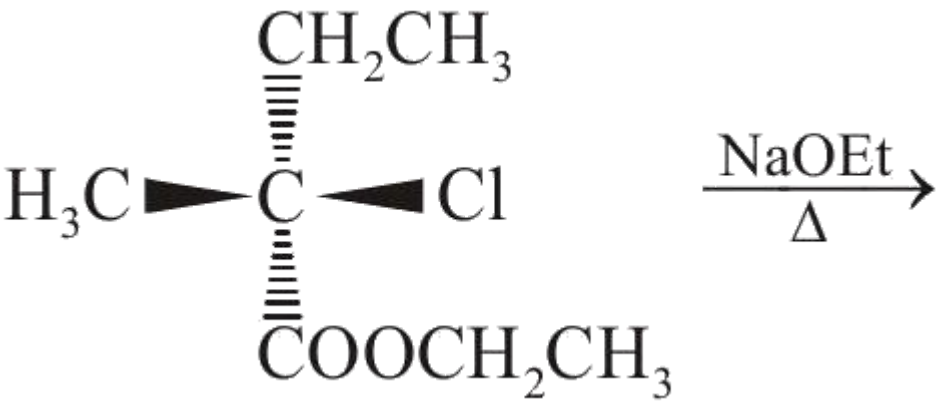
Source solution

Sol.

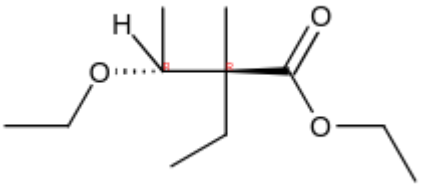


Question 92

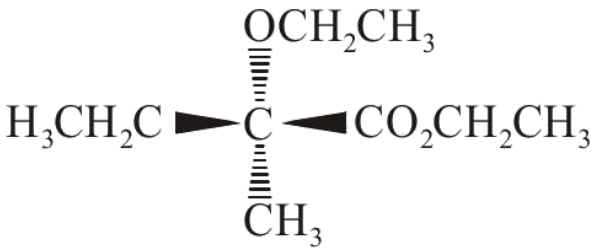
The major product of the following reaction is:



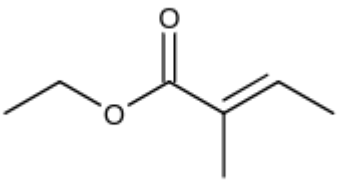
A.



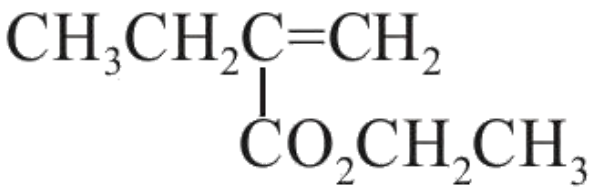
B.



C.



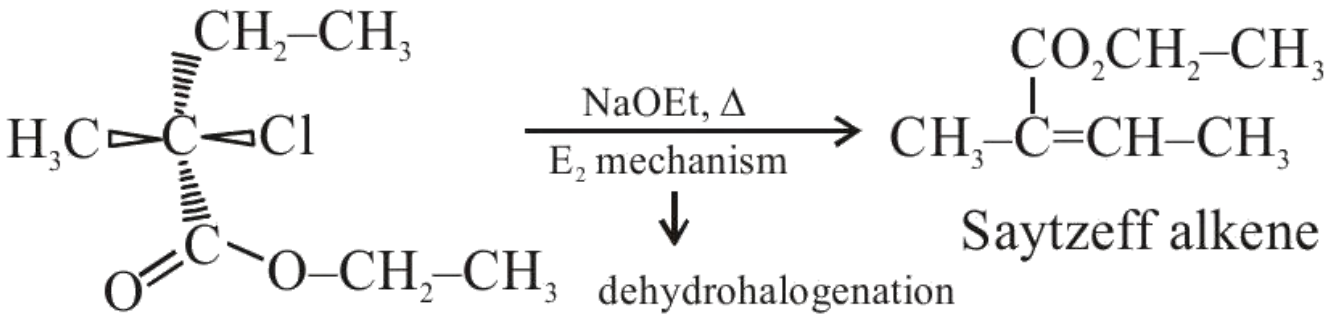
D.



Correct answer: C

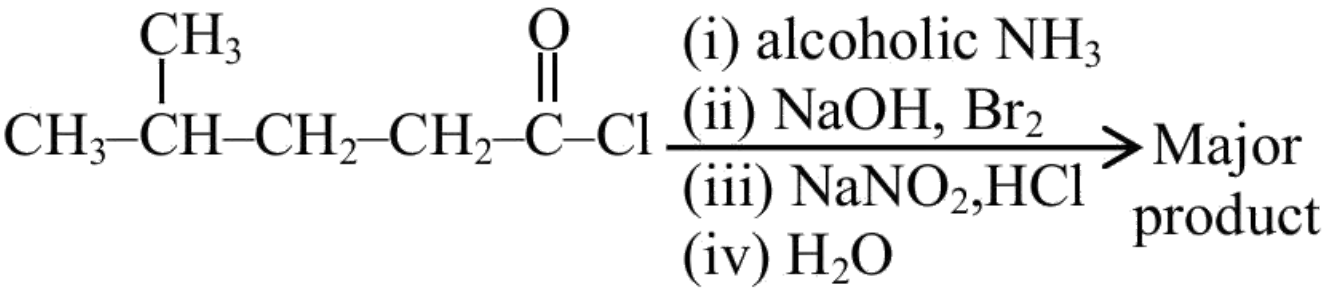
Source solution

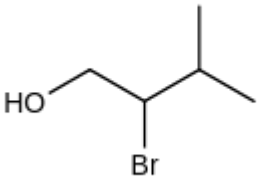
Sol.


CH2–CH3
H3C
C
Cl
C
O
O–CH2–CH3
NaOEt, Δ
E2 mechanism
dehydrohalogenation
CO2CH2–CH3
CH3–C=CH–CH3
Saytzeff alkene

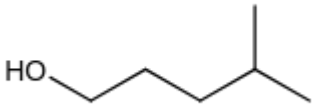
Question 93

The major product of the following reaction is :

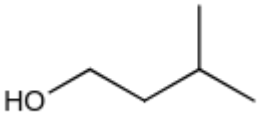




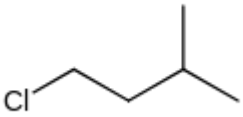
A.



B.



C.

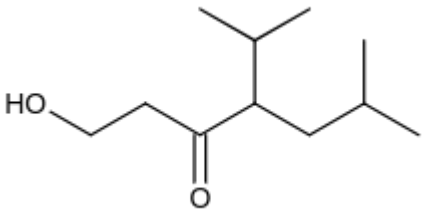


D.

Correct answer: C

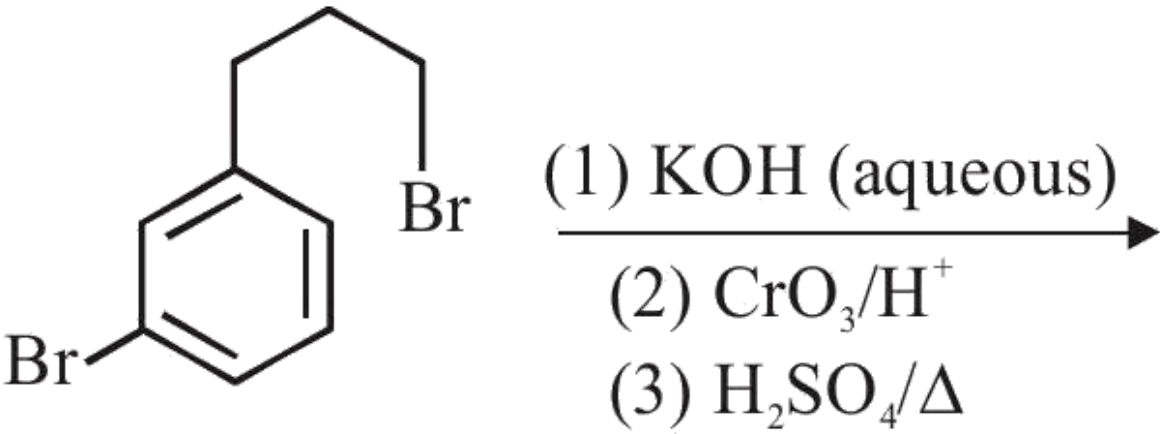
Source solution

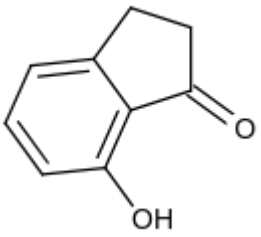
Sol.



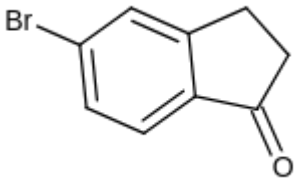
Question 94

The major product of the following reaction is:

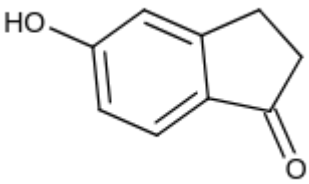




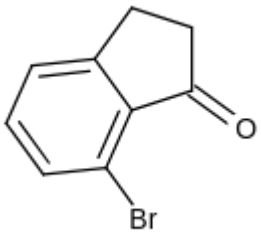
A.



B.



C.



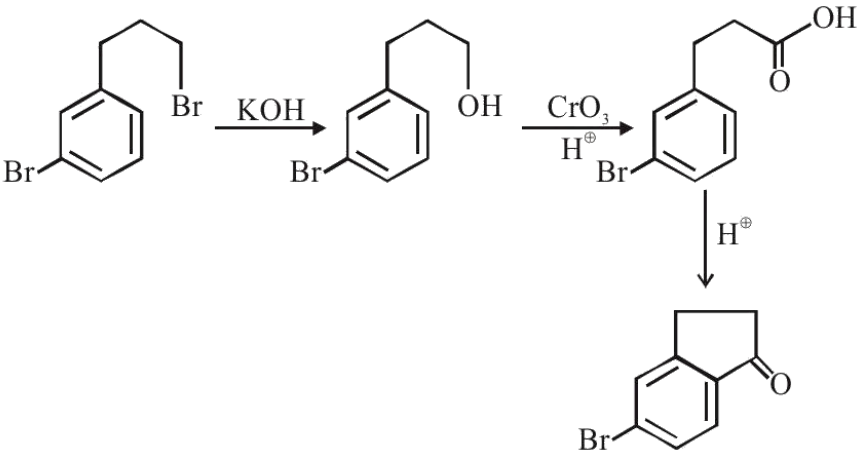
D.

Correct answer: B

Source solution

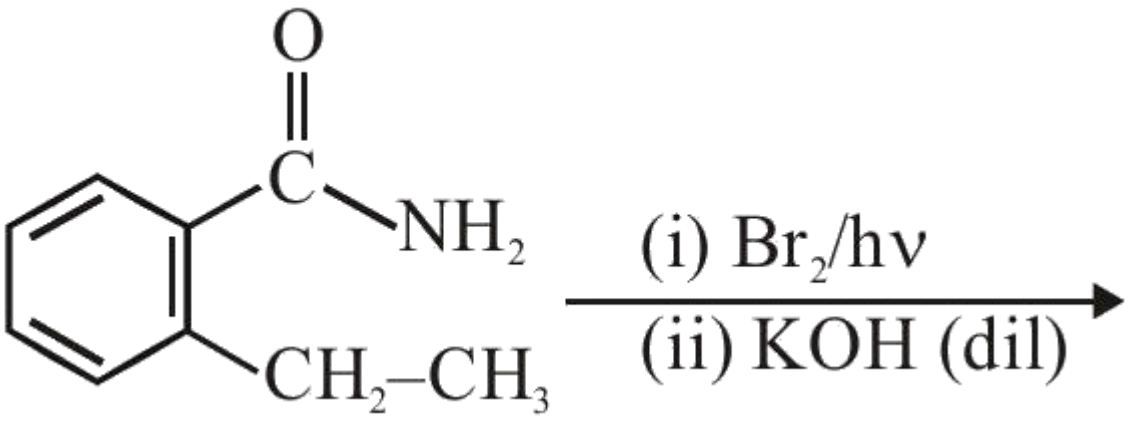
Sol.

During AES Br is o/p directing and major product will be formed on less hindrance p position :

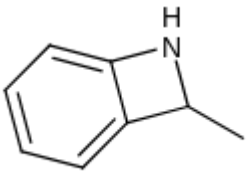

Br
Br
KOH
OH
Br
CrO_3
$H^{\oplus}$
OH
O
Br
$H^{\oplus}$
O
Br

Question 95

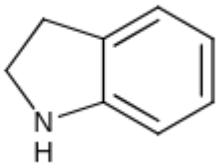
The major product of the following reaction is :



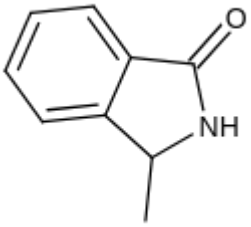
A.



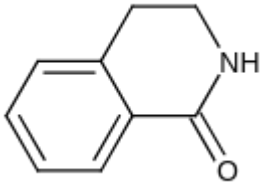
B.



C.



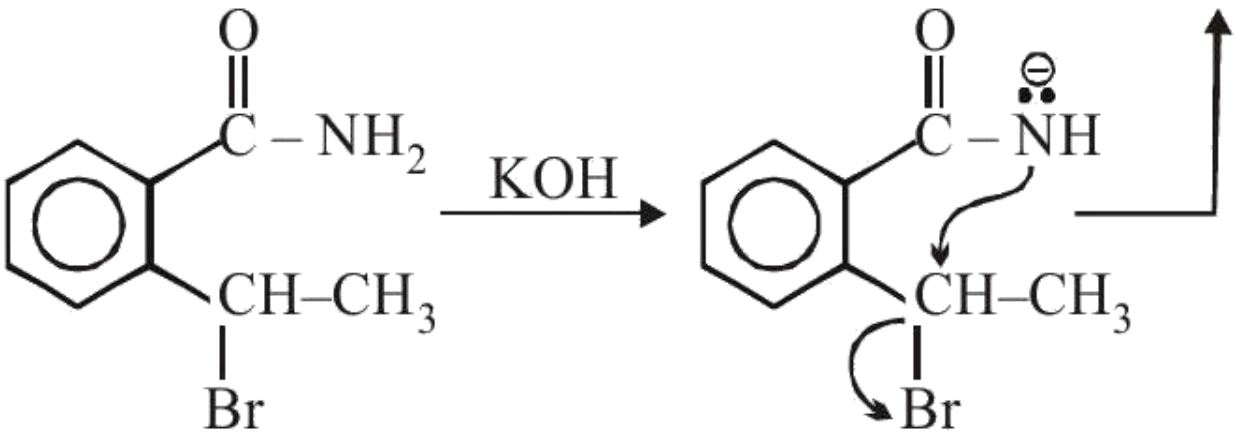
D.



Correct answer: C

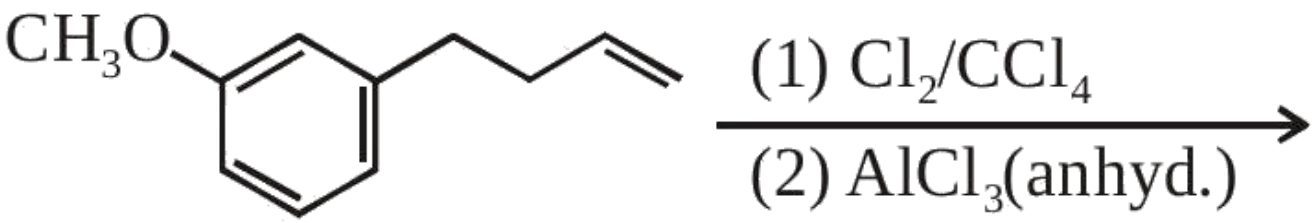
Source solution

Sol.

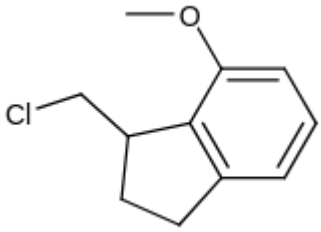

O
C – NH2
KOH
CH–CH3
Br
O
C – NH
CH–CH3
Br

Question 96

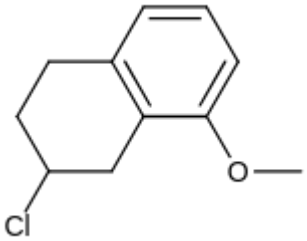
The major product of the following reaction is:



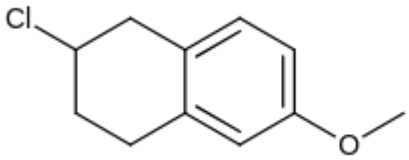
A.



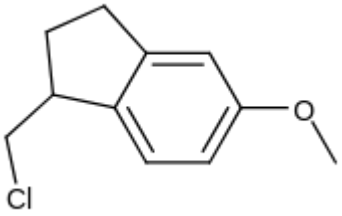
B.



C.



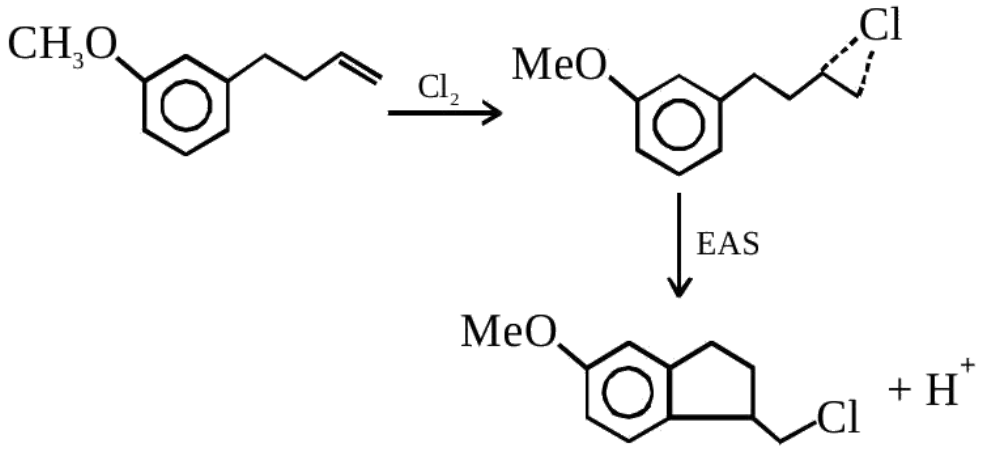
D.



Correct answer: D

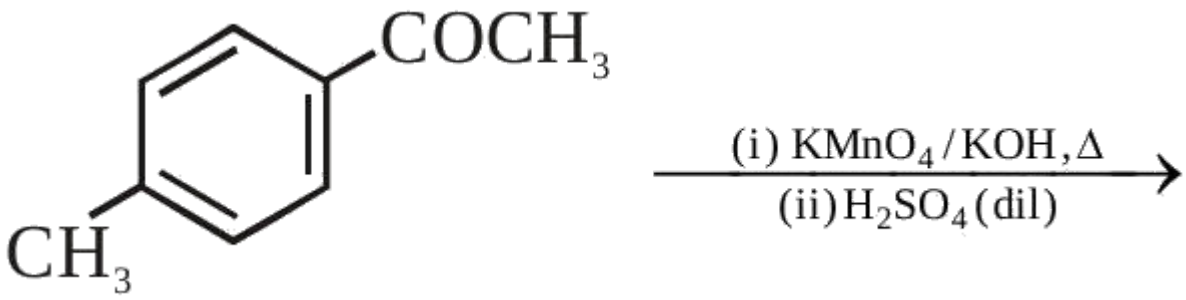
Source solution

Sol.

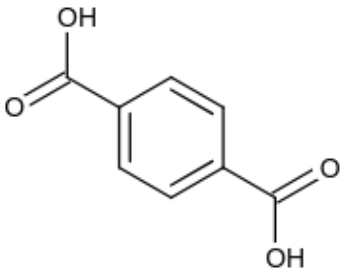

CH3O
Cl2
MeO
Cl
EAS
MeO
Cl
+ H+

Question 97

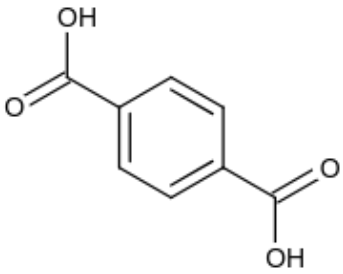
The major product of the following reaction is :



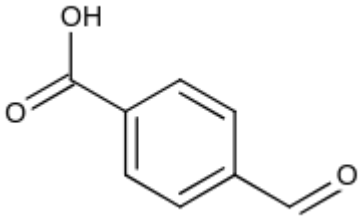
A.



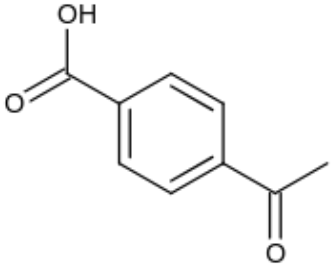
B.



C.



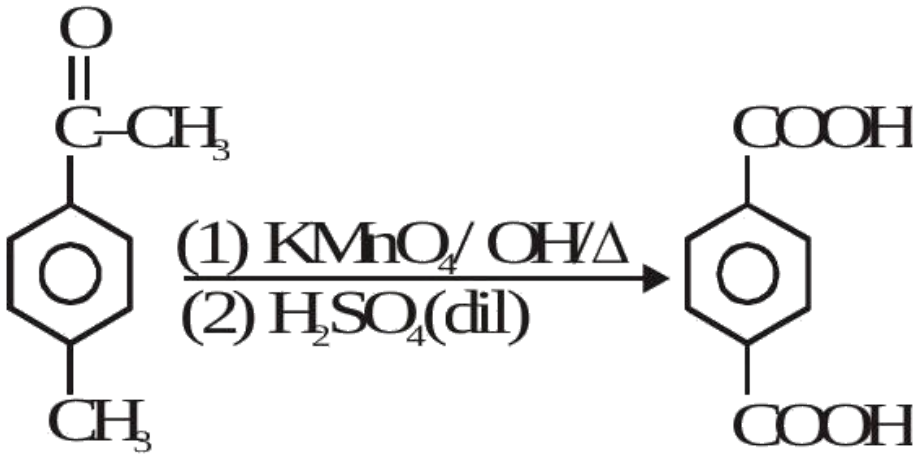
D.



Correct answer: B

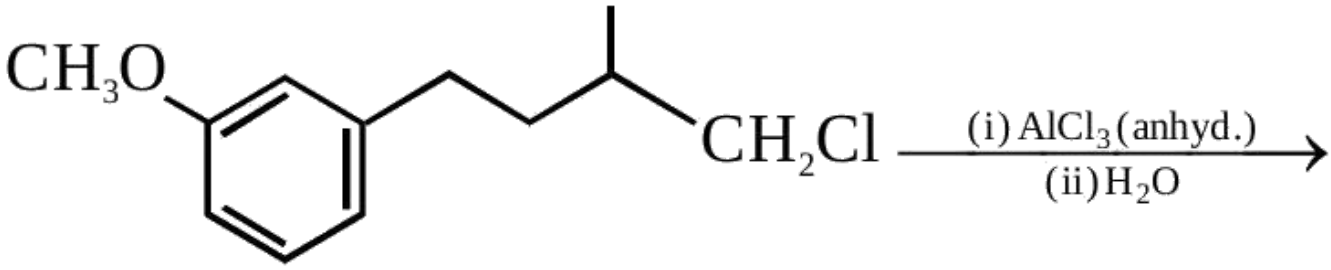
Source solution

Sol.

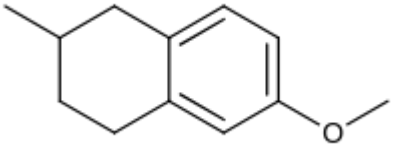

O
C–CH3
CH3
(1) KMnO4/ OH/Δ
(2) H2SO4(dil)
COOH
COOH

Question 98

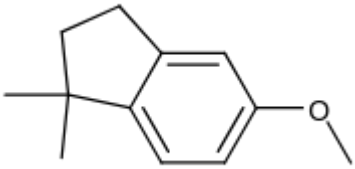
The major product of the following reaction is:



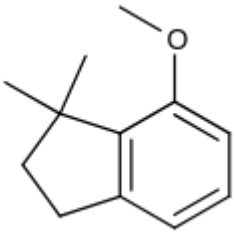
A.



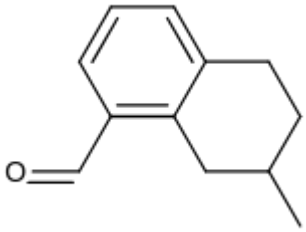
B.



C.



D.

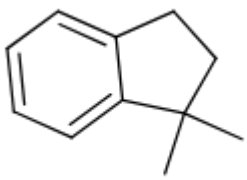


Correct answer: B

Source solution

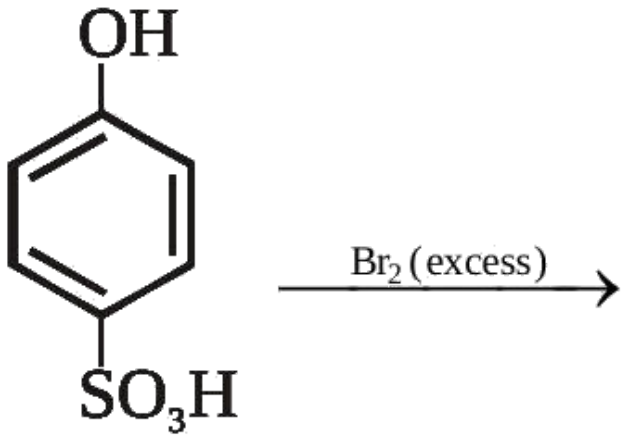
Sol.

1, 2shift of $\mathbf{H^-}$
int ra F.C.A.

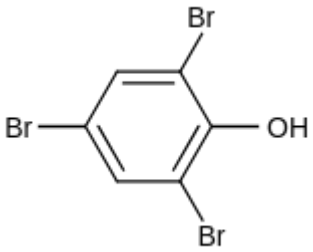


Question 99

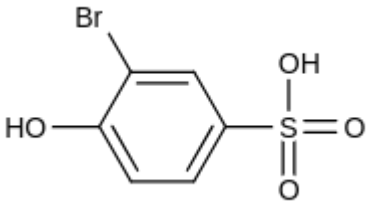
The major product of the following reaction is :



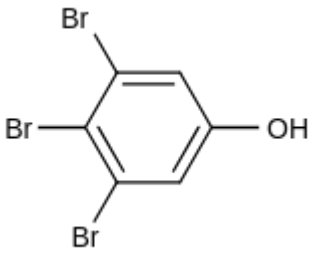
A.



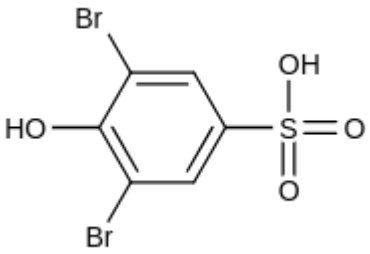
B.



C.



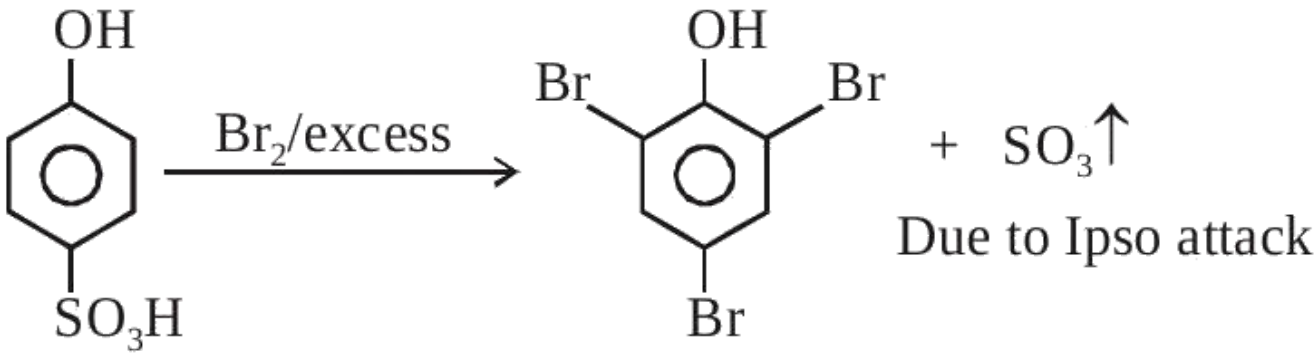
D.



Correct answer: A

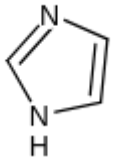
Source solution

Sol.



Question 100

The increasing order of basicity of the following compounds is:



A. (D) < (A) < (B) < (C)

B. (A) < (B) < (C) < (D)

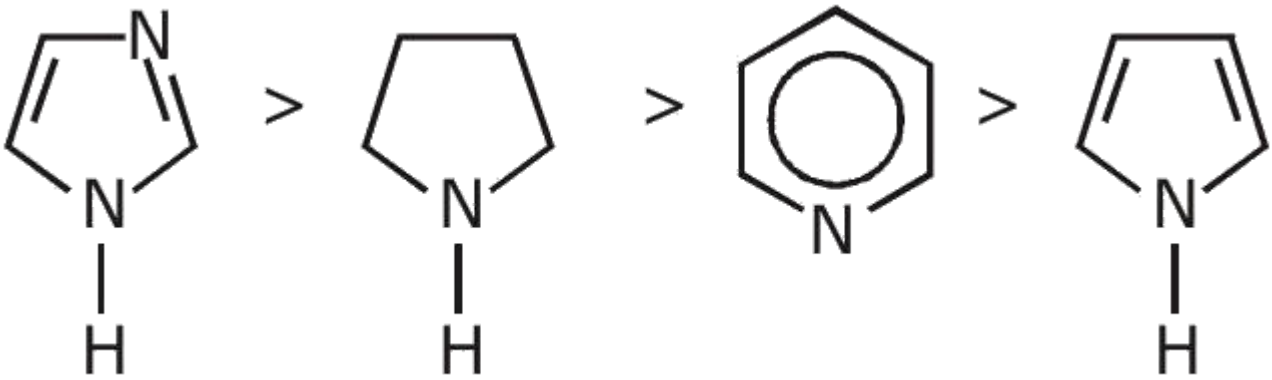
C. (B) < (A) < (D) < (C)

D. (B) < (A) < (C) < (D)

Correct answer: D

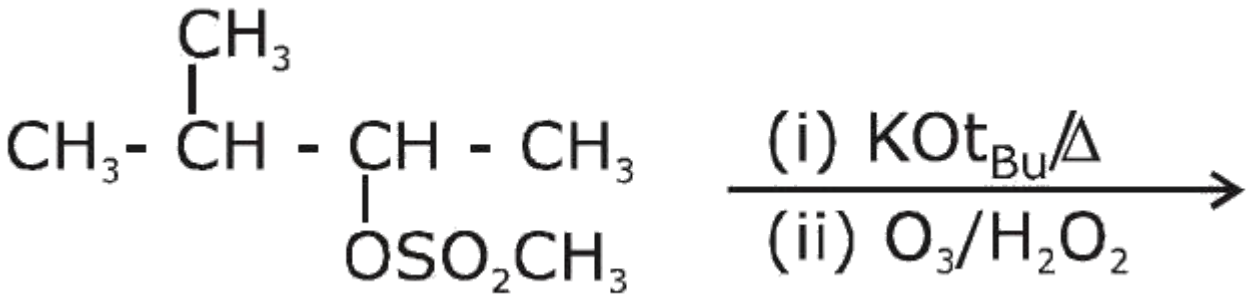
Source solution

Sol. 4
Correct order of basicity

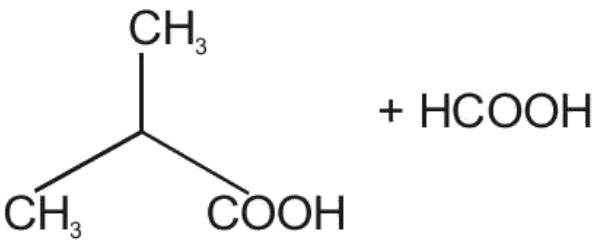


Question 101

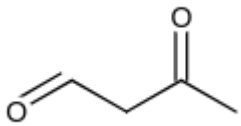
The major products of the following reactions are :



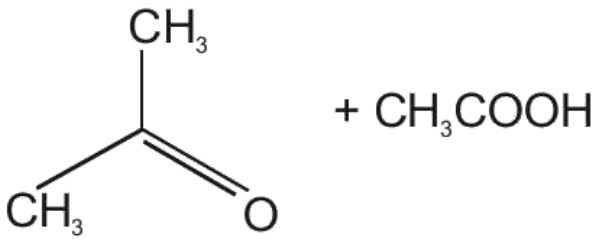
A.



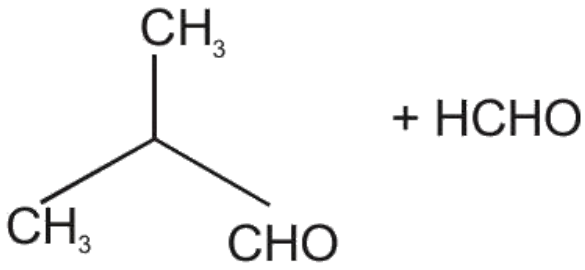
B.



C.



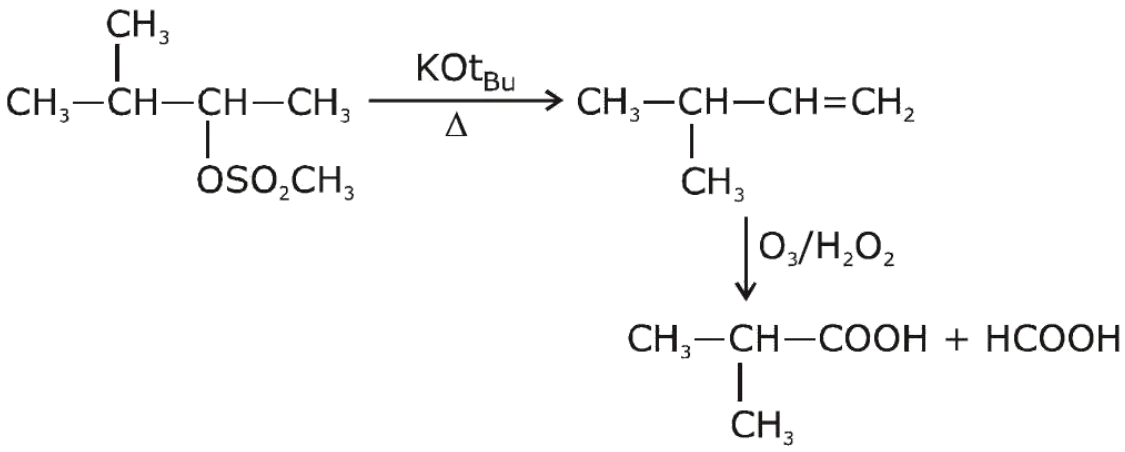
D.



Correct answer: A

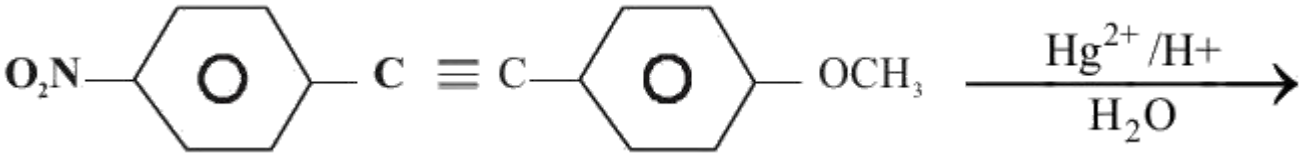
Source solution

Sol. 1}

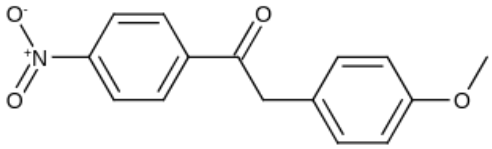

CH3
CH3—CH—CH—CH3
OSO2CH3
KOtBu
Δ
CH3—CH—CH=CH2
CH3
O3/H2O2
CH3—CH—COOH + HCOOH
CH3

Question 102

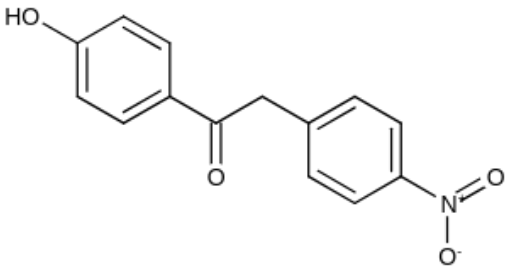
The major product obtained from the following reactions is :



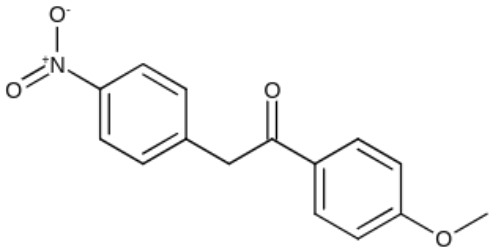
A.



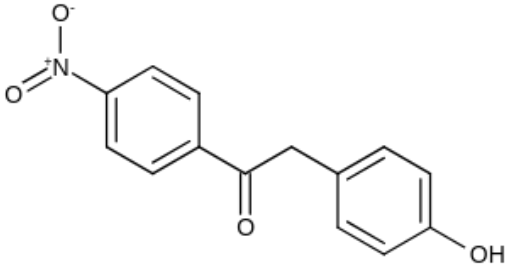
B.



C.



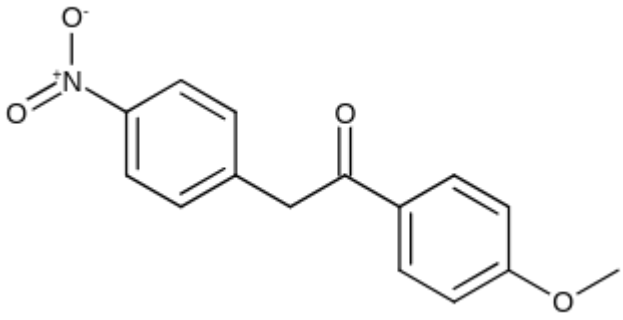
D.



Correct answer: C

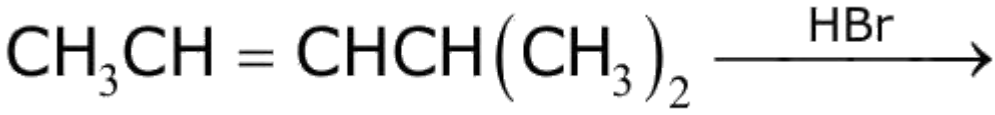
Source solution

Sol. 3}



Question 103

The major product formed in the following reaction is :



A. $CH_3CH(Br)CH_2CH(CH_3)_2$

B. $CH_3CH_2CH_2C(Br)(CH_3)_2$

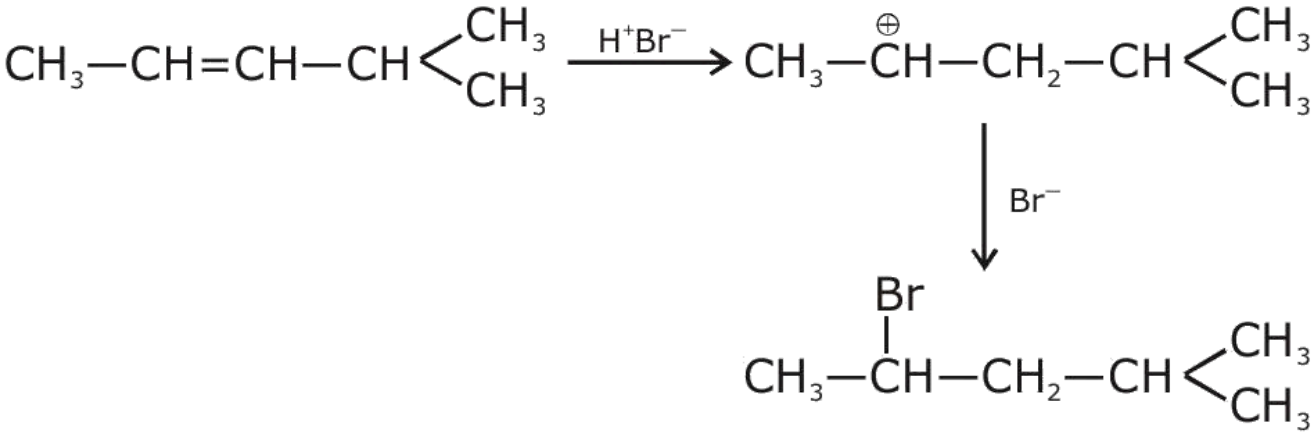
C. $CH_3CH_2CH(Br)CH(CH_3)_2$

D. $Br(CH_2)_3CH(CH_3)_2$

Correct answer: A

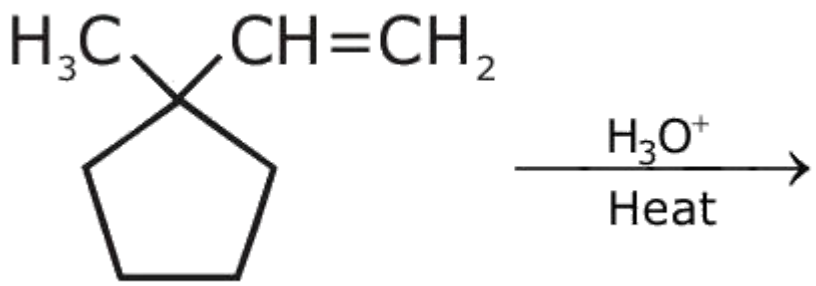
Source solution

Sol. 1

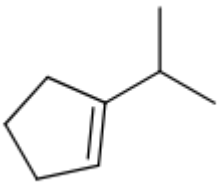


Question 104

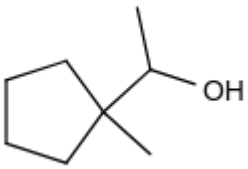
The major product in the following reaction is:



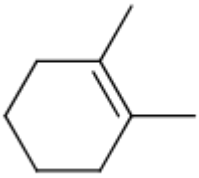
A.



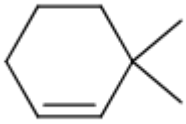
B.



C.



D.

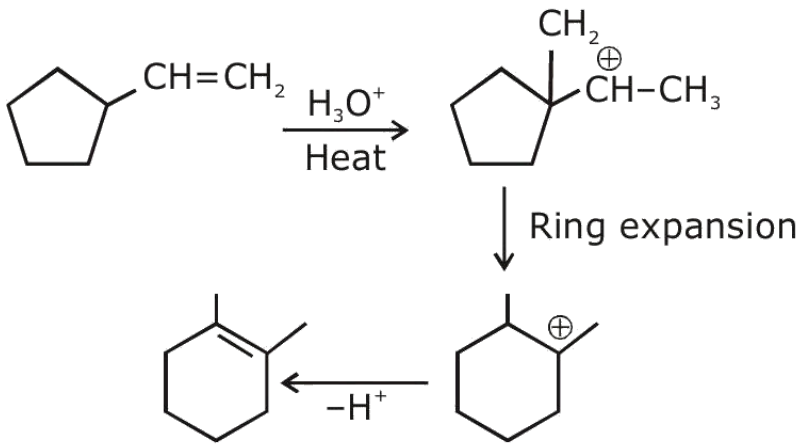


Correct answer: C

Source solution

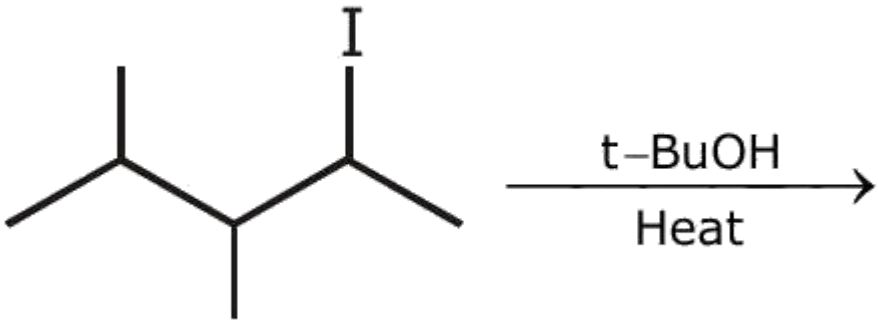
Sol.

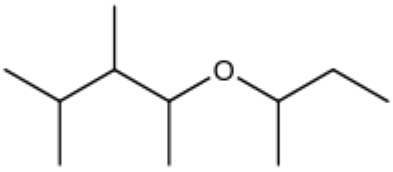
Option (3) is correct answer.


CH=CH2
H3O+
Heat
CH2
CH–CH3
Ring expansion
–H+

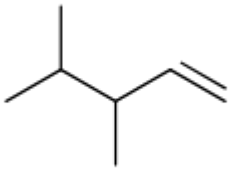
Question 105

The major product in the following reaction is:

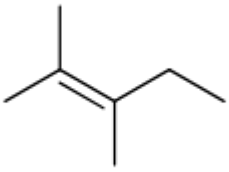




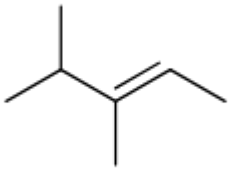
A.



B.



C.

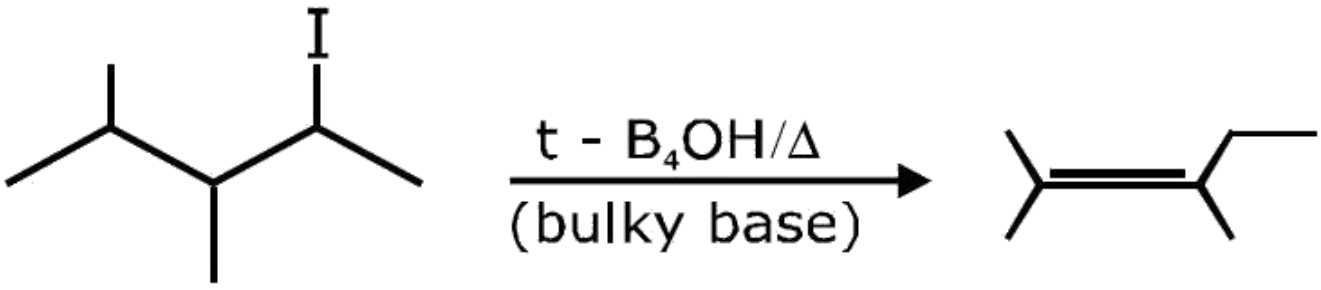


D.

Correct answer: C

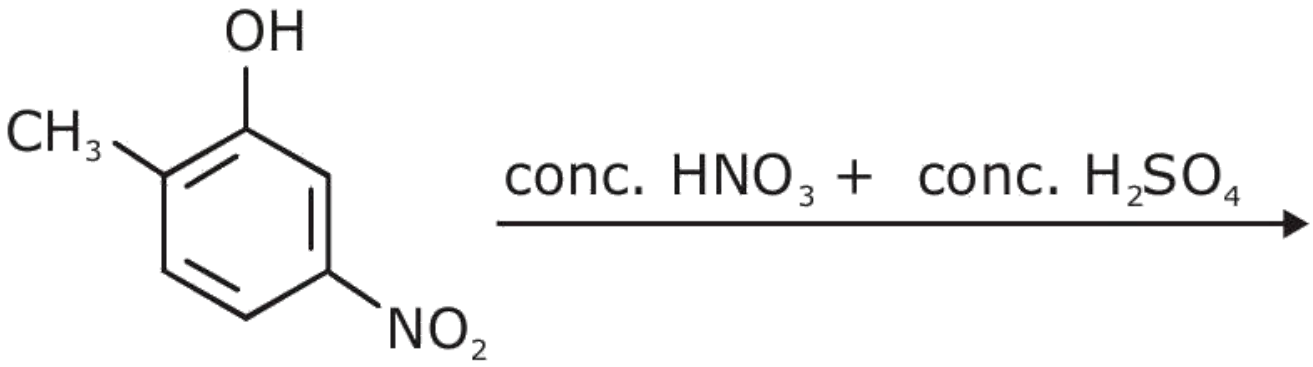
Source solution

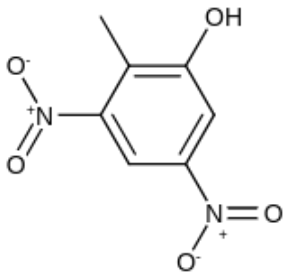
Sol. 3}



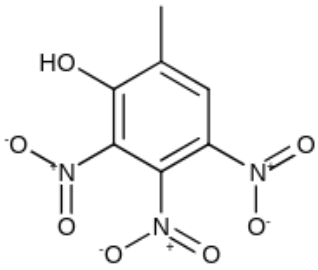
Question 106

The major product of the following reaction is :

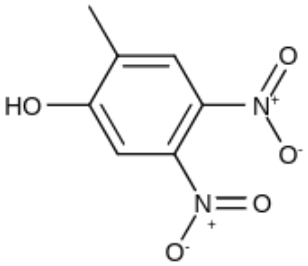




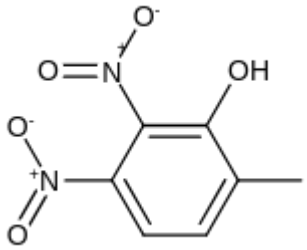
A.



B.



C.

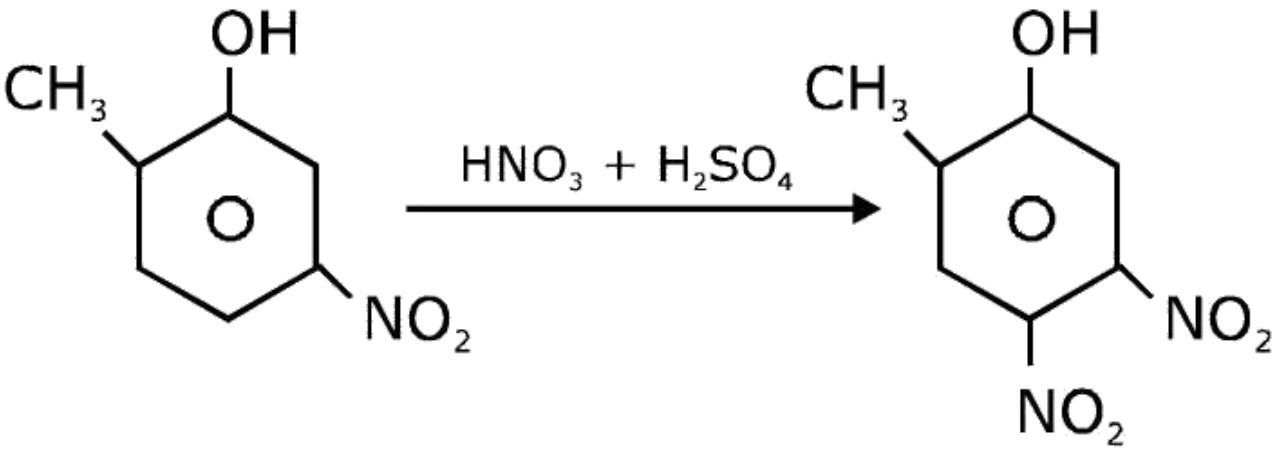


D.

Correct answer: C

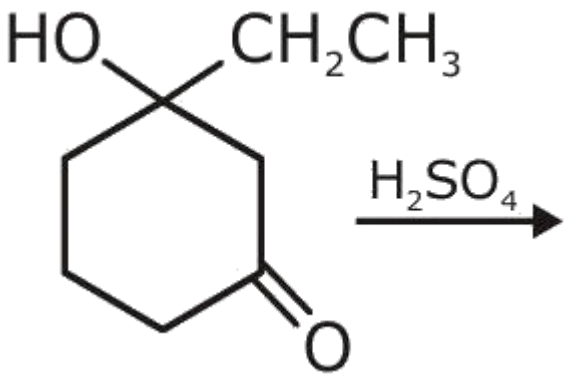
Source solution

Sol. 3}

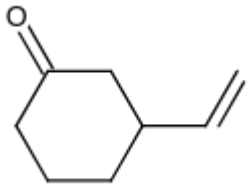

OH
CH3
O
NO2
HNO3 + H2SO4
OH
CH3
O
NO2
NO2

Question 107

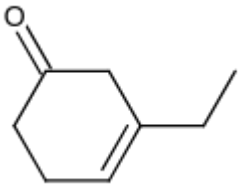
The major product of the following reaction is:



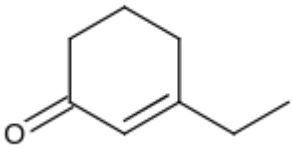
A.



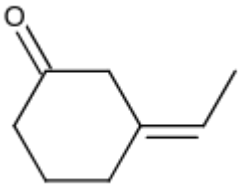
B.



C.



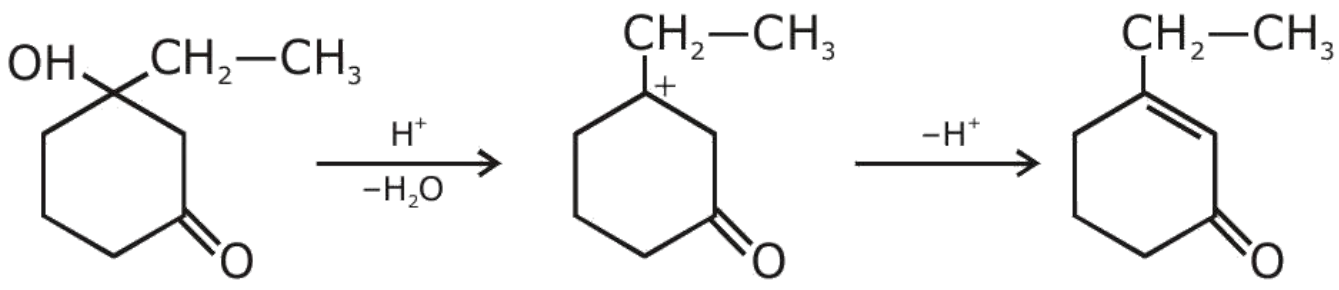
D.



Correct answer: C

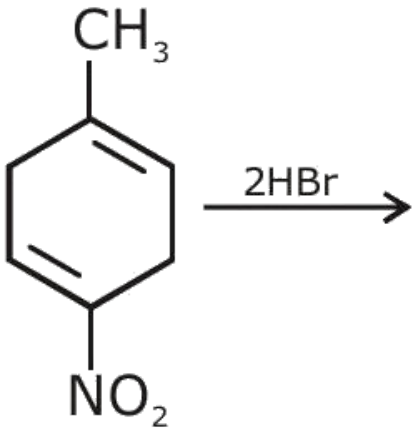
Source solution

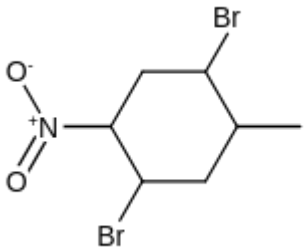
Sol. 3



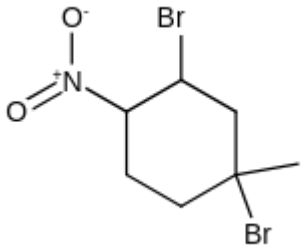
Question 108

The major product of the following reaction is:

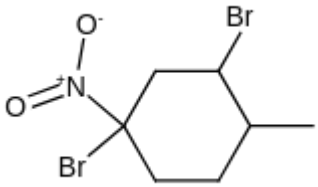




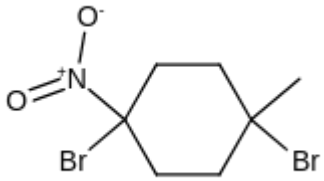
A.



B.



C.

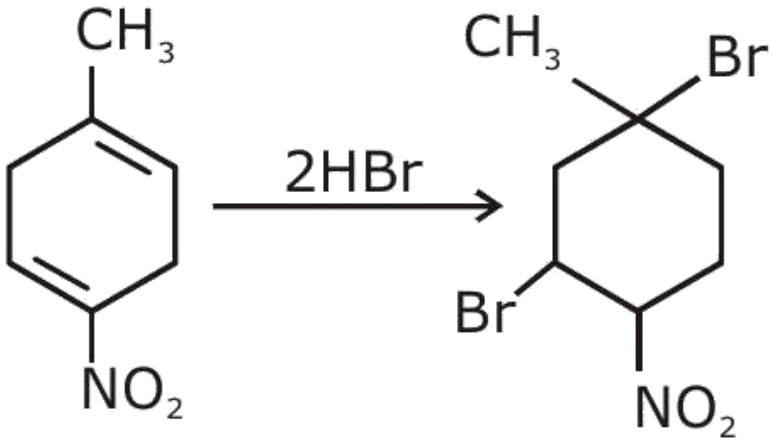


D.

Correct answer: B

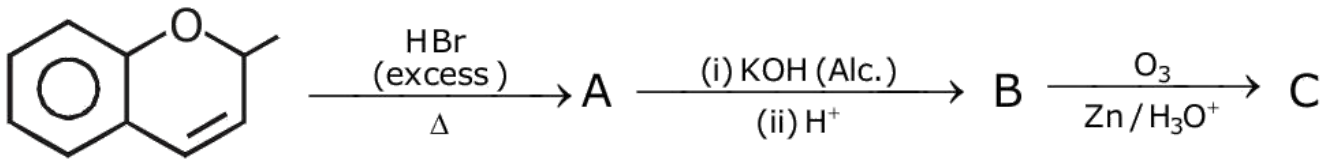
Source solution

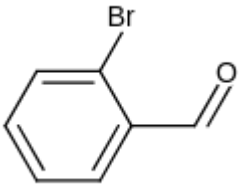
Sol. 2}


CH3
2HBr
NO2
CH3
Br
Br
NO2

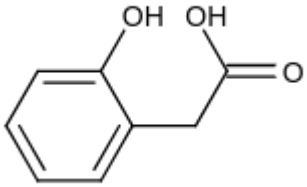
Question 109

The major aromatic product C in the following reaction sequence will be :

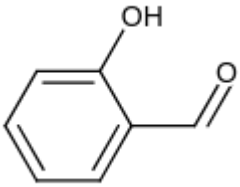




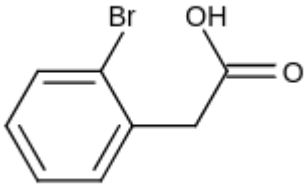
A.



B.



C.



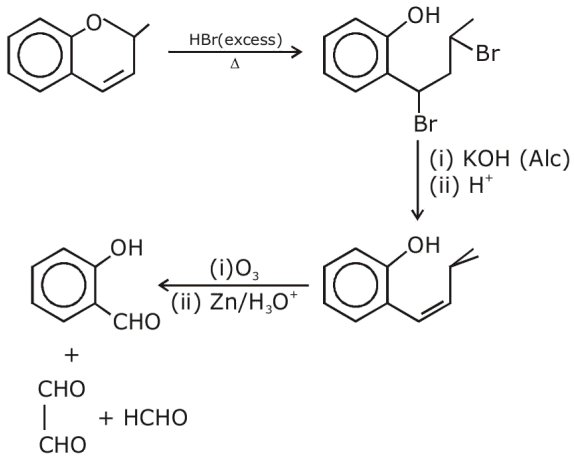
D.

Correct answer: C

Source solution

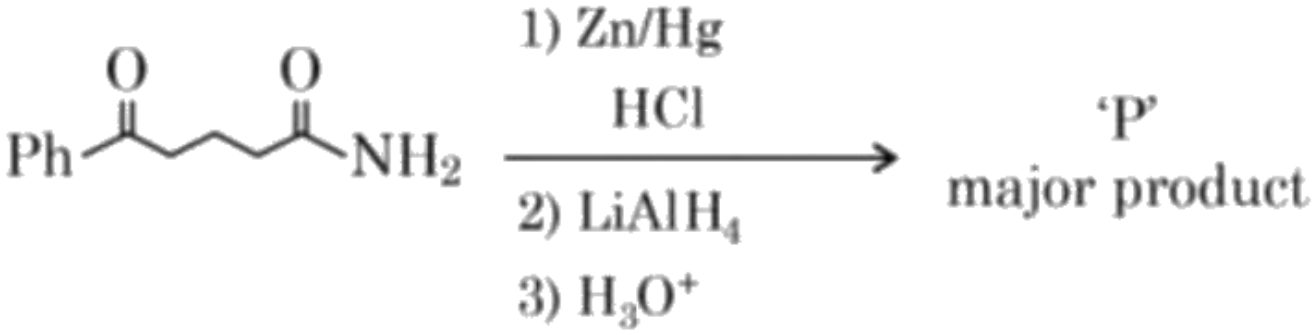
Sol.

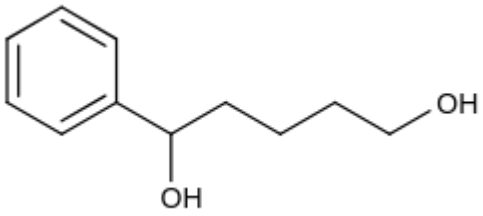
Option (3) is correct answser.



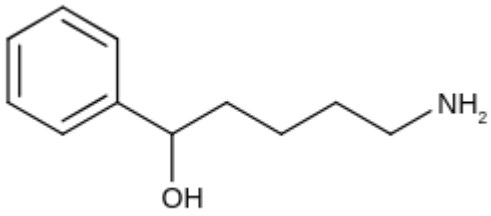
Question 110

The major product ' P ' for the following sequence of reactions is:

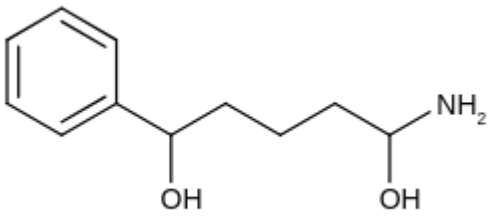




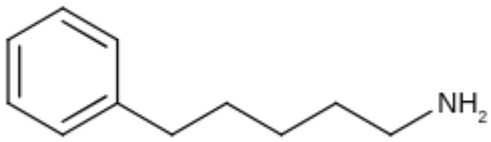
A.



B.



C.

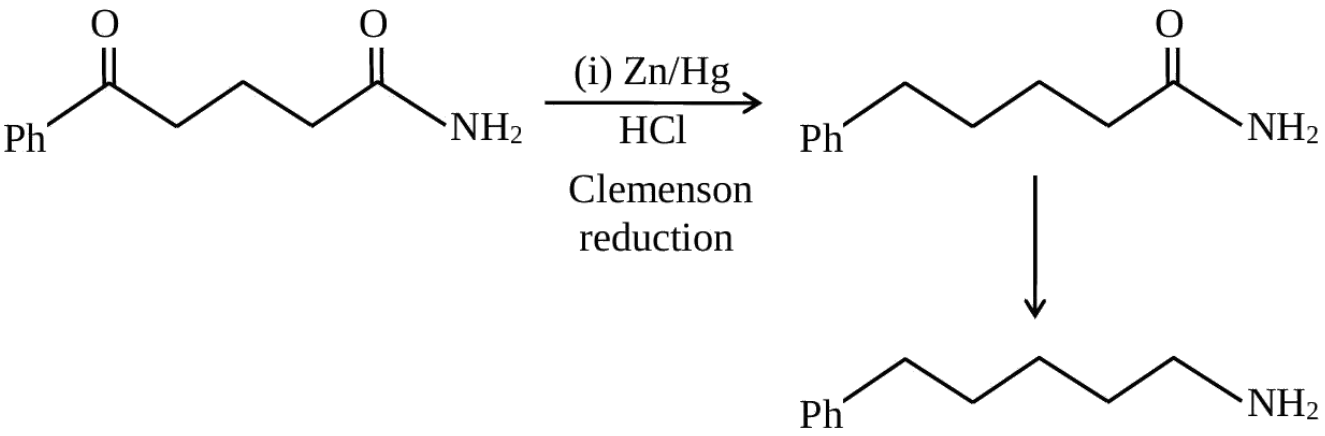


D.

Correct answer: D

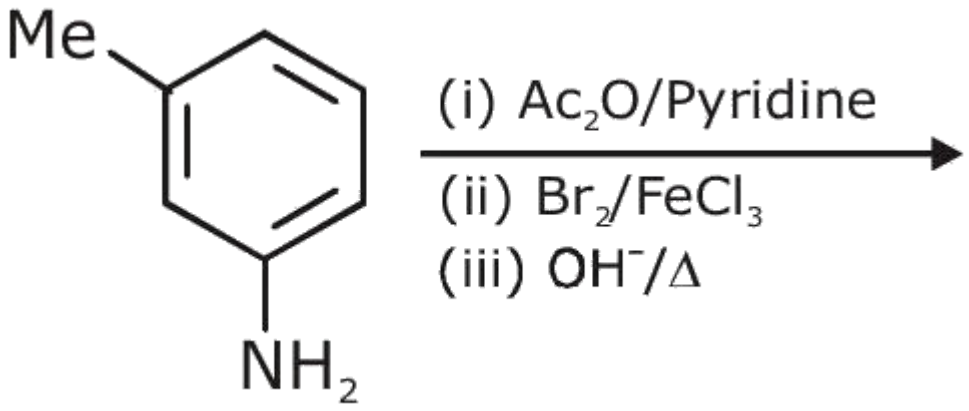
Source solution

Sol. 4

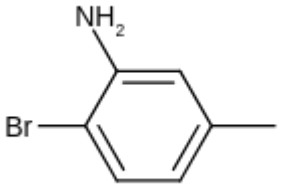

O
O
Ph
NH2
(i) Zn/Hg
HCl
Clemenson
reduction
O
Ph
NH2
Ph
NH2

Question 111

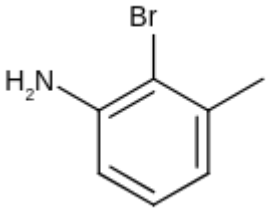
The final major product of the following reaction is :



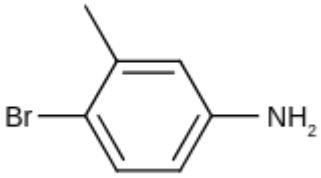
A.



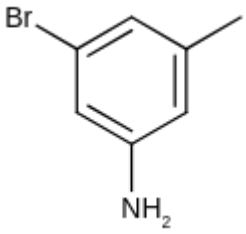
B.



C.



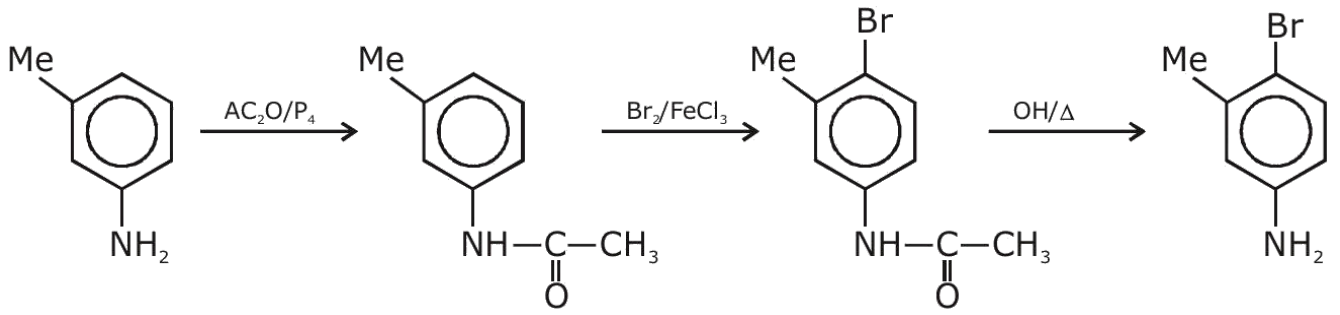
D.



Correct answer: C

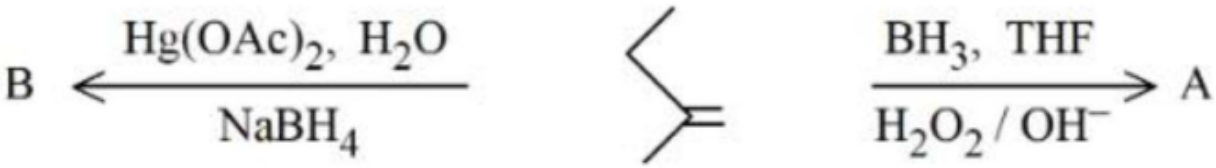
Source solution

Sol. 3



Question 112

Find out the major products from the following reaction



A. 

B. 

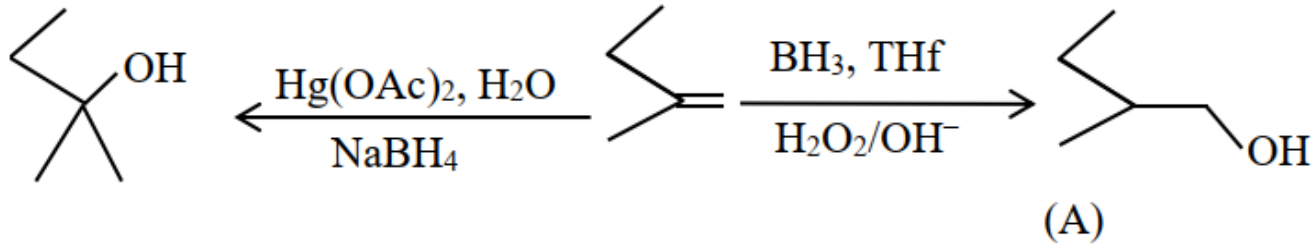
C. 

D. 

Correct answer: B

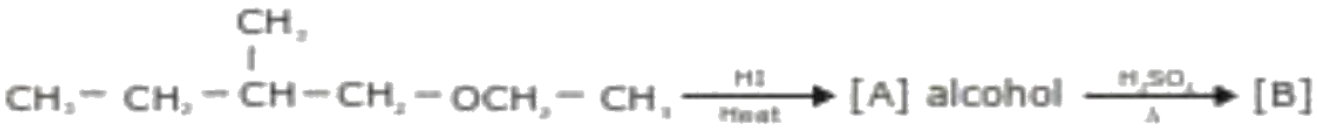
Source solution

Sol. 2

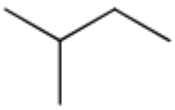


Question 113

The major product $[B]$ in the following reactions is :

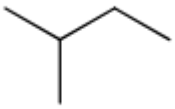


A. $CH_3 - CH_2 - CH = CH - CH_3$



B.

D. $CH_2 = CH_2$

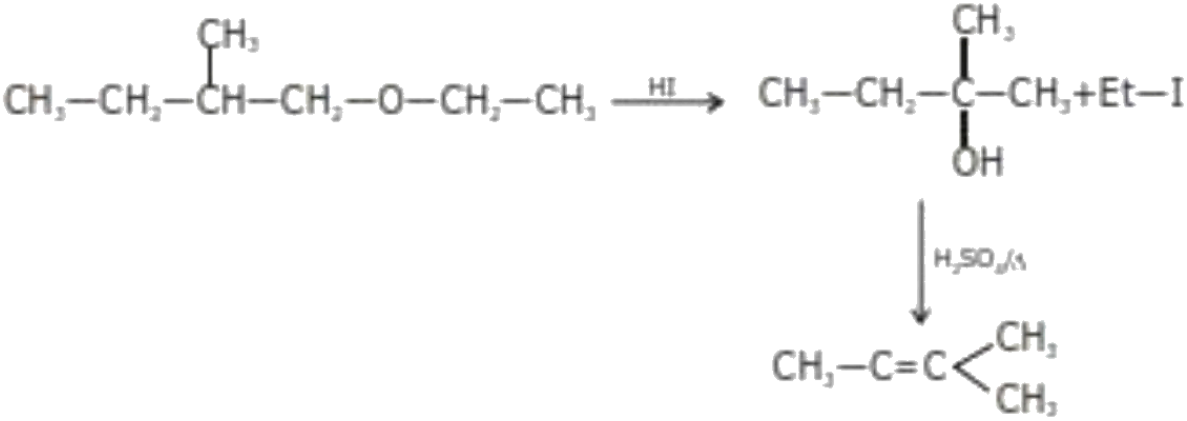


C.

Correct answer: C

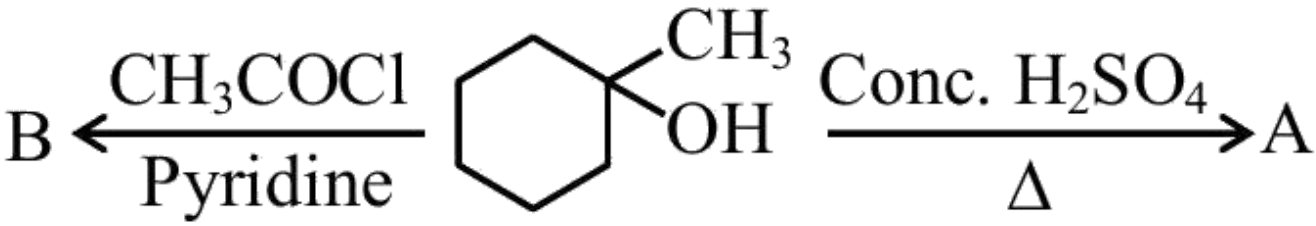
Source solution

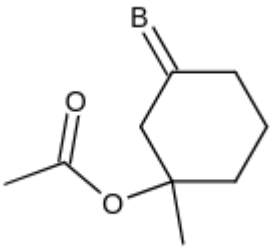
Sol. 3}



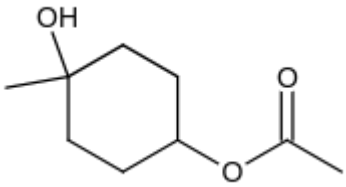
Question 114

Identify the major products A and B respectively in the following set of reactions.

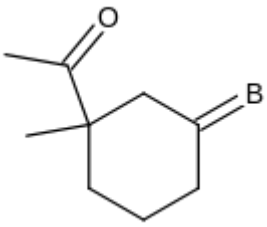




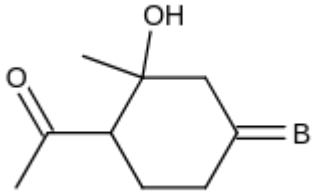
A.



B.



C.

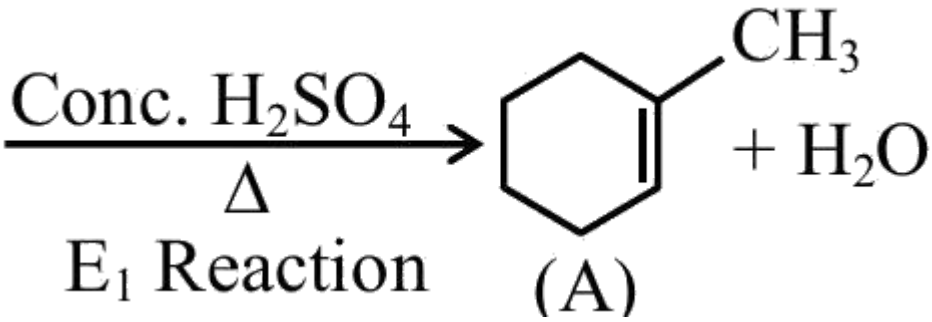


D.

Correct answer: A

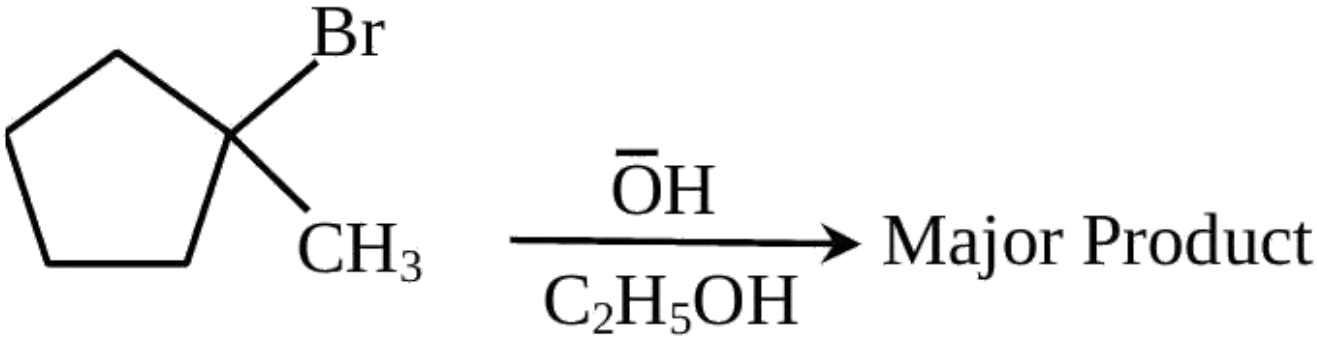
Source solution

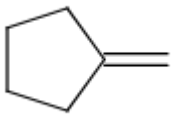
Sol.



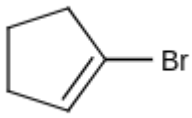
Question 115

Identify the major product in the following reaction.

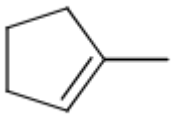




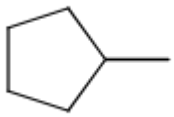
A.



B.



C.

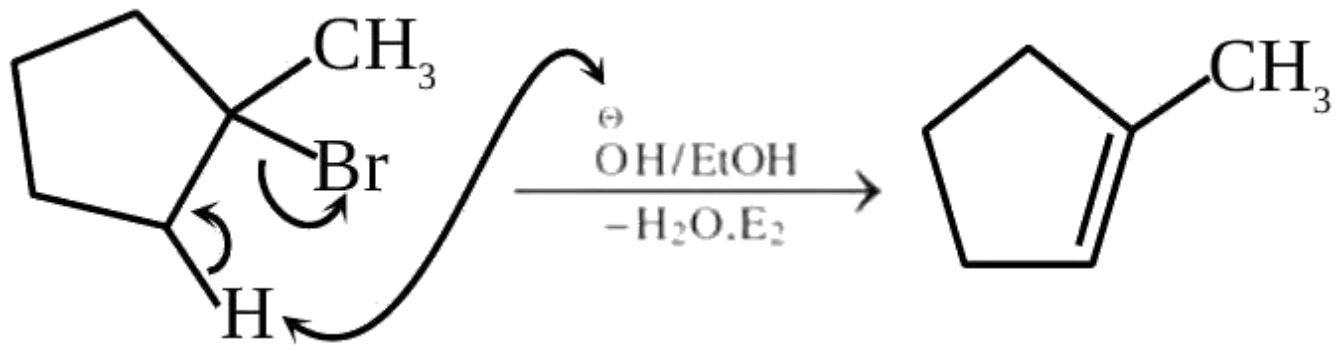


D.

Correct answer: C

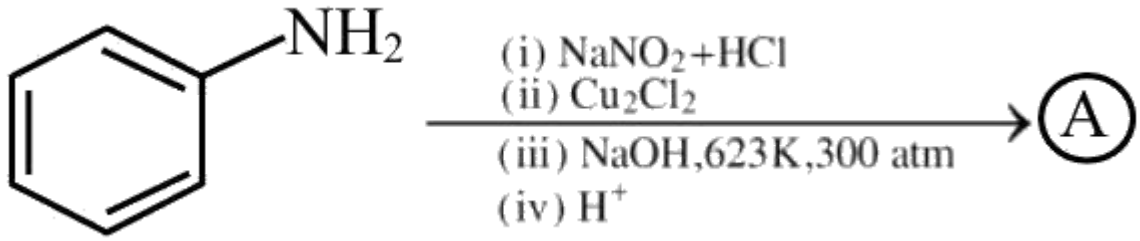
Source solution

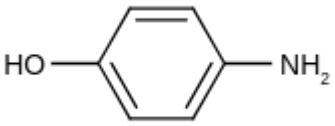
Sol.



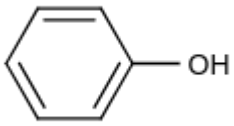
Question 116

Identify the product (A) in the following reaction.

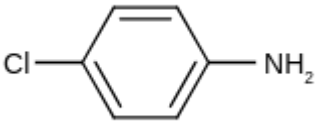




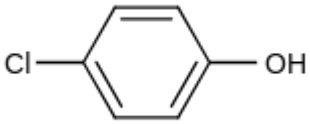
A.



B.



C.

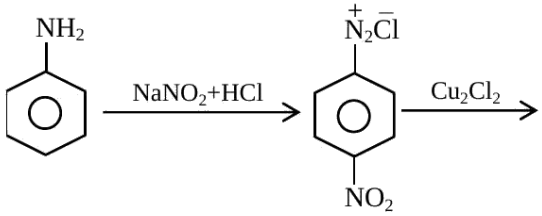


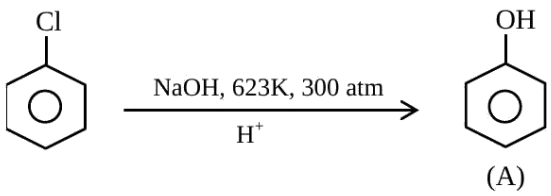
D.

Correct answer: B

Source solution

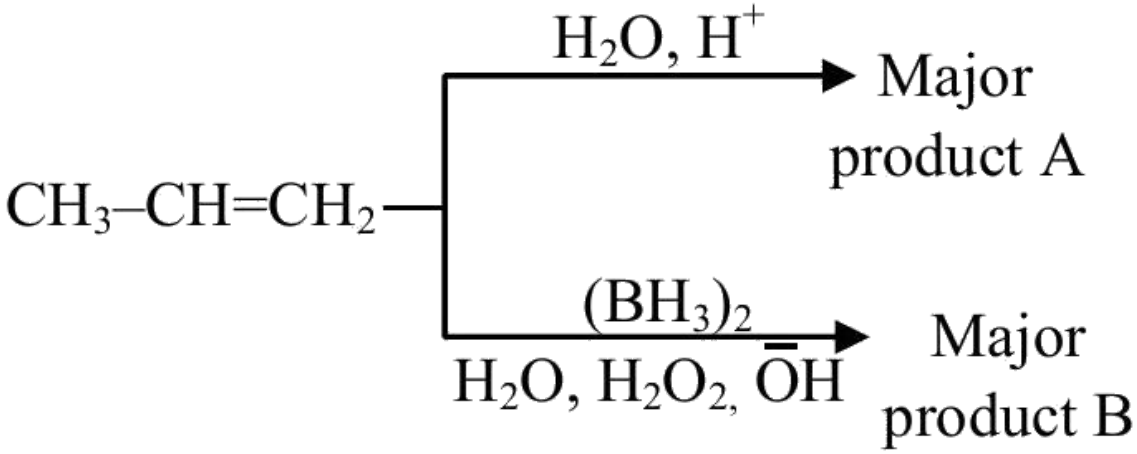
Sol.





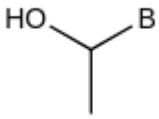
Question 117

Identify the product A and product B in the following set of reactions.



A. $A - CH_3CH_2CH_2 - OH, B - CH_3CH_2CH_2 - OH$

B. $A - CH_3CH_2CH_2 - OH$,



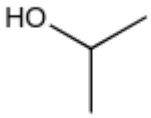
C. (2) Hydroboration Oxidation Reaction :}

(B)

$$3CH_3–CH=CH_2 + B_2H_6 \xrightarrow{THF} 2(CH_3CH_2CH_2)_3B$$

$$(CH_3CH_2CH_2)_3B + 3H_2O_2 \xrightarrow{OH^-} \underset{(B)}{3CH_3CH_2CH_2OH} + H_3BO_3$$

D. (3)

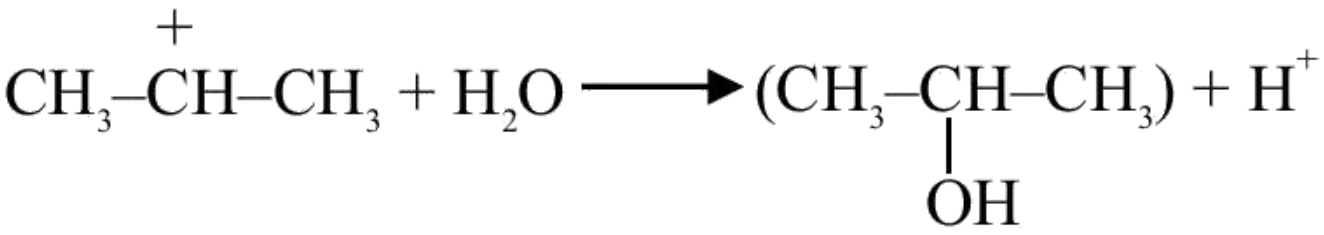


Correct answer: C

Source solution

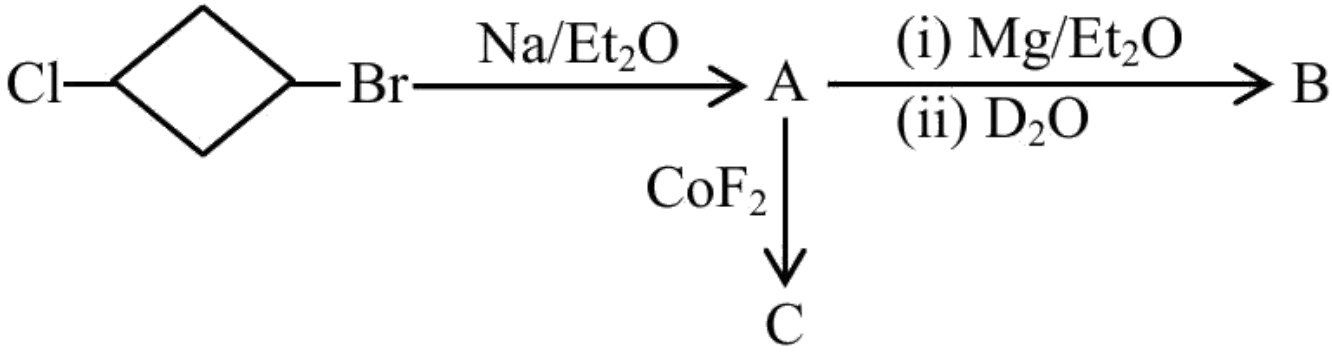
Sol. (1) Hydration Reaction :

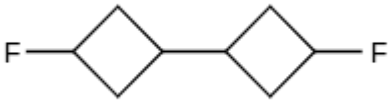
(A)



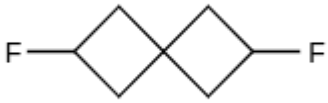
Question 118

In the following sequence of reaction, the major products B and C respectively are :

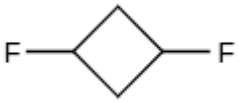




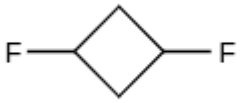
A.



B.



C.

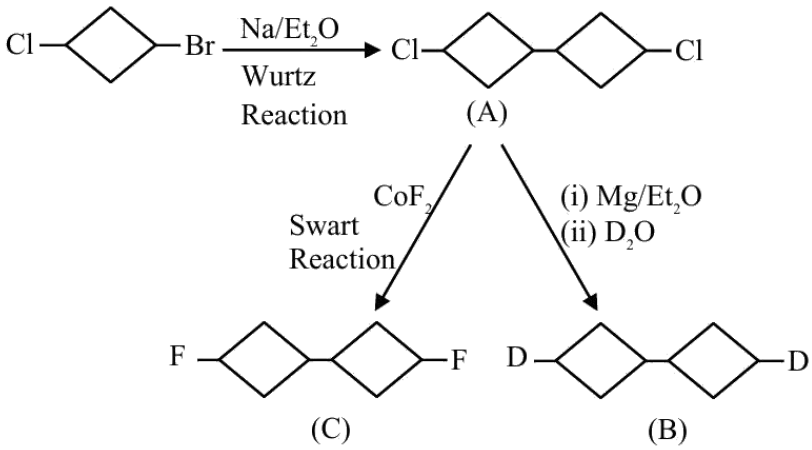


D.

Correct answer: A

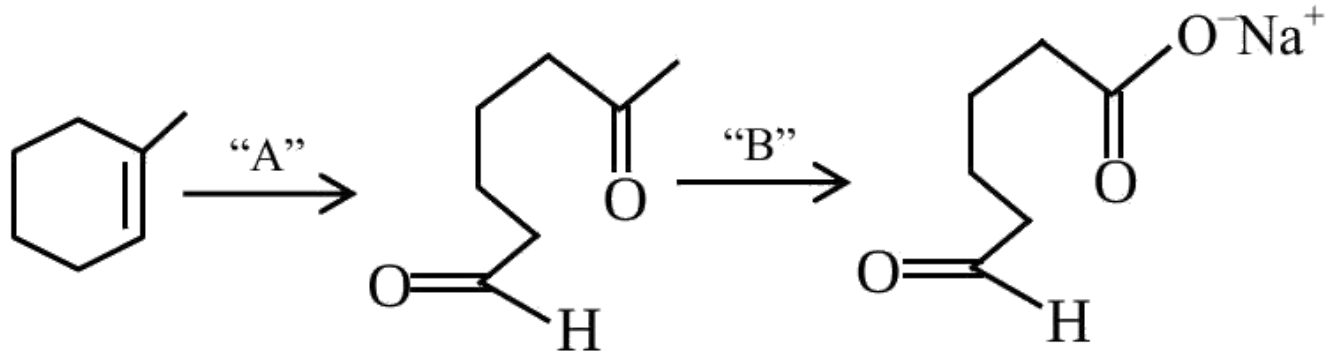
Source solution

Sol.



Question 119

In the above chemical reaction sequence "A" and " B " respectively are :



A. $O_3, Zn/H_2O$ and $NaOH_{(alc.)}$ /I_2

B. $H_2O, H^+$and $NaOH_{(alc.)}$ /I_2

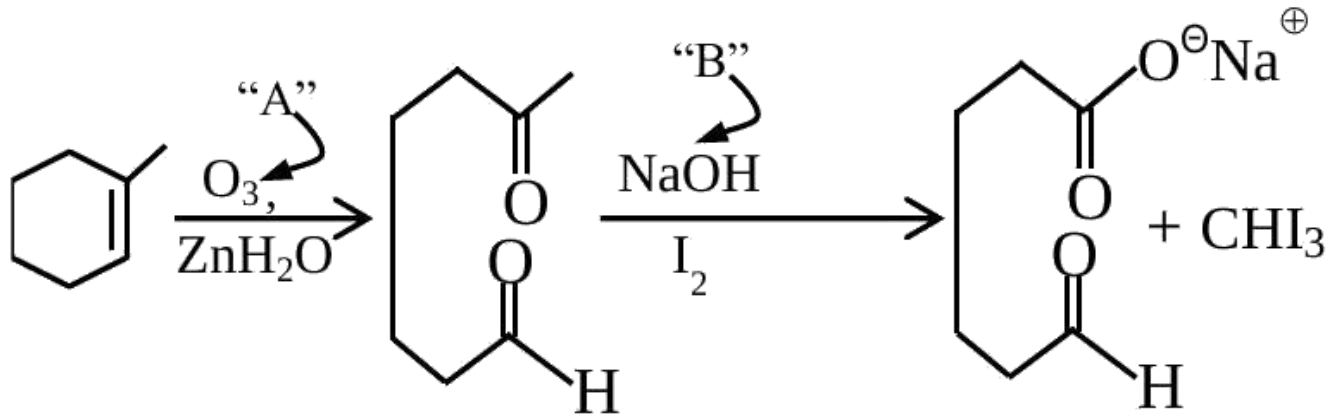
C. $H_2O, H^+$and $KMnO_4$

D. $O_3, Zn/H_2O$ and $KMnO_4$

Correct answer: A

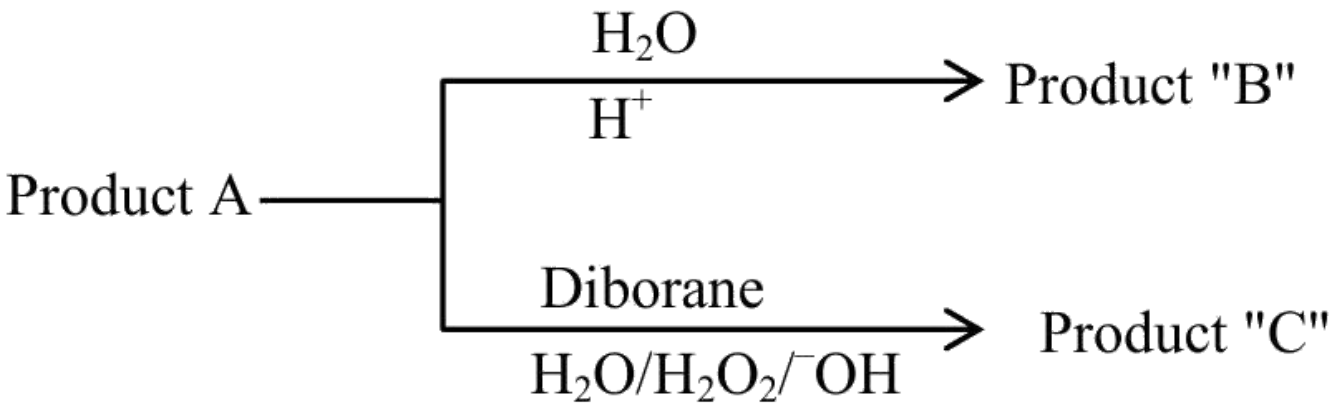
Source solution

Sol.



Question 120

Consider the above reactions, identify product B and product C .



A. $\mathbf{B = C =}$ 2-Propanol

B. $\mathbf{B =}$ 2-Propanol $\mathbf{C =}$ 1-Propanol

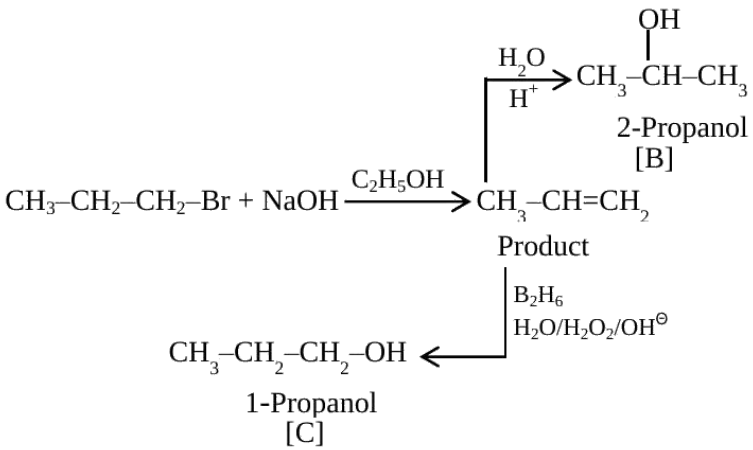
C. $\mathbf{B =}$ 1-Propanol $\mathbf{C =}$ 2-Propanol

D. $\mathbf{B = C =}$ 1-Propanol

Correct answer: B

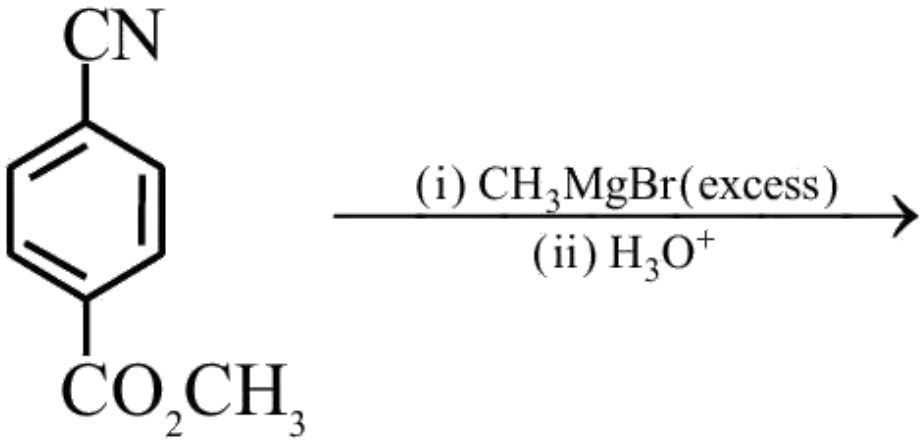
Source solution

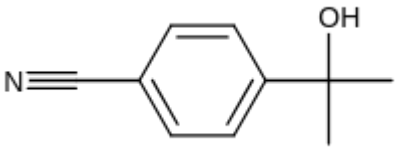
Sol.



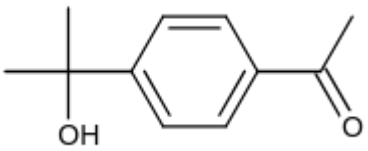
Question 121

Major product of the following reaction is

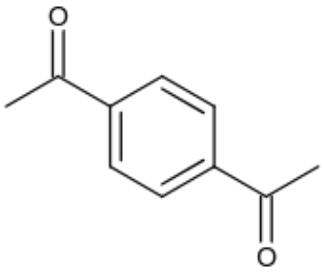




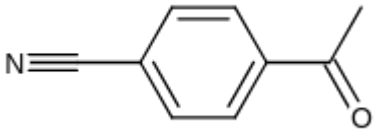
A.



B.



C.

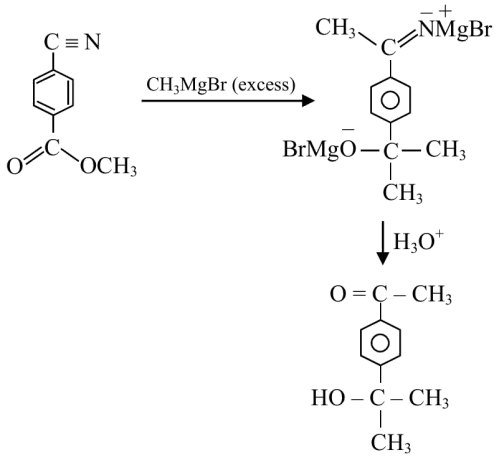


D.

Correct answer: B

Source solution

Sol.


C ≡ N
O
C
OCH3
CH3MgBr (excess)
CH3
C
NMgBr
BrMgO
C
CH3
CH3
H3O+
O = C – CH3
HO – C – CH3
CH3

Question 122

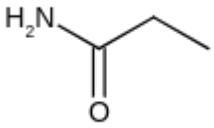
Consider the given reaction, identify the major product P .

$$CH_3-COOH \xrightarrow[(iv)\ H_2O/\bar{O}H,\Delta]{(i)\ LiAlH_4 \quad (ii)\ PCC \quad (iii)\ HCN/\bar{O}H} \text{"P"}$$

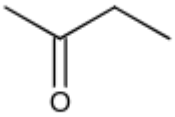
A.



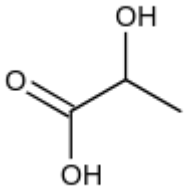
B.



C.



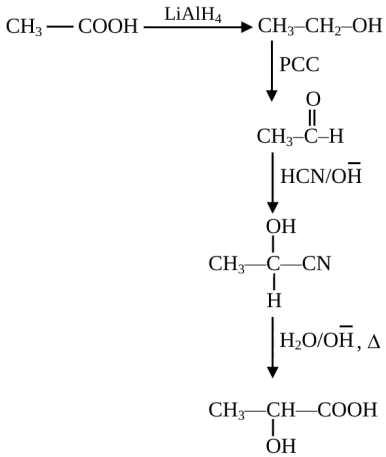
D.



Correct answer: D

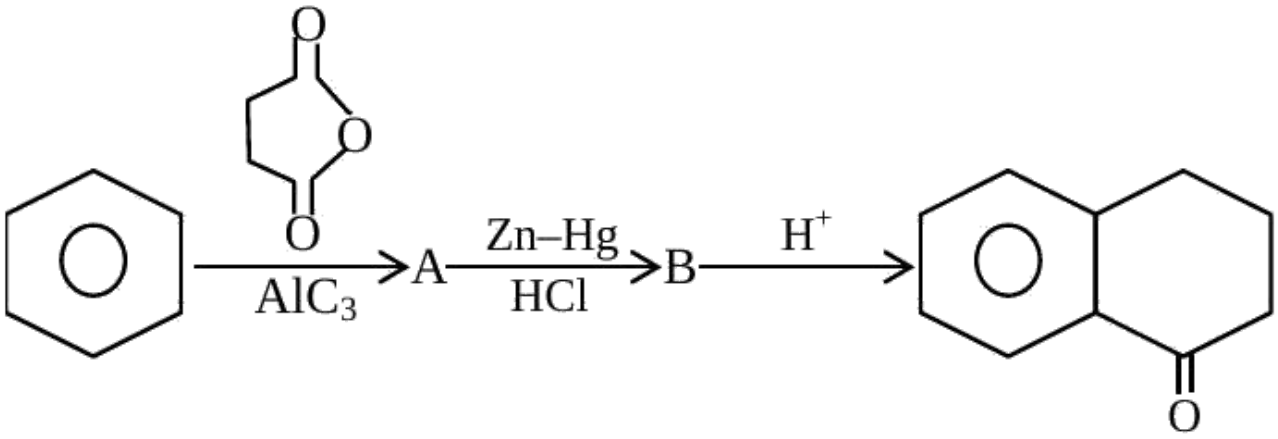
Source solution

Sol.

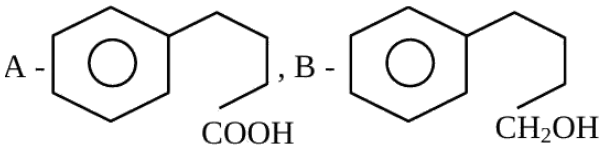


Question 123

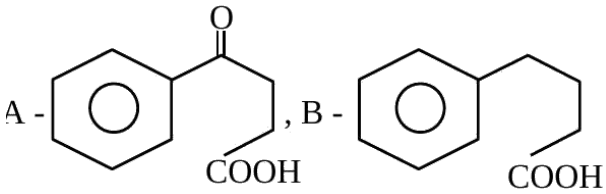
Identify A and B in the given chemical reaction sequence : -



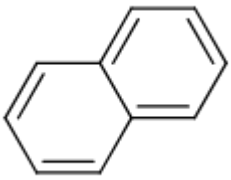
A.



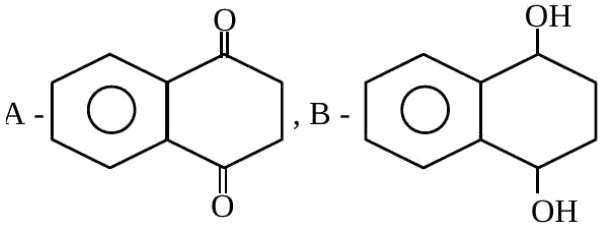
B.



C.



D.



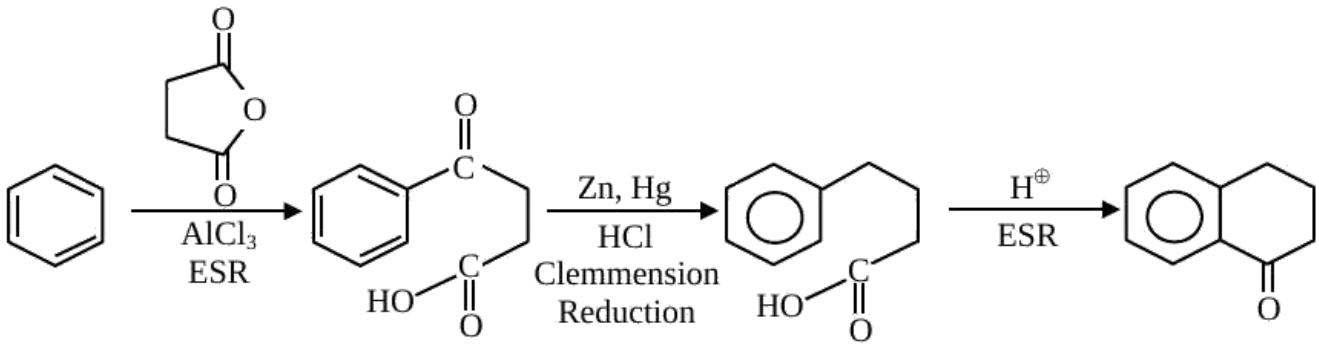
Correct answer: B

Source solution

Sol.

(A)

(B)


O
O
O
AlCl3
ESR
O
C
HO
C
O
Zn, Hg
HCl
Clemmension
Reduction
HO
C
O
H⊕
ESR
O

Question 124

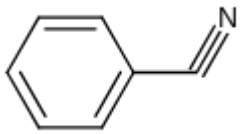
The increasing order of reactivity of the following compounds towards aromatic electrophilic substitution reaction is

A

B

C

D



A. $D < B < A < C$

B. D < A < C < B

C. $B < C < A < D$

D. A < B < C < D

Correct answer: B

Source solution

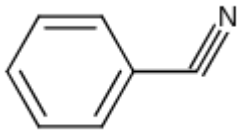
Sol.

(+M)

(+H)

($-\mathbf{I} > +\mathbf{M}$)

(-M, -1)



Question 125

Decreasing order of reactivity towards electrophilie substitution for the following compounds is :

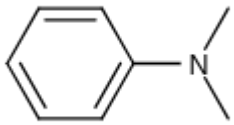
(a)

(b)

(c)

(d)

(e)



A. $c > b > a > d > e$

B. $e > d > a > b > c$

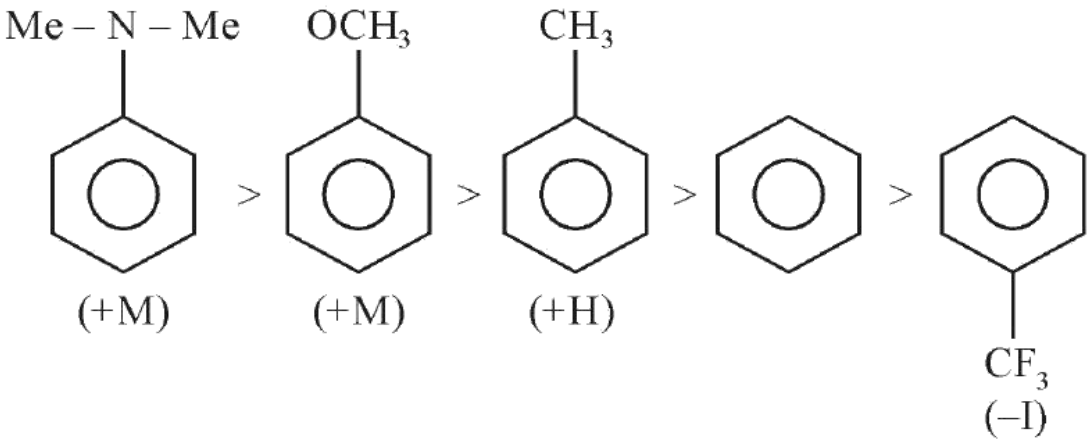
C. $a > d > e > b > c$

D. $d > a > e > c > b$

Correct answer: B

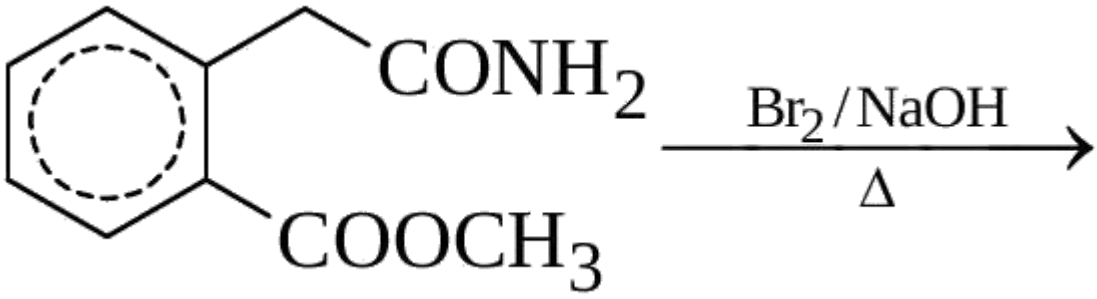
Source solution

Sol. Higher the electron density on Benzene Ring, Higher its Reactivity towards electrophilic substitution Reaction

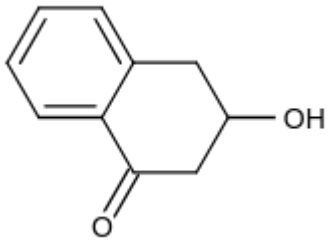


Question 126

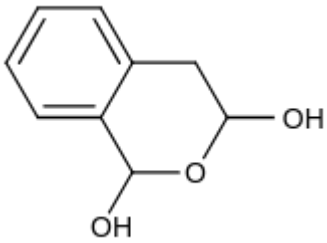
The major product formed in the following reaction is



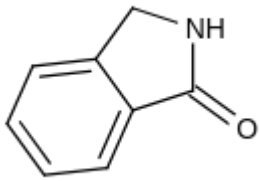
A.



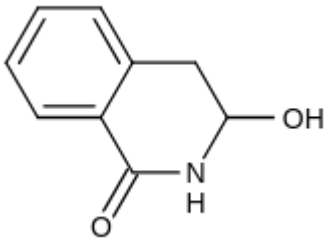
B.



C.



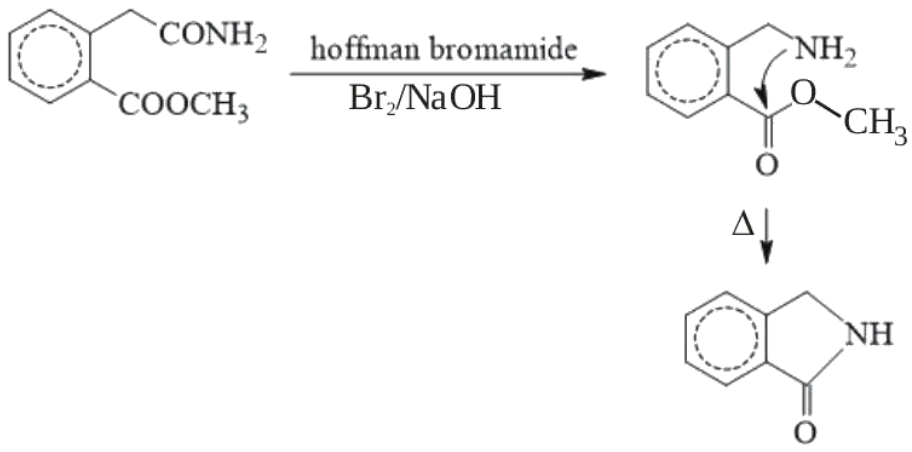
D.



Correct answer: C

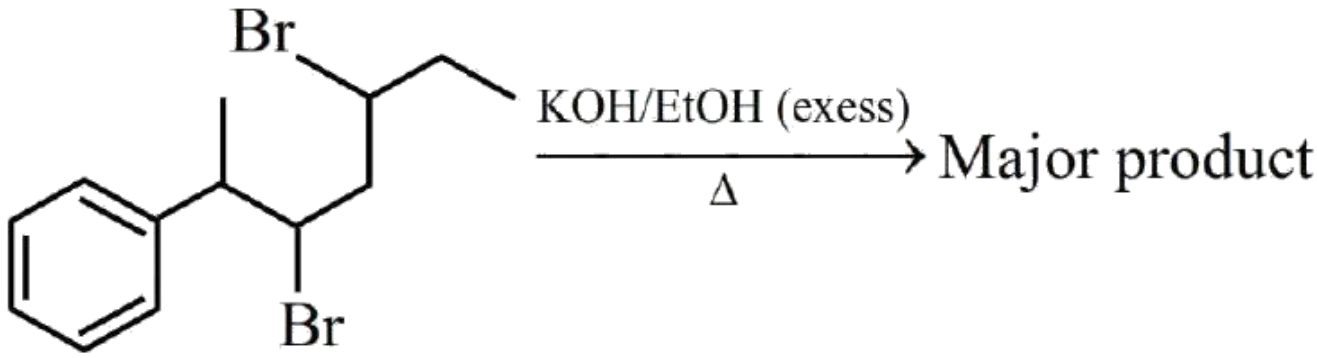
Source solution

Sol.


CONH2
COOCH3
hoffman bromamide
Br2/NaOH
NH2
O
CH3
O
Δ
NH
O

Question 127

The major product of the following reaction is :



A. 6-Phenylhepta-2,4-diene

B. 2-Phenylhepta-2,5-diene

C. 6-Phenylhepta-3,5-diene

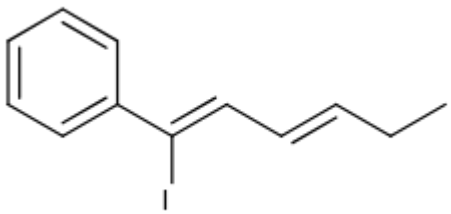
D. 2-Phenylhepta-2,4-diene

Correct answer: D

Source solution

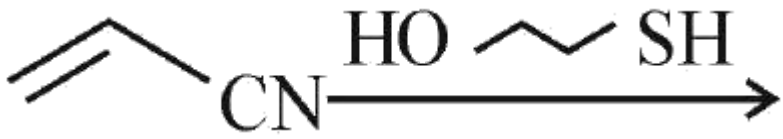
Sol.

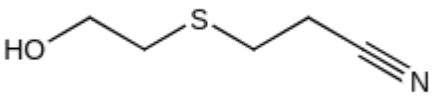
2-Phenylhepta-2,4-diene



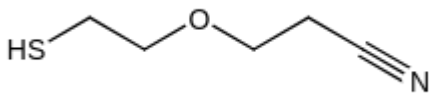
Question 128

The major product for the following reaction is:

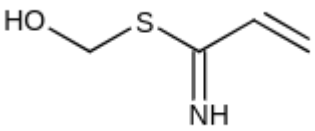




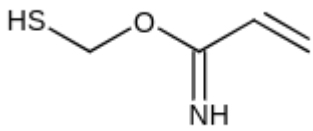
A.



B.



C.

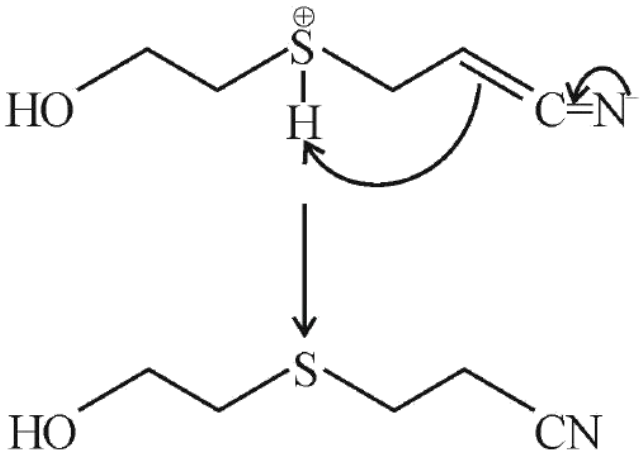


D.

Correct answer: A

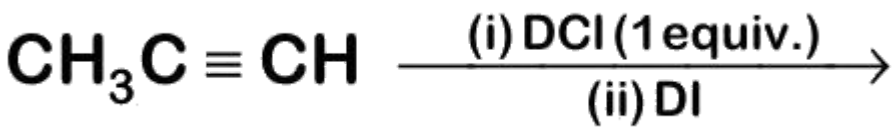
Source solution

Sol.



Question 129

The major product of the following reaction is



A. $CH_3C(I)(Cl)CHD_2$

B. $CH_3CD(I)CHD(Cl)$

C. $CH_3CD(Cl)CHD(I)$

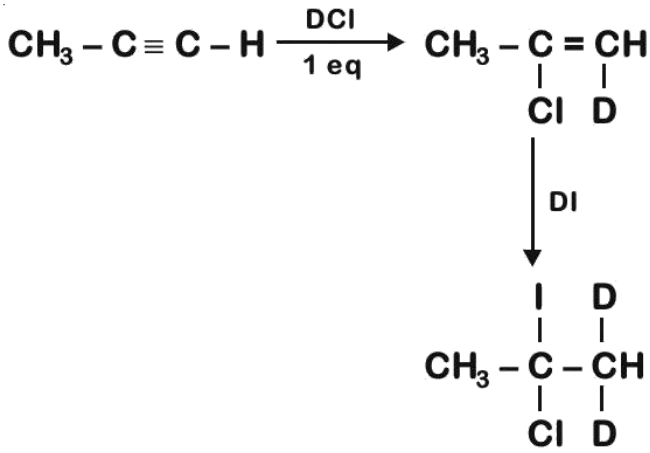
D. $CH_3CD_2CH(Cl)(I)$

Correct answer: A

Source solution

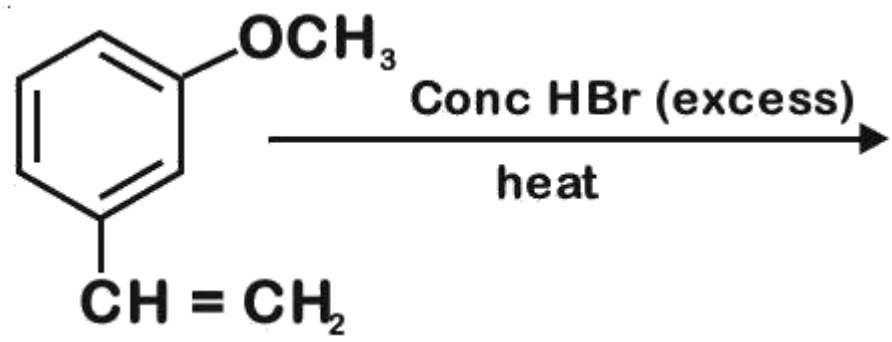
Sol.

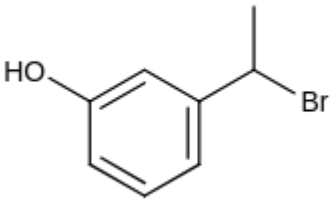
Both addition follow Markownikov's rule.



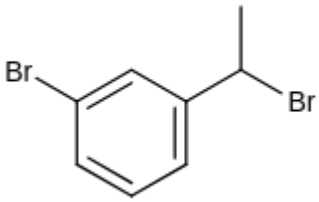
Question 130

The major product of the following reaction is

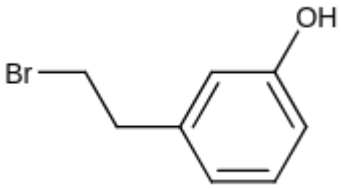




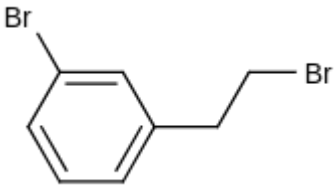
A.



B.



C.

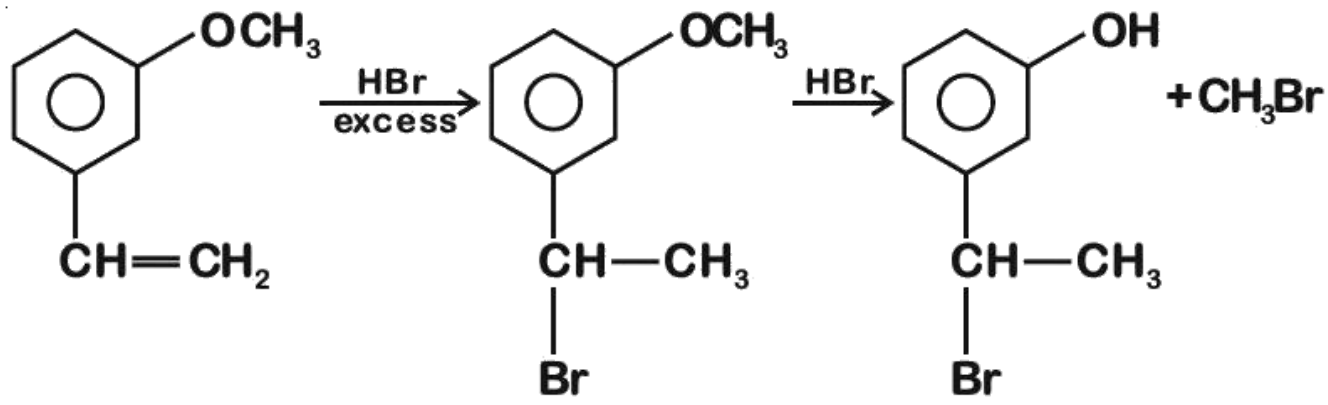


D.

Correct answer: A

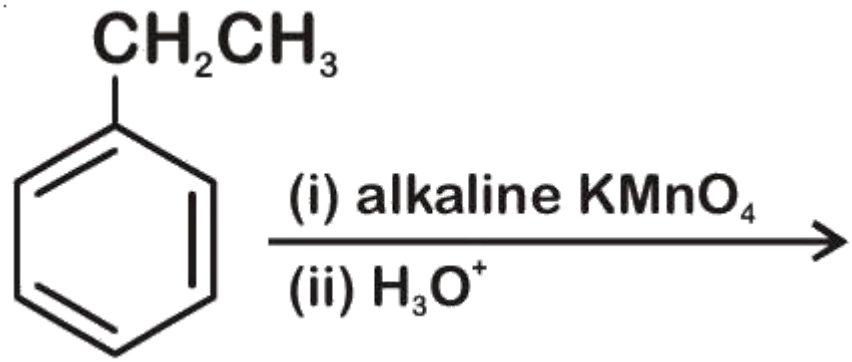
Source solution

Sol.

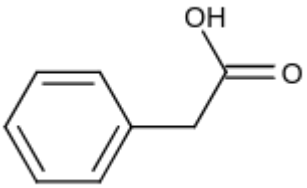

OCH3
CH=CH2
HBr
excess
OCH3
CH—CH3
Br
HBr
OH
CH—CH3
Br
+CH3Br

Question 131

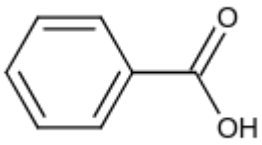
The major product of the following reaction is



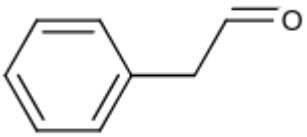
A.



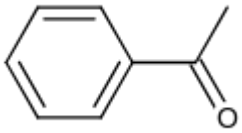
B.



C.



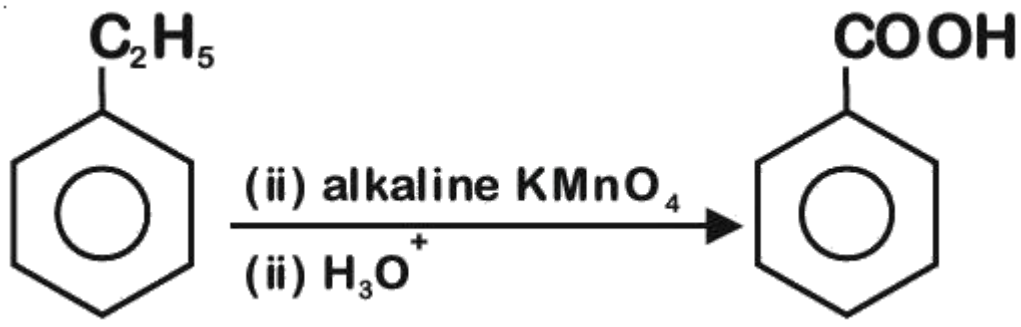
D.



Correct answer: B

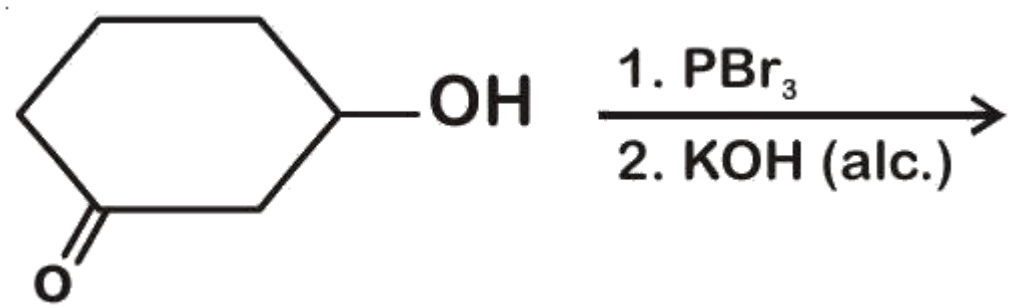
Source solution

Sol. Alkaline $\mathbf{KMnO_4}$ converts

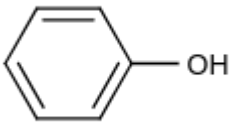


Question 132

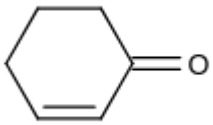
The major product of the following reaction is



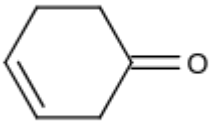
A.



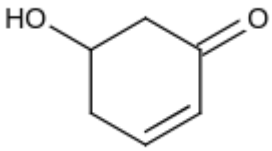
B.



C.



D.

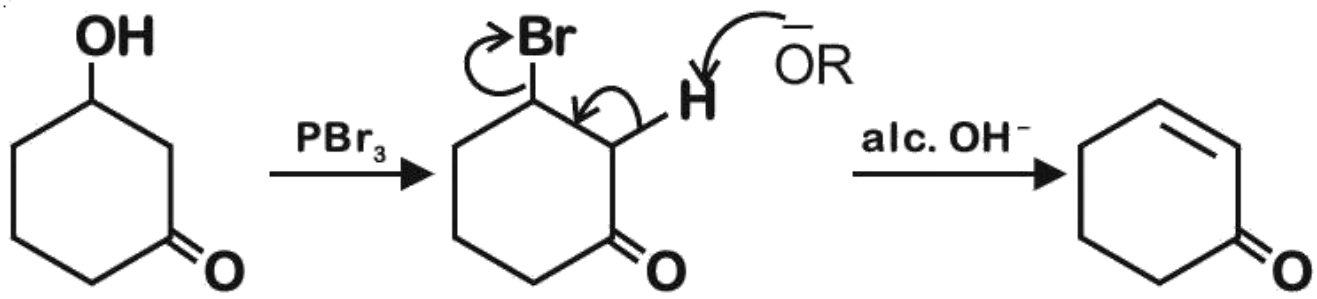


Correct answer: B

Source solution

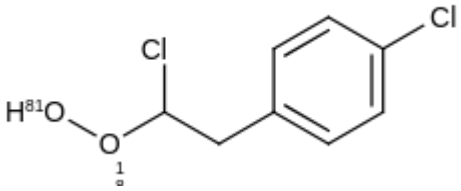
Sol.

More stable product due to conjugation .

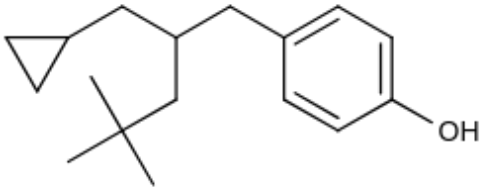


Question 133

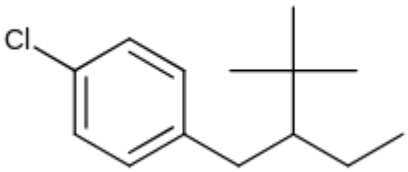
The major product of the following reaction is



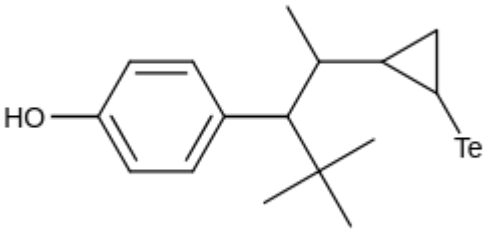
A.



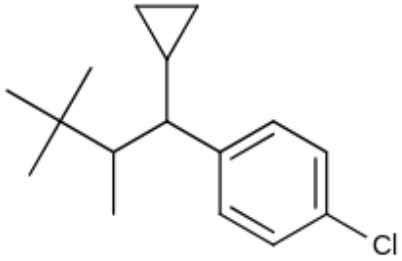
B.



C.



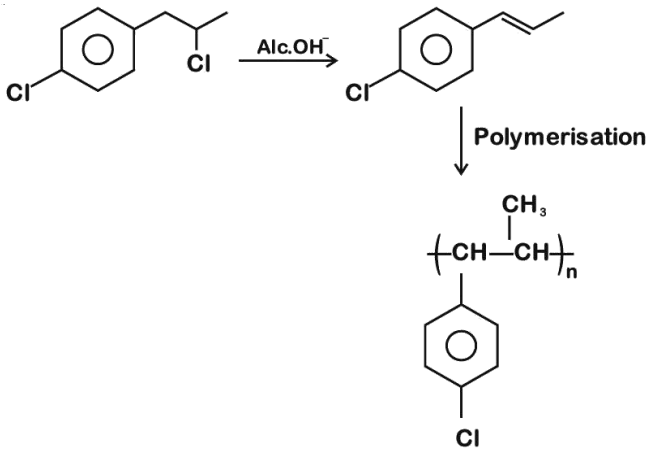
D.



Correct answer: D

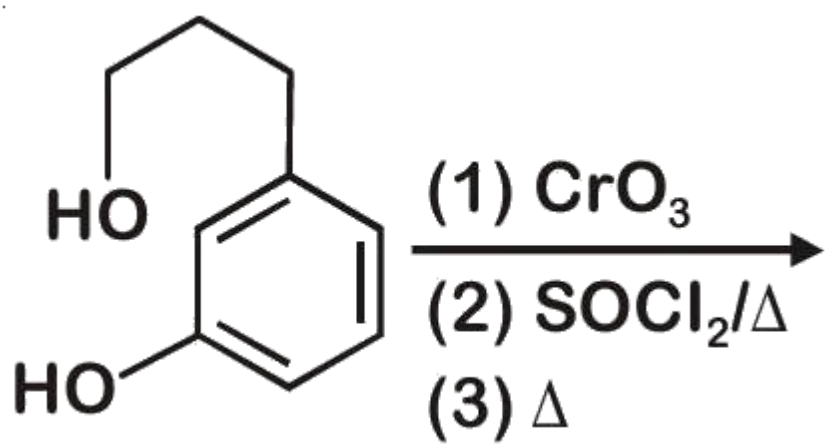
Source solution

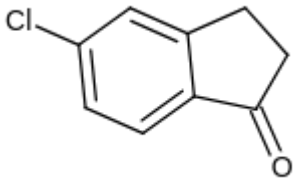
Sol.



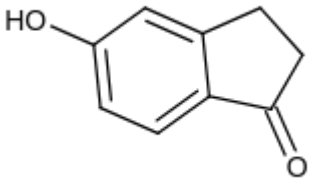
Question 134

The major product of the following reaction is

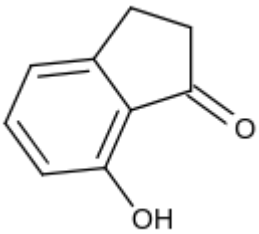




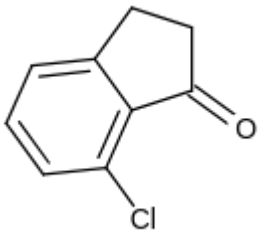
A.



B.



C.

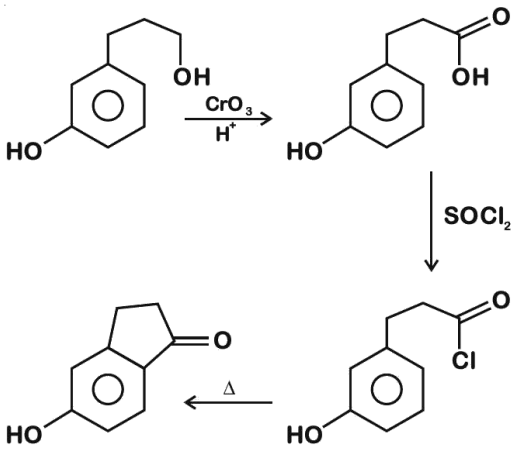


D.

Correct answer: B

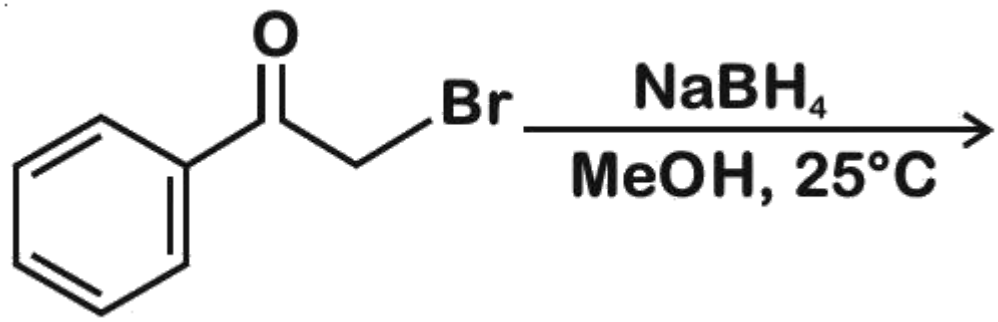
Source solution

Sol.

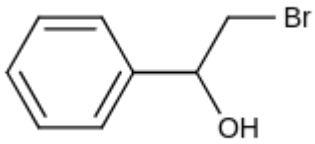

OH
HO
CrO3
H+
O
OH
HO
SOCl2
O
Cl
HO
Δ
O
HO

Question 135

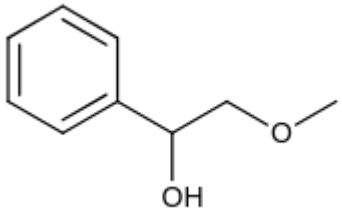
The major product of the following reaction is



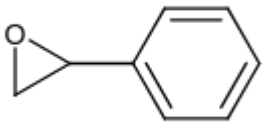
A.



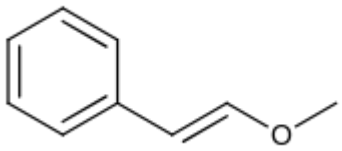
B.



C.



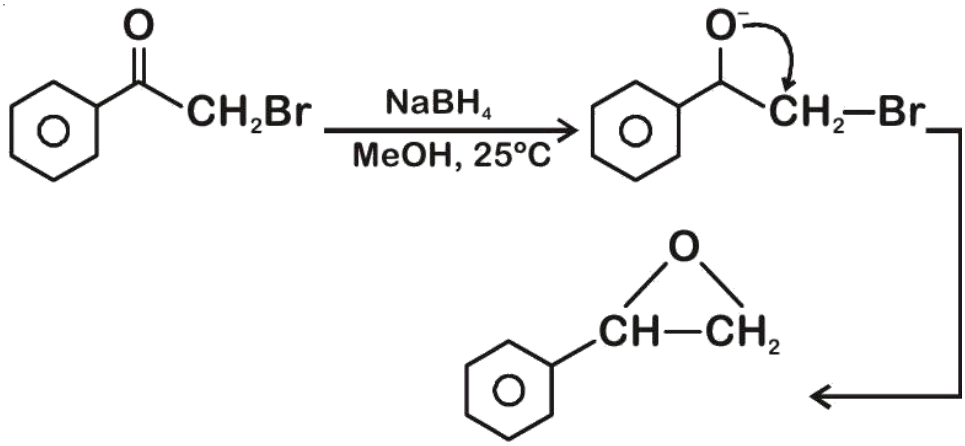
D.



Correct answer: C

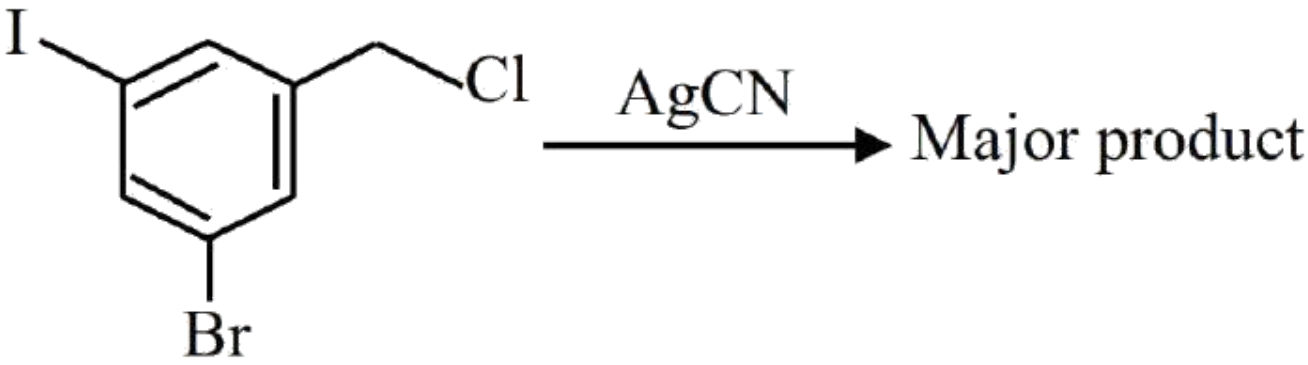
Source solution

Sol.

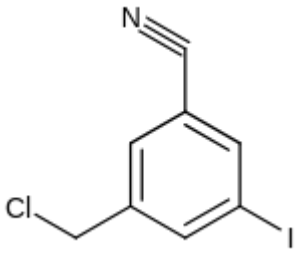

O
CH2Br
NaBH4
MeOH, 25°C
O⁻
CH2—Br
O
CH—CH2

Question 136

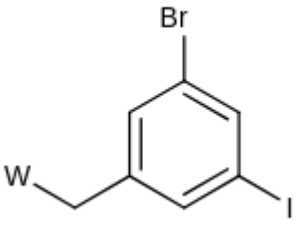
The structure of the major product formed in the following reaction is:



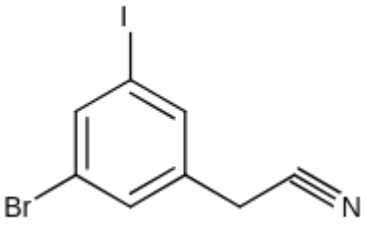
A.



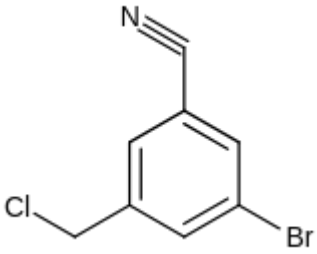
B.



C.



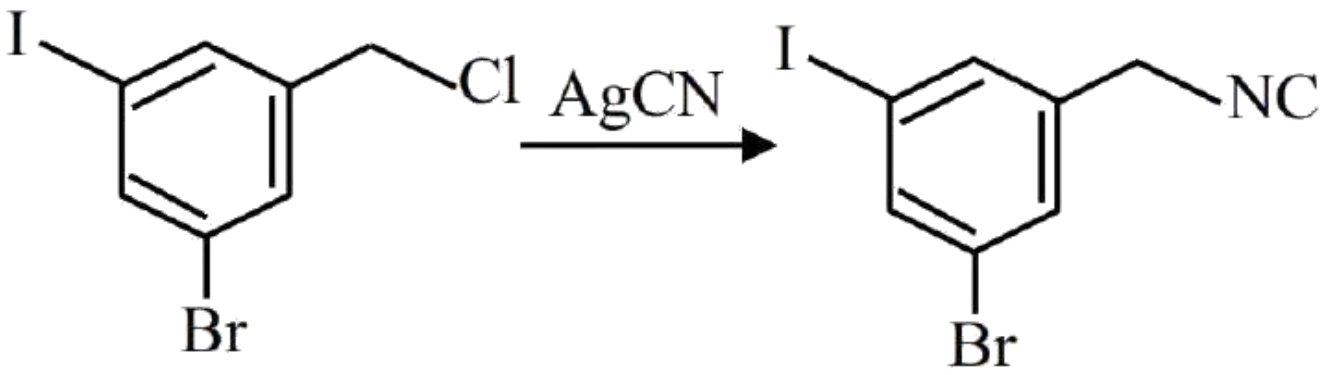
D.



Correct answer: B

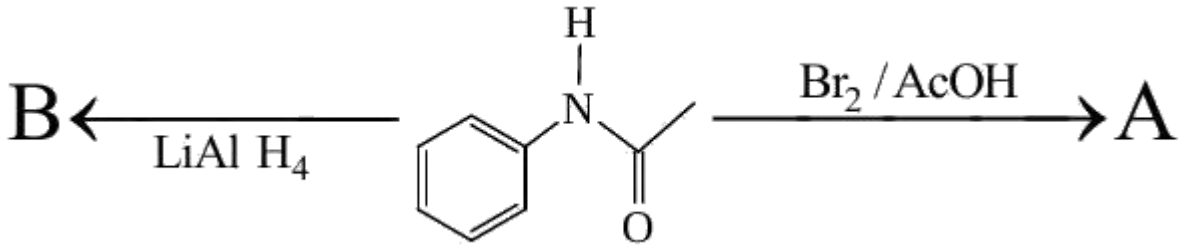
Source solution

Sol.

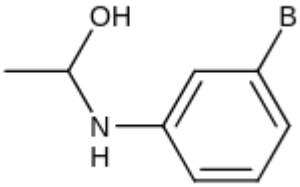

I
Cl
AgCN
Br
I
NC
Br

Question 137

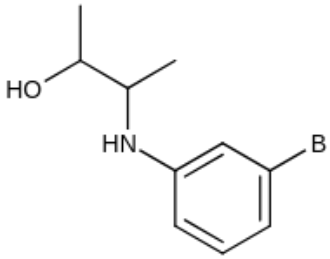
The major products A and B from the following reactions are:



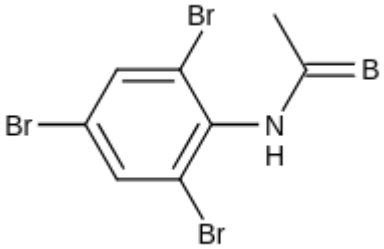
A.



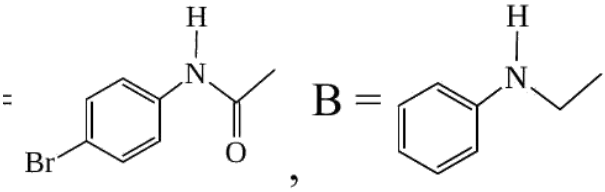
B.



C.



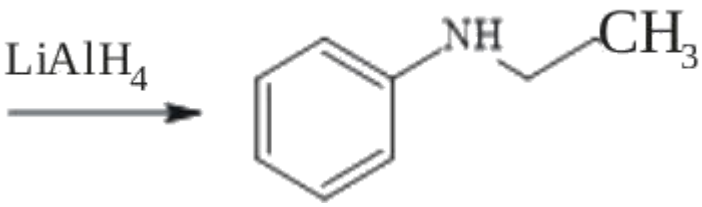
D.



Correct answer: D

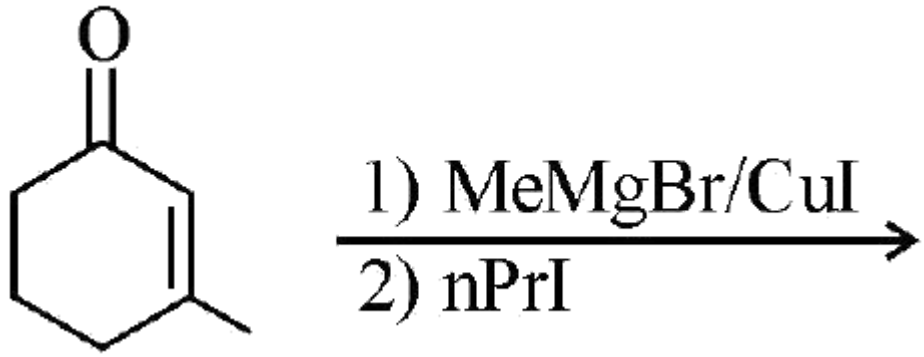
Source solution

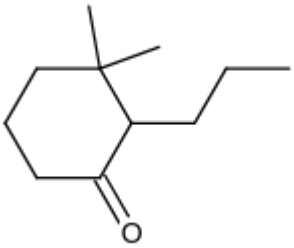
Sol.



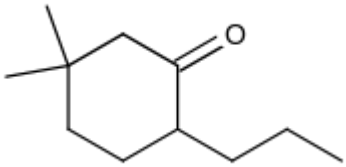
Question 138

Find out the major product from the following reaction

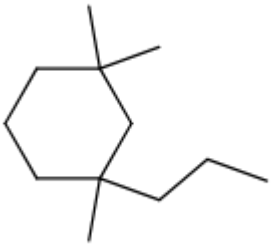




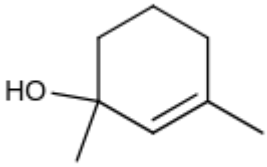
A.



B.



C.

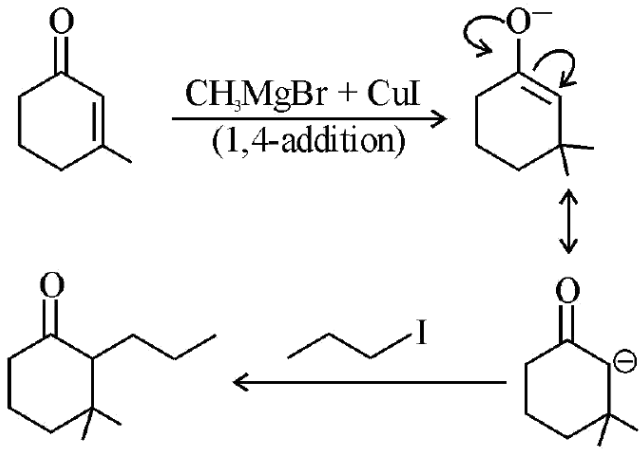


D.

Correct answer: A

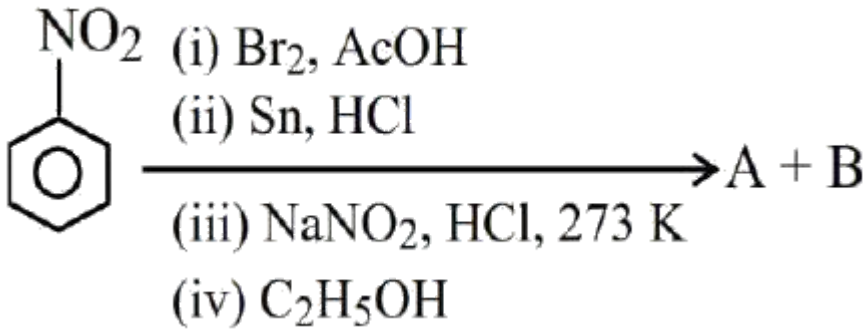
Source solution

Sol.

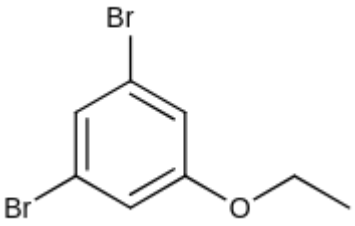

O
CH3MgBr + CuI
(1,4-addition)
O−
O
I
O
⊖

Question 139

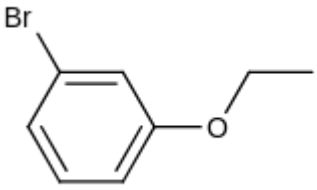
The products formed in the following reaction sequence are :



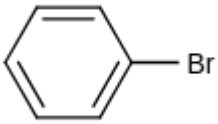
A.



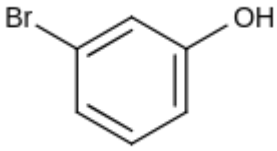
B.



C. $CH_3 - CHO$



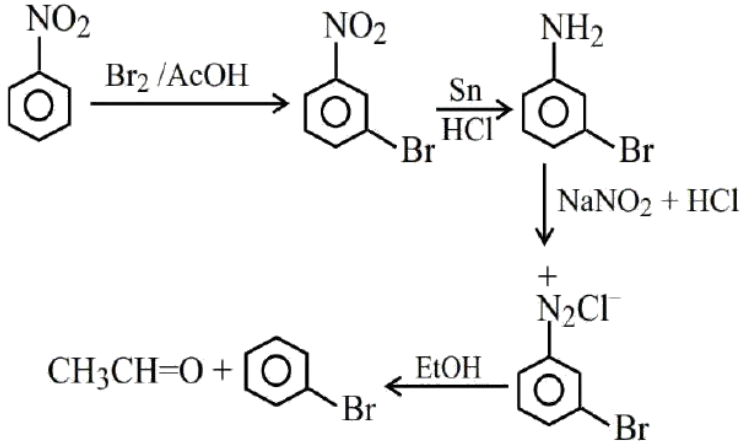
D.



Correct answer: C

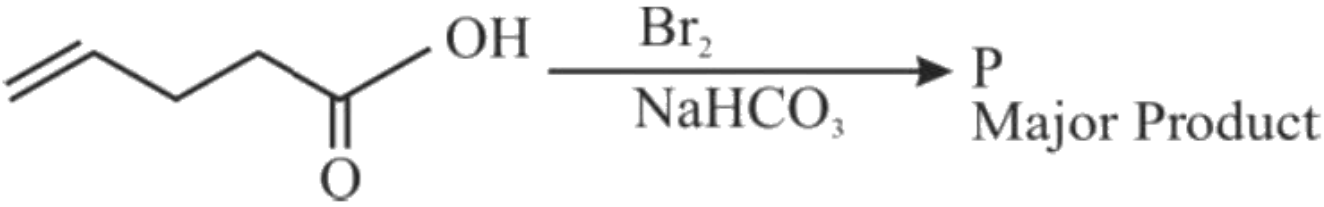
Source solution

Sol.

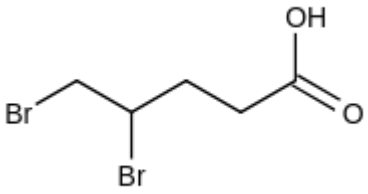

NO2
Br2 /AcOH
NO2
Br
Sn
HCl
NH2
Br
NaNO2 + HCl
+
N2Cl⁻
Br
EtOH
CH3CH=O +
Br

Question 140

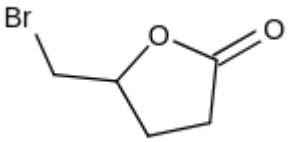
Major product ' P ' formed in the following reaction is :-



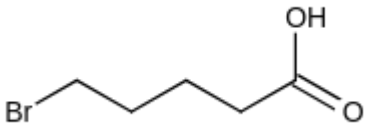
A.



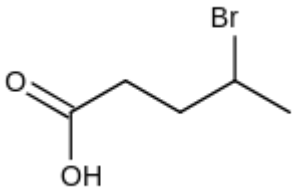
B.



C.



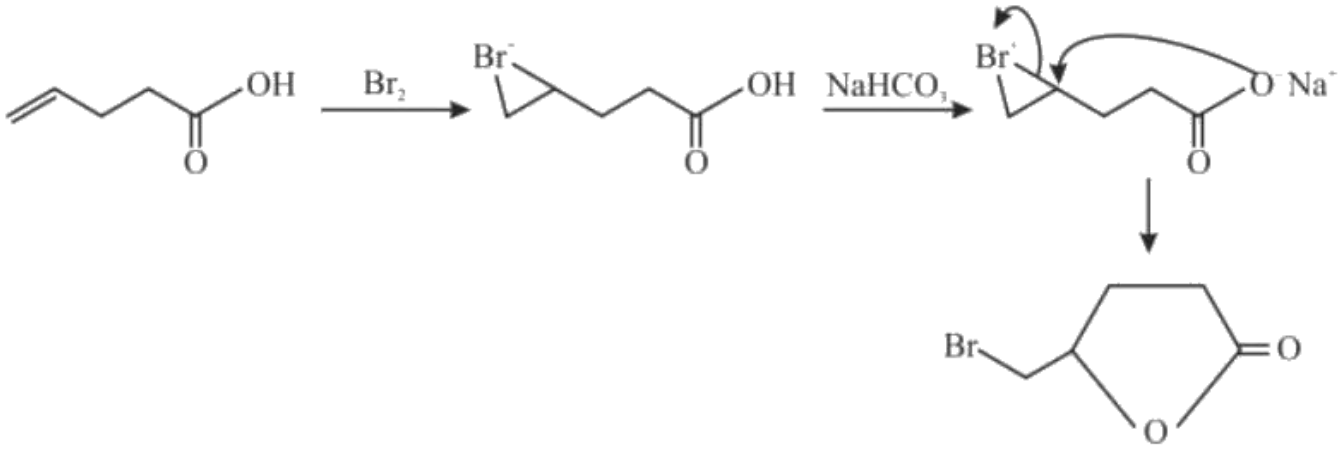
D.



Correct answer: B

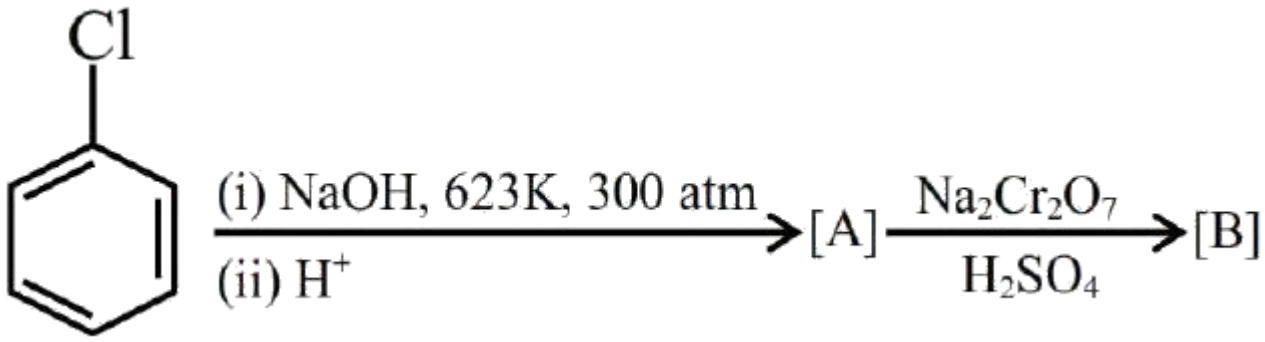
Source solution

Sol.

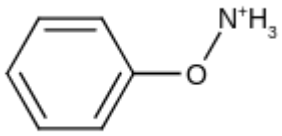


Question 141

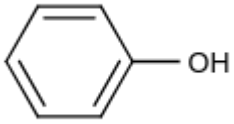
Identify the products [A] and [B], respectively in the following reaction :



A.



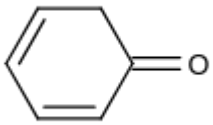
B.



C.



D.



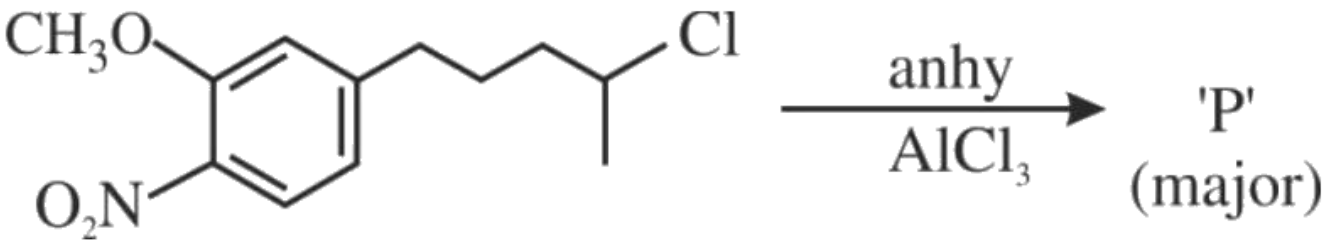
Correct answer: C

Source solution

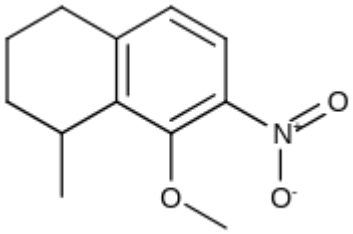
Sol. A is phenol and B is para benzoquinone.

Question 142

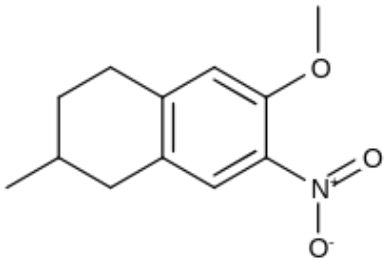
The major product ' P ' formed in the given reaction is:



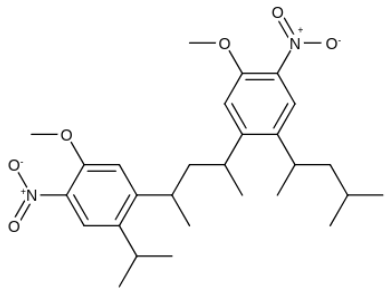
A.



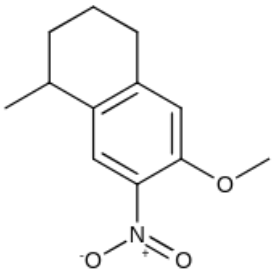
B.



C.



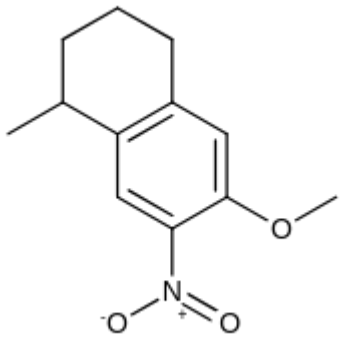
D.



Correct answer: D

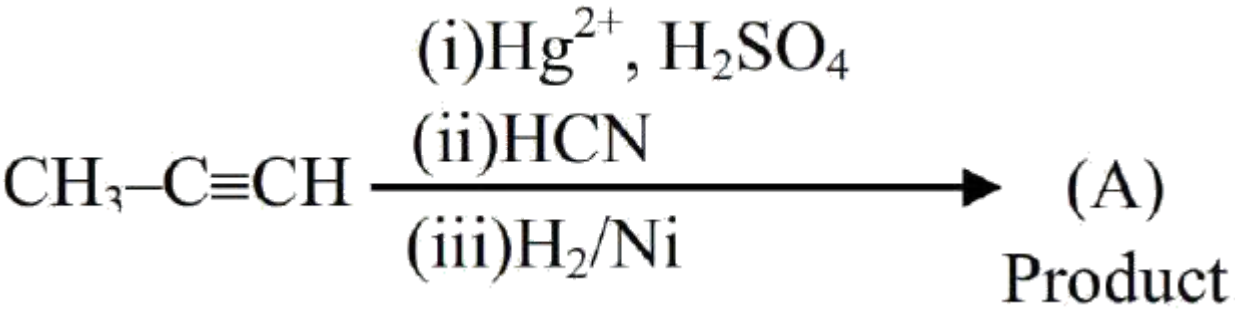
Source solution

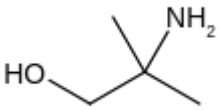
Sol.


O
N
O
O

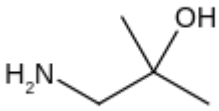
Question 143

The product (A) formed in the following reaction sequence is :

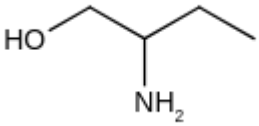




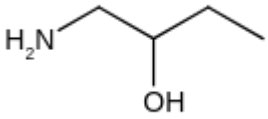
A.



B.



C.



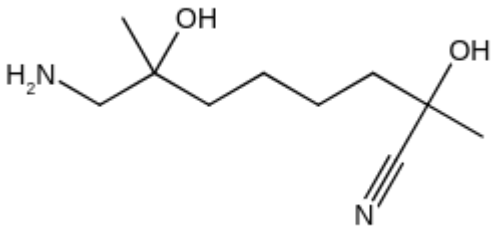
D.

Correct answer: B

Source solution

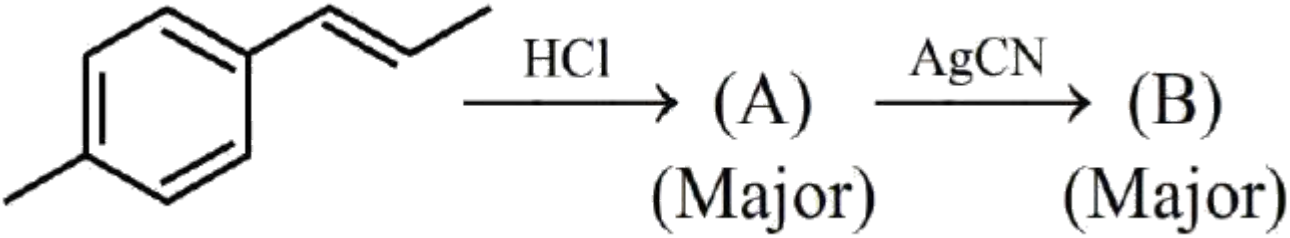
Sol.

SECTION-B}

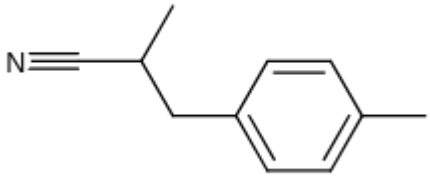


Question 144

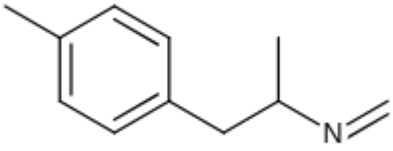
The product B formed in the following reaction sequence is :



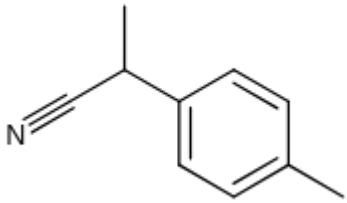
A.



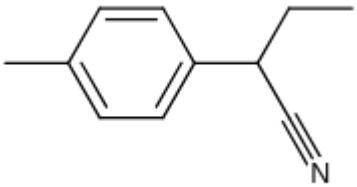
B.



C.



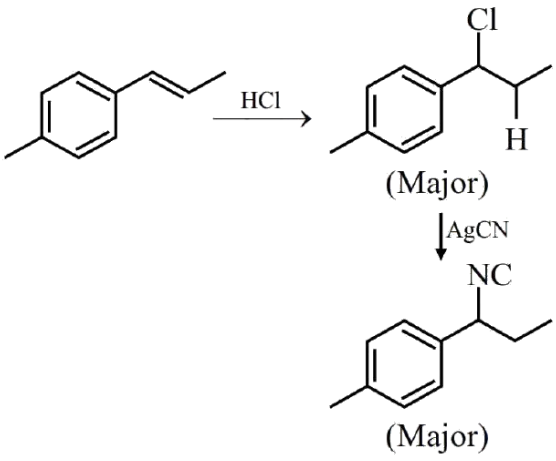
D.



Correct answer: D

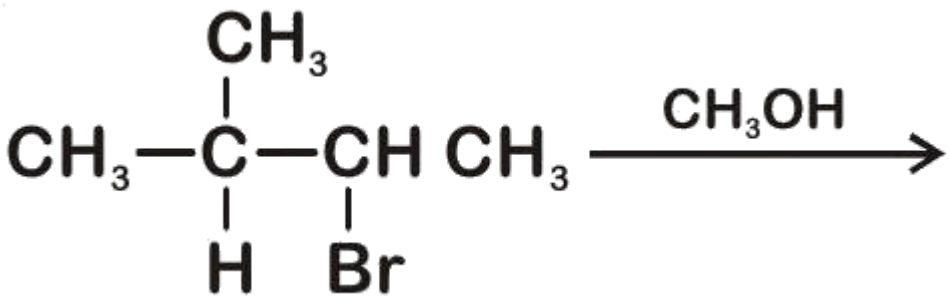
Source solution

Sol.



Question 145

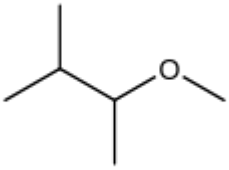
The major product of the following reaction is :



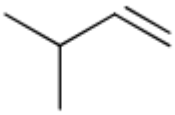
A.



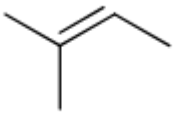
B.



C.



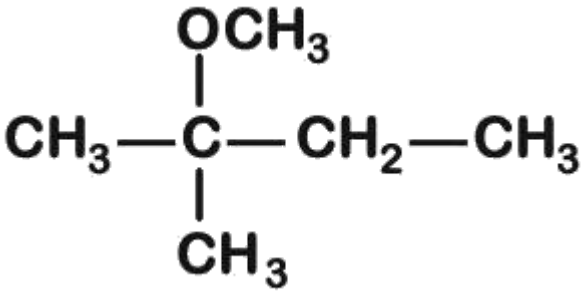
D.



Correct answer: A

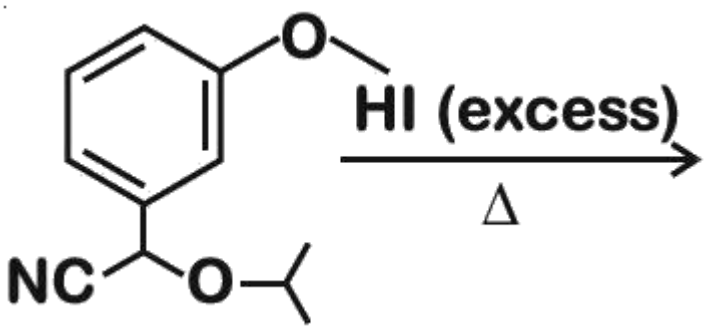
Source solution

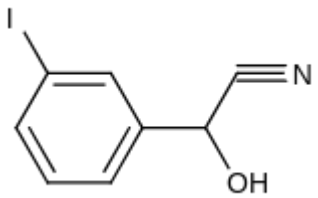
Sol.



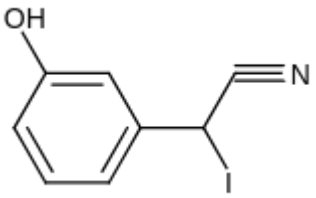
Question 146

The major product of the following reaction is:

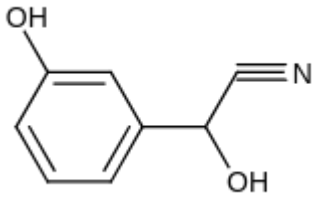




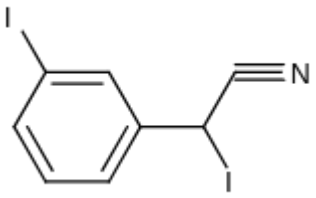
A.



B.



C.

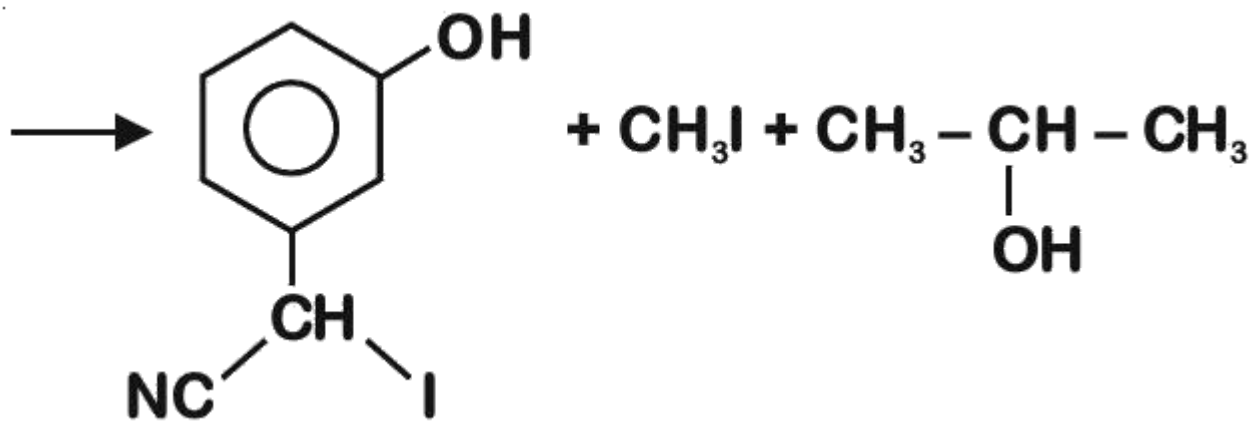


D.

Correct answer: B

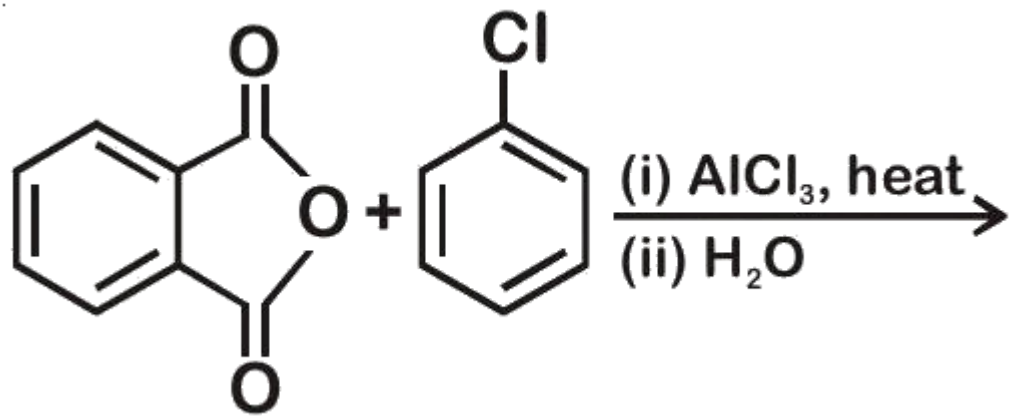
Source solution

Sol.

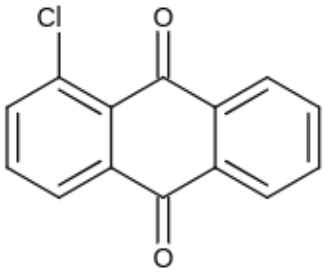

OH
CH
NC
I
+ CH3I + CH3 – CH – CH3
OH

Question 147

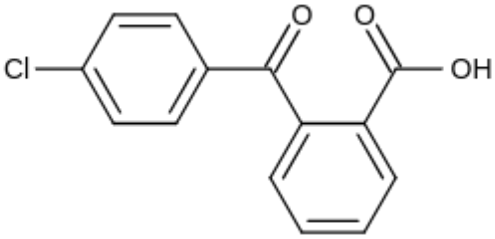
The major product of the following reaction is :



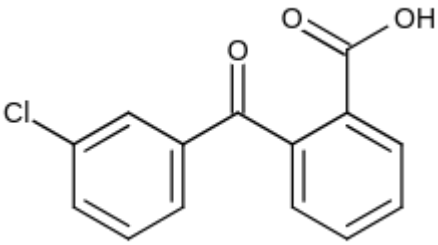
A.



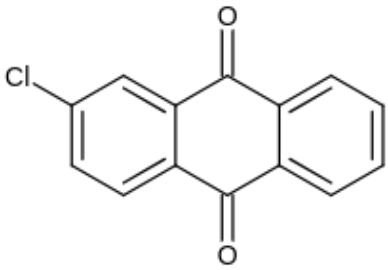
B.



C.



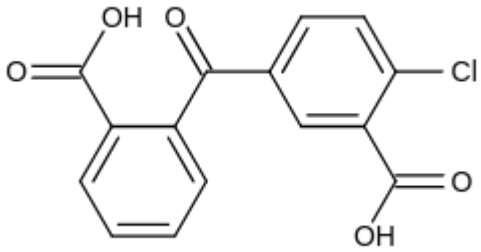
D.



Correct answer: B

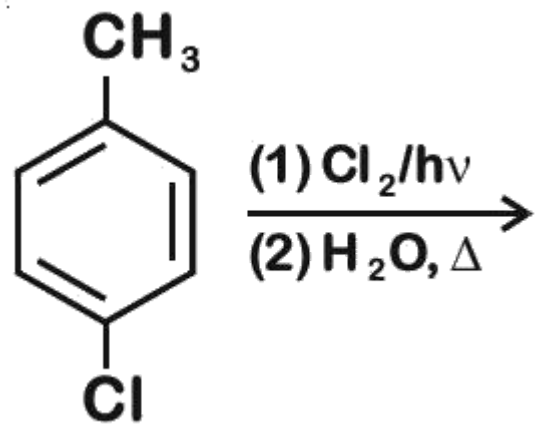
Source solution

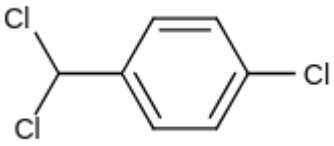
Sol.


OH
O
O
Cl
O
OH

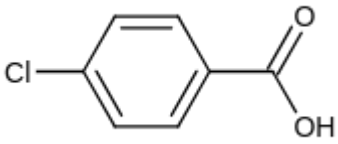
Question 148

The major product of the following reaction is:

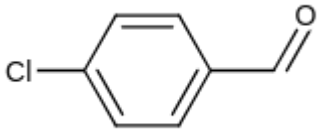




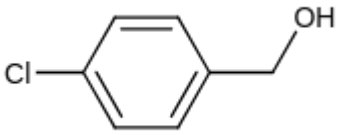
A.



B.



C.

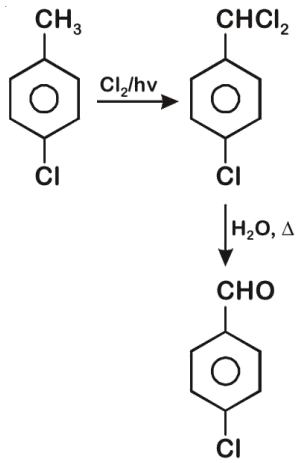


D.

Correct answer: C

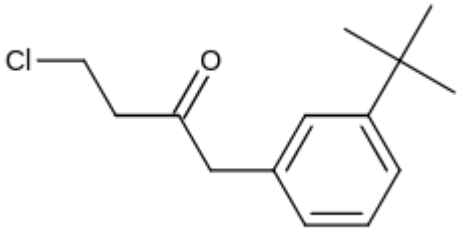
Source solution

Sol.

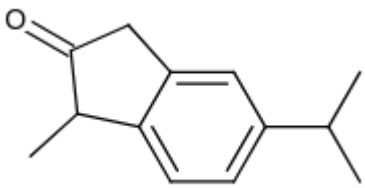

CH3
Cl2/hv
CHCl2
Cl
H2O, Δ
CHO
Cl

Question 149

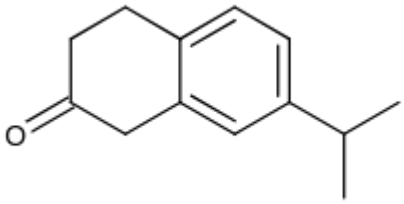
The major product of the following reaction is :



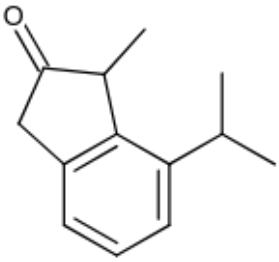
A. $\xrightarrow[(2)\ \text{Conc. } H_2SO_4/\Delta]{(1)\ t\ BuOK}$



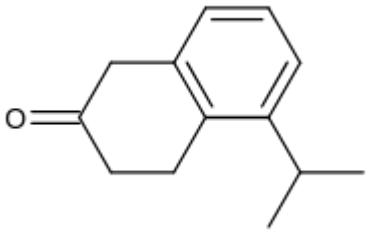
B.



C.



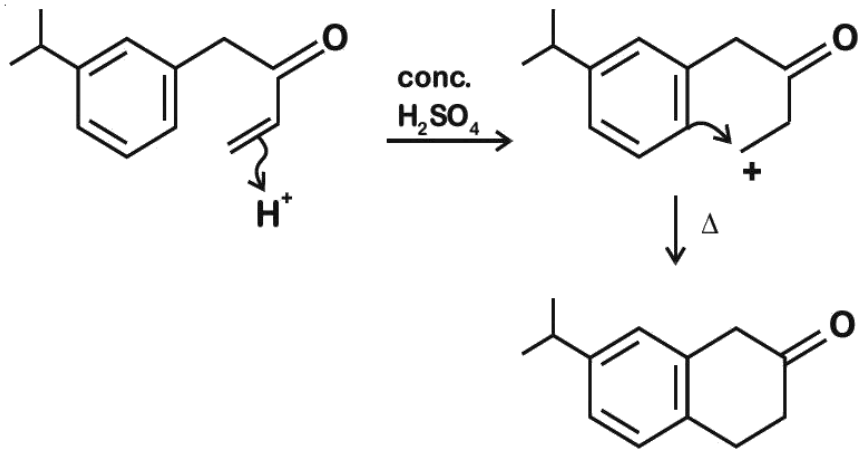
D.



Correct answer: B

Source solution

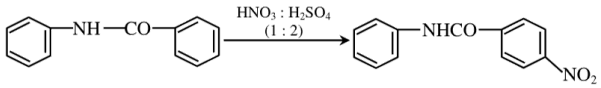
Sol.


O
conc.
H_2SO_4
H^+
+
Δ
O
O

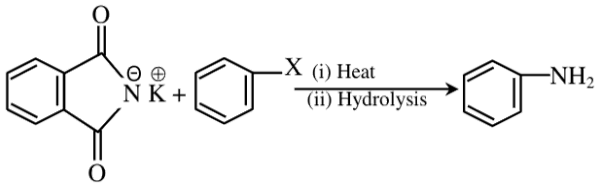
Question 150

Consider the following reactions giving major product. Identify the correct reaction.

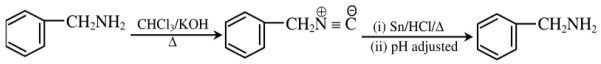
A.



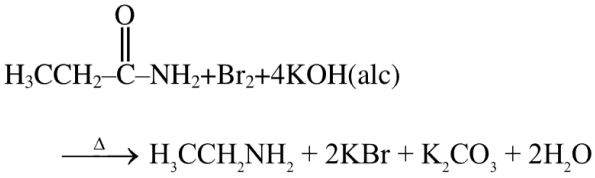
B.



C.

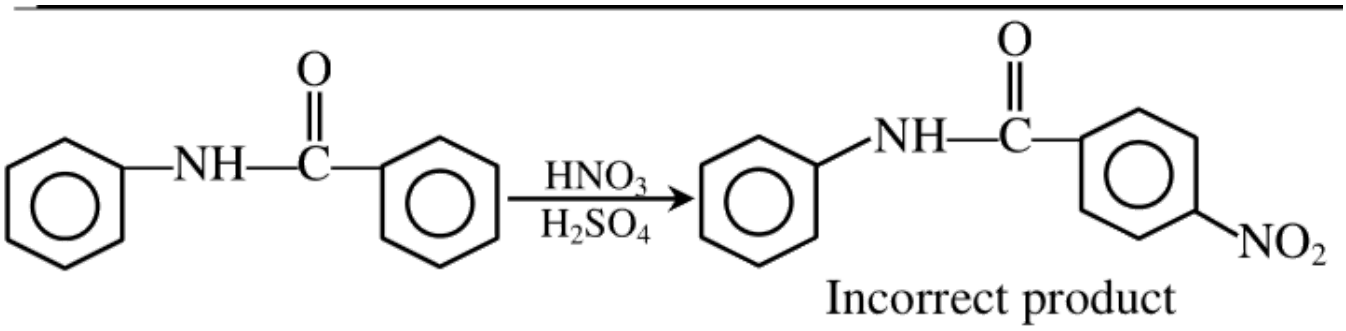


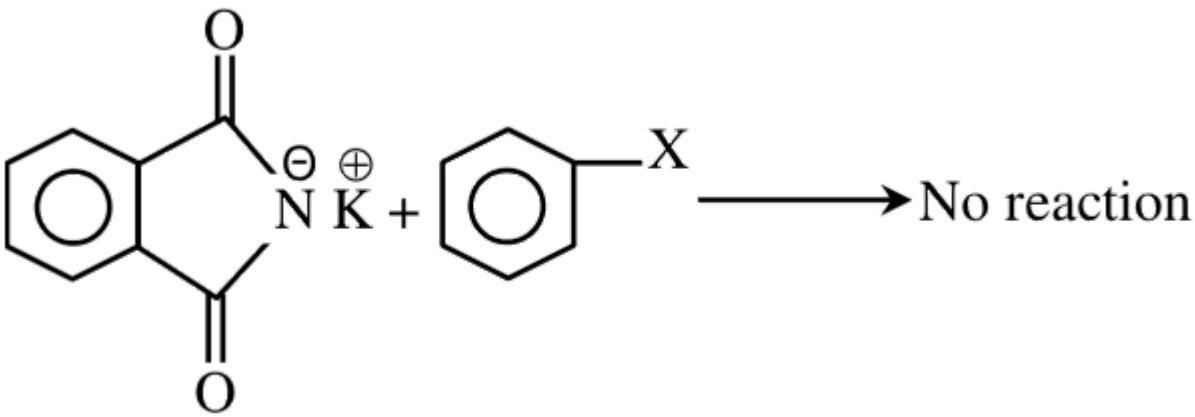
D.

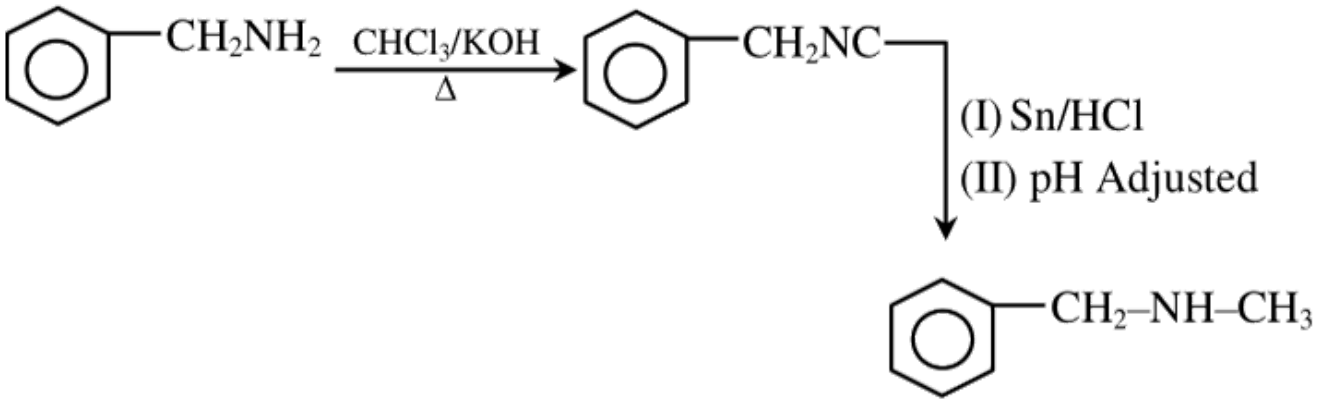


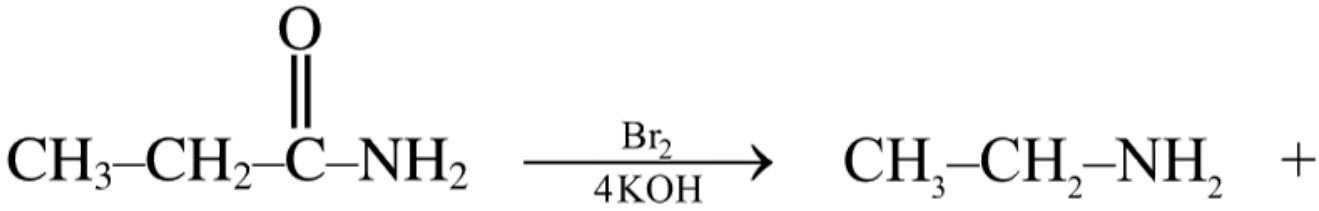
Correct answer: D

Source solution






CH_2NH_2
$CHCl_3/KOH$
Δ
CH_2NC
(I) Sn/HCl
(II) pH Adjusted
$CH_2–NH–CH_3$


O
$CH_3–CH_2–C–NH_2$
Br_2
$4KOH$
$CH_3–CH_2–NH_2$
+

Question 151

Match List I with List II

LIST-I (Test)		LIST-II (Observation)	
A.	Br_2 water test	I.	Yellow orange or orange red precipitate formed
B.	Ceric ammonium nitrate test	II.	Reddish orange colour disappears
C.	Ferric chloride test	III.	Red colour appears
D.	2, 4-DNP test	IV.	Blue, Green, Violet or Red colour appear

Choose the correct answer from the options given below:

A. A-I, B-II, C-III, D-IV

B. A-II, B-III, C-IV, D-I

C. A-III, B-IV, C-I, D-II

D. A-IV, B-I, C-II, D-III

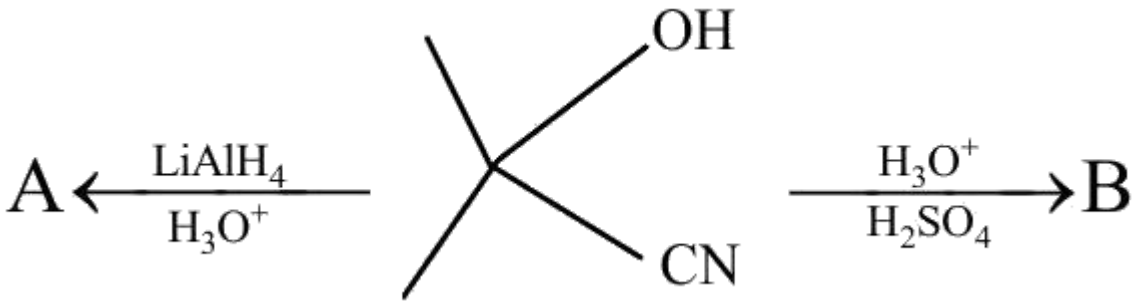
Correct answer: B

Source solution

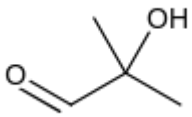
Sol. (A) Br_2 water test is test of unsaturation in which reddish orange colour of bromine water disappears.
(B) Alcohols given Red colour with ceric ammonium nitrate.
(C) Phenol gives Violet colour with natural ferric chloride.
(D) Aldehyde & Ketone give Yellow/Orange/Red Colour compounds with 2, 4-DNP i.e., 2, 4-Dinitrophenyl hydrazine.

Question 152

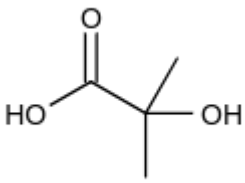
The major products A and B in the following set of reactions are :



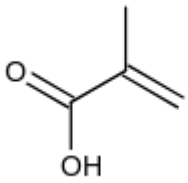
A.



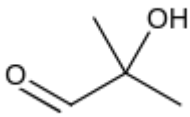
B.



C.



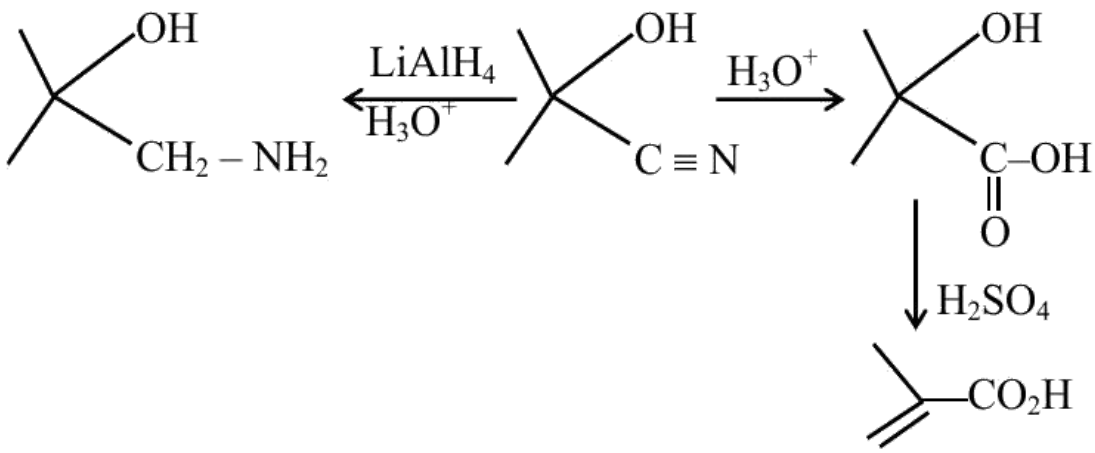
D.



Correct answer: C

Source solution

Sol.

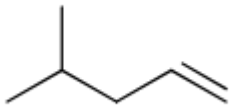

OH
CH2 – NH2
LiAlH4
H3O+
OH
C ≡ N
H3O+
OH
C–OH
O
H2SO4
CO2H

Question 153

Match List-I with List-II.

List-I (Structure)		List-II (IUPAC Name)	
(B)	$(CH_3)_2C(C_3H_7)_2$	(II)	3-Ethyl-5methylheptane

Choose the correct answer from the options given below:



A. (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

B. (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

C. (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

D. (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

Correct answer: C

Source solution

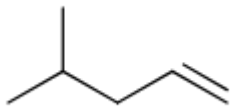
Sol. (A)

3-Ethyl-5-methylheptane
(B) $(CH_3)_2C(C_3H_7)_2$

4, 4-Dimethylheptane
(C)

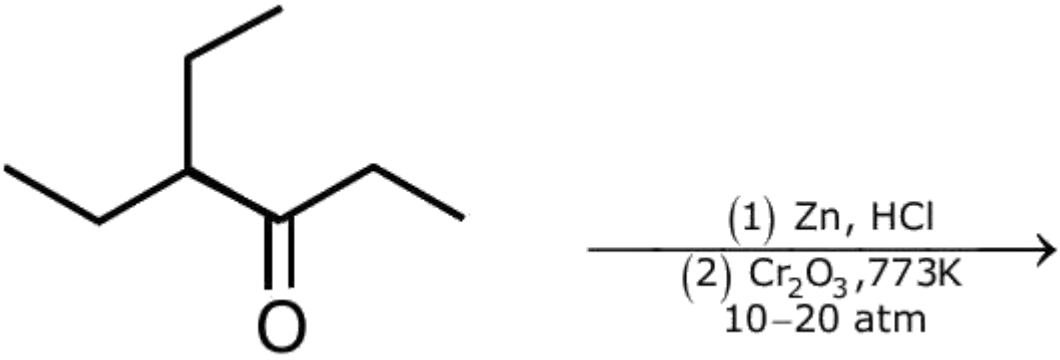
2-Methyl-1, 3-pentadiene
(D)

4-Methylpent-1-ene

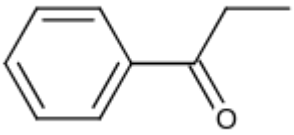


Question 154

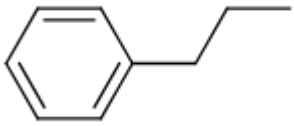
Considering the above reaction, the major product among the following is:



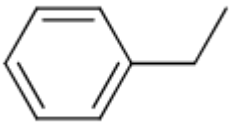
A.



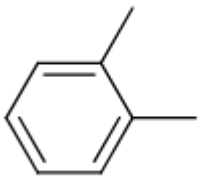
B.



C.



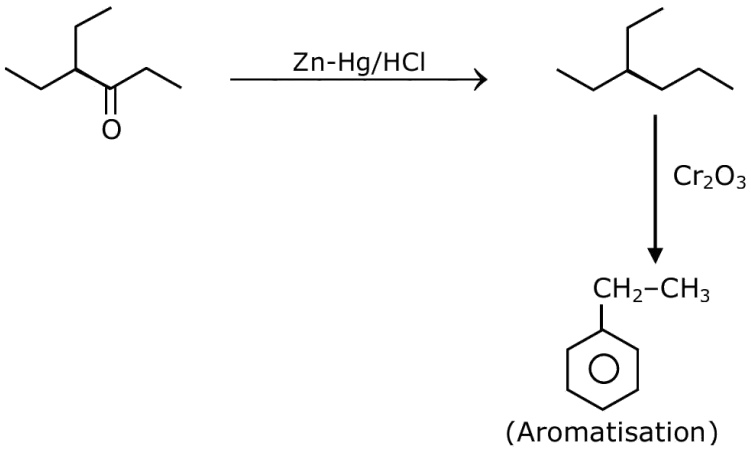
D.



Correct answer: C

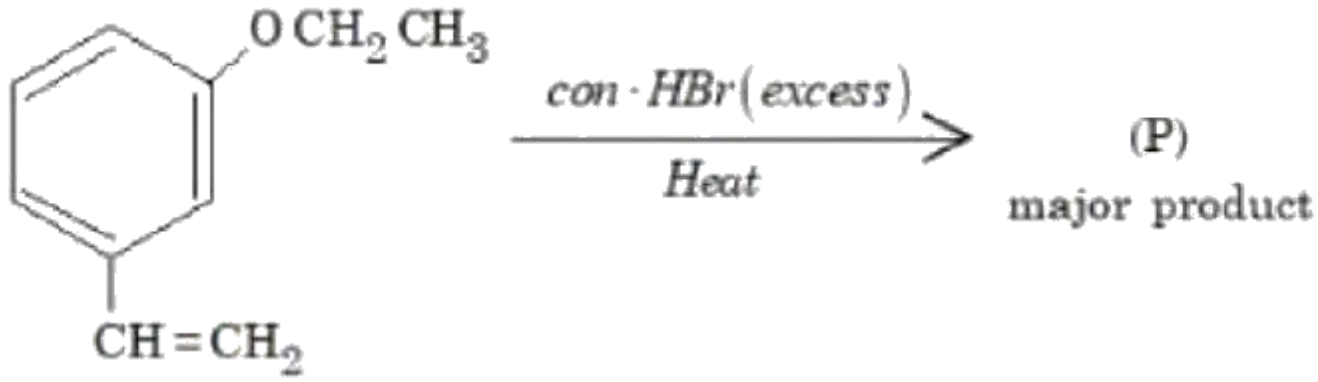
Source solution

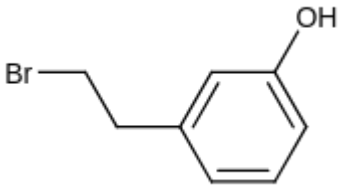
Sol.


Zn-Hg/HCl
O
Cr_2O_3
$CH_2–CH_3$
(Aromatisation)

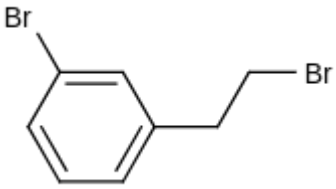
Question 155

The major product(P) in the following reaction is

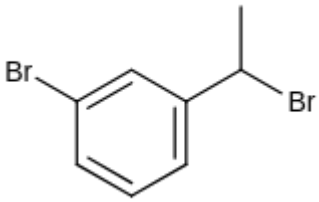




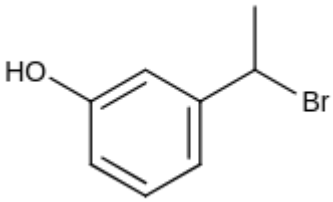
A.



B.



C.

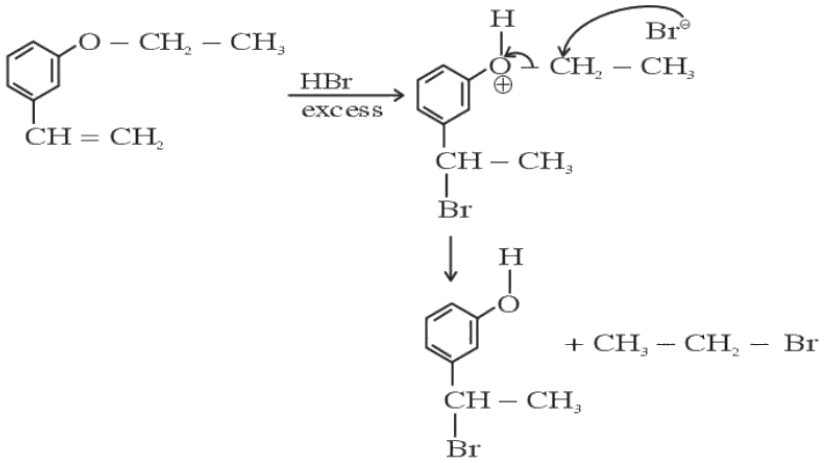


D.

Correct answer: D

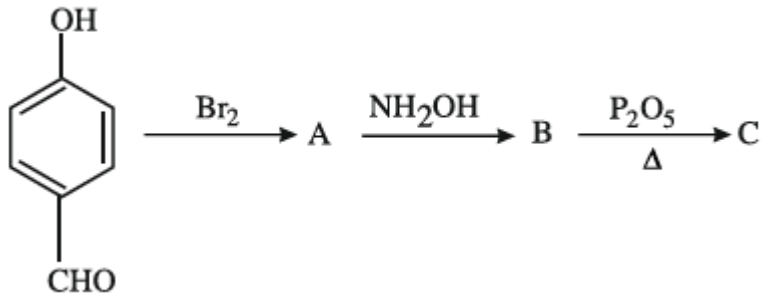
Source solution

Sol.

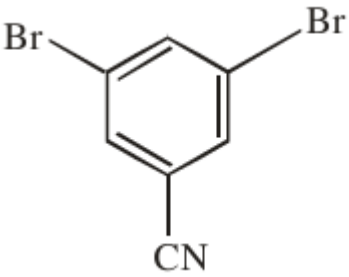

O − CH2 − CH3
CH = CH2
HBr
excess
H
O
Br⊖
CH2 − CH3
CH − CH3
Br
H
O
+ CH3 − CH2 − Br
CH − CH3
Br

Question 156

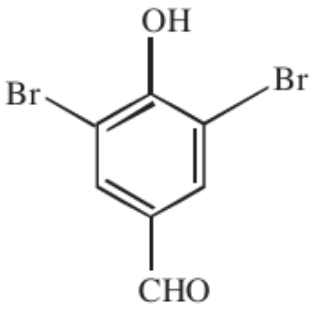
Consider the above reaction sequence, the Product ' C ' is :



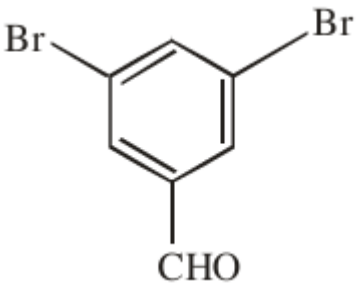
A.



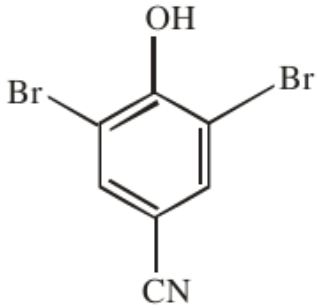
B.



C.



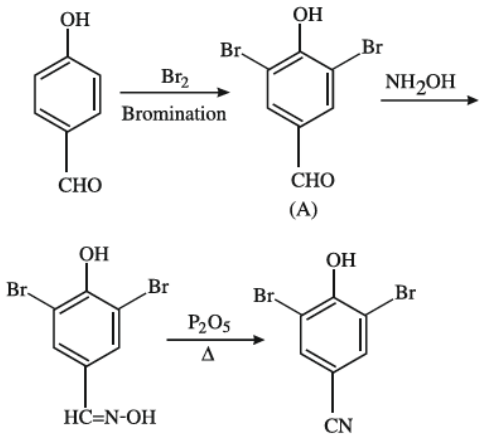
D.



Correct answer: D

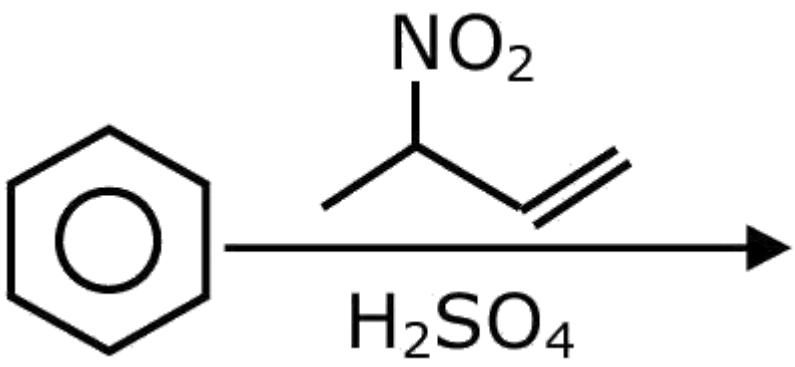
Source solution

Sol.

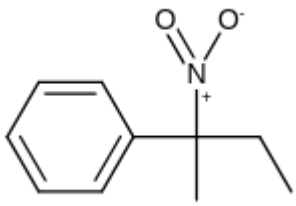

OH
CHO
Br_2
Bromination
OH
Br
Br
CHO
(A)
NH_2OH
OH
Br
Br
HC=N-OH
P_2O_5
Δ
OH
Br
Br
CN

Question 157

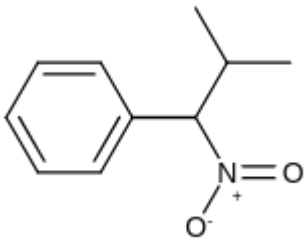
The major product of the following reaction is :



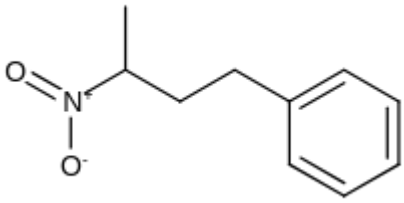
A.



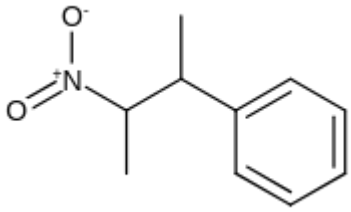
B.



C.



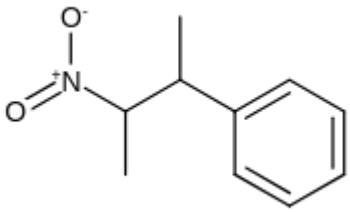
D.



Correct answer: D

Source solution

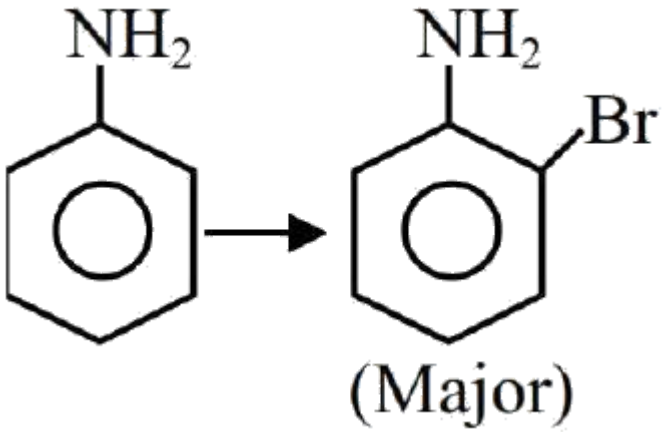
Sol.



Question 158

For reaction

The correct order of set of reagents for the above conversion is :



A. $Br_2 \mid FeBr_3, H_2O(\Delta), NaOH$

B. $H_2SO_4, Ac_2O, Br_2, H_2O(\Delta), NaOH$

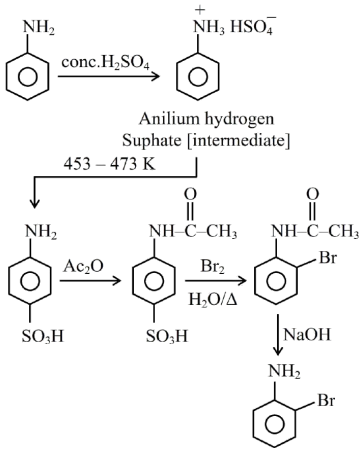
C. $Ac_2O, Br_2, H_2O(\Delta), NaOH$

D. $Ac_2O, H_2SO_4, Br_2, NaOH$

Correct answer: B

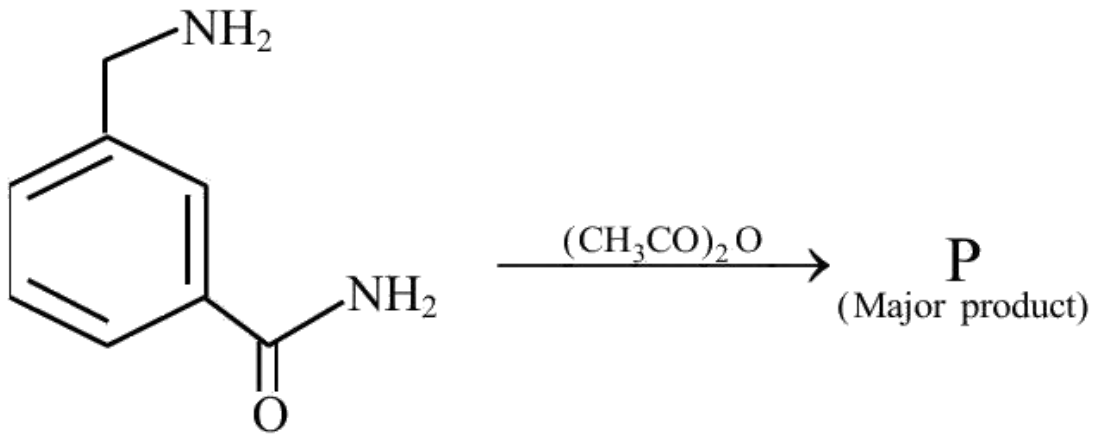
Source solution

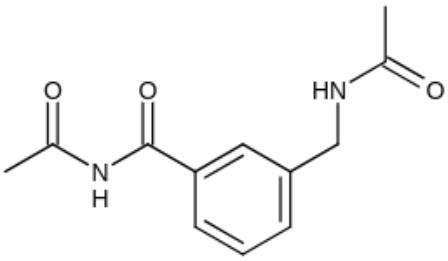
Sol.



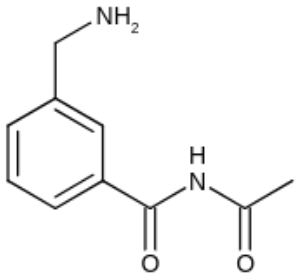
Question 159

The major product in the above reaction is :

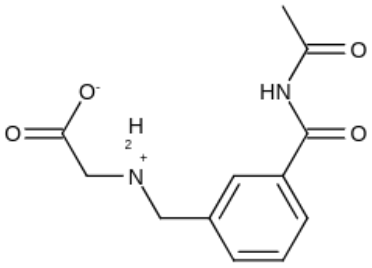




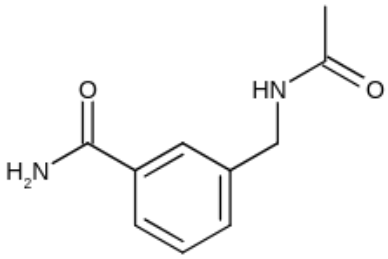
A.



B.



C.

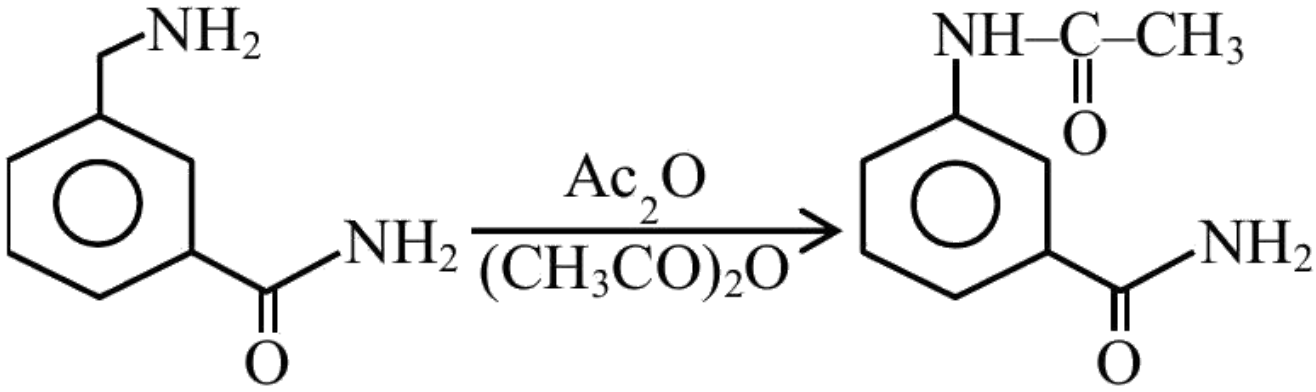


D.

Correct answer: D

Source solution

Sol.



Question 160

The major product of the following reaction is P .

$$CH_3C \equiv C - CH_3 \xrightarrow[(ii)\text{dil. } KMnO_4,\ 273\ K]{(i)\ Na/\ liq\ \cdot NH_3} 'P'$$

Number of oxygen atoms present in product ' P ' is

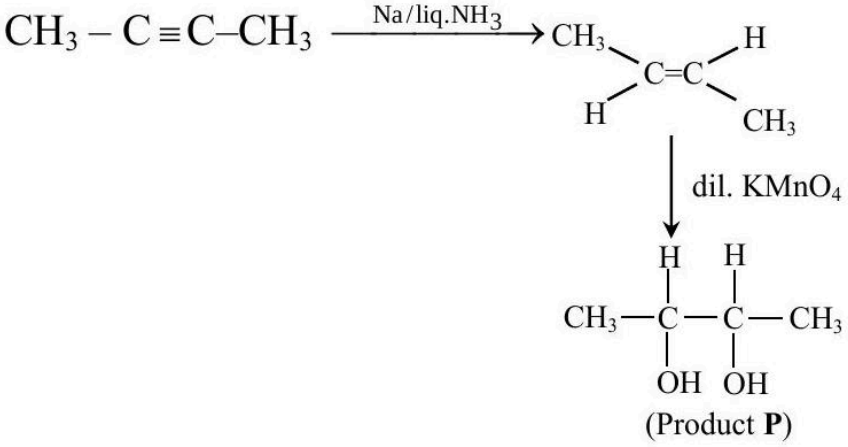
(nearest integer).

Numerical answer: _____

Enter the requested value or coefficient rounded to the nearest integer (0 decimal places).

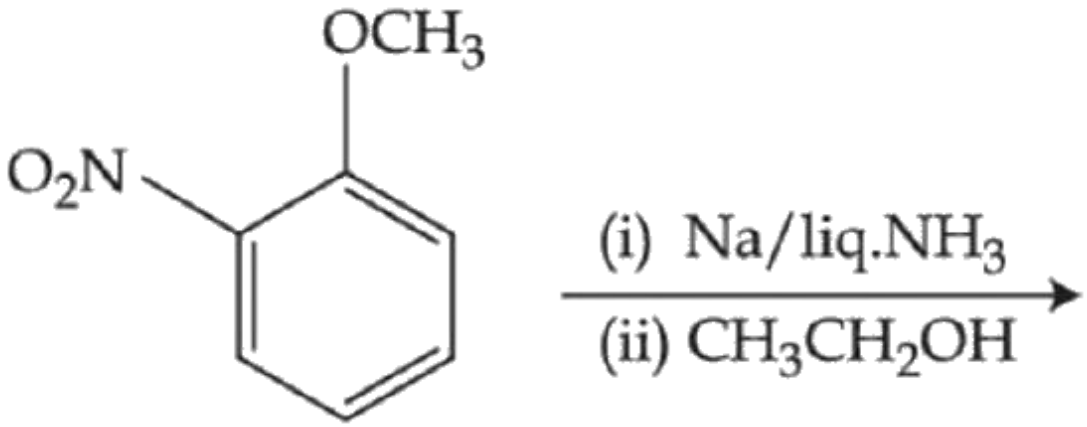
Correct answer: 2

Source solution

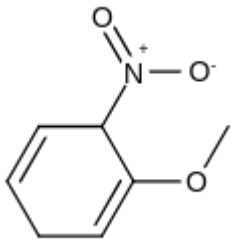


Question 161

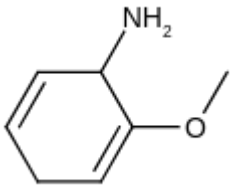
The major product of the following reaction is



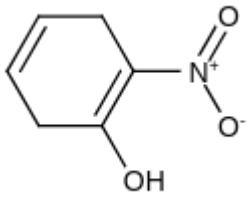
A.



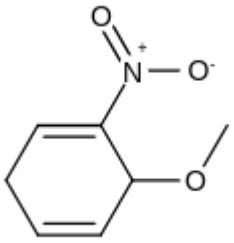
B.



C.



D.

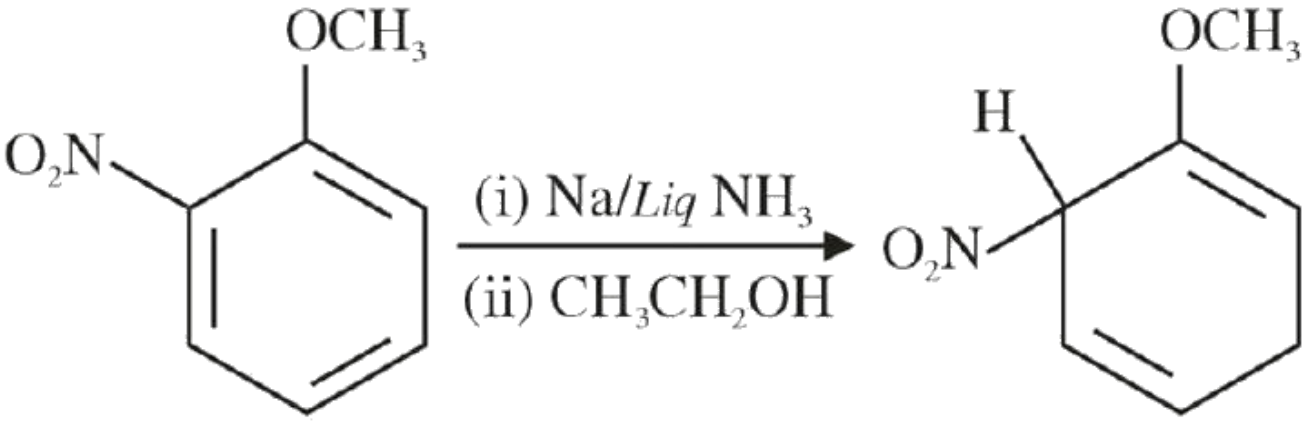


Correct answer: A

Source solution

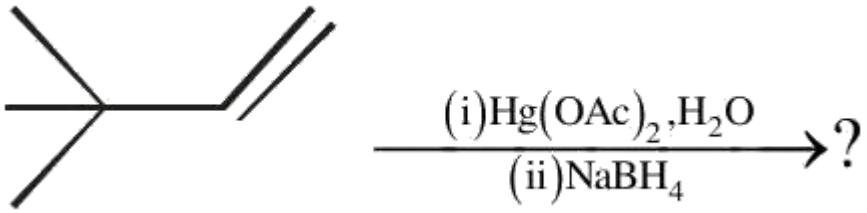
Sol.

Given reaction is an example of birch reduction.

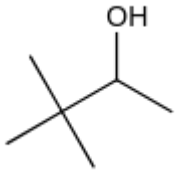

OCH3
O2N
(i) Na/Liq NH3
(ii) CH3CH2OH
OCH3
H
O2N

Question 162

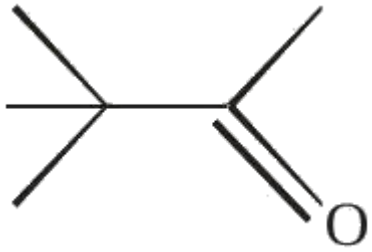
The major product in the following reaction



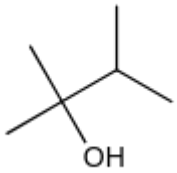
A.



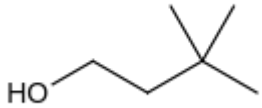
B.



C.



D.

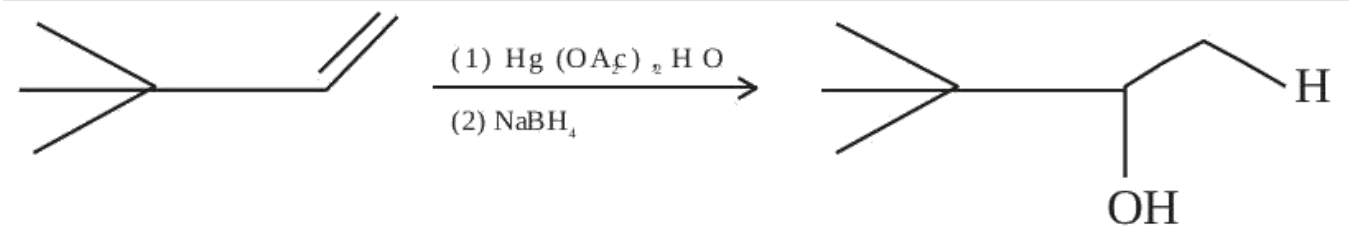


Correct answer: A

Source solution

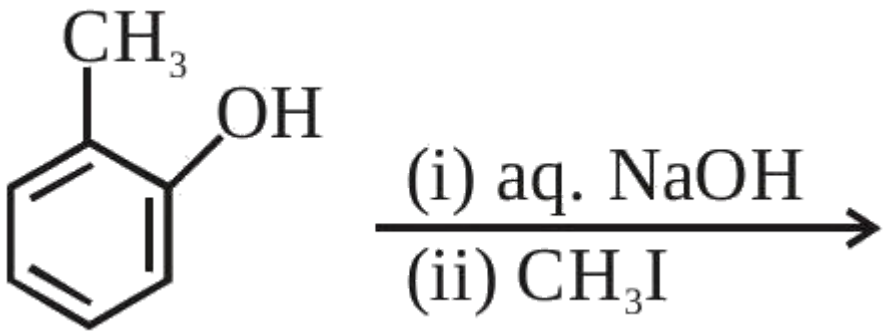
Sol.

Oxymercuration - Demercuration
Addition of $\mathbf{H_2O}$
Markovnikov's addition without rearrangement

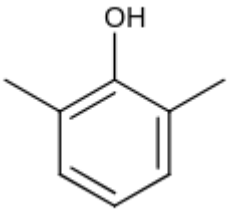


Question 163

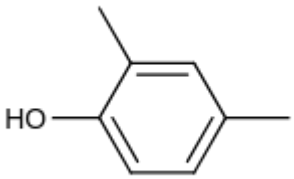
The major product of the following reaction is:



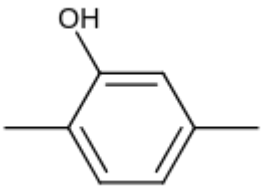
A.



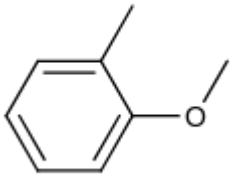
B.



C.



D.



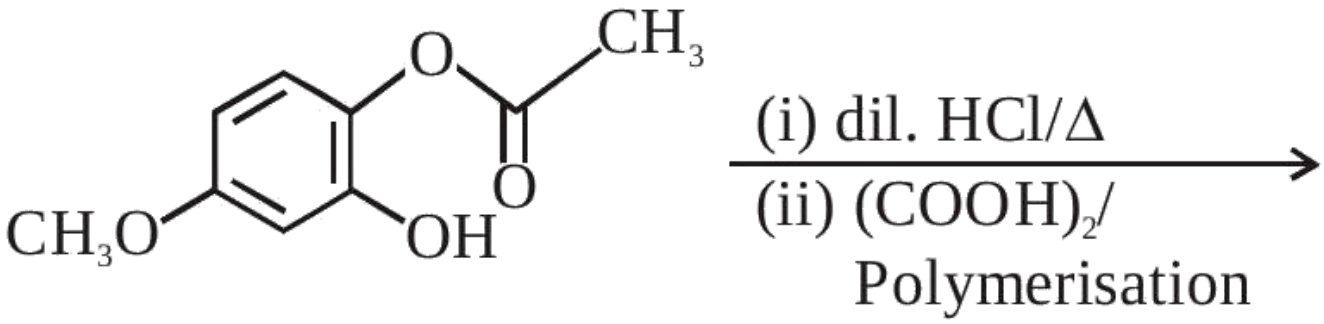
Correct answer: D

The source provides a brief answer only. A detailed worked solution is not available for this question.

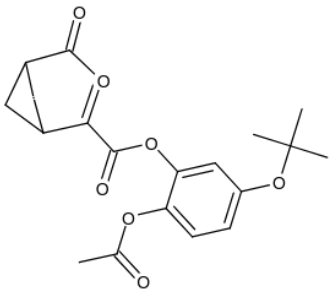
Source solution

Question 164

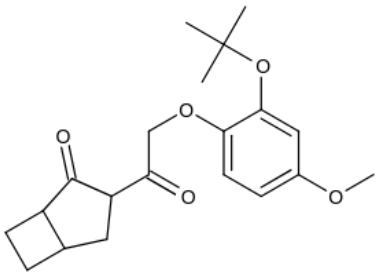
The major product of the following reaction is:



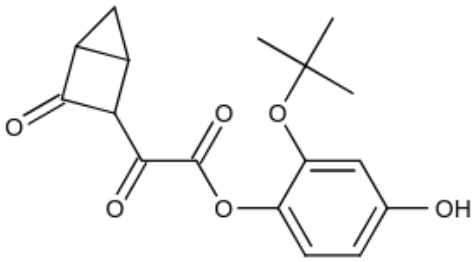
A.



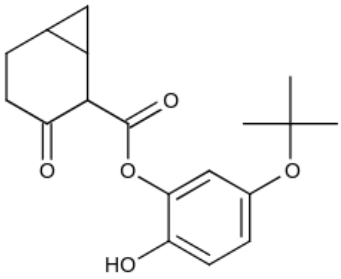
B.



C.



D.



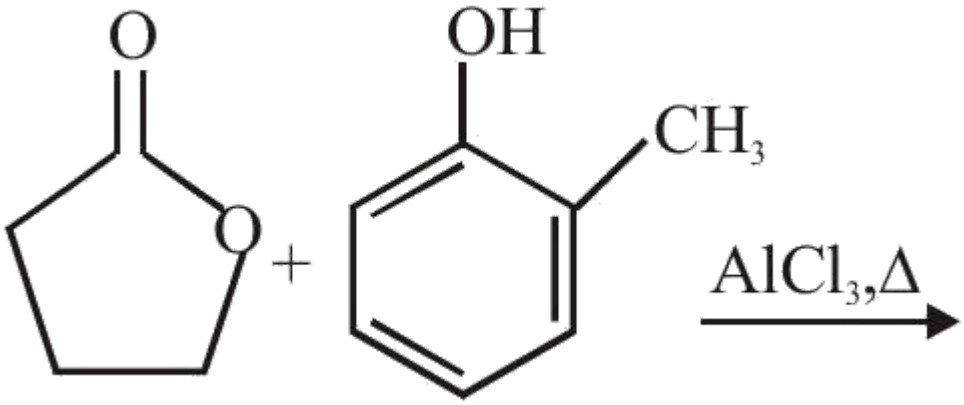
Correct answer: C

The source provides a brief answer only. A detailed worked solution is not available for this question.

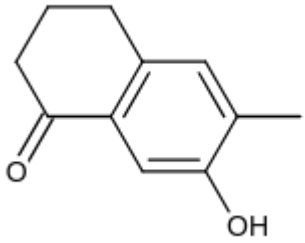
Source solution

Question 165

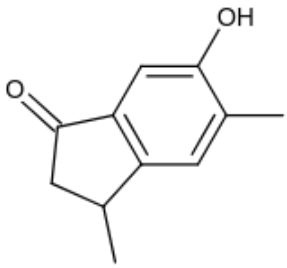
The major product of the following reaction is:



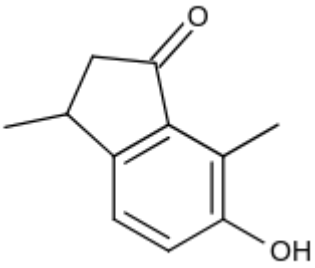
A.



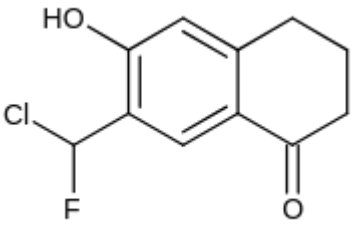
B.



C.



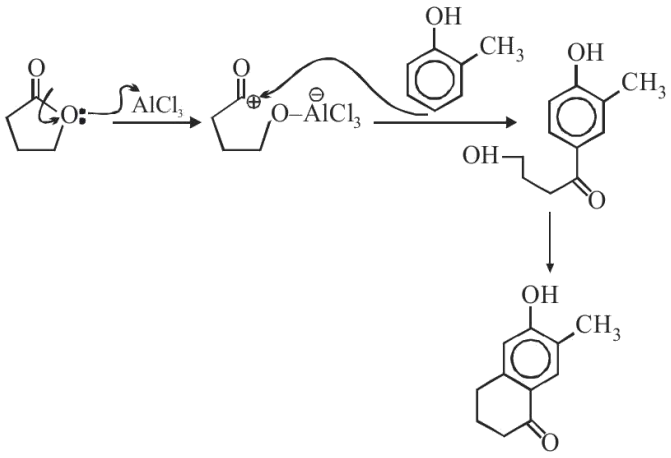
D.



Correct answer: D

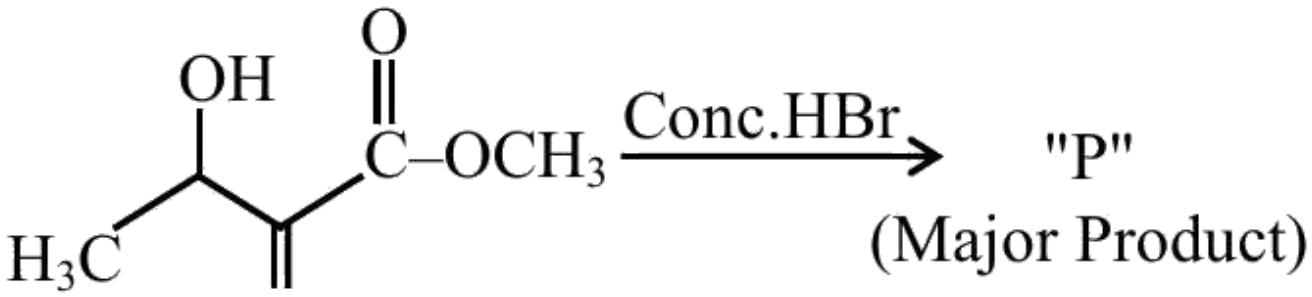
Source solution

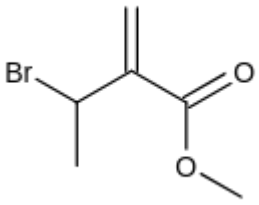
Sol.


O
O:
AlCl3
O
O–AlCl3
OH
CH3
OH
CH3
OH
O
OH
CH3
O

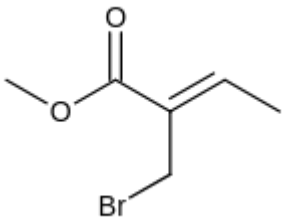
Question 166

Consider the above reaction, the major product "P" formed is :-

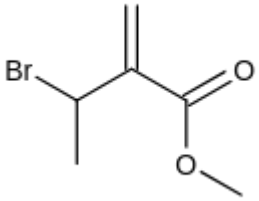




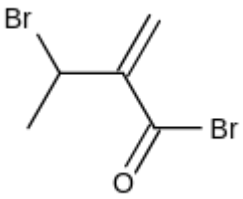
A.



B.



C.



D.

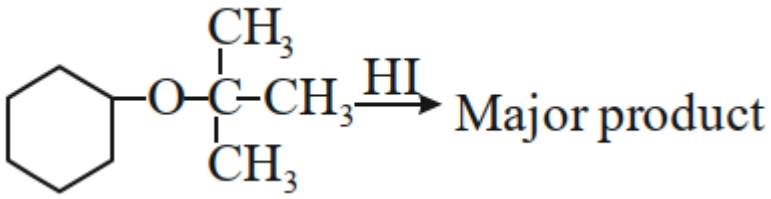
Correct answer: B

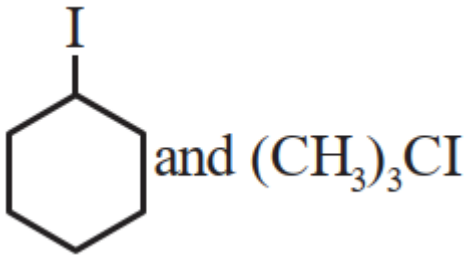
The source provides a brief answer only. A detailed worked solution is not available for this question.

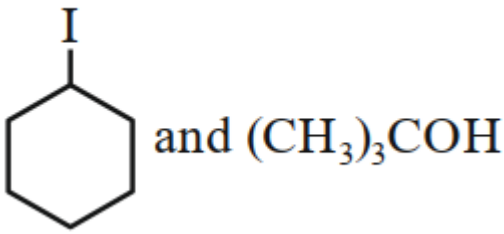
Source solution

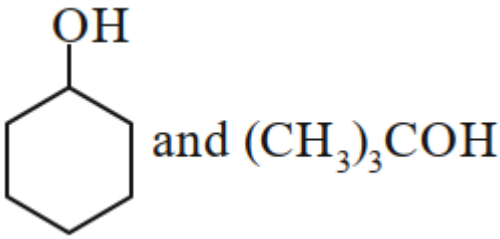
Question 167

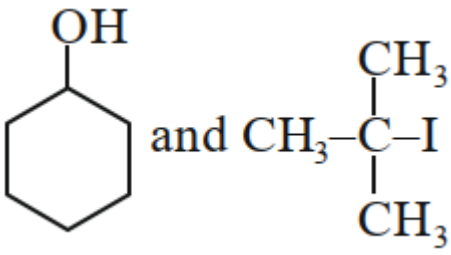
Major product formed in the following reaction is a mixture of:



A. 

B. 

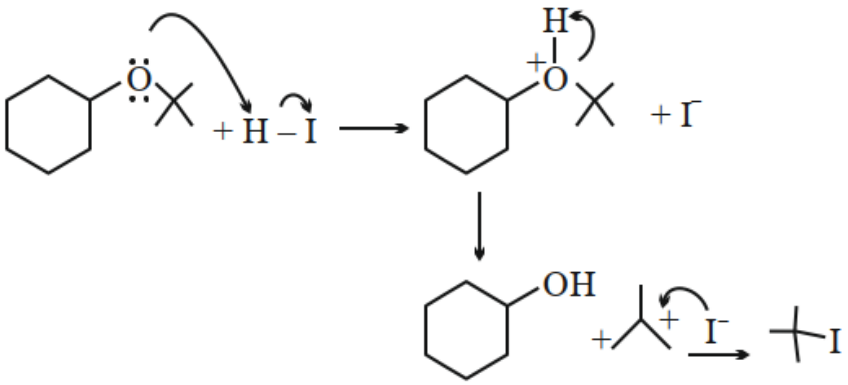
C. 

D. 

Correct answer: D

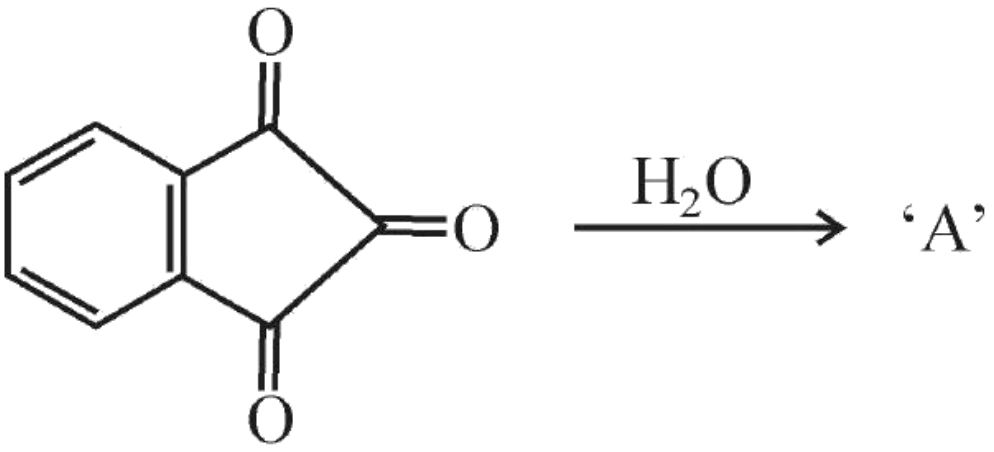
Source solution

Sol.

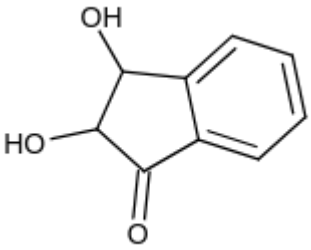


Question 168

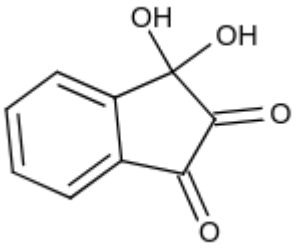
major product ' A ' formed in the above reaction is



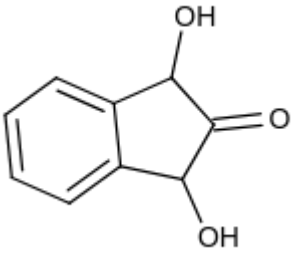
A.



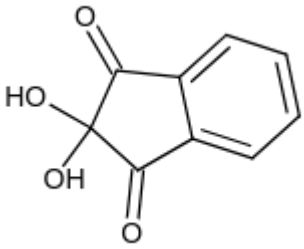
B.



C.



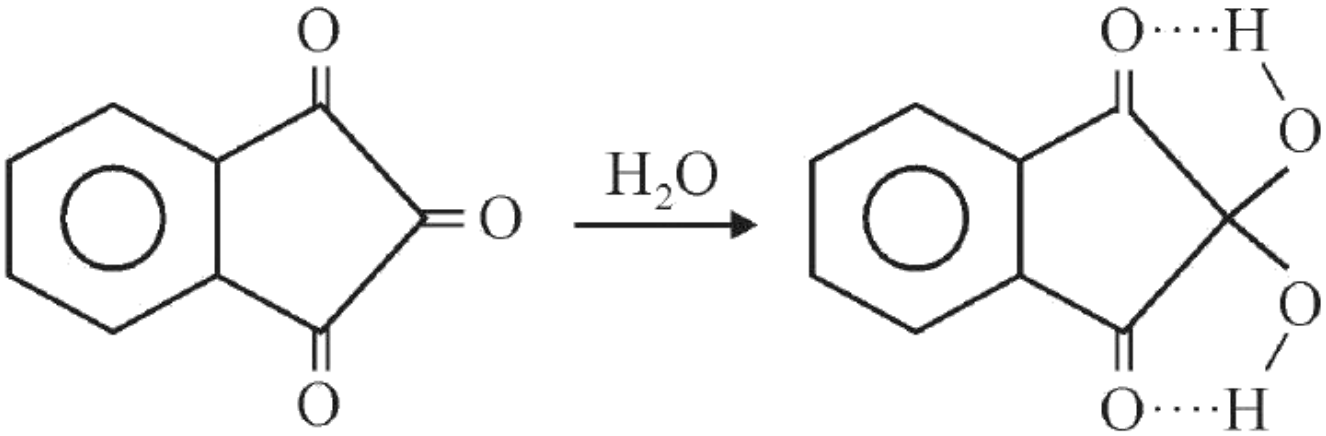
D.



Correct answer: D

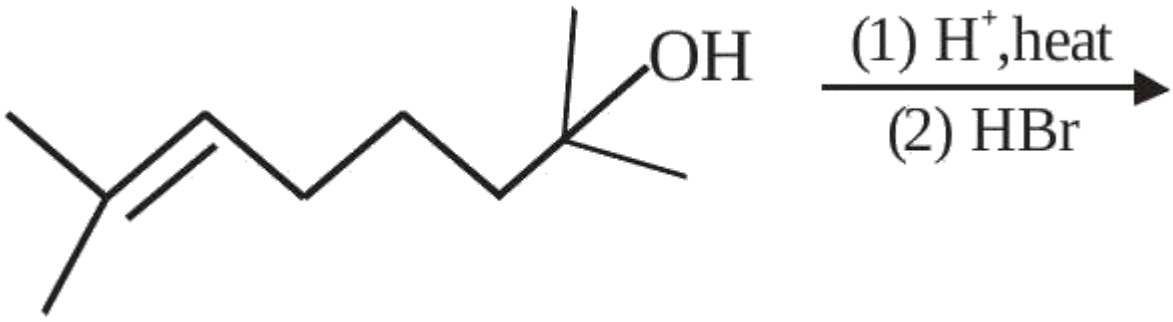
Source solution

Sol.

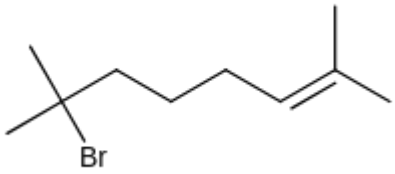

O
O
O
H_2O
O····H
O
O
O····H

Question 169

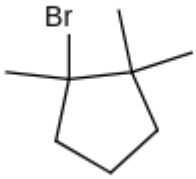
The major product in the given reaction is



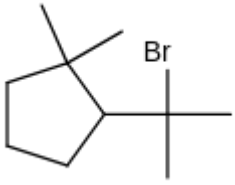
A.



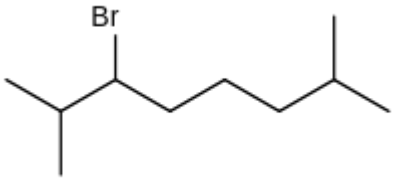
B.



C.



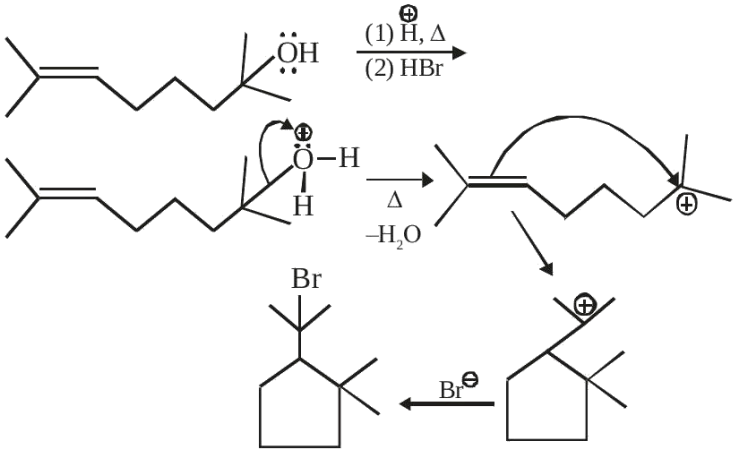
D.



Correct answer: C

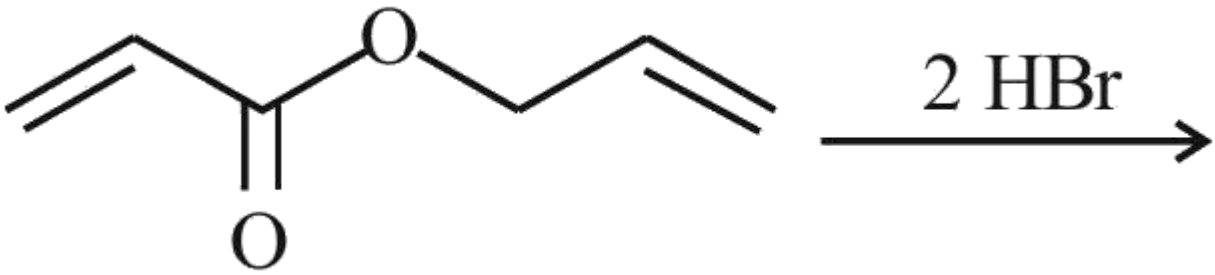
Source solution

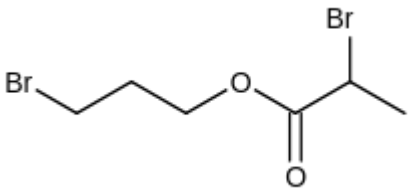
Sol.


OH
(1) H⊕, Δ
(2) HBr
O–H
H
Δ
–H2O
Br
Br⊖

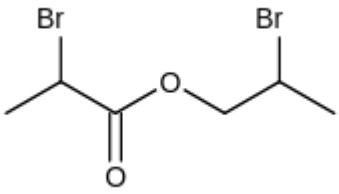
Question 170

Major product of the following reaction is

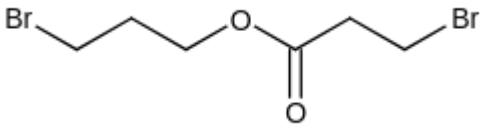




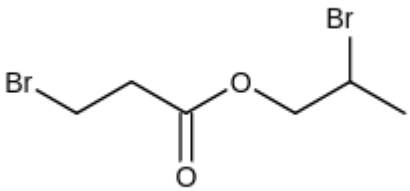
A.



B.



C.

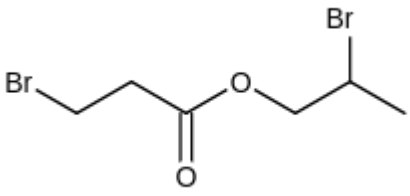


D.

Correct answer: D

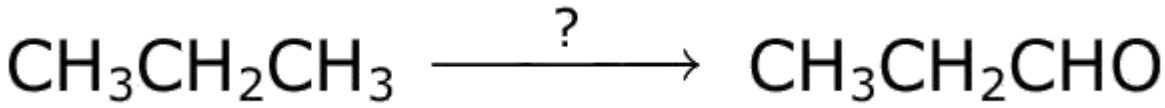
Source solution

Sol.



Question 171

Which of the following reagent is used for the following reaction?



A. Potassium permanganate

B. Molybdenum oxide

C. Copper at high temperature and pressure

D. Manganese acetate

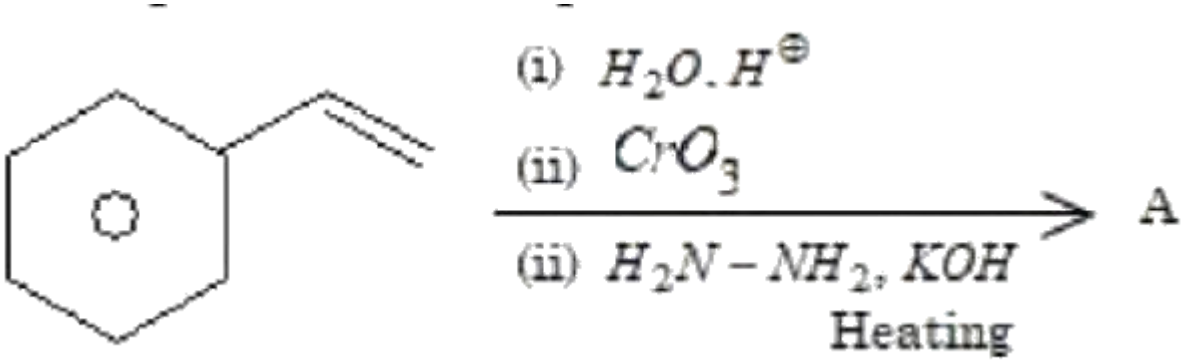
Correct answer: B

Source solution

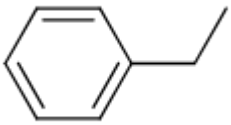
Sol. $\mathbf{CH_3 - CH_2 - CH_3 \xrightarrow{MO_2O_3} CH_3 - CH_2 - CH = 0}$

Question 172

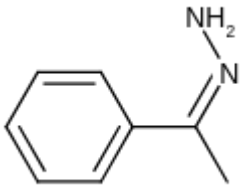
The final product A formed in the following multistep reaction sequence is



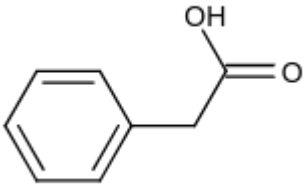
A.



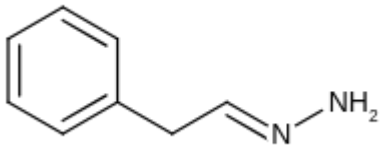
B.



C.



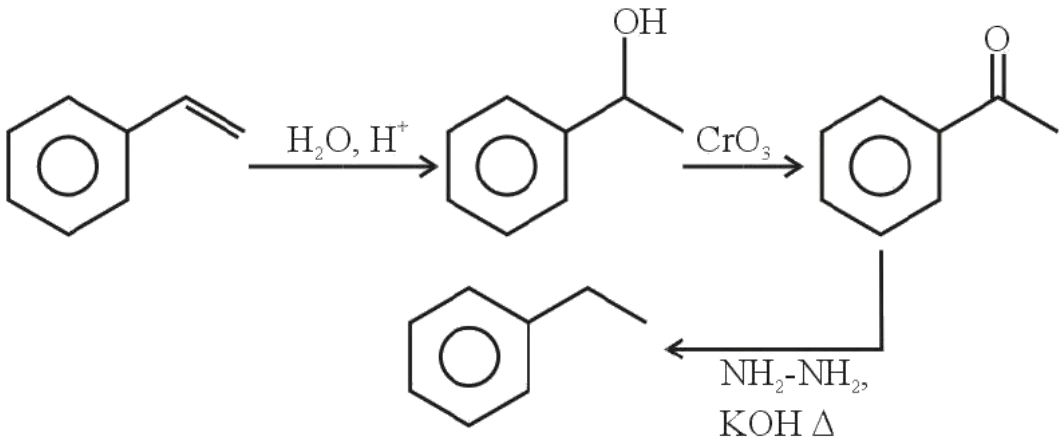
D.



Correct answer: A

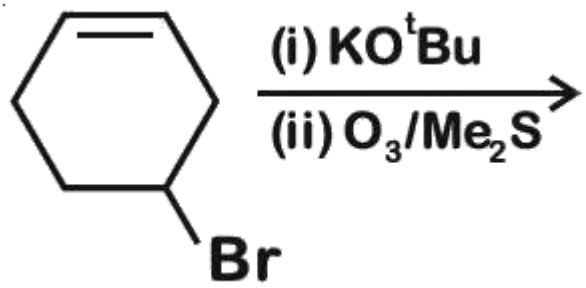
Source solution

Sol.

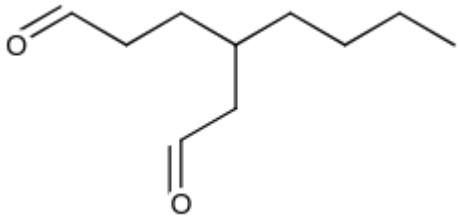

OH
O
H_2O, H^+
CrO_3
NH_2-NH_2,
KOH Δ

Question 173

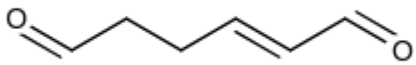
The major product(s) obtained in the following reaction is/are



A. 

B. 

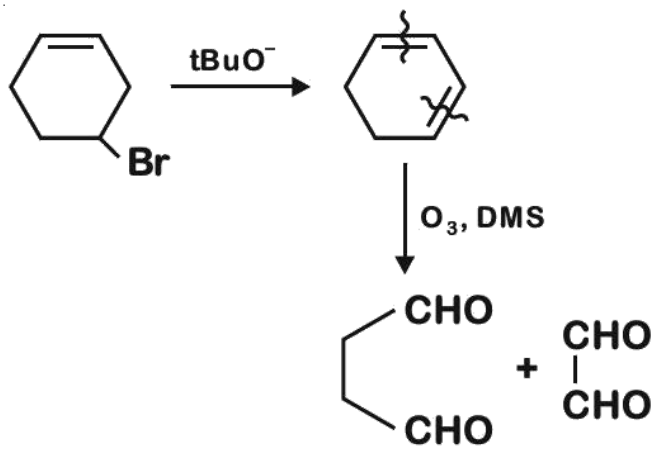
C. 

D. 

Correct answer: A

Source solution

Sol.

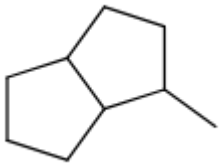


Question 174

Match List - I with List - II.

List - I (Isomers of $C_{10}H_{14}$)	List - II (Ozonolysis product)

Choose the correct answer from the options given below:



A. (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

B. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

C. (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

D. (A)-(I), (B)-(IV), (C)-(III), (D)-(II)

Correct answer: B

Source solution

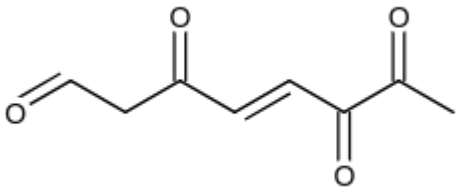
Sol. Ozonolysis product

(A)

(B)

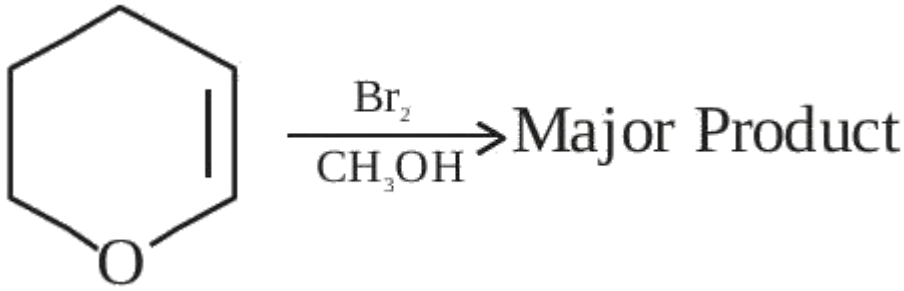
(C)

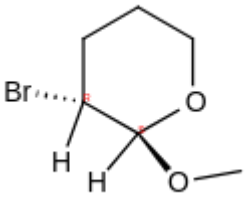
(D)



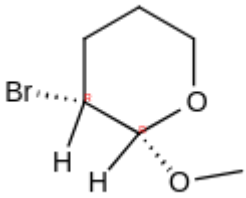
Question 175

Amongst the following, the major product of the given chemical reaction is

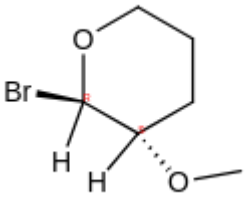




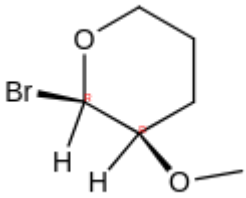
A.



B.



C.

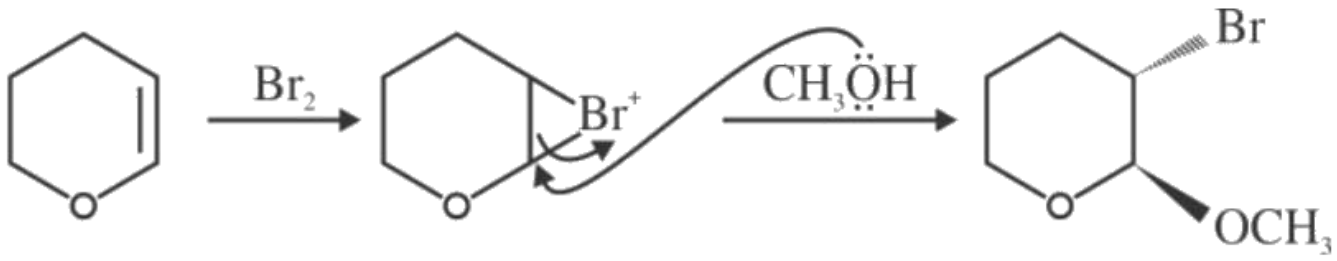


D.

Correct answer: A

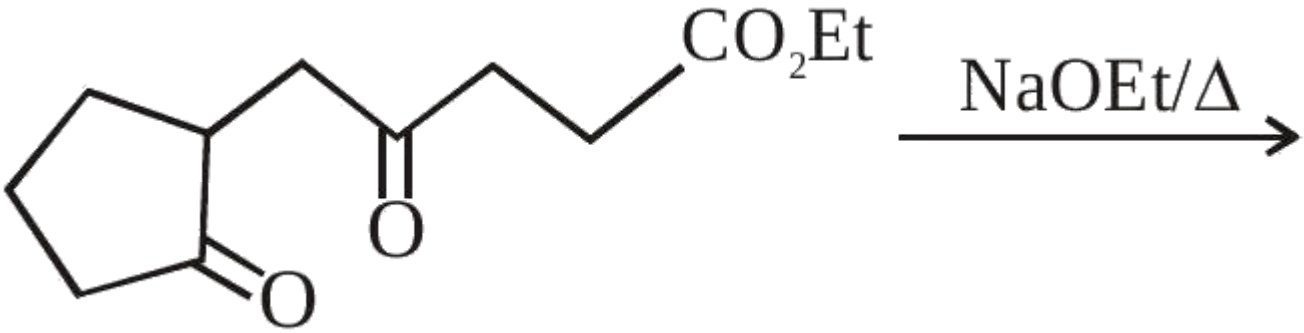
Source solution

Sol.

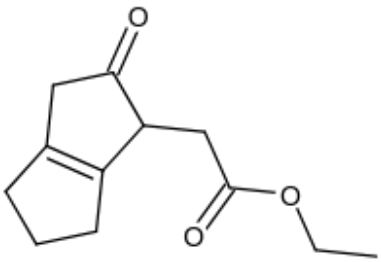


Question 176

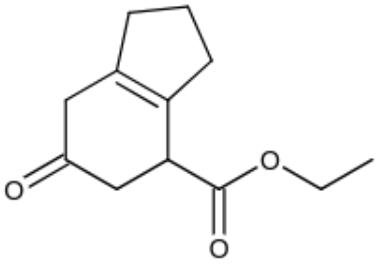
The major product obtained in the following reaction is :



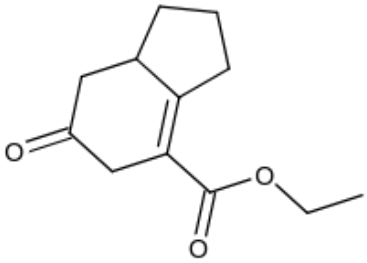
A.



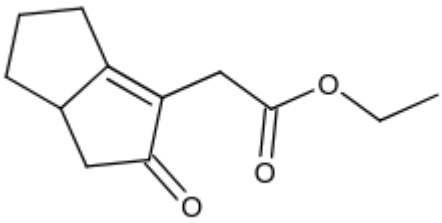
B.



C.



D.



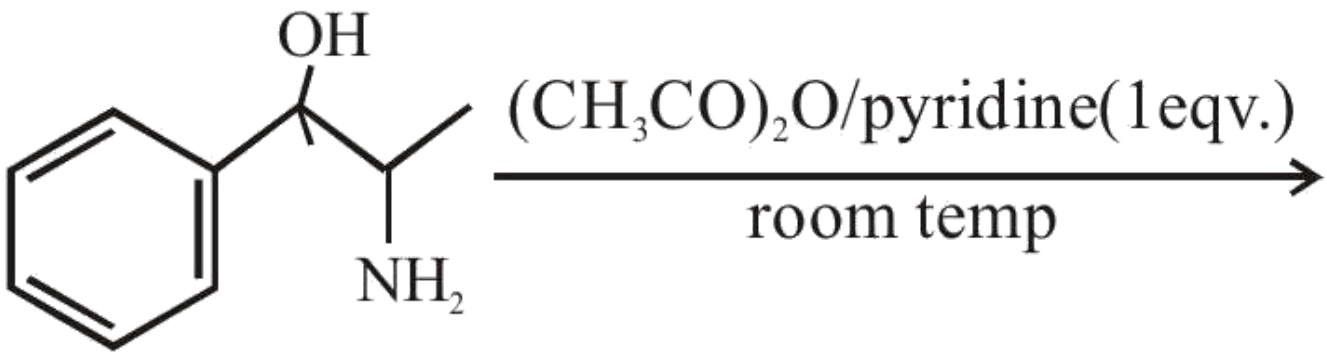
Correct answer: D

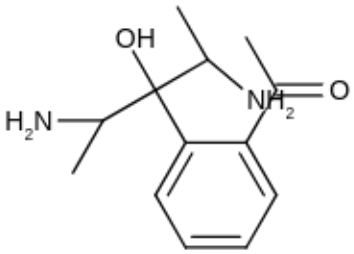
The source provides a brief answer only. A detailed worked solution is not available for this question.

Source solution

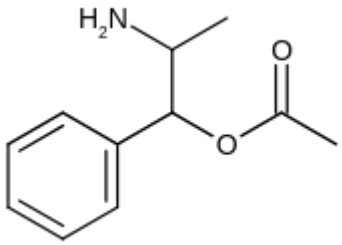
Question 177

The major product obtained in the following reaction is :

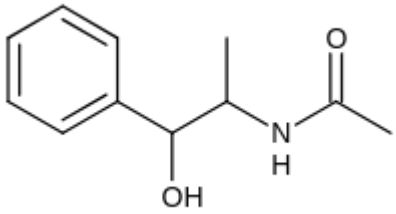




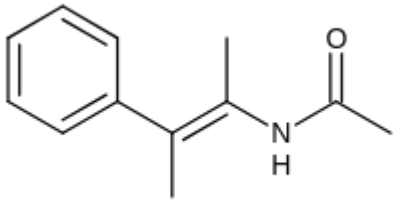
A.



B.



C.

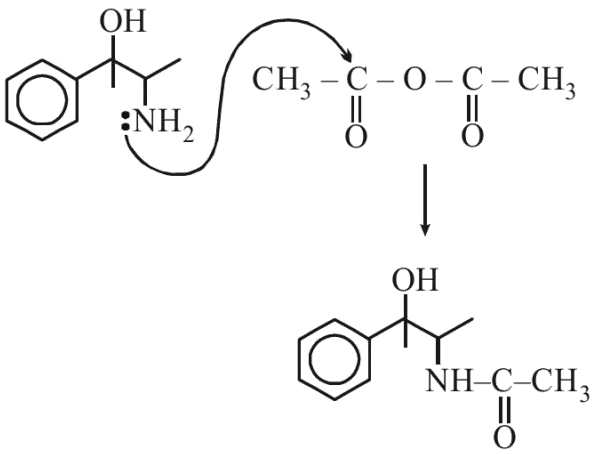


D.

Correct answer: C

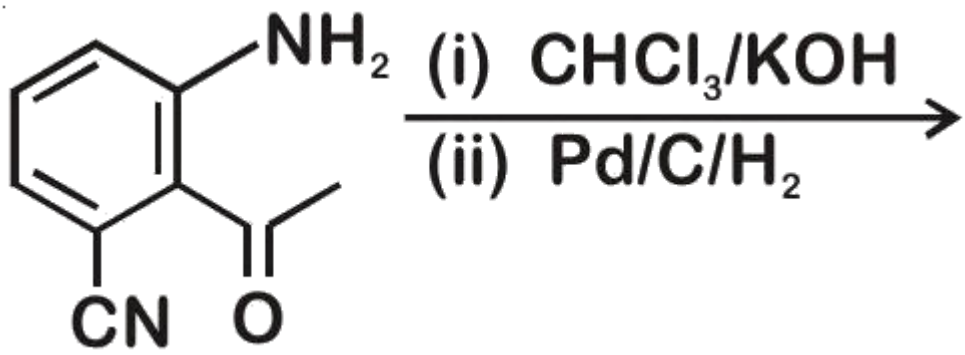
Source solution

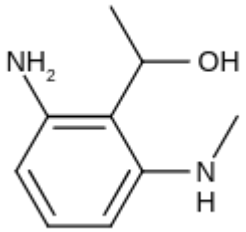
Sol.


OH
NH2
CH3 – C – O – C – CH3
O
O
OH
NH–C–CH3
O

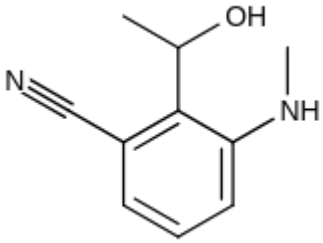
Question 178

The major product obtained in the following reaction is:

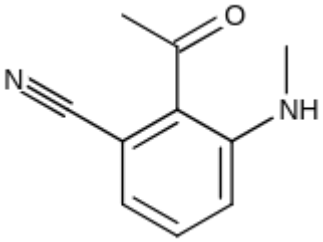




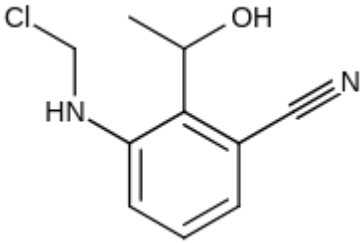
A.



B.



C.

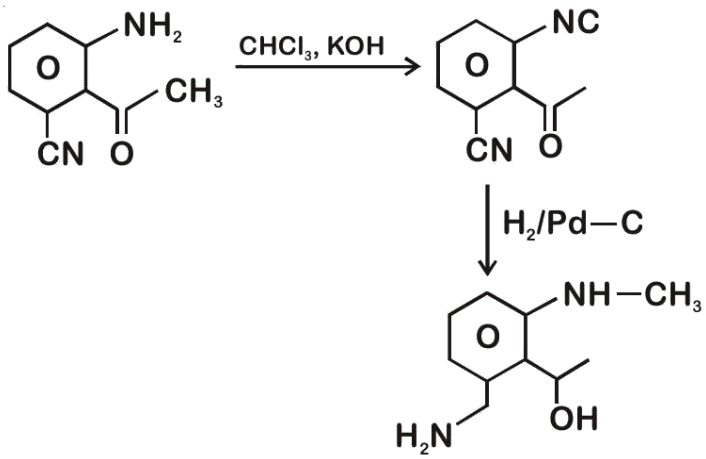


D.

Correct answer: A

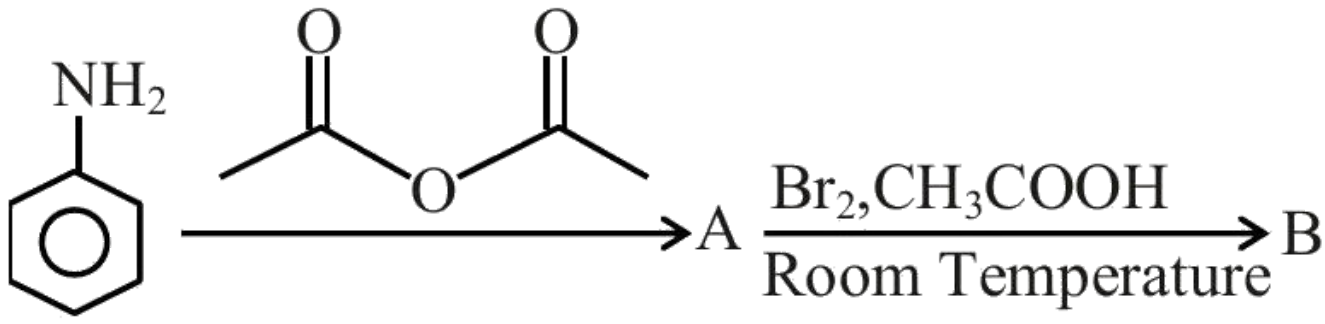
Source solution

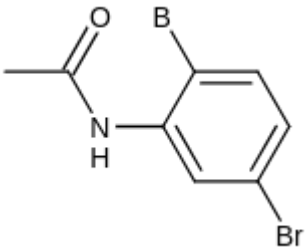
Sol.


NH2
O
CH3
CN
O
CHCl3, KOH
NC
O
CN
O
H2/Pd—C
NH—CH3
O
H2N
OH

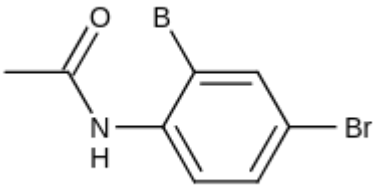
Question 179

The major products A and B formed in the following reaction sequence are :



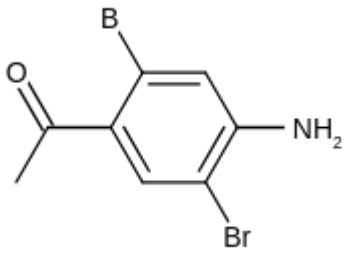


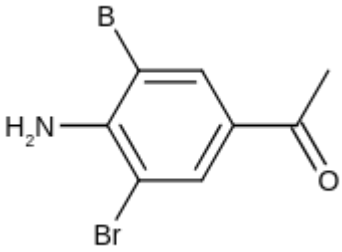
A.



B.

C. ,



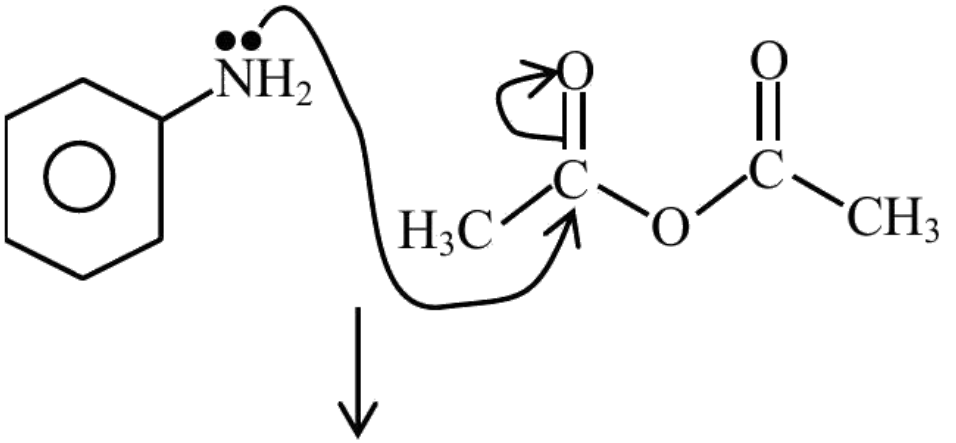


D.

Correct answer: B

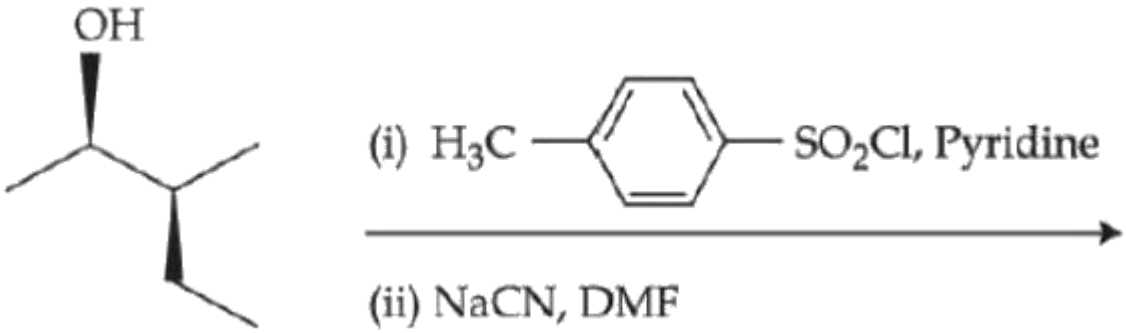
Source solution

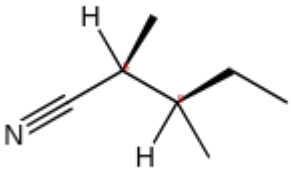
Sol.


NH2
O
O
C
C
H3C
O
CH3

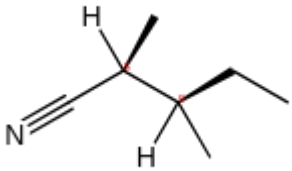
Question 180

Most stable product of the following reaction is:

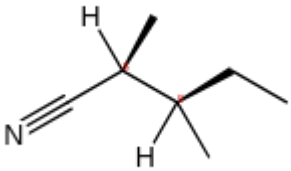




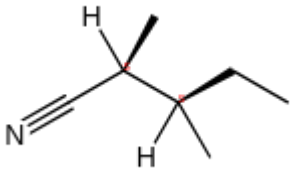
A.



B.



C.

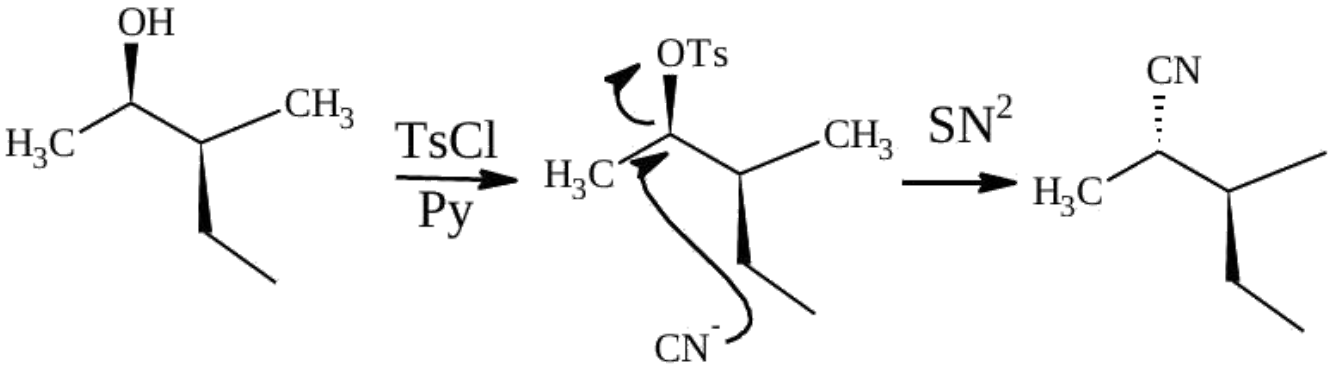


D.

Correct answer: B

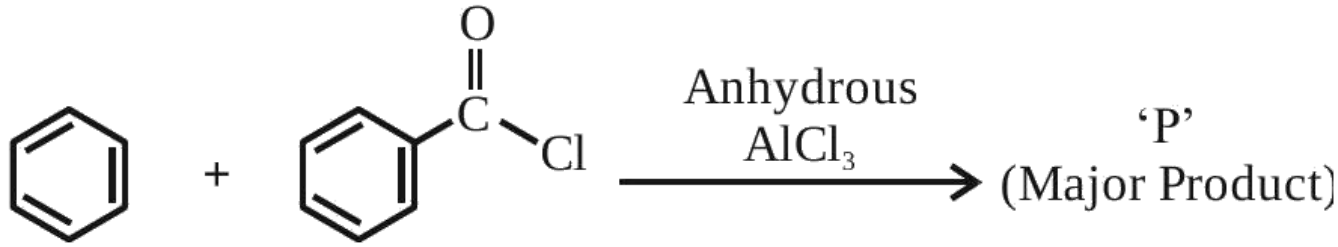
Source solution

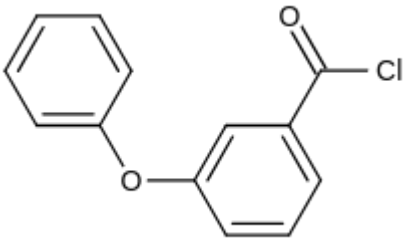
Sol.



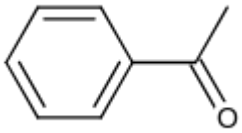
Question 181

Identify major product ' P ' formed in the following reaction.

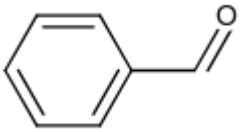




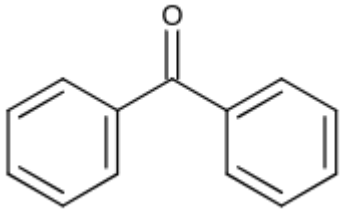
A.



B.



C.



D.

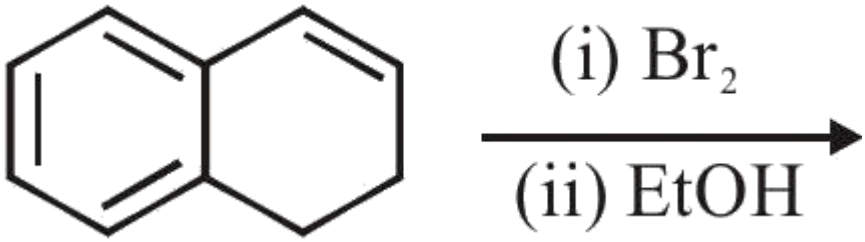
Correct answer: D

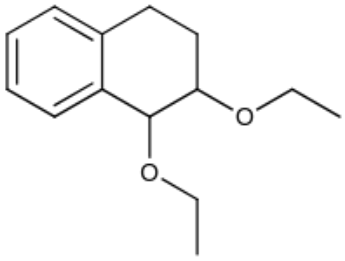
The source provides a brief answer only. A detailed worked solution is not available for this question.

Source solution

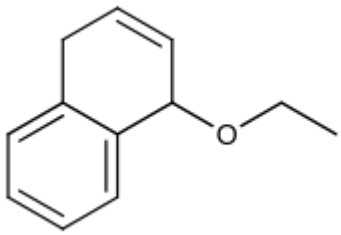
Question 182

The major product the following reaction is :

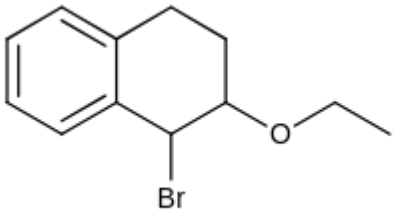




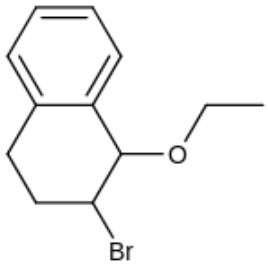
A.



B.



C.

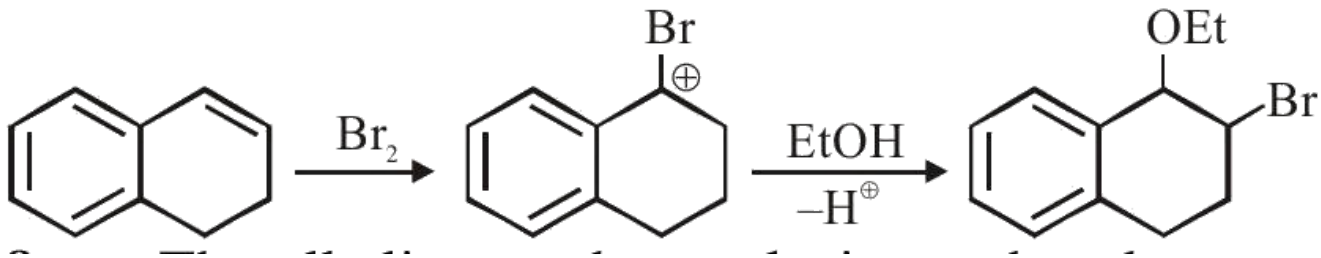


D.

Correct answer: D

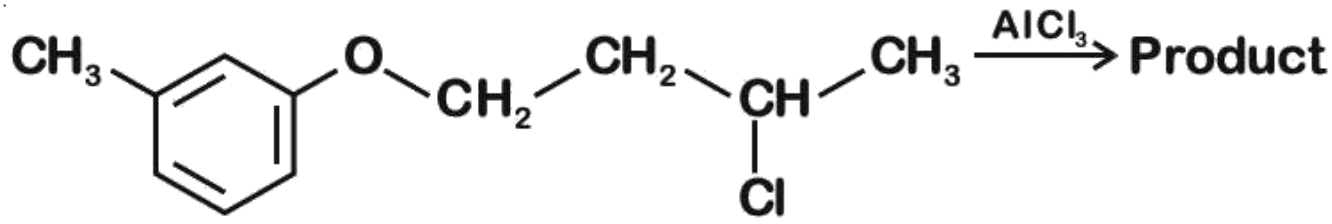
Source solution

Sol.

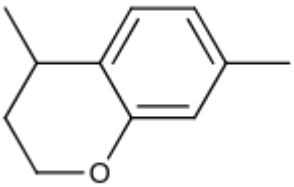


Question 183

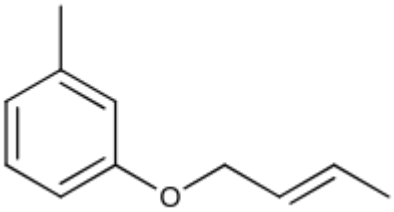
The major product obtained in the given reaction is :



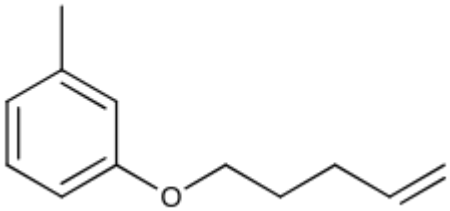
A.



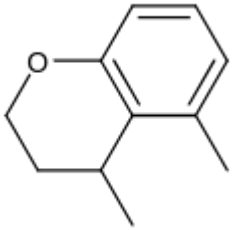
B.



C.



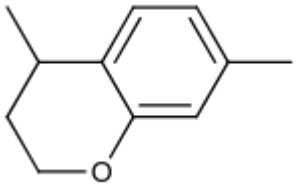
D.



Correct answer: A

Source solution

Sol.



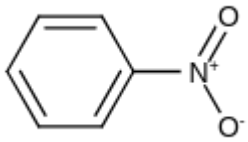
Question 184

Match the Compounds (List-I) with the appropriate Catalyst/Reagents (List-II) for their reduction into corresponding amines.

List-I	List-II (Compounds)	(Catalyst/Reagents)

(A)
(I) $\mathbf{NaOH}$ (aqueous)
(B)
(II) $\mathbf{H_2/Ni}$
(C) $\mathbf{R-C\equiv N}$
(III) $\mathbf{LiAlH_4, H_2O}$
(D)
(IV) $\mathbf{Sn, HCl}$

Choose the correct answer from the options given below:



A. (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

B. (A)-(II), (B)-(IV), (C)-(III), (D)-(I)

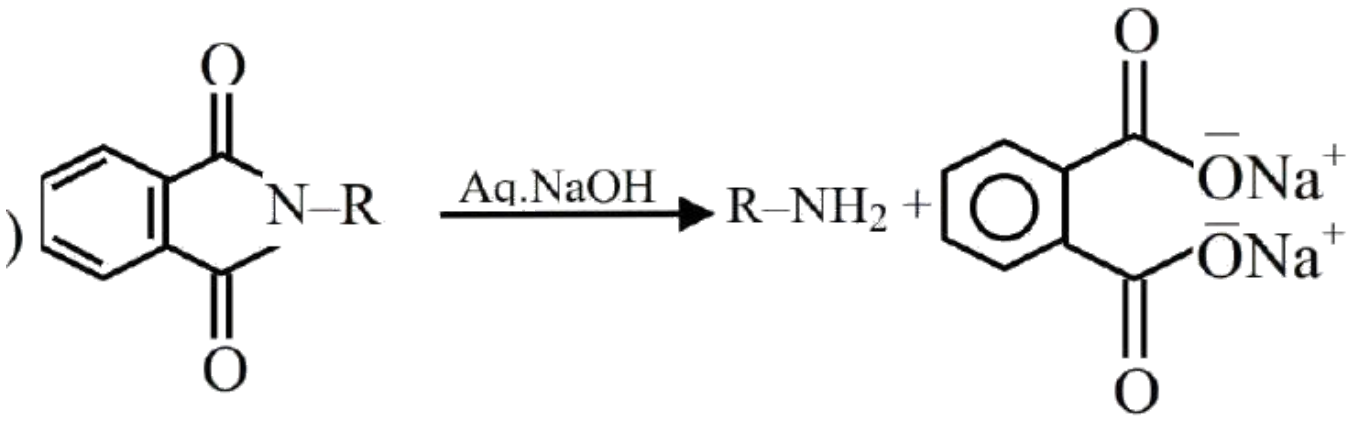
C. (A)-(II), (B)-(I), (C)-(III), (D)-(IV)

D. (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

Correct answer: D

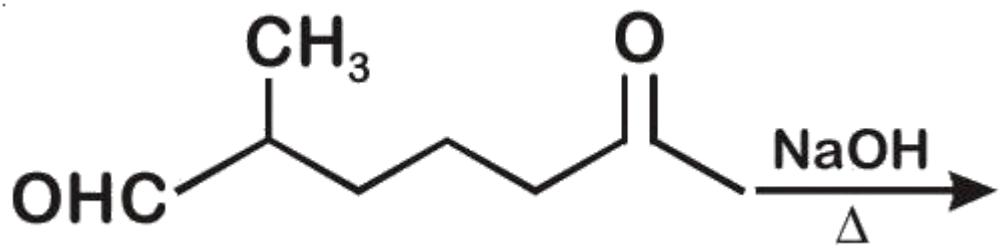
Source solution

Sol. (A)
(C) $\mathbf{R-C\equiv N \xrightarrow{H_2/Ni} R-CH_2NH_2}$
(D)

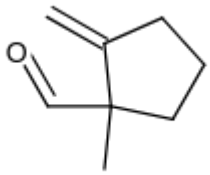

O
N–R
O
Aq.NaOH
R–NH2 +
O
ONa+
ONa+
O

Question 185

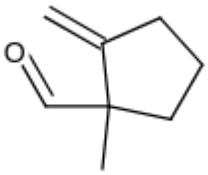
The major product obtained in the following reaction is



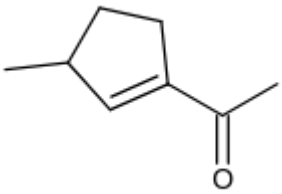
A.



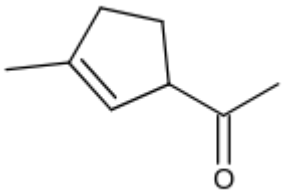
B.



C.



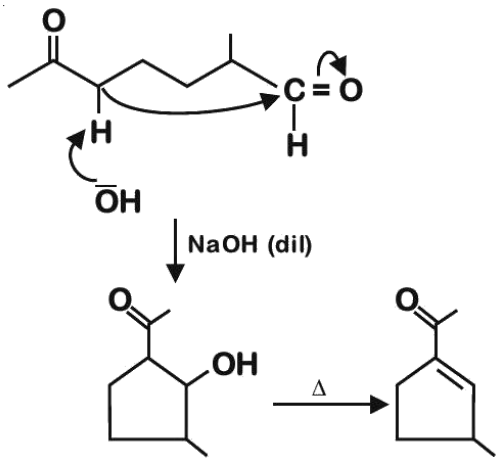
D.



Correct answer: C

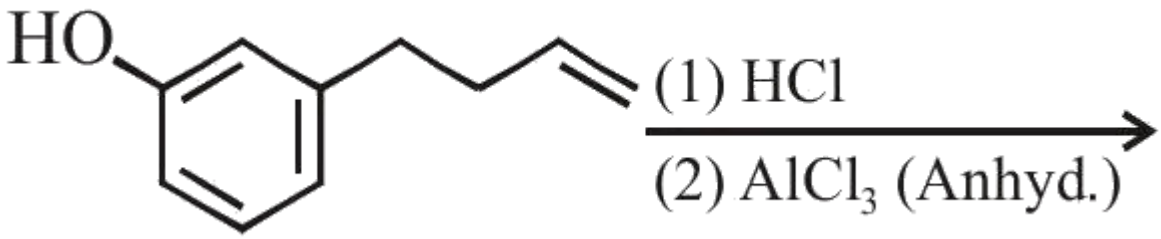
Source solution

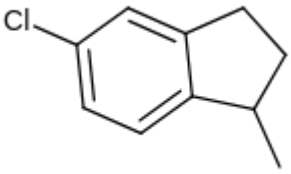
Sol.



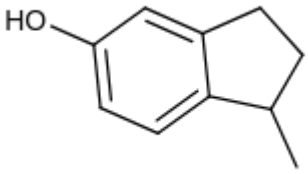
Question 186

The major product of the following reaction is :-

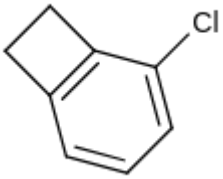




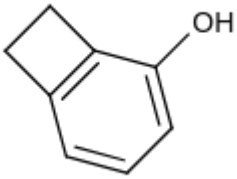
A.



B.



C.

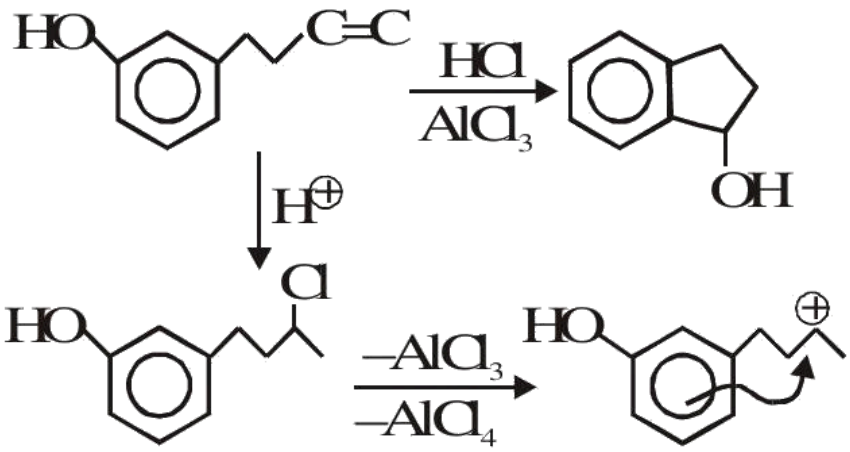


D.

Correct answer: B

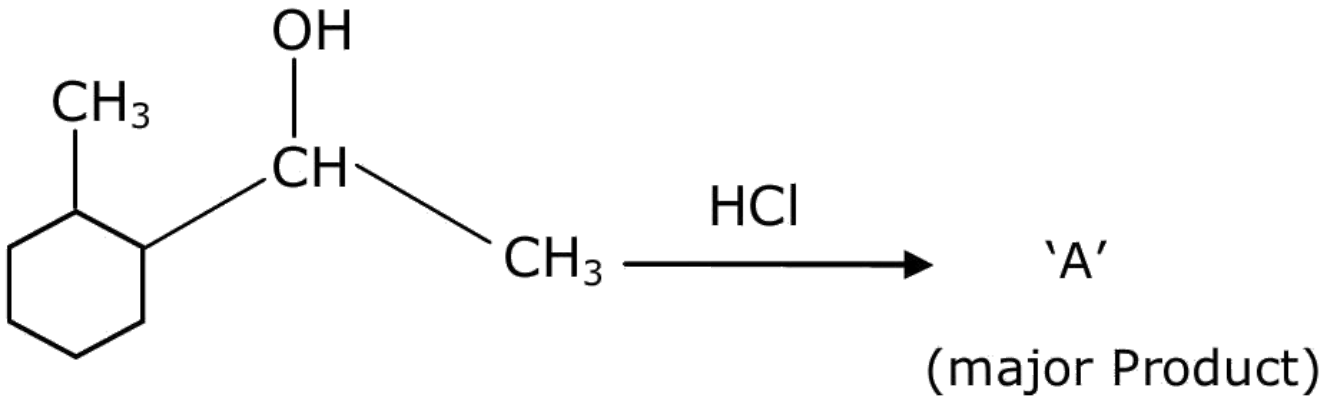
Source solution

Sol.

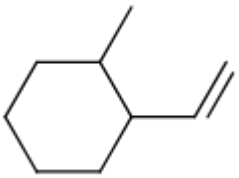


Question 187

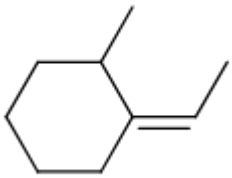
Which is the final product (major) ' A ' in the given reaction?



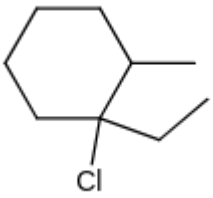
A.



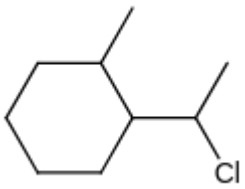
B.



C.



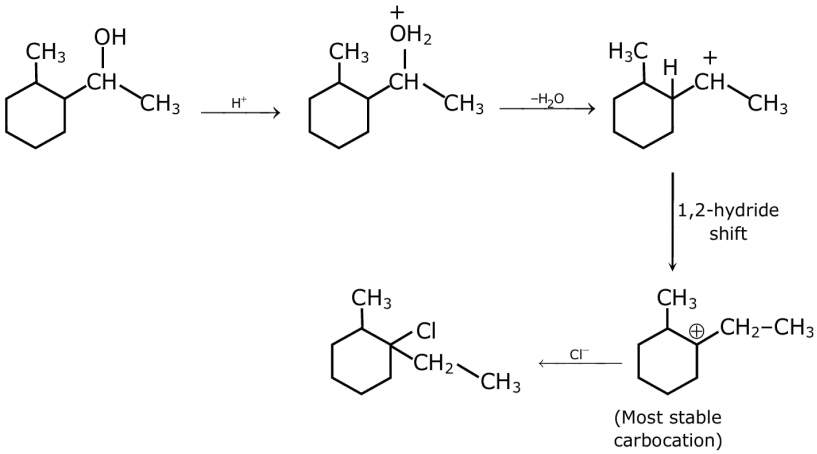
D.



Correct answer: C

Source solution

Sol.



Question 188

Which among the following is incorrect statement?

A. Electromeric effect dominates over inductive effect

B. The electromeric effect is, temporary effect

C. The organic compound shows electromeric effect in the presence of the reagent only

D. Hydrogen ion $(\mathbf{H}^{+})$shows negative electromeric effect

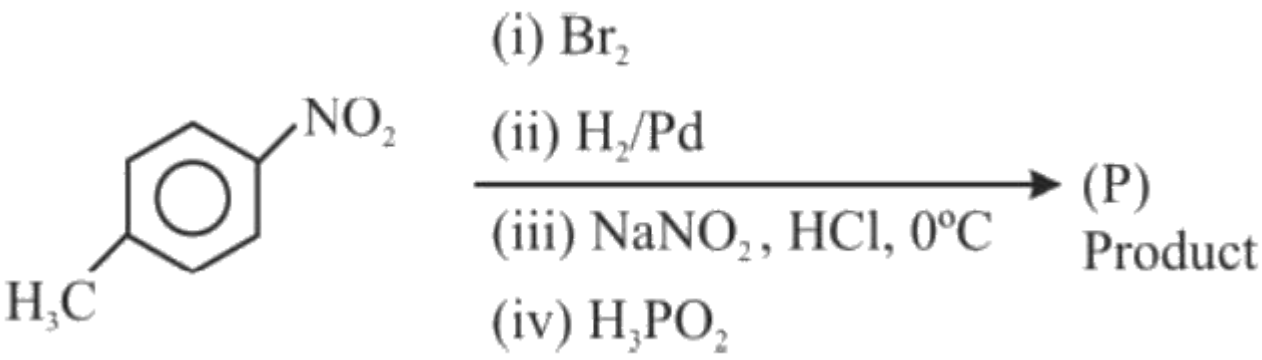
Correct answer: D

Source solution

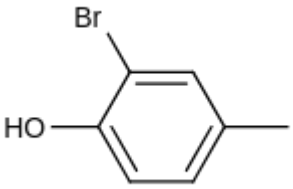
Sol. Hydrogen ion $(\mathbf{H}^{+})$shows positive electromeric effect.

Question 189

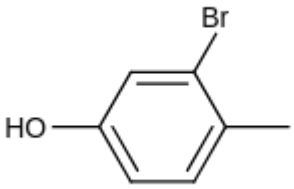
The product (P) formed from the following multistep reaction is :-



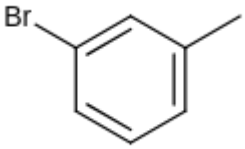
A.



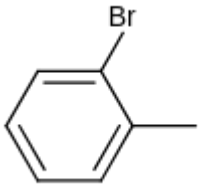
B.



C.



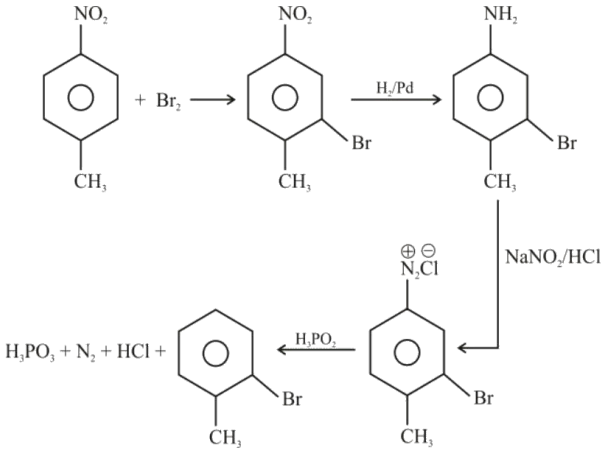
D.



Correct answer: D

Source solution

Sol.


NO2
+ Br2
NO2
Br
CH3
H2/Pd
NH2
Br
CH3
NaNO2/HCl
⊕ ⊖
N2Cl
Br
CH3
H3PO2
H3PO3 + N2 + HCl +
Br
CH3

Solutions

Questions 190-194 / 5 selected / 1.7% practice weight / Consolidate

Question 190

Elements P and Q form two types of non-volatile, non-ionizable compounds PQ and $\mathbf{PQ_2}$. When 1 g of PQ is dissolved in 50 g of solvent ' A '. $\mathbf{\Delta T_b}$ was 1.176 K while when 1 g of $\mathbf{PQ_2}$ is dissolved in 50 g of solvent 'A', $\mathbf{\Delta T_b}$ was 0.689 K . ($\mathbf{K_b}$ of 'A' = 5 K $\mathbf{kgmol^{-1}}$). The molar masses of elements P and Q (in $\mathbf{gmol^{-1}}$) respectively, are :

A. 70, 110

B. 65, 145

C. 60, 25

D. 25, 60

Correct answer: D

Source solution

$$(\Delta T_b)_{PQ} = K_b m$$

$$1.176 = 5 \times \frac{1}{M_1} \times \frac{1000}{50}$$

$M_1 = 85.03$

$(\Delta T_b)_{PQ_2} = 5 \times \frac{1}{M_2} \times \frac{1000}{50} = 0.689$

$M_2 = 145.13$

Let molar mass of $\mathbf{P\&Q}$ are $\mathbf{M_P}$ and $\mathbf{M_Q}$ respectively

$$M_P + M_Q = 85.03$$
$$M_P + 2M_Q = 145.13$$
$$M_P = 24.93 \approx 25$$
$$M_Q = 60.1 \approx 60$$

Question 191

At T(K), 100 g of 98% $\mathbf{H_2SO_4(w/w)}$ aqueous is mixed with 100 g of $\mathbf{49}$ aqueous solution. What is the mole fraction of $\mathbf{H_2SO_4}$ in the resultant solution?
(Given : Atomic mass $\mathbf{H = 1u; S = 32u; O = 16u}$)
(Assume that temperature after mixing remains constant)

A. 0.9

B. 0.1

C. 0.337

D. 0.663

Correct answer: C

Source solution

Total weight of $\mathbf{H_2SO_4}$

$$= \left(100 \times \frac{98}{100}\right) + \left(100 \times \frac{49}{100}\right) = \mathbf{147gm}$$

Total weight of $\mathbf{H_2O = 200 - 147 = 53gm}$
Mole fraction of $\mathbf{H_2SO_4} = \frac{\frac{147}{98}}{\left(\frac{147}{98} + \frac{53}{18}\right)} = \mathbf{0.337}$

Question 192

A solution containing 10 g of an electrolyte $\mathbf{AB_2}$ in 100 g of water boils at $\mathbf{100.52^\circ C}$. The degree of ionization of the electrolyte ($\boldsymbol{\alpha}$) is $\quad\times\mathbf{10^{-1}}$.
(nearest integer)
[Given : Molar mass of $\mathbf{AB_2 = 200\ g\ mol^{-1}}$. $\mathbf{K_b}$ (molal boiling point elevation const. of water) $\mathbf{= 0.52\ K\ kg\ mol^{-1}}$, boiling point of water $\mathbf{= 100^\circ C}$;
$\mathbf{AB_2}$ ionises as $\mathbf{AB_2 \rightarrow\ A^{2+} + 2\,B^-}$]

Numerical answer: _____

Enter the requested value or coefficient rounded to the nearest integer (0 decimal places).

Correct answer: 5

Source solution

$\mathbf{AB_2 \rightarrow\ A^{+2} + 2\,B^{\ominus}}$
$\mathbf{i = 1 + (3 - 1)\alpha}$
$\mathbf{i = 1 + 2\alpha}$
$\mathbf{\Delta T_b = k_b i m}$
$\mathbf{0.52 = 0.52(1 + 2\alpha)\frac{\frac{10}{200}}{\frac{100}{1000}}}$
$\mathbf{1 = (1 + 2\alpha)\frac{10}{20}}$
$\mathbf{2 = 1 + 2\alpha}$
$\mathbf{\alpha = 0.5}$
Ans. $\boldsymbol{\alpha = 5 \times 10^{-1}}$

Question 193

20% of acetic acid is dissociated when its 5 g is added to 500 mL of water. The depression in freezing point of such water is $\times 10^{-3}{}^{\circ}\mathrm{C}$

Atomic mass of C, H and O are 12,1 and 16 a.m.u. respectively.
[Given : Molal depression constant and density of water are $1.86\ \mathrm{K\ kg\ mol^{-1}}$ and $1\ \mathrm{g\ cm^{-3}}$ respectively.

Numerical answer: _____

Enter the requested value or coefficient rounded to the nearest integer (0 decimal places).

Correct answer: 372

Source solution

The van t Hoff factor is $i = 1 + 0.20 = 1.2$. Molality is $(5/60)/0.5 = 1/6$ mol/kg. Thus $\Delta T_f = 1.2 \times 1.86/6 = 0.372$ degrees C, or 372×10^{-3} degrees C.

Question 194

1.24 g of $\mathbf{AX_2}$ (molar mass $\mathbf{124\ g\ mol^{-1}}$) is dissolved in 1 kg of water to form a solution with boiling point of $\mathbf{100.0156^{\circ}C}$, while 25.4 g of $\mathbf{AY_2}$ (molar mass $\mathbf{250\ g\ mol^{-1}}$) in 2 kg of water constitutes a solution with a boiling point of $\mathbf{100.0260^{\circ}C}$.
$\mathbf{K_b\ (H_2O) = 0.52\ K\ kg\ mol^{-1}}$

Which of the following is correct ?

A. $\mathbf{AX_2}$ and $\mathbf{AY_2}$ (both) are completely unionised.

B. $\mathbf{AX_2}$ and $\mathbf{AY_2}$ (both) are fully ionised.

C. $\mathbf{AX_2}$ is completely unionised while $\mathbf{AY_2}$ is fully ionised.

D. $\mathbf{AX_2}$ is fully ionised while $\mathbf{AY_2}$ is completely unionised.

Correct answer: D

Source solution

Sol. For $\mathbf{AX_2}$:- $\mathbf{\Delta T_b = K_b \times m \times i}$
$\mathbf{0.0156 = 0.52 \times \frac{0.01}{1} \times i_{AX_2}}$
$\mathbf{\Rightarrow i_{AX_2} = 3 \Rightarrow}$ complete ionisation
For $\mathbf{AY_2 : -\Delta T_b = K_b \times m \times i}$
$\mathbf{0.026 = 0.52 \times 0.0508 \times i_{AY_2}}$
$\mathbf{\Rightarrow i_{AY_2} \simeq 1 \therefore}$ complete unionisation

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Electrochemistry

Questions 195-196 / 2 selected / 0.7% practice weight / Consolidate

Question 195

Match List-I with List-II :

List-I Applications		List-II Batteries/Cell	
(A)	Transistors	(I)	Anode - Zn/Hg; Cathode - HgO + C
(B)	Hearing aids	(II)	Hydrogen fuel cell
(C)	Invertors	(III)	Anode - Zn; Cathode - Carbon
(D)	Apollo space ship	(IV)	Anode - Pb ; Cathode $-\mathbf{Pb} \mid \mathbf{PbO_2}$

Choose the correct answer from the options given below:

A. -(III), (B)-(I), (C)-(IV), (D)-(II)

B. (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

C. (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

D. (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

Correct answer: A

The source provides a brief answer only. A detailed worked solution is not available for this question.

Source solution

Question 196

Match List I with List II

LIST-I (Cell)		LIST-II (Use/Property/Reaction)	
A.	Leclanche cell	I.	Converts energy of combustion into electrical energy
B.	Ni-Cd cell	II.	Does not involve any ion in solution and is used in hearing aids
C.	Fuel cell	III.	Rechargeable
D.	Mercury cell	IV.	Reaction at anode $\mathbf{Zn \rightarrow Zn^{2+} + 2e^-}$

Choose the correct answer from the options given below:

A. A-I, B-II, C-III, D-IV

B. A-III, B-I, C-IV, D-II

C. A-IV, B-III, C-I, D-II

D. A-II, B-III, C-IV, D-I

Correct answer: C

Source solution

Sol. A-IV, B-III, C-I, D-II

Chemical Kinetics

Questions 197-198 / 2 selected / 0.7% practice weight / Consolidate

Question 197

The following data was obtained for chemical reaction given below at 975 K .

$$2NO_{(g)} + 2H_{2(g)} \rightarrow N_{2(g)} + 2H_2O_{(g)}$$

$[NO]$	$[H_2]$	Rate
$molL^{-1}$	$mol\ L^{-1}$	$mol\ L^{-1}\ s^{-1}$

(A) 8×10^{-5} 8×10^{-5} 7×10^{-9}
(B) 24×10^{-5} 8×10^{-5} 2.1×10^{-8}
(C) 24×10^{-5} 32×10^{-5} 8.4×10^{-8}

The order of the reaction with respect to NO is
. [Integer answer]

Numerical answer: _____

Enter the requested integer (0 decimal places).

Correct answer: 1

Source solution

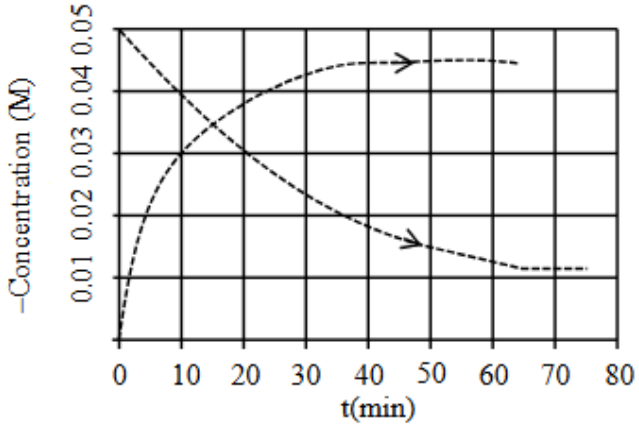
$$7 \times 10^{-9} = K \times \left(8 \times 10^{-5}\right)^{x}\left(8 \times 10^{-5}\right)^{y}$$

$$2.1 \times 10^{-8} = K \times \left(24 \times 10^{-5}\right)^{x}\left(8 \times 10^{-5}\right)^{y} \quad (1)$$

$$\frac{1}{3}=\left(\frac{1}{3}\right)^{x} \Rightarrow x=1 \tag{2}$$

Question 198

Given above is the concentration vs time plot for a dissociation reaction : A → nB.
Based on the data of the initial phase of the reaction (initial 10 min), the value of n is _____.



A. 4

B. 3

C. 2

D. 5

Correct answer: B

Source solution

$$\mathbf{A \rightarrow nB}$$

During the initial $\mathbf{10\ min}$, from the graph,

$$[A]_0 = 0.05\ \mathrm{M}, \qquad [A]_{10} = 0.04\ \mathrm{M}$$

Therefore, the concentration of $\mathbf{A}$ consumed is

$$-\Delta[A] = 0.05 - 0.04 = 0.01\ \mathrm{M}$$

Similarly,

$$[B]_0 = 0, \qquad [B]_{10} = 0.03\ \mathrm{M}$$

Therefore, the concentration of $\mathbf{B}$ formed is

$$\Delta[B] = 0.03\ \mathrm{M}$$

For the reaction $\mathbf{A \rightarrow nB}$,

$$n = \frac{\Delta[B]}{-\Delta[A]} = \frac{0.03}{0.01} = 3$$

Hence,

$$\boxed{n = 3}$$

Therefore, the correct option is $\boxed{(2)}$.

The p-Block Elements

Question 199

Given below are two statements :
Statement I : The number of pairs among [SiO_2, CO_2], $[SnO, SnO_2]$, $[PbO, PbO_2]$ and $[GeO, GeO_2]$, which contain oxides that are both amphoteric is 2.
Statement II : BF_3 is an electron deficient molecule can act as a lewis acid, forms adduct with NH_3 and has a trigonal planar geometry.
In the light of the above statement, choose the correct answer from the option given below.

A. Both Statement I and Statement II are true.

B. Both Statement I and Statement II are false.

C. Statement I is true but Statement II is false.

D. Statement I is false Statement II is true.

Correct answer: A

Source solution

$\Rightarrow SiO_2, CO_2, GeO, GeO_2$ are acidic in nature.
SnO, SnO_2, PbO, PbO_2 are amphoteric in nature.
$\Rightarrow BF_3$ is lewis acid acoording to lewic octet theory and has sp^2 hybridization with trigonal planar geometry and it can accept lone pair form ammonia to form adduct.

Question 200

Match List-I with List-II, match the gas evolved during each reaction.

	List-I		List-II
(A)	$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta}$	(I)	H_2
(B)	$KMnO_4 + HCl \rightarrow$	(II)	N_2
(C)	$Al + NaOH + H_2O \rightarrow$	(III)	O_2
(D)	$NaNO_3 \xrightarrow{\Delta}$	(IV)	Cl_2

Choose the correct answer from the options given below:

A. - (II), (B) - (III), (C) - (I), (D) - (IV)

B. (A) - (III), (B) - (I), (C) - (IV), (D) - (II)

C. (A) - (II), (B) - (IV), (C) - (I), (D) - (III)

D. (A) - (III), (B) - (IV), (C) - (I), (D) - (II)

Correct answer: C

Source solution

$$(NH_4)_2Cr_2O_7 \xrightarrow{\Delta} N_2 + Cr_2O_3 + 4H_2O$$
$$KMnO_4 + HCl \rightarrow MnCl_2 + KCl + Cl_2 + H_2O$$
$$Al + NaOH + H_2O \rightarrow H_2 + Na\,[Al(OH)_4]$$
$$NaNO_3 \longrightarrow NaNO_2 + O_2$$

Question 201

Match List I with List II

	List I	List II
(A)	Slaked lime	(I) NaOH
(B)	Dead burnt plaster	(II) $Ca(OH)_2$
(C)	Caustic soda	(III) $Na_2CO_3 \cdot 10H_2O$
(D)	Washing soda	(IV) $CaSO_4$

Choose the correct answer from the options given below:

A. - III, (B) - IV, (C) - II, (D) - I

B. (A) - III, (B) - II, (C) - IV, (D) - I

C. (A) - I, (B) - IV, (C) - II, (D) - III

D. (A) -II, (B) - IV, (C) - I, (D) - III

Correct answer: D

Source solution

Slaked Lime $\rightarrow Ca(OH)_2$
Dead burnt plaster $\rightarrow CaSO_4$
Caustic Soda $\rightarrow NaOH$
Washing Soda $\rightarrow Na_2CO_3.10H_2O$

Question 202

Given below are two statements

Statement I: The N-N single bond is weaker and longer than that of $\mathbf{P-P}$ single bond
Statement II : Compounds of group 15 elements in +3 oxidation states readily undergo disproportionation reactions.
In the light of above statements, choose the correct answer from the options given below

A. Statement I is true but statement II is false

B. Both statement I and statement II are false

C. Statement I is false but statement II is true

D. Both statement I and statement II are true

Correct answer: B

Source solution

$\ddot{\mathbf{N}}-\ddot{\mathbf{N}}$ single bond weaker than $\ddot{\mathbf{P}}-\ddot{\mathbf{P}}$ due to more ℓ p- ℓ p repulsion.

Bond length $\Rightarrow \mathbf{d_{p-p} > d_{N-N}}$ (size $\uparrow$, B.L. $\uparrow$)
In group 15 elements only N & P show disproportionation in +3 oxidation state, As, Sb & Bi have almost inert for disproportionation in +3 oxidation state.
So both statements are false.

TEST PAPER WITH SOLUTION

Question 203

Match List I with List II

LIST I		LIST II	
A.	Nitrogen oxides in air	I.	Eutrophication
B.	Methane in air	II.	pH of rain water becomes 5.6.
C.	Carbon dioxide	III.	Global warming
D.	Phosphate fertilisers in water	IV.	Acid rain

Choose the correct answer from the options given below:

A. A-IV, B-III, C-II, D-I

B. A-II, B-III, C-I, D-IV

C. A-I, B-II, C-III, D-IV

D. A-IV, B-II, C-III, D-I

Correct answer: A

Source solution

:

i. $4NO_2(g) + O_2(g) + 2H_2O(\ell) \rightarrow 4HNO_3(aq)$
SO_2&NO_2 have major contribution in acid rain
ii. CO_2, CH_4, O_3, CFC are responsible for global warming
iii. $H_2O(\ell) + CO_2(g) \rightleftharpoons H_2CO_3$ (aq.)

$$H_2CO_3\ (aq.) \rightleftharpoons H^+(aq.) + HCO_3^-(aq.)$$

Rain water has pH of 5.6 due to the Presence of H^+ions formed by the reaction of rain water with CO_2
iv. Phosphates present in fertilizers contribution for Eutrophication (Process in which nutrient enriched

water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity is known as Eutrophication.)

Question 204

Match List I with List-II

List-I (Name of the test)		List-II (Reaction sequence involved) [M is metal]	
A	Borax bead test	I.	$MCO_3 \rightarrow MO \xrightarrow[+\Delta]{Co(NO_3)_2}$ CoO. MO
B.	Charcoal cavity test	II.	$MCO_3 \rightarrow MCl_2 \rightarrow M^{2+}$
C.	Cobalt nitrate test	III	$MSO_4 \xrightarrow[\Delta]{Na_2B_4O_7} M(BO_2)_2 \rightarrow MBO_2 \rightarrow M$
D.	Flame test	IV	$MSO_4 \xrightarrow[\Delta]{Na_2CO_3} MCO_3 \rightarrow MO \rightarrow M$

Choose the correct answer from the option below :

A. A-III, B-I, C-IV, D-II

B. A-III, B-II, C-IV, D-I

C. A-III, B-I, C-II, D-IV

D. A-III, B-IV, C-I, D-II

Correct answer: D

Source solution

Cobalt nitrate test

$MCO_3 \rightarrow MO \xrightarrow[+\Delta]{Co(NO_3)_2}$ CoO. MO

Flame test

$MCO_3 \rightarrow MCl_2 \rightarrow M^{2+}$

Borax Bead test

$MSO_4 \xrightarrow[\Delta]{Na_2B_4O_7} M(BO_2)_2 \rightarrow MBO_2 \rightarrow M$

Charcoal cavity test

$$\mathrm{MSO_4} \xrightarrow[\Delta]{\mathrm{Na_2CO_3}} \mathrm{MCO_3} \rightarrow \mathrm{MO} \rightarrow \mathrm{M}$$

The d- and f-Block Elements

Question 205

Match List-I with List-II

\multirow{2}{*}{ List-I Complex }		List-II Primary valency and Secondary valency		
		(I)	3	6
(B)	$[Pt(NH_3)_2Cl(NO_2)]$	(II)	3	4
(C)	$Hg[Co(SCN)_4]$	(III)	2	6
(D)	$[Mg(EDTA)]^{2-}$	(IV)	2	4

Choose the correct answer from the options given below :

A. -(III), (B)-(I), (C)-(II), (D)-(IV)

B. (A)-(I), (B)-(IV), (C)-(II), (D)-(III)

C. (A)-(I), (B)-(III), (C)-(II), (D)-(IV)

D. (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

Correct answer: B

Source solution

Primary valency = Oxidation state Secondary valency = Co-ordination number

	Complex	Primary valency	Secondary
(A)	$[Co(\ en\ )_2Cl_2]Cl$	3	6
(B)	$[Pt(NH_3)_2Cl\,(NO_2)]$	2	4
(C)	$Hg\,[Co(SCN)_4]$	3	4
(D)	$[Mg(EDTA)]^{2-}$	2	6

Question 206

Given below are two statements : One is labelled as Assertion $\mathbf{A}$ and the other is labelled as Reason $\mathbf{R}$
Assertion A :- Sodium is about 30 times as abundant as potassium in the oceans.
Reason $\mathbf{R}$:- Potassium is bigger in size than sodium.
In the light of above statements, choose the correct answer from the options given below

A. Both A and R are true and R is the correct explanation of A .

B. A is true but R is false.

C. A is false but R is true

D. Both A and R are true but R is NOT the correct explanation of A.

Correct answer: A

Source solution

Due to bigger size of potassium, it forms more efficient lattices as compared to sodium with silicates.
The abundance of sodium in ocean is more due to the more soluble nature of salt of sodium as compared to potassium salts.

Question 207

Match List I with List II.

List I Complex		List II Colour	
A.	$Mg(NH_4)PO_4$	I.	Brown
B.	$K_3[Co(NO_2)_6]$	II.	White
C.	$MnO(OH)_2$	III.	Yellow
D.	$Fe_4[Fe(CN)_6]_3$	IV.	blue

Choose the correct answer from the options given below:

A. A-II, B-III, C-I, D-IV

B. A-III, B-IV, C-II, D-I

C. A-II, B-IV, C-I, D-III

D. A-II, B-III, C-IV, D-I

Correct answer: A

Source solution

Solution : $Mg(NH_4)PO_4 \Rightarrow$ White
$K_3[Co(NO_2)_6] \Rightarrow$ Yellow
$MnO(OH)_2 \Rightarrow$ Brown
$Fe_4[Fe(CN)_6]_3 \Rightarrow$ Blue

Question 208

Which one of the following statements is incorrect ?

A. van Arkel method is used to purify tungsten.

B. The malleable iron is prepared from cast iron by oxidising impurities in a reverberatory furnace.

C. Cast iron is obtained by melting pig iron with scrap iron and coke using hot air blast.

D. Boron and Indium can be purified by zone refining method.

Correct answer: A

Source solution

Van Arkel method is used for refining of Ti, Zr, Hf, Bi, B

Question 209

Match List-I with List-II.

List-I
(Complex ion)
(A) $[Cr(NH_3)_6]^{3+}$
(B) $[NiCl_4]^{2-}$
(C) $[CoF_6]^{3-}$
(D) $[Ni(CN)_4]^{2-}$

List-II
(Spin only magnetic
moment in B.M.)
(I) 4.90
(II) 3.87
(III) 0.0
(IV) 2.83

Choose the correct answer from the options given below:

A. (A)-(I), (B)-(IV), (C)-(II), (D)-(III)

B. (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

C. (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

D. (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

Correct answer: C

Source solution

Sol. (A) $[Cr(NH_3)_6]^{3+}$
$Cr^{3+} : 3\,d^3$
$n = 3$ (unpaired electrons)
$\mu \simeq 3.87$ B.M. (II)
(B) $[NiCl_4]^{2-}$
$Ni^{2+} : 3\,d^8$
$n = 2$
$\mu \simeq 2.83$ B.M. (IV)
(C) $[CoF_6]^{3-}$
$Co^{3+} : 3\,d^6$

$n = 4$
$\mu \simeq 4.90$ B.M. (I)
(D) $[Ni(CN)_4]^{2-}$
$Ni^{2+} : 3d^8$
$n = 0$
$\mu = 0$ B.M. (III)

SECTION-B}

Question 210

Which one of the following statements is incorrect?

A. Atomic hydrogen is produced when H_2 molecules at a high temperature are irradiated with UV radiation.

B. At around 2000 K , the dissociation of dihydrogen into its atoms is nearly 8.1%.

C. Bond dissociation enthalpy of H_2 is highest among diatomic gaseous molecules which contain a single bond .

D. Dihydrogen is produced on reacting zinc with HCl as well as $NaOH_{(aq)}$.

Correct answer: B

Source solution

Atomic hydrogen is produced at high temperature in an electric are or under ultraviolet radiations The dissociation of dihydrogen at 2000 K is only 0.081%
$H - H$ bond dissociation enthalpy is highest for a single bond for any diatomic molecule.
Dihydrogen can be produced on reacting Zn with dil. HCl as well as NaOH (aq.)

Question 211

Which of the following statements are incorrect?

A. A, D

B. B, C

C. $\mathbf{A, B}$

D. A, B, C, D

Correct answer: A

Source solution

Sol:}
$\mathbf{Co^{3+}}$ has $\mathbf{d^6}$ electronic configuration. In the presence of strong field ligand, $\mathbf{\Delta_o > P}$. Thus the splitting occurs as: $\mathbf{t_{2\,g}^6, e_g^0}$; so the magnetic moment is zero.

According to the spectrochemical series, en is a stronger ligand than F and therefore promotes pairing. This implies that the Δ_o of en is more than the Δ_o of F .

$$\Delta_o = \frac{hc}{\lambda_{abs}} \Delta_t = \frac{4}{9}\Delta_o = 8000 \text{ cm}^{-1}$$

Question 212

The incorrect statements among the following is

A. $\mathbf{PH_3}$ shows lower proton affinity than $\mathbf{NH_3}$.

B. $\mathbf{PF_3}$ exists but $\mathbf{NF_5}$ does not.

C. $\mathbf{NO_2}$ can dimerise easily.

D. $\mathbf{SO_2}$ can act as an oxidizing agent, but not as a reducing agent.

Correct answer: D

Source solution

$\mathbf{SO_2}$ can oxidise as well as reduce.
Hence it can act as both oxidising and reducing agent.

Question 213

Match List I with List II

LIST - I (Complex ion)		LIST - II (Electronic Configuration	
A.	$[Cr(H_2O)_6]^{3+}$	I.	$t_{2g}^2e_g^0$
B.	$[Fe(H_2O)_6]^{3+}$	II.	$t_{2g}^3e_g^0$
C.	$[Ni(H_2O)_6]^{2+}$	III.	$t_{2g}^3e_g^2$
D.	$[V(H_2O)_6]^{3+}$	IV.	$t_{2g}^6e_g^2$

Choose the correct answer from the options given below:

A. A-III, B-II, C-IV, D-I

B. A-IV, B-I, C-II, D-III

C. A-IV, B-III, C-I, D-II

D. A-II, B-III, C-IV, D-I

Correct answer: D

Source solution

Sol:- $[Cr(H_2O)_6]^{3+}$ Contains $Cr^{3+} : [Ar]3\,d^3 : t_{2g}^3e_g^o$

$$[Fe(H_2O)_6]^{3+} \text{ Contains } Fe^{3+} : [Ar]3\,d^5 : t_{2g}^3e_g^2$$
$$[Ni(H_2O)_6]^{2+} \text{ Contains } Ni^{2+} : [Ar]3\,d^8 : t_{2g}^6e_g^2$$
$$[\,V(H_2O)_6]^{3+} \text{ Contains } V^{3+} : [Ar]3\,d^2 : t_{2g}^2e_g^0$$

Question 214

Match List-I with List-II.

List-I
(Transition metal ion) (Spin only magnetic moment (B.M.))
(A) Ti^{3+}
(I) 3.87
(B) V^{2+}
(II) 0.00
(C) Ni^{2+}
(III) 1.73
(D) Sc^{3+}
(IV) 2.84

Choose the correct answer from the options given below:

A. (A)-(III), (B)-(I), (C)-(II), (D)-(IV)

B. (A)-(III), (B)-(I), (C)-(IV), (D)-(II)

C. (A)-(IV), (B)-(II), (C)-(III), (D)-(I)

D. (A)-(II), (B)-(IV), (C)-(I), (D)-(III)

Correct answer: B

Source solution

Sol. $\mathrm{Sc}^{+3} = 3\,\mathrm{d}^{\circ}$
$\therefore \mu_{\text{spin}} = 0$
$\mathrm{V}^{+2} = 3\,\mathrm{d}^{3}$
$\therefore \mu_{\text{spin}} = 3.87$ B.M.
$\mathrm{Ni}^{+2} = 3\,\mathrm{d}^{8}$
$\therefore \mu_{\text{spin}} = 2.84$ B.M.
$\mathrm{Ti}^{+3} = 3\,\mathrm{d}^{1}$
$\therefore \mu_{\text{spin}} = 1.73$ B.M.

Coordination Compounds

Questions 215-229 / 15 selected / 5.0% practice weight / Focus first

Question 215

Match the metals (Column I) with the coordination compound(s) / enzyme(s) (Column II)

Column-I}
Metals}
(A) Co
(B) Zn
(C) Rh
(D) Mg

Column-II}
Coordination}
compound(s) / Enzyme(s)(i) Wilkinson catalyst
(ii) Chlorophyll
(iii) Vitamin $\mathbf{B_{12}}$
(iv) Carbonic anhydrase

A. A-ii ; B-i ; C-iv ; D-iii

B. A-iii ; B-iv ; C-i ; D-ii

C. A-iv ; B-iii ; C-i ; D-ii

D. A-i ; B-ii ; C-iii ; D-iv

Correct answer: B

Source solution

$$\textbf{Column I (Metals) and Column II (Compounds/Enzymes)}$$

$$\textbf{(A) Co} \rightarrow \text{Vitamin } B_{12} \text{ (iii)}$$

$$\textbf{(B) Zn} \rightarrow \text{Carbonic anhydrase (iv)}$$

$$\textbf{(C) Rh} \rightarrow \textbf{Wilkinson catalyst (i)}$$

$$\textbf{(D) Mg} \rightarrow \textbf{Chlorophyll (ii)}$$

\vspace{0.4cm}

$$\boxed{A \rightarrow iii, \quad B \rightarrow iv, \quad C \rightarrow i, \quad D \rightarrow ii}$$

Question 216

The d-electron configuration of $[\mathrm{Ru(en)_3}]\mathrm{Cl_2}$ and $[\mathrm{Fe(H_2O)_6}]\mathrm{Cl_2}$, respectively are:

A. $t_{2g}^4 e_g^2$ and $t_{2g}^6 e_g^0$

B. $t_{2g}^6 e_g^0$ and $t_{2g}^6 e_g^0$

C. $t_{2g}^4 e_g^2$ and $t_{2g}^4 e_g^2$

D. $t_{2g}^6 e_g^0$ and $t_{2g}^4 e_g^2$

Correct answer: D

Source solution

$$\left[\mathrm{Fe}^{2+}(\mathrm{en})_3\right]^{2+} \rightarrow t_{2g}^6 e_g^0 \quad \text{(low spin)}$$

$$\left[\mathrm{Fe(H_2O)_6}\right]^{2+} \rightarrow t_{2g}^4 e_g^2 \quad \text{(high spin)}$$

$$\boxed{(4)\ t_{2g}^6 e_g^0 \text{ and } t_{2g}^4 e_g^2}$$

Question 217

Identify the diamagnetic octahedral complex ions from below ;

A. $[\mathrm{Mn(CN)_6}]^{3-}$

B. $[\mathrm{Co(NH_3)_6}]^{3+}$

C. $[\mathrm{Fe(CN)_6}]^{4}$

D. $[\mathrm{Co(H_2O)_3\ F_3}]$

Choose the correct answer from the options given below:

A. B and D Only

B. A and D Only

C. A and C Only

D. B and C Only

Correct answer: D

Source solution

$$\mathrm{A.\ [Mn(CN)_6]^{3-}}$$

Oxidation state of Mn:

$$x + 6(-1) = -3$$

$$x = +3$$

$$\mathrm{Mn^{3+}} : 3d^4$$

$\mathrm{CN^-}$ is a strong field ligand, so the complex is low spin:

$$t_{2g}^4 e_g^0$$

It contains $\mathbf{2}$ unpaired electrons.

$$\therefore \textbf{Paramagnetic}$$

$$\textbf{B. } [\mathrm{Co(NH_3)_6}]^{3+}$$

Oxidation state of Co:

$$\mathrm{Co}^{3+} : 3d^6$$

$\mathbf{NH_3}$ acts as a sufficiently strong field ligand with Co^{3+}.

$$t_{2g}^6 e_g^0$$

No unpaired electrons.

$$\therefore \textbf{Diamagnetic}$$

$$\textbf{C. } [\mathrm{Fe(CN)_6}]^{4-}$$

Oxidation state of Fe:

$$x + 6(-1) = -4$$

$$x = +2$$

$$\mathrm{Fe}^{2+} : 3d^6$$

CN^- is a strong field ligand.

$$t_{2g}^6 e_g^0$$

No unpaired electrons.

$$\therefore \text{Diamagnetic}$$

$$\text{D. } [\mathrm{Co(H_2O)_3F_3}]$$

Both $\mathrm{H_2O}$ and F^- are weak field ligands.

Assuming Co is in the +3 oxidation state,

$$\mathrm{Co}^{3+} : 3d^6$$

High-spin configuration:

$$t_{2g}^4 e_g^2$$

contains 4 unpaired electrons.

$$\therefore \text{Paramagnetic}$$

Diamagnetic complexes are B and C only.

Question 218

Match list I with List II

\multirow{2}{*}{LIST I Coordination entity}		\multirow{2}{*}{ LIST II Wavelength of light absorbed in nm }	
A.	$[CoCl(NH_3)_5]^{2+}$	I.	310
B.	$[Co(NH_3)_6]^{3+}$	II.	475
C.	$[Co(CN)_6]^{3-}$	III.	535
D.	$[Cu(H_2O)_4]^{2+}$	IV.	600

Choose the correct answer from the options given below:

A. A-III, B-I, C-II, D-IV

B. A-IV, B-I, C-III, D-II

C. A-III, B-II, C-I, D-IV

D. A-II, B-III, C-IV, D-I

Correct answer: C

Source solution

$\Delta_o \uparrow \lambda \downarrow$

$$(\text{splitting energy } = \frac{hc}{\lambda_{abs}})$$

Question 219

Given following complexes:

I. $\mathbf{Na_4\,[Fe(CN)_6]}$

II. $\mathbf{[Cr(H_2O)_6]Cl_2}$

III. $\mathbf{(NEt_4)_2\,[CoCl_4]}$

IV. $\mathbf{Na_3\,[Fe(C_2O_4)_3]\,(\Delta_0 > P)}$

The correct order of spin only magnetic moment for the above complexes

A. (II) > (II) > (IV) > (I)

B. (II) > (IV) > (III) > (I)

C. (I) > (III) > (III) > (II)

D. (II) > (I) > (IV) > (III)

Correct answer: A

Source solution

$$[\mathrm{Fe(CN)_6}]^{4-}$$

$$x + 6(-1) = -4 \Rightarrow x = +2$$

$$\mathrm{Fe^{2+}} : 3d^6$$

CN^- is strong field ligand → low spin octahedral

$$t_{2g}^6 e_g^0 \Rightarrow n = 0$$

$$\mu = \sqrt{0(0+2)} = 0$$

\vspace{0.3cm}

\section*{II. } [\mathrm{Cr(H_2O)_6}]Cl_2

$$[\mathrm{Cr(H_2O)_6}]^{2+}$$

$$x = +2 \Rightarrow \mathrm{Cr}^{2+} : 3d^4$$

H_2O is weak field ligand → high spin octahedral

$$t_{2g}^3 e_g^1 \Rightarrow n = 4$$

$$\mu = \sqrt{4(4+2)} = \sqrt{24} \approx 4.9\,\mathrm{B.M.}$$

\vspace{0.3cm}

\section*{III. } (\mathrm{NEt_4})_2[\mathrm{CoCl_4}]

$$[\mathrm{CoCl_4}]^{2-}$$

$$x + 4(-1) = -2 \Rightarrow x = +2$$

$$\mathrm{Co}^{2+} : 3d^7$$

Tetrahedral complex with weak field ligand → high spin

$$n = 3$$

$$\mu = \sqrt{3(3+2)} = \sqrt{15} \approx 3.87\,\mathrm{B.M.}$$

\vspace{0.3cm}

\section*{IV. } \mathrm{Na_3[Fe(C_2O_4)_3]}

$$[\mathrm{Fe(C_2O_4)_3}]^{3-}$$

$$x + 3(-2) = -3 \Rightarrow x = +3$$

$$\mathrm{Fe}^{3+} : 3d^5$$

Given $\Delta_0 > P \Rightarrow$ low spin octahedral

$$t_{2g}^5 e_g^0 \Rightarrow n = 1$$

$$\mu = \sqrt{1(1+2)} = \sqrt{3} \approx 1.73\,\mathrm{B.M.}$$

\vspace{0.5cm}

\section*{Comparison of magnetic moments}

$$\mathrm{II}(4.9) > \mathrm{III}(3.87) > \mathrm{IV}(1.73) > \mathrm{I}(0)$$

\vspace{0.3cm}

$$\boxed{\text{Final Order: II} > \text{III} > \text{IV} > \text{I}}$$

Question 220

	List-I (Complex)		List-II (Primary, Secondary Valency)
A	$[Co(NH_3)_6]Cl_3$	I	3, 6
B	$[Pt(NH_3)_2Cl(NO_2)]$	II	3, 4
C	$Hg[Co(SCN)_4]$	III	2, 6
D	$[Mg(EDTA)]^{2-}$	IV	2, 4

A. (A)-(III), (B)-(I), (C)-(II), (D)-(IV)

B. (A)-(I), (B)-(IV), (C)-(II), (D)-(III)

C. (A)-(I), (B)-(III), (C)-(II), (D)-(IV)

D. (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

Correct answer: B

Source solution

$$\text{Primary valency} = \text{Oxidation state}$$

$$\text{Secondary valency} = \text{Coordination number}$$

$$\text{A. } [Co(en)_2Cl_2]Cl$$

$$\text{Primary valency} = 3, \qquad \text{Secondary valency} = 6$$

$$A \rightarrow \text{I}$$

$$\text{B. } [Pt(NH_3)_2Cl(NO_2)]$$

$$\text{Primary valency} = 2, \qquad \text{Secondary valency} = 4$$

$$B \rightarrow \text{IV}$$

$$\text{C. } \text{Hg}\left[\text{Co}(\text{SCN})_4\right]$$

$$\text{Primary valency} = 3, \qquad \text{Secondary valency} = 4$$

$$C \rightarrow \text{II}$$

$$\text{D. } [\text{Mg}(\text{EDTA})]^{2-}$$

$$\text{Primary valency} = 2, \qquad \text{Secondary valency} = 6$$

$$D \rightarrow \text{III}$$

$$\boxed{A - \text{I},\ B - \text{IV},\ C - \text{II},\ D - \text{III}}$$

Question 221

Given below are two statements :

Statement I : $[Mn(CN)_6]^{3-}$, $[Fe(CN)_6]^{3-}$ and $[Co(C_2O_4)_3]^{3-}$ are d^2sp^3 hybridised.
Statement II : $[MnCl_6]^{3-}$ and $[FeF_6]^{3-}$ are paramagnetic and have 4 and 5 unpaired electrons, respectively.
In the light of the above statements, choose the correct answer from the options given below :

A. Statement I is correct but statement II is false

B. Both statement I and statement II are false

C. Statement I is incorrect but statement II is true

D. Both statement I and statement II are are true

Correct answer: D

Source solution

$$[Mn(CN)_6]^{3-},\ [Fe(CN)_6]^{3-},\ [Co(C_2O_4)_3]^{3-}$$

Oxidation states:

$$Mn^{3+} : d^4, \quad Fe^{3+} : d^5, \quad Co^{3+} : d^6$$

CN^- and C_2O_4^{2-} are strong field ligands $\Rightarrow$ low spin octahedral complexes

$$\Rightarrow d^2sp^3 \text{ hybridisation for all three complexes}$$

$$\therefore \text{Statement I is TRUE}$$

Statement II:

$$[MnCl_6]^{3-} \Rightarrow Mn^{3+} : d^4$$

Cl^- is weak field ligand $\Rightarrow$ high spin $\Rightarrow$ 4 unpaired electrons

$$[FeF_6]^{3-} \Rightarrow Fe^{3+} : d^5$$

F^- is weak field ligand $\Rightarrow$ high spin $\Rightarrow$ 5 unpaired electrons

$\therefore$ Statement II is TRUE

Both Statement I and Statement II are correct

Question 222

LIST-I	Complex	LIST-II	Hybridisation
A	$K_2[Ni(CN)_4]$	I	sp^3
B	$[Ni(CO)_4]$	II	sp^3d^2
C	$[Co(NH_3)_6]Cl_3$	III	dsp^2
D	$Na_3[CoF_6]$	IV	d^2sp^3

Choose the correct answer from the options given below:

A. A-III, B-I, C-II, D-IV

B. A-III, B-II, C-IV, D-I

C. A-I, B-III, C-II, D-IV

D. A-III, B-I, C-IV, D-II

Correct answer: D

Source solution

$$\textbf{(A) } K_2[Ni(CN)_4]$$

$$Ni^{2+} : [Ar]\, 3d^8$$

CN^- is a strong field ligand → pairing occurs

$$3d \text{ electrons pair up}$$

$$\text{Hybridisation: } dsp^2$$

$$\text{Geometry: Square planar}$$

\vspace{0.4cm}

(B) $[Ni(CO)_4]$

Ni : $[Ar]\,3d^8 4s^2$

CO is a strong field ligand → pairing occurs

Pre-hybridisation: $3d^{10}$

Hybridisation: sp^3

Geometry: Tetrahedral

\vspace{0.4cm}

(C) $[Co(NH_3)_6]Cl_3$

Co^{3+} : $[Ar]\,3d^6$

NH_3 acts as a strong field ligand with Co^{3+} → low spin complex

$t_{2g}^6 e_g^0$

Hybridisation: d^2sp^3

Geometry: Octahedral (inner orbital complex)

\vspace{0.4cm}

(D) $\mathrm{Na_3[CoF_6]}$

$$\mathrm{Co^{3+}} : [Ar]\, 3d^6$$

F^- is a weak field ligand → no pairing

$$t_{2g}^4 e_g^2$$

Hybridisation: sp^3d^2

Geometry: Octahedral (outer orbital complex)

Question 223

Identify the CORRECT set of details from the following :

A. $[Co(NH_3)_6]^{3+}$: Inner orbital complex ; d^2sp^3 hybridized

B. $[MnCl_6]^{3-}$ Outer orbital complex; $sp^3\ d^2$ hybridized

C. $[CoF_6]^3$: Outer orbital complex ; d^2sp^3 hybridized

D. $[FeF_6]^{3-}$: Outer orbital complex: $sp^3\ d^2$ hybridized

E. $[Ni(CN)]^{2-}$: Inner orbital complex ; sp^3 hybridized

Choose the correct answer from the options given below:

A. C & D only

B. A, B & D only

C. A, C & E only

D. A, B, C, D & E

Correct answer: B

Source solution

(A) $Co^{3+} : -3\ d^6$

$NH_3 \Rightarrow$ S.F.L

Hybridisation $\Rightarrow d^2sp^3$, Inner orbital complex

(B) $Mn^{3+} : -3\ d^4$

$Cl^- \Rightarrow$ W.F.L

Hybridisation $\Rightarrow sp^3\ d^2$, Outer orbital complex

(C) $Co^{3+} : -3\ d^6$

$F^- \Rightarrow$ W.F.L

Hybridisation $\Rightarrow sp^3\ d^2$, Outer orbital complex

(D) $Fe^{3+} : -3\ d^5$

$F^- \Rightarrow$ W.F.L

Hybridisation $\Rightarrow sp^3\ d^2$, Outer orbital complex

(E) $Ni^{2+} : -3\ d^8$

$CN^- \Rightarrow$ S.F.L

Hybridisation $\Rightarrow dsp^2$, Inner orbital complex

Question 224

List I (Complex)	List II (Hybridisation)
$(A)\ [\mathrm{CoF_6}]^{3-}$	$(I)\ d^2sp^3$
$(B)\ [\mathrm{NiCl_4}]^{2-}$	$(II)\ sp^3$
$(C)\ [\mathrm{Co(NH_3)_6}]^{3+}$	$(III)\ sp^3d^2$
$(D)\ [\mathrm{Ni(CN)_4}]^{2-}$	$(IV)\ dsp^2$

A. (A)-(I), (B)-(IV), (C)-(III), (D)-(II)

B. (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

C. (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

D. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

Correct answer: B

Source solution

$$(A)\ [\mathrm{CoF_6}]^{3-}$$

$$\mathrm{Co^{3+}}: d^6,\ F^- \text{ weak field} \Rightarrow \text{octahedral high spin} \Rightarrow sp^3d^2 \Rightarrow (III)$$

$$(B)\ [\mathrm{NiCl_4}]^{2-}$$

$$\mathrm{Ni^{2+}}: d^8,\ Cl^- \text{ weak field} \Rightarrow \text{tetrahedral} \Rightarrow sp^3 \Rightarrow (II)$$

$$(C)\ [\mathrm{Co(NH_3)_6}]^{3+}$$

$$\mathrm{Co^{3+}}: d^6,\ NH_3 \text{ strong field} \Rightarrow \text{inner orbital complex} \Rightarrow d^2sp^3 \Rightarrow (I)$$

$$(D)\ [\mathrm{Ni(CN)_4}]^{2-}$$

$$\mathrm{Ni^{2+}}: d^8,\ CN^- \text{ strong field} \Rightarrow \text{square planar} \Rightarrow dsp^2 \Rightarrow (IV)$$

Final Matching:

$$\boxed{A \to III,\ B \to II,\ C \to I,\ D \to IV}$$

Question 225

Given below are two statements:

Statement I: The hybridisation, shape and spin-only magnetic moment of $K_3[Co(CO_3)_3]$ are sp^3d^2, octahedral and $4.9\,BM$, respectively.

Statement II: The geometry, hybridisation and spin-only magnetic moment (BM) of the ions $[Ni(CN)_4]^{2-}$, $[MnBr_4]^{2-}$ and $[CoF_6]^{3-}$ are square planar, tetrahedral and octahedral; dsp^2, sp^3 and sp^3d^2; and 0, 5.9 and 4.9, respectively.

In the light of the above statements, choose the correct answer from the options given below.

A. Both statement-I and statement-II are false

B. Statement I is false but statement-II is true

C. Both statement-I and statement-II are true

D. Statement-I is true but statement-II is false

Correct answer: C

Source solution

In $K_3\,[Co(CO_3)_3] \Rightarrow sp^3\,d^2$ hybridized, octahedral

$\Rightarrow 4$ unpaired electron

$\Rightarrow 4.9$ B. M.

$[Ni(CN)_4]^{2-} \Rightarrow dsp^2$ hybridized, square planar

$\Rightarrow 0$ unpaired electron

$\Rightarrow 0$ B.M.

$[MnBr_4]^{2-} \Rightarrow sp^3$ hybridized , tetrahedral

$\Rightarrow 5$ unpaired electron

$\Rightarrow 5.9$ B.M.

$[CoF_6]^{3-} \Rightarrow sp^3\,d^2$ hybridized, octahedral

$\Rightarrow 4$ unpaired electron

$\Rightarrow 4.9$ B.M.

Question 226

Match List I with List II

LIST-I

(Substances)
A.Ziegler catalyst
B.Blood Pigment
C.Wilkinson catalyst
D.Vitamin $\mathbf{B_{12}}$

LIST-II

(Element Present)
I.Rhodium
II. Cobalt
III.Iron
IV.Titanium

Choose the correct answer from the options given below:

A. A-II, B-IV, C-I, D-III

B. A-II, B-III, C-IV, D-I

C. A-III, B-II, C-IV, D-I

D. A-IV, B-III, C-I, D-II

Correct answer: D

Source solution

Ziegler catalyst $\rightarrow$ Titanium
Blood pigment $\rightarrow$ Iron
Wilkinson catalyst $\rightarrow$ Rhodium
Vitamin $\mathbf{B_{12}} \rightarrow$ Cobalt

TEST PAPER WITH SOLUTION

Question 227

Match the LIST-I with LIST-II

LIST-I (Complex/Species)		LIST-II (Shape & magnetic moment)	
A.	$[Ni(CO)_4]$	I.	Tetrahedral, 2.8 BM
B.	$[Ni(CN)_4]^{2-}$	II.	Square planar, 0 BM
C.	$[NiCl_4]^{2-}$	III.	Tetrahedral, 0 BM
D.	$[MnBr_4]^{2-}$	IV	Tetrahedral, 5.9 BM

Choose the correct answer from the options given below :

A. A-III, B-IV, C-II, D-I

B. A-I, B-II, C-III, D-IV

C. A-III, B-II, C-I, D-IV

D. A-IV, B-I, C-III, D-II

Correct answer: C

Source solution

$$\textbf{A. } [Ni(CO)_4]$$

Ni is in 0 oxidation state: $3d^8 4s^2 \rightarrow d^{10}$ (after bonding picture), CO is strong field → tetrahedral, diamagnetic

$$\boxed{A \rightarrow III}$$

\vspace{0.3cm}

B. $[Ni(CN)_4]^{2-}$

Ni^{2+} = $3d^8$, CN^- strong field → square planar, all paired

$$\boxed{B \to II}$$

\vspace{0.3cm}

C. $[NiCl_4]^{2-}$

Cl^- weak field → tetrahedral, 2 unpaired electrons

$$\mu \approx 2.8 \text{ BM}$$

$$\boxed{C \to I}$$

\vspace{0.3cm}

D. $[MnBr_4]^{2-}$

Mn^{2+} = $3d^5$, tetrahedral high spin → 5 unpaired electrons

$$\mu \approx 5.9 \text{ BM}$$

$$\boxed{D \to IV}$$

\vspace{0.4cm}

$$\boxed{A \to III, \quad B \to II, \quad C \to I, \quad D \to IV}$$

Question 228

Match List-I with List-II.

List-I (Complex)

(A) $[CoF_6]^{3-}$
(B) $[NiCl_4]^{2-}$
(C) $[Co(NH_3)_6]^{3+}$
(D) $[Ni(CN)_4]^{2-}$

List-II
(Hybridisation of central metal ion)
(I) d^2sp^3
(II) sp^3
(III) $sp^3\ d^2$
(IV) dsp^2

Choose the correct answer from the options given below:

A. -(I), (B)-(IV), (C)-(III), (D)-(II)

B. (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

C. (A)-(I), (B)-(II), (C)-(III), (D)-(IV)

D. (A)-(III), (B)-(IV), (C)-(I), (D)-(II)

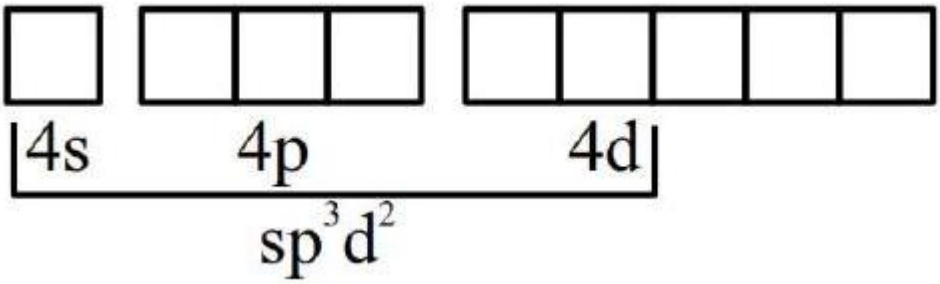
Correct answer: B

Source solution

(A) $[CoF_6]^{-3}$

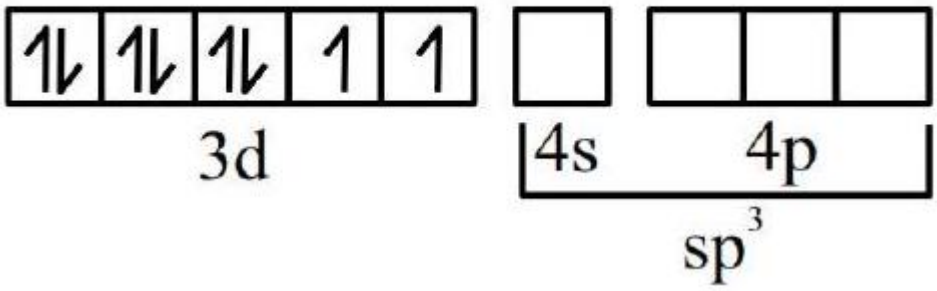
[

]



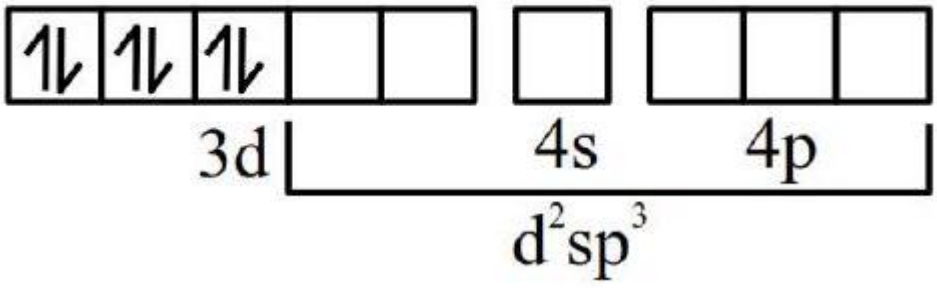
(B) $[NiCl_4]^{2-}$

$$Ni^{2+} \rightarrow 3d^8$$



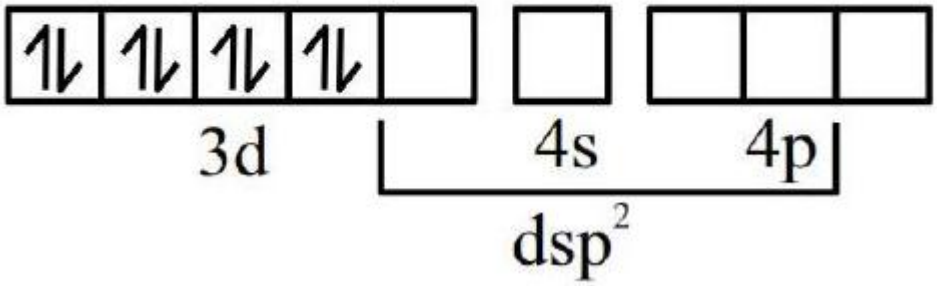
(C) $[Co(NH_3)_6]^{3+}$

$$Co^{3+} \rightarrow 3d^6$$



(D) $[Ni(CN)_4]^{2-}$

$$Ni^{2+} \rightarrow 3d^8$$



dsp^2

Question 229

Match List - I with List - II

List - I (Complex)	**List - II** (Hybridization)
(A) $Ni(CO)_4$	(I) sp^3
(B) $[Ni(CN)_4]^{2-}$	(II) sp^3d^2
(C) $[Co(CN)_6]^{3-}$	(III) d^2sp^3
(D) $[CoF_6]^{3-}$	(IV) dsp^2

Choose the correct answer from the options given below.

A. A-IV, B-I, C-III, D-II

B. A-I. B-IV, C-III, D-II

C. A-I. B-IV, C-II, D-III

D. A-IV, B-I, C-II. D-III

Correct answer: B

Source solution

Step 1: Determine hybridisation based on ligand field strength and geometry

(A) $Ni(CO)_4$

$Ni^0 : d^{10}$ CO is strong field ligand

Geometry: tetrahedral $\Rightarrow sp^3$

$(A) \rightarrow (I)$

(B) $[Ni(CN)_4]^{2-}$

Ni^{2+} : d^8 CN^- strong field ligand

Geometry: square planar $\Rightarrow dsp^2$

$(B) \rightarrow (IV)$

(C) $[Co(CN)_6]^{3-}$

Co^{3+} : d^6 CN^- strong field ligand

Geometry: octahedral low spin $\Rightarrow d^2sp^3$

$(C) \rightarrow (III)$

(D) $[CoF_6]^{3-}$

Co^{3+} : d^6 F^- weak field ligand

Geometry: octahedral high spin $\Rightarrow sp^3d^2$

$(D) \rightarrow (II)$

Final Matching:

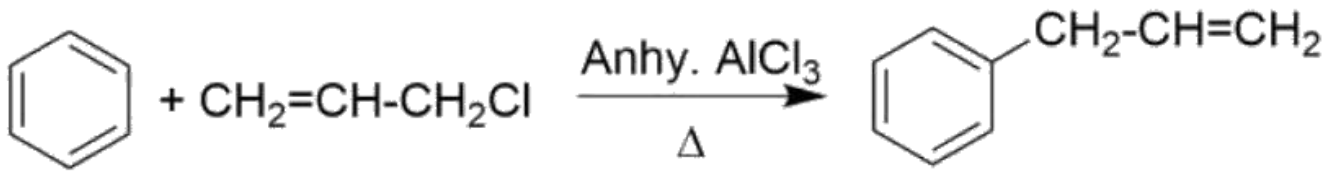
$$\boxed{A \rightarrow I,\ B \rightarrow IV,\ C \rightarrow III,\ D \rightarrow II}$$

Haloalkanes and Haloarenes

Questions 230-242 / 13 selected / 4.3% practice weight / Focus first

Question 230

Which of the following reactions are possible?



A. A, B, C

B. **B, D**

C. A, C, D

D. **A, C**

Correct answer: B

Source solution

Sol:}
In aryl halides, due to the partial double bond character generated by chlorine, the aryl cation is not formed.

Vinyl halides do not give Friedel-Crafts reaction, because the intermediate that is generated (vinyl cation) is not stable.

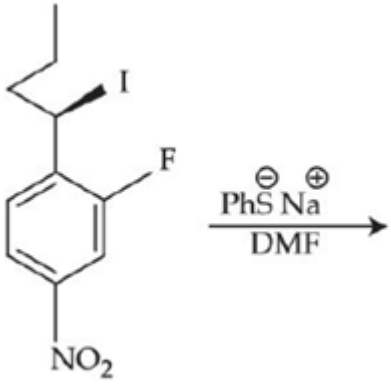
$H_2C=\overset{+}{C}H$

vinyl

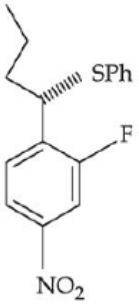
cation

Question 231

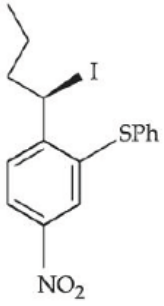
The major product of the following reaction is:



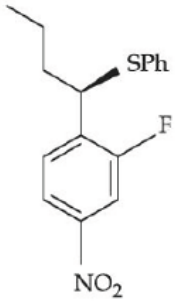
A.



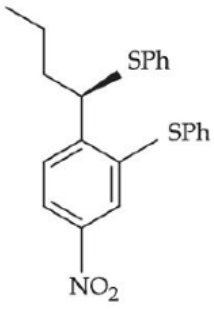
B.



C.



D.

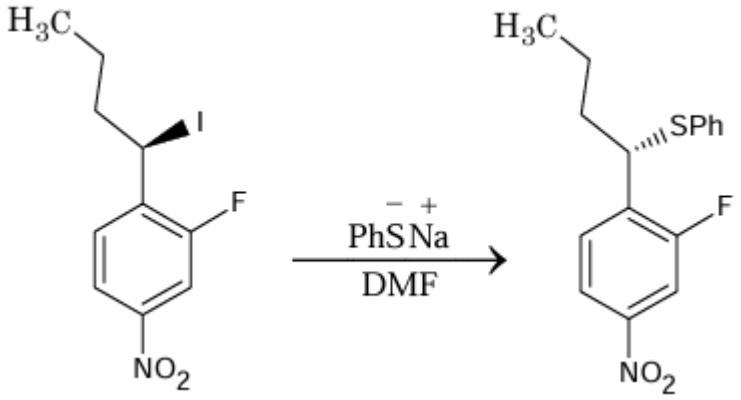


Correct answer: A

Source solution

Sol.

It is bimolecular nucleophilic substitution (SN^2) which occur at benzylic carbon by inversion in contiguration. This reaction cannot undergo substitution at benzene ring

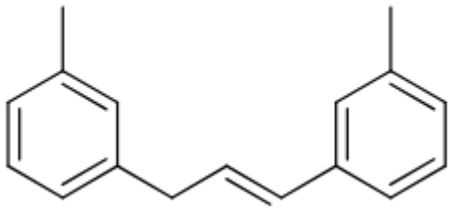

H3C
I
F
NO2
− +
PhSNa
DMF
H3C
SPh
F
NO2

Question 232

Match List-I with List-II

List-I Conversion		List-II Reagents, Conditions used
	(III)	(a) $\mathbf{NaOH, 443\ K}$; (b) $\mathbf{H_3O^+}$
(a) $\mathbf{NaOH, 623\ K}$, 300 atm ; (b) $\mathbf{H_3O}$		

Choose the correct answer from the options given below :



A. (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

B. (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

C. (A)-(IV), (B)-(III), (C)-(II), (D)-(I)

D. (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

Correct answer: C

Source solution

Sol. Aromatic halide give nucleophilic substitution reaction at high temperature or in presence of $-\mathbf{I}/-$ M group rate of reaction high even at low temperature.

A-IV

B-III

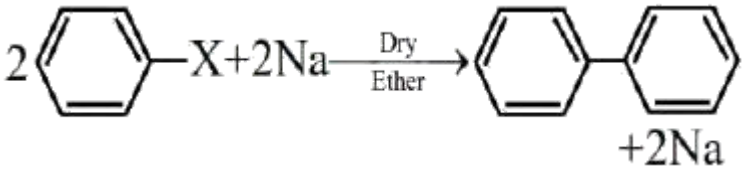
C-II
D-I

Question 233

Match List-I with List-II

List-I (Reaction)		List-II (Name of reaction)	
	(I)	Lucas reaction	
(B)	$ArN_2^+X^- \xrightarrow[HCl]{Cu} ArCl + N_2 \uparrow + CuX$	(II)	Finkelstein reaction
(C)	$C_2H_5Br + NaI \xrightarrow[Acctonc]{Dry} C_2H_5I + NaBr$	(III)	Fittig reaction
(D)	$CH_3C(OH)(CH_3)CH_3 \xrightarrow[ZnCl_2]{HCl} CH_3C(Cl)(CH_3)CH_3$	(IV)	Gatterman reaction

Choose the correct answer from the options given below:



A. (A)-(III), (B)-(II), (C)-(IV), (D)-(I)

B. (A)-(III), (B)-(IV), (C)-(II), (D)-(I)

C. (A)-(IV), (B)-(III), (C)-(I), (D)-(II)

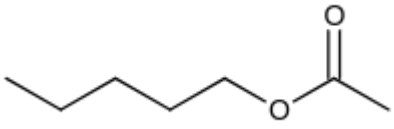
D. (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

Correct answer: B

Source solution

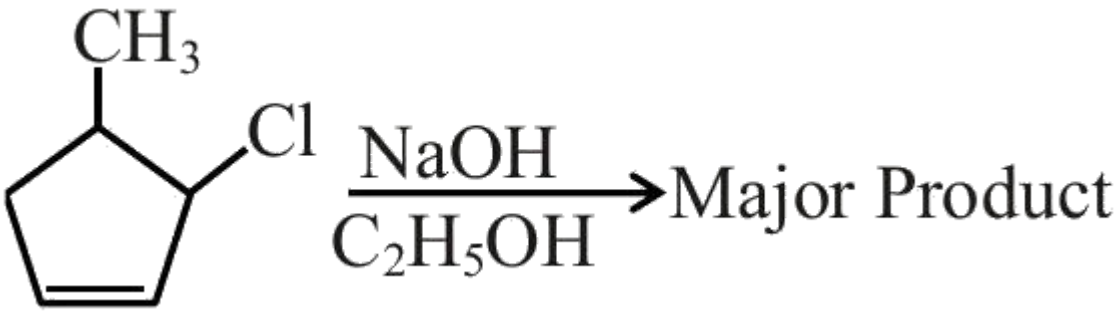
Sol.

List-I (Reaction)		List-II (Name of reaction)	
(B)	$\mathrm{ArN_2^+X^-} \xrightarrow[\mathrm{HCl}]{\mathrm{Cu}} \mathrm{ArCl + N_2 \uparrow + CuX}$	(IV)	Gatterman reaction
(C)	$\mathrm{C_2H_5Br + NaI} \xrightarrow[\mathrm{Acctone}]{\mathrm{Dry}} \mathrm{C_2H_5I + NaBr}$	(II)	Finkelstein reaction

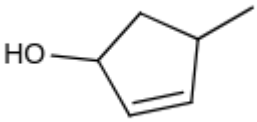


Question 234

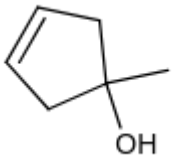
The major product of the following reaction is :



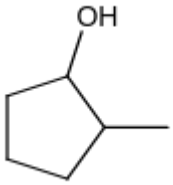
A.



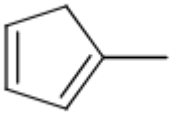
B.



C.



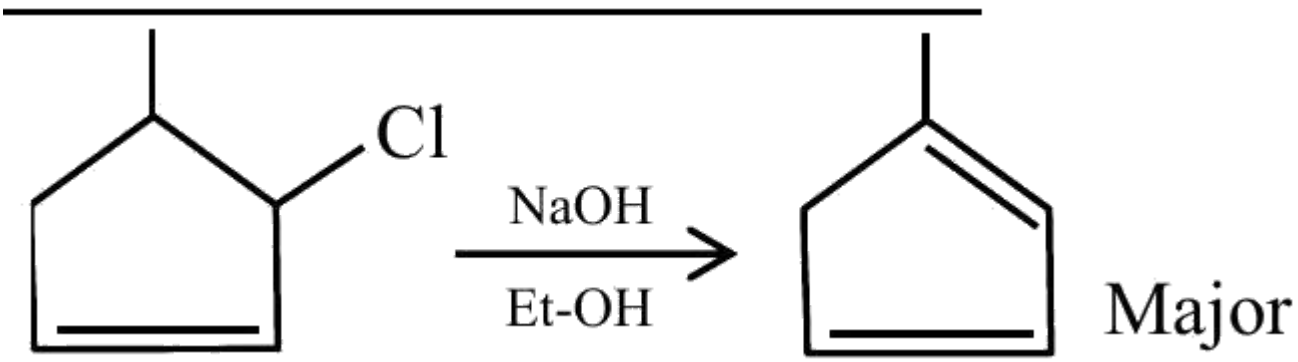
D.



Correct answer: C

Source solution

Sol. $\mathbf{NaOH + EtOH}$ is known as alcoholic NaOH , so it give $\mathbf{E^2}$ reaction with given alkyl halide.

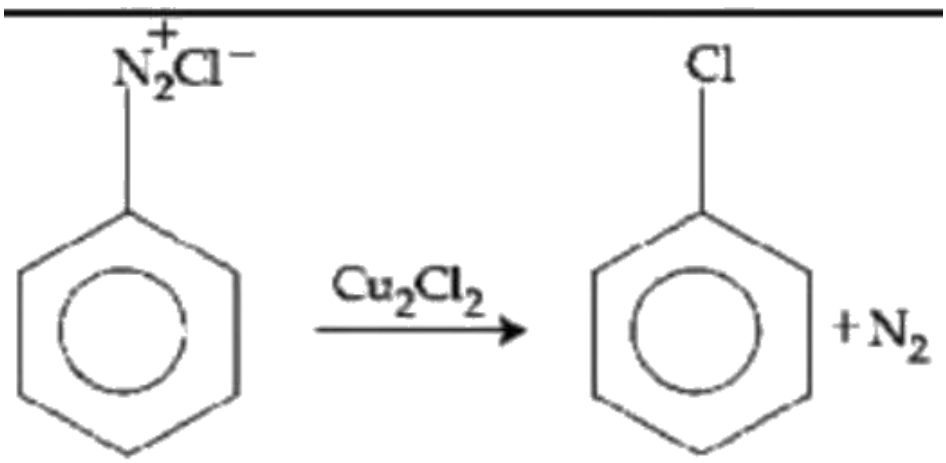


Question 235

Match List I with List II

LIST I			LIST II	
		I.	Fittig reaction	
	II.	Wurtz Fittig reaction		
	III.	Finkelstein reaction		
D.	$C_2H_5Cl + NaI \rightarrow C_2H_5I + NaCl$		IV.	Sandmeyer reaction

Choose the correct answer from the options given below:



A. A - II, B - I, C - IV, D - III

B. A - IV, B - II, C - III, D - I

C. A - III, B - II, C - IV, D - I

D. A - II, B - I, C - III, D - IV

Correct answer: A

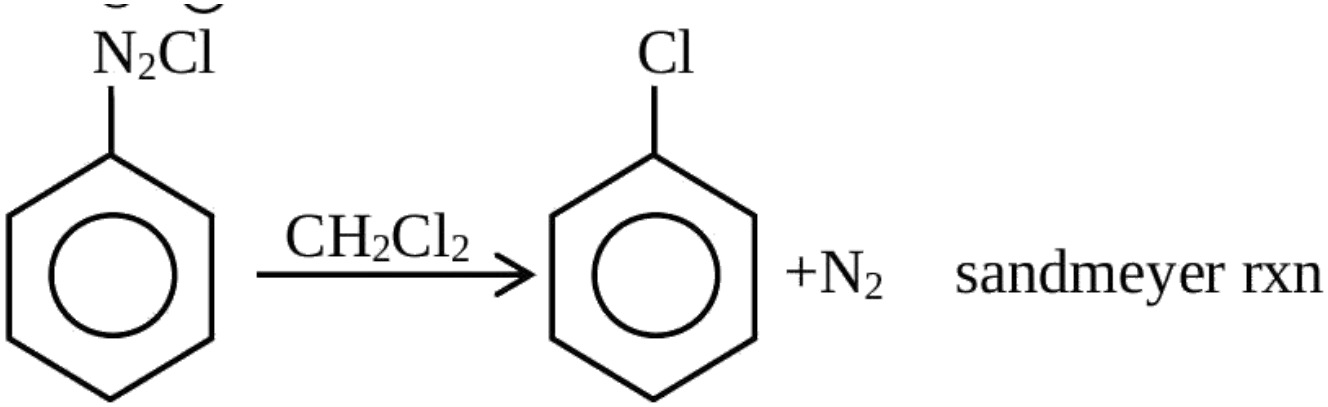
Source solution

Sol. 1
(A)

(B)

(C)

(D) $C_2H_5Cl + NaI \rightarrow C_2H_5I + NaCl$ Finkelstein rxn



Question 236

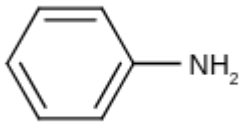
The increasing order of reactivity of the following compounds towards reaction with alkyl halides directly is :

(A)

(B)

(C)

(D)



A. $(B) < (A) < (D) < (C)$

B. (B) < (A) < (C) < (D)

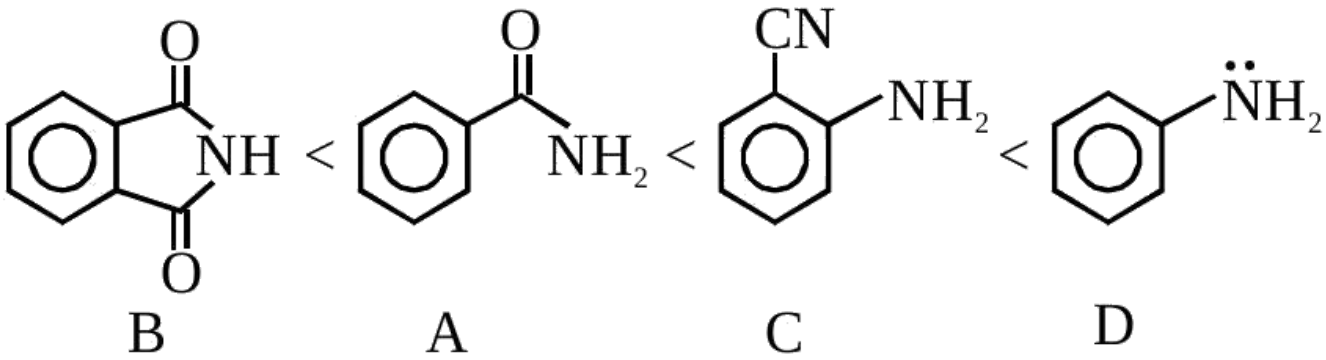
C. (A) < (C) < (D) < (B)

D. (A) < (B) < (C) < (D)

Correct answer: B

Source solution

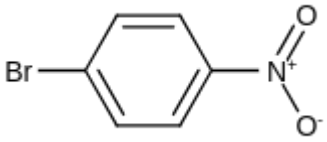
Sol. Nucleophilicity order



Question 237

Identify the correct order of reactivity for the following pairs towards the respective mechanism
(A)
(B)
(C) Electrophilic substitution
(D) Nucleophilic substitution

Choose the correct answer from the options given below:



A. (A), (B) and (D) only

B. (A), (B), (C) and (D)

C. (A), (C) and (D) only

D. (B), (C) and (D) only

Correct answer: B

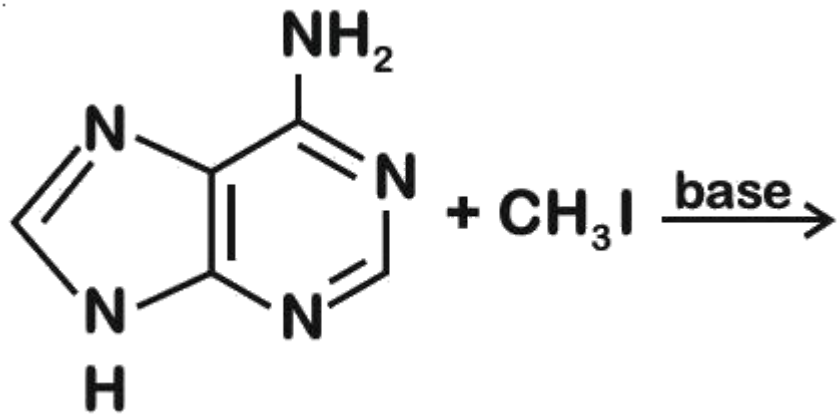
Source solution

Sol.}
All are correct
(A) S_N2 reaction decreases with increase in steric crowding.
(B) S_N1 reaction increases with stability of carbocation.
(C) EAS reaction decreases with decrease in electron density.
(D) Presence of electron withdrawing group at ortho and para-position to a halogen in haloarene increase nucleophilic aryl substitution.

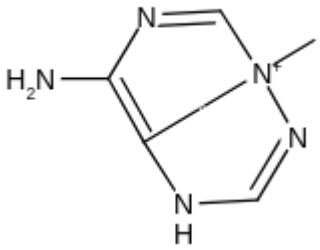
SECTION-B}

Question 238

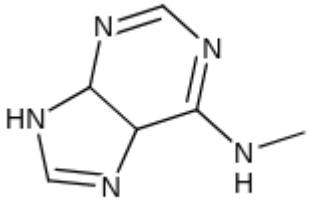
The major product in the following reaction is:



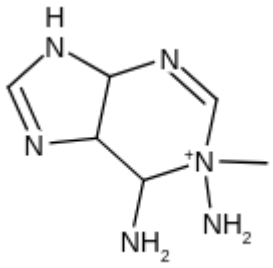
A.



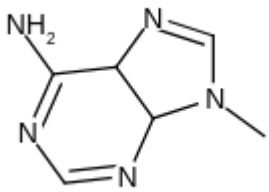
B.



C.



D.

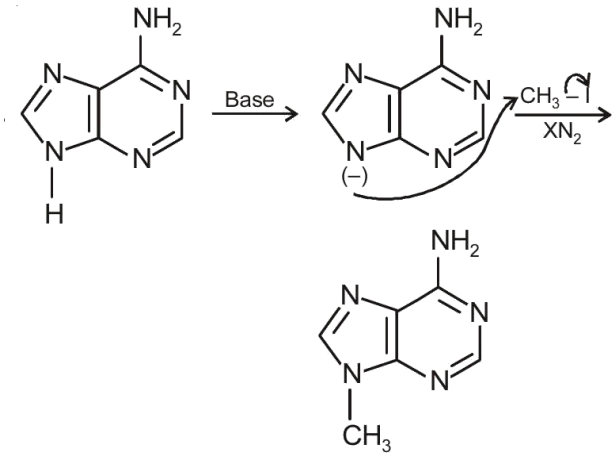


Correct answer: D

Source solution

Sol.

In the given compound, H -atom attached to secondary N -atom is more acidic. The base removes the more acidic H -atom and the conjugate base of the given compound attacks at CH_3 group to give the final product shown above.


NH2
N
N
N
H
Base
NH2
N
N
N
N
(–)
CH3 –I
XN2
NH2
N
N
N
N
CH3

Question 239

Match the LIST-I with LIST-II

LIST-I Name reaction		LIST-II Product obtainable	
A.	Swarts reaction	I.	Ethyl benzene
B.	Sandmeyer's reaction	II.	Ethyl iodide
C.	Wurtz Fittig reaction	III.	Cyanobenzene
D.	Finkelstein reaction	IV.	Ethyl fluoride

Choose the correct answer from the options given below:

A. A-II, B-III, C-I, D-IV

B. A-IV, B-I, C-III, D-II

C. A-IV, B-III, C-I, D-II

D. A-II, B-I, C-III, D-IV

Correct answer: C

Source solution

Sol. (3)

LIST-I Name reaction		LIST-II Product obtainable	
A.	Swarts reaction	I.	Et-I $\xrightarrow[\text{DMF}]{\text{KF}}$ Et-F
B.	Sandmeyer's reaction	II.	$\text{PhN}_2^{\oplus}\text{Cl}^- \xrightarrow{\text{CuCN/KCN}} \text{PhCN} + \text{N}_2$
C.	Wurtz Fittig reaction	III.	$\text{Ph} - \text{Cl} + \text{EtCl} \xrightarrow[\text{ether}]{\text{Na}}$ $\text{Ph} - \text{Et} + \text{Ph} - \text{Ph} + \text{Et} - \text{Et}$
D.	Finkelstein reaction	IV.	$\text{Et} - \text{Cl} \xrightarrow[\text{acetone}]{\text{NaI}} \text{Et} - \text{I} + \text{NaCl}$

Question 240

Match List I with List II

List I	List II
A.	I. Br_2 in CS_2
B.	II. $Na_2Cr_2O_7/H_2SO_4$
C.	III. Zn
D.	IV. $CHCl_3/NaOH$

Choose the correct answer from the options given below:

A. A-IV, B-III, C-II, D-I

B. A-IV, B-III, C-I, D-II

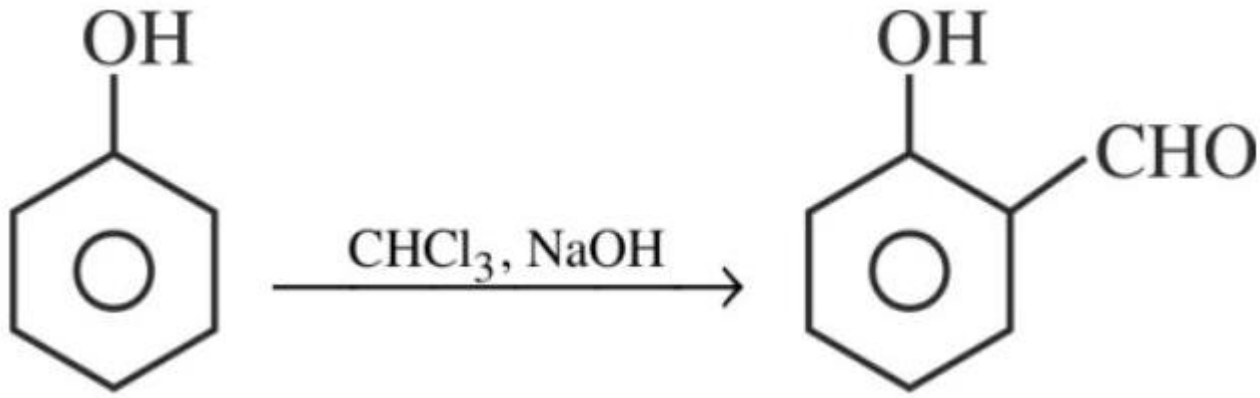
C. A-II, B-III, C-I, D-IV

D. A-IV, B-II, C-III, D-I

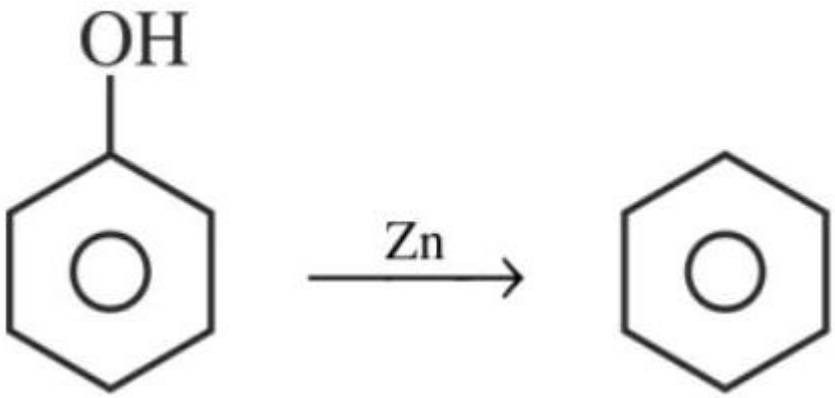
Correct answer: A

Source solution

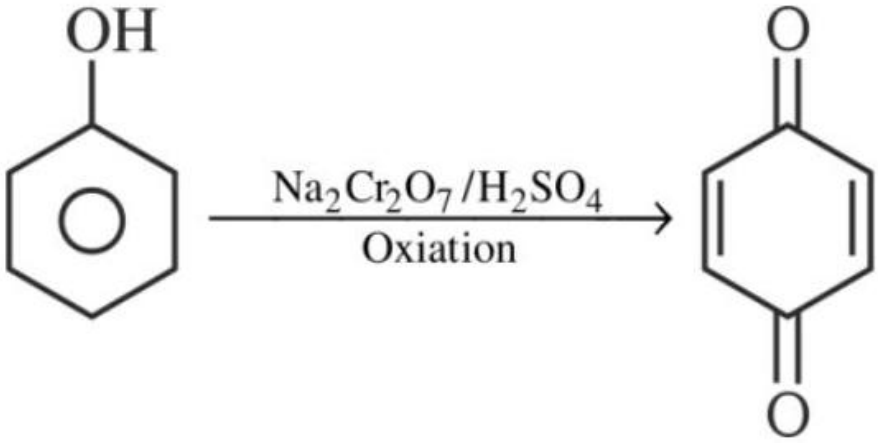
(A)



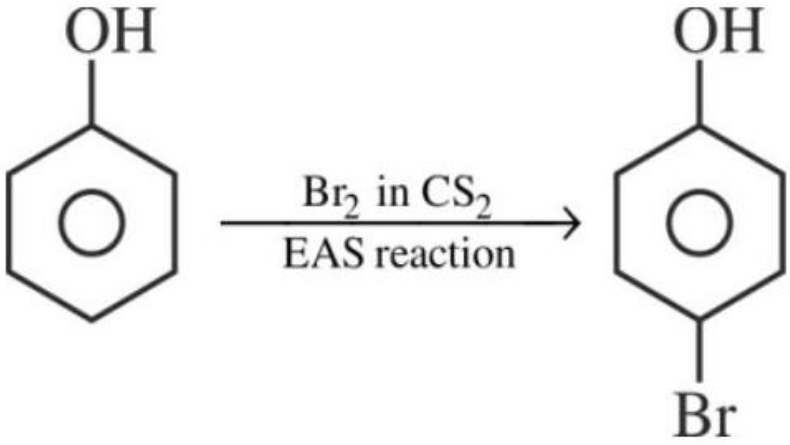
(B)


OH
Zn

(C)


OH
$Na_2Cr_2O_7/H_2SO_4$
Oxiation
O
O

(D)


OH
Br_2 in CS_2
EAS reaction
OH
Br

Question 241

Match List I with List II

List I Name of reaction		List II Reagent used	
A	Hell-VolhardZelinsky reaction	I.	$NaOH + I_2$
B	Iodoform reaction	II.	(i) CrO_2Cl_2, CS_2 (ii) H_2O
C	Etard reaction	III.	(i) $Br_2/$ red phosphorus (ii) H_2O
D	Gatterman-Koch reaction	IV.	CO, HCl, anhyd. $A1C1_3$

Choose the correct answer from the options given below:

A. A-III, B-II, C-I, D-IV

B. A-III, B-I, C-IV, D-II

C. A-I, B-II, C-III, D-IV

D. A-III, B-I, C-II, D-IV

Correct answer: D

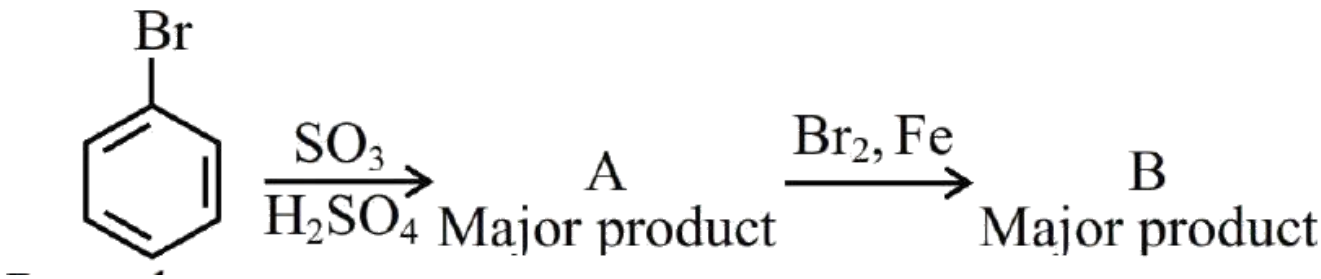
Source solution

Sol. HVZ reactions $= Br_2/$ red P
Iodoform reaction $= NaOH + I_2$
Etard reaction $=$ (i) CrO_2Cl_2, CS_2 (ii) H_2O
Gatterman-Koch Reaction = CO, HCl, Anhydrous, $AlCl_3$

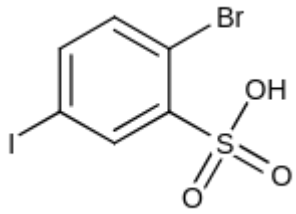
Question 242

In the following series of reactions identify the major products A & B respectively.

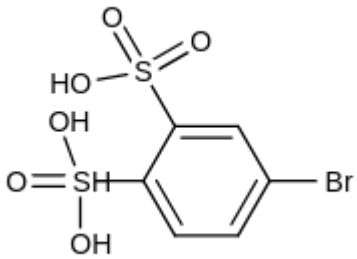
Bromobenzene



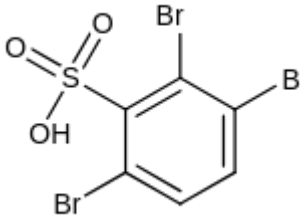
A.



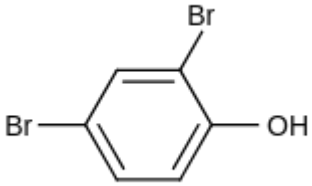
B.



C.



D.

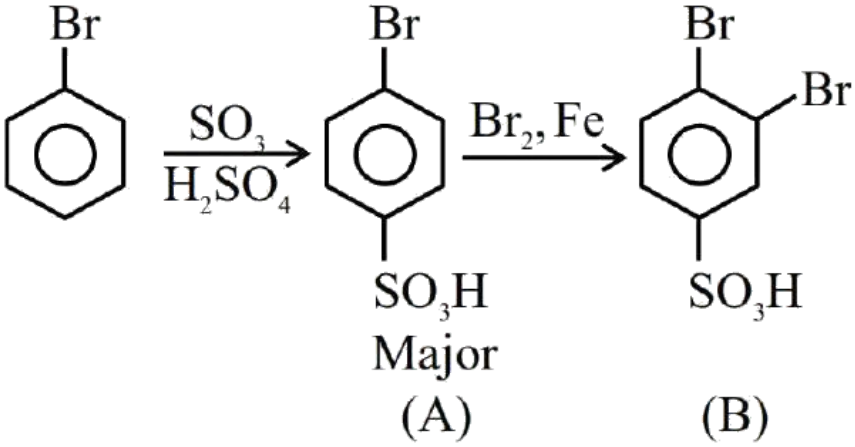


Correct answer: B

Source solution

Sol.

Both reactions are electrophilic substitution reaction, $\mathbf{I^{st}}$ is sulphonation and $\mathbf{II^{nd}}$ is halogenation :


Br
SO3
H2SO4
Br
SO3H
Major
(A)
Br2, Fe
Br
Br
SO3H
(B)

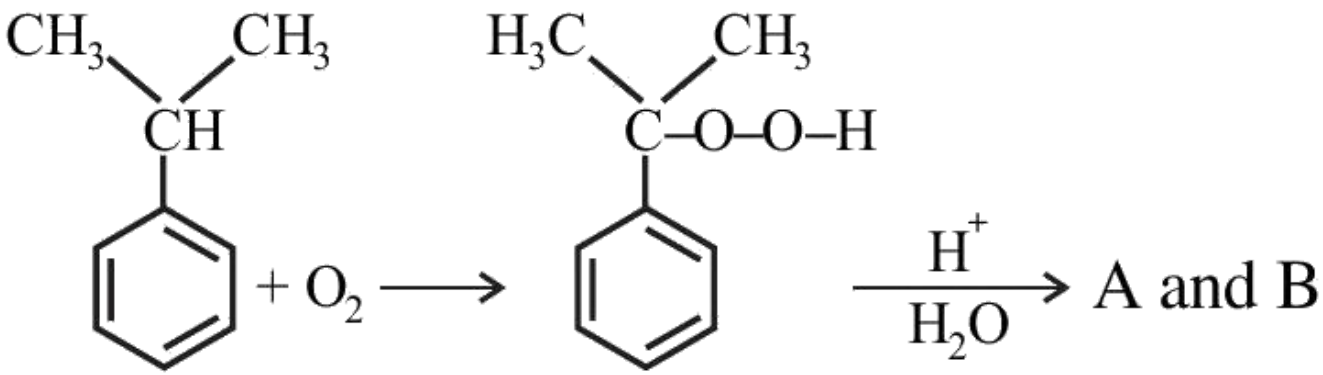
Alcohols, Phenols and Ethers

Questions 243-263 / 21 selected / 7.0% practice weight / Focus first

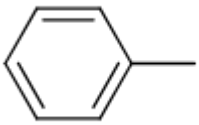
Question 243

In the following reaction:

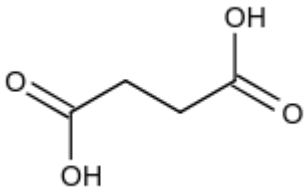
The compounds A and B respectively are :-



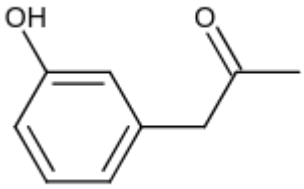
A.



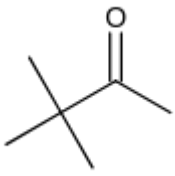
B.



C.



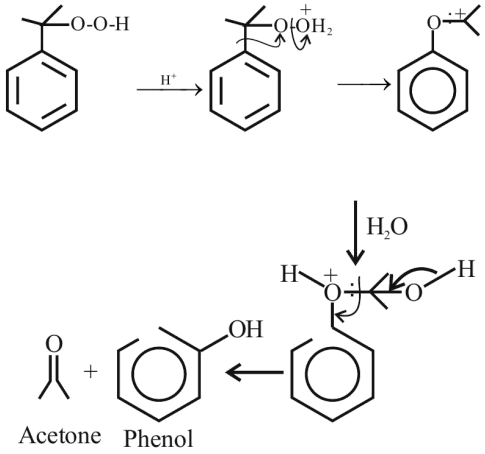
D.



Correct answer: C

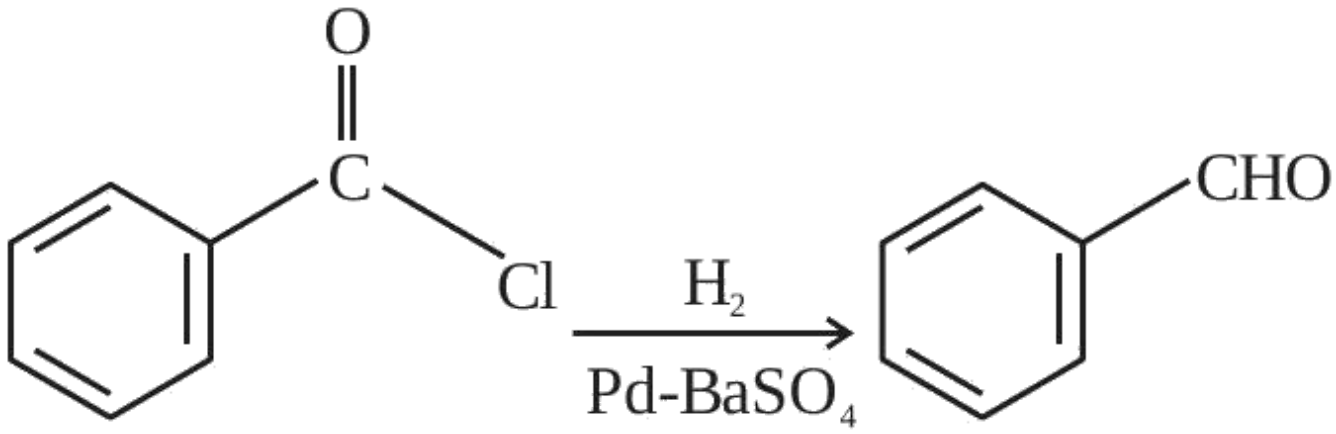
Source solution

Sol. Given reaction is cumene-Peroxide method for the preparation of phenol. In this reaction


O-O-H
H+
OH2
H2O
H
O
H
OH
O
+
Acetone
Phenol

Question 244

This reduction reaction is known as:



A. Rosenmund reduction

B. Wolff-Kishner reduction

C. Stephen reduction

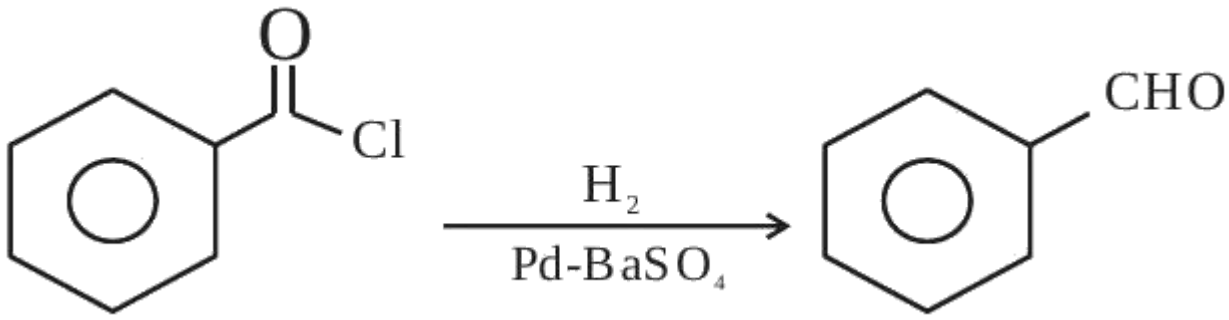
D. Etard reduction

Correct answer: A

Source solution

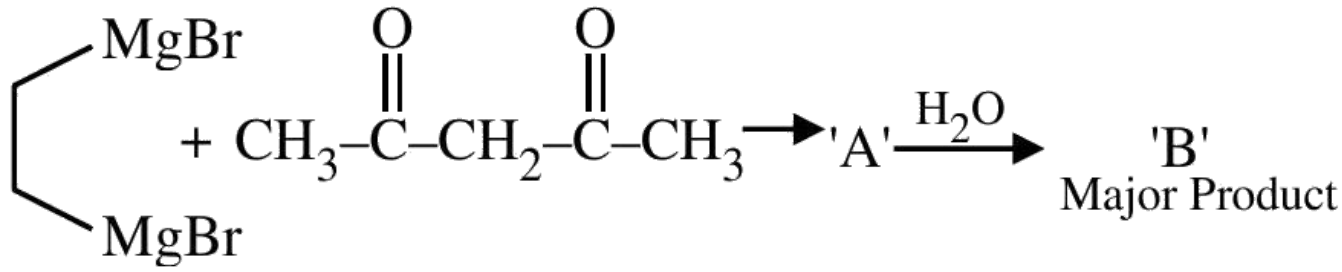
Sol.

It is known as rosenmund reduction that is the partial reduction of acid chloride to aldehyde

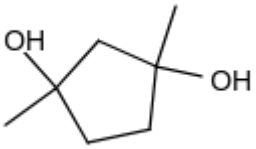


Question 245

Consider the above reaction sequence and identify the product B.



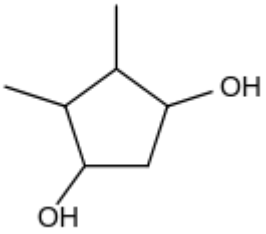
A.



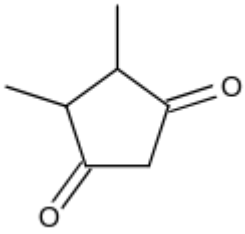
B.



C.



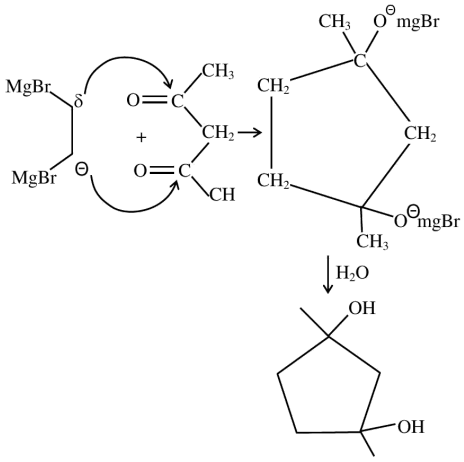
D.



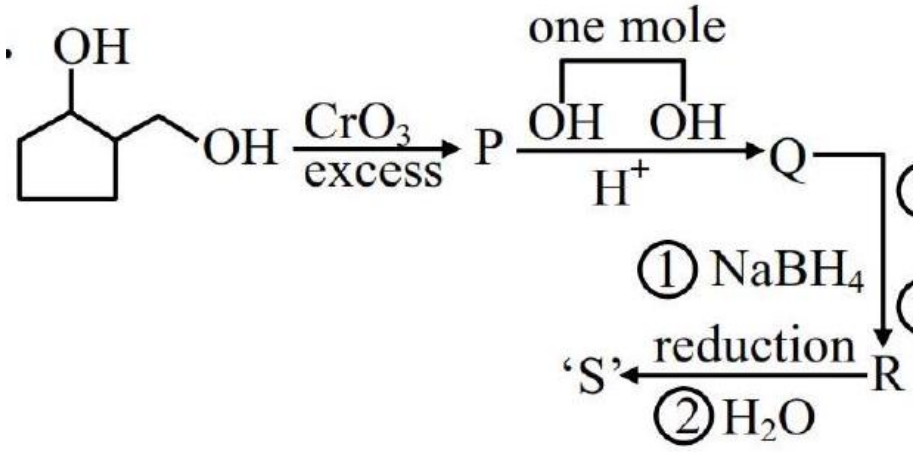
Correct answer: A

Source solution

Sol. Although Acetyl Acetone predominantly gives Acid base reaction with G.R due to Active methylene group but according to given option ans should be based on nucleophilic addition reaction (NAR).


MgBr
δ
MgBr
Θ
O
C
CH3
CH2
+
O
C
CH
CH3
O Θ mgBr
C
CH2
CH2
CH2
O Θ mgBr
CH3
H2O
OH
OH

Question 246



(1) CH_3Mg I in ether

(2) $H_3O^{(+)}$

0.1 mole of compound ' S ' will weigh g.

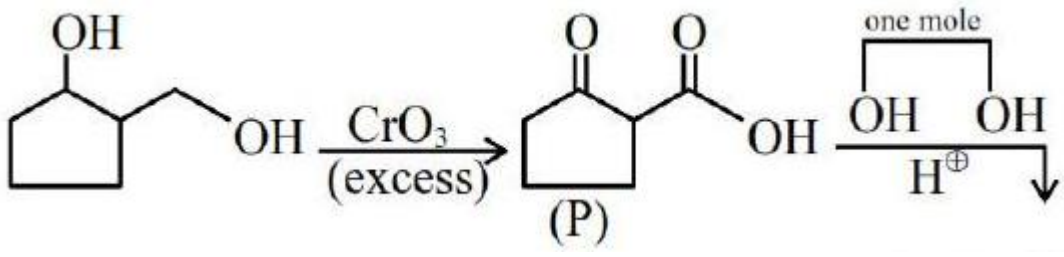
(Given molar mass in $gmol^{-1}$ $C : 12, H : 1, O : 16$)

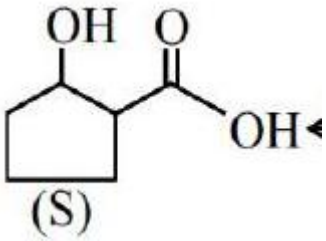
Numerical answer: _____

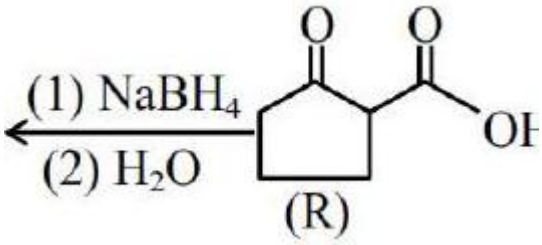
Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 13

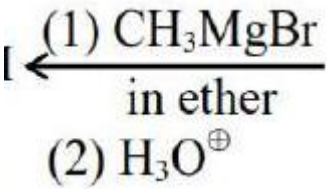
Source solution

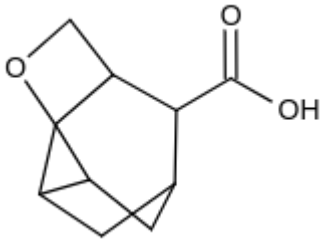






(R)





(2) $\mathbf{H_3O^{\oplus}}$

$\mathbf{CH_4}$

0.1 mole of compound (S) weight in gm

$= \mathbf{0.1}\times$ molar mass of compound $\mathbf{(S)}$

$= \mathbf{0.1 \times 130 = 13gm}$

Question 247

Match the LIST-I with LIST-II

LIST-I (Reagent)		LIST-II (Functional Group detected)	
A.	Sodium bicarbonate solution	I.	double bond/unsaturation
B.	Neutral ferric chloride	II.	carboxylic acid
C.	ceric ammonium nitrate	III.	phenolic - OH
D.	alkaline $KMnO_4$	IV	alcoholic - OH

Choose the correct answer from the options given below:

A. A-II, B-III, C-IV, D-I

B. A-II, B-III, C-I, D-IV

C. A-III, B-II, C-IV, D-I

D. A-II, B-IV, C-III, D-I

Correct answer: A

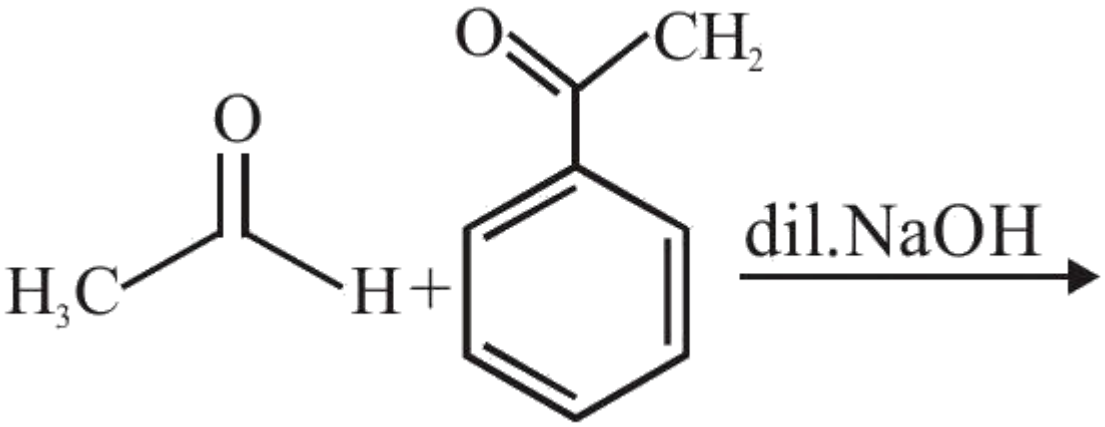
Source solution

Sol.

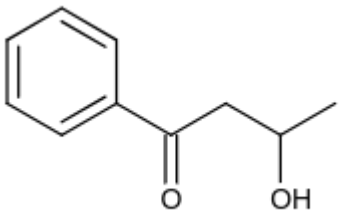
(1) Carboxylic acid gives effervescence with sodium bicarbonate solution.
(2) Phenolic-OH gives violet coloured complex with Neutral $FeCl_3$.
(3) Alcoholic-OH gives red colour with ceric ammonium nitrate.
(4) When alkaline $KMnO_4$ reacts with an unsaturated compound (alkene or alkyne), the purple colour of $KMnO_4$ solution disappears, indicating positive test for unsaturation.

Question 248

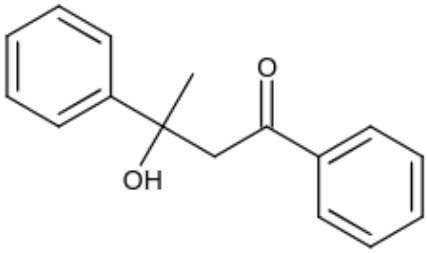
The major product formed in the following reaction is:



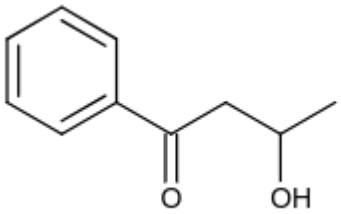
A.



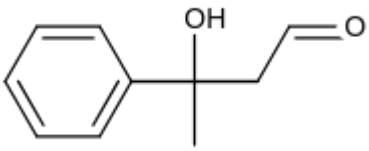
B.



C.



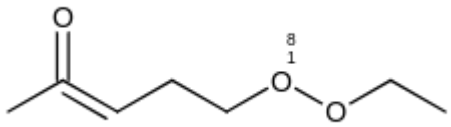
D.



Correct answer: A

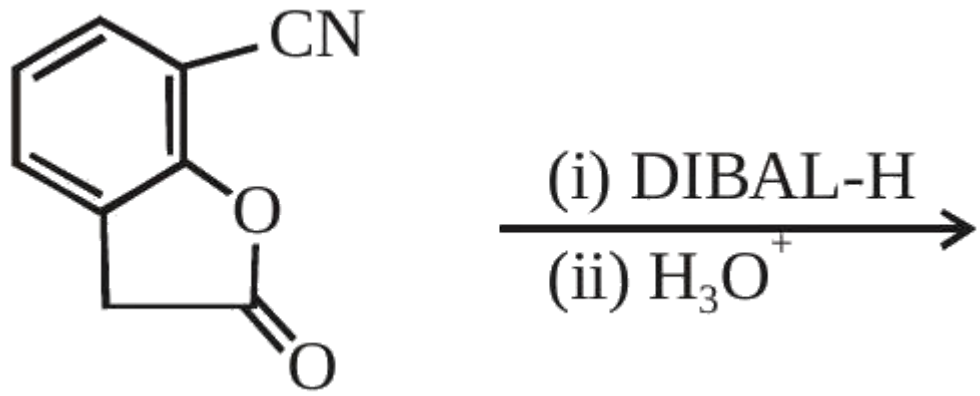
Source solution

Sol. Aldehyde reacts at a faster rate than keton during aldol and stericall less hindered anion will be a better nucleophile so sefl aldol at

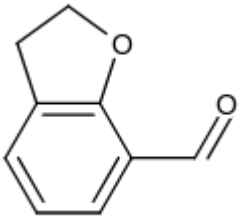

O
8
1
O
O

Question 249

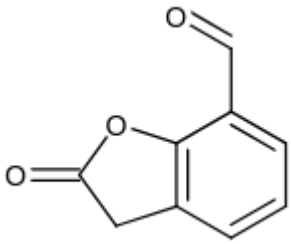
The major product of the following reaction is:



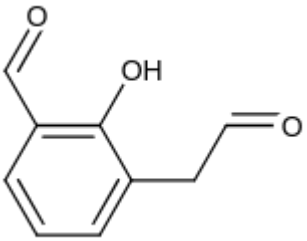
A.



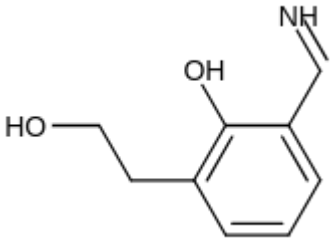
B.



C.



D.

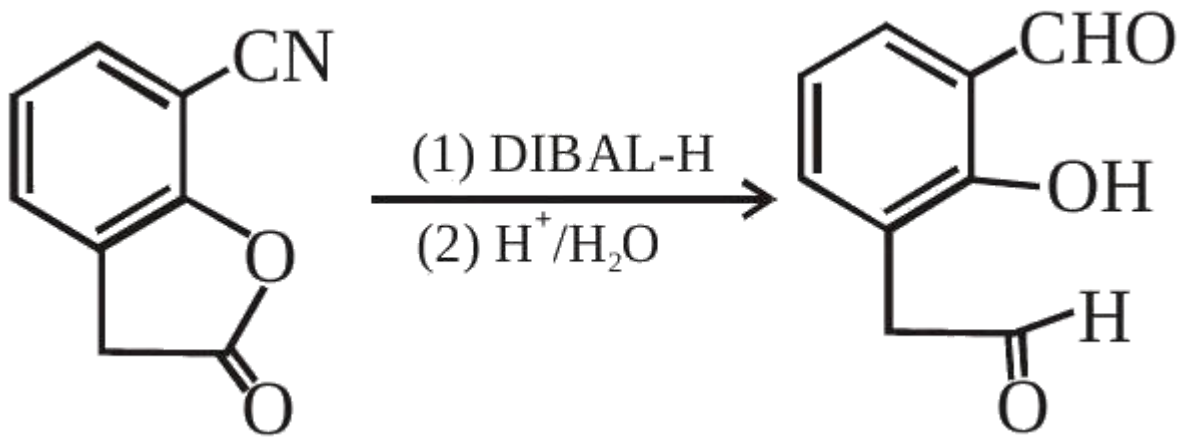


Correct answer: C

Source solution

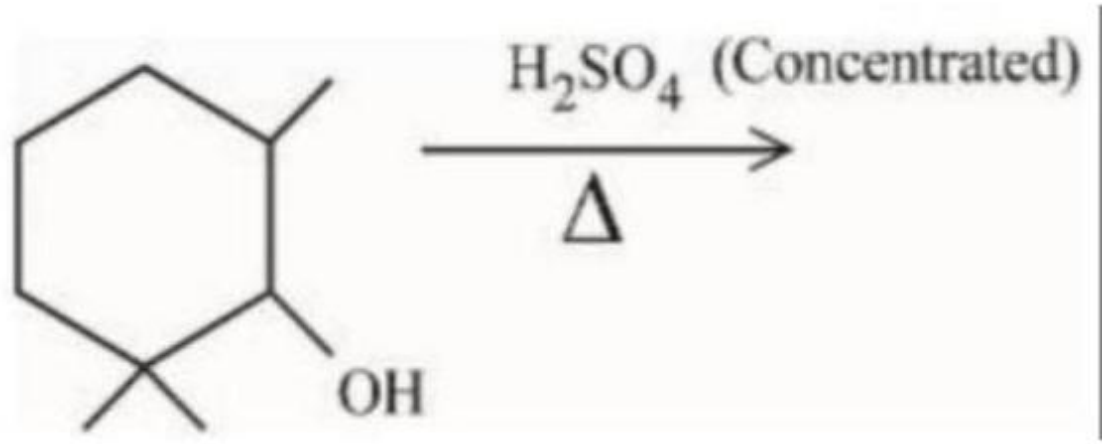
Sol.

DIBAL-H will reduce cyanides & esters to aldehydes.

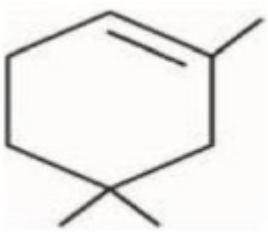

CN
O
O
(1) DIBAL-H
(2) H+/H2O
CHO
OH
H
O

Question 250

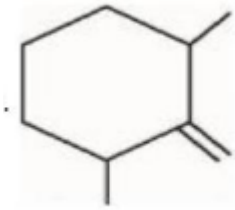
Find out the major product from the following reaction.



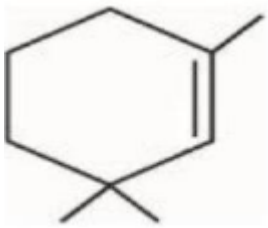
A.



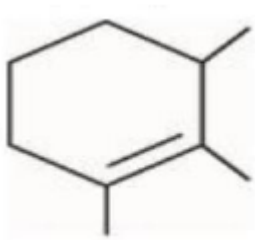
B.



C.

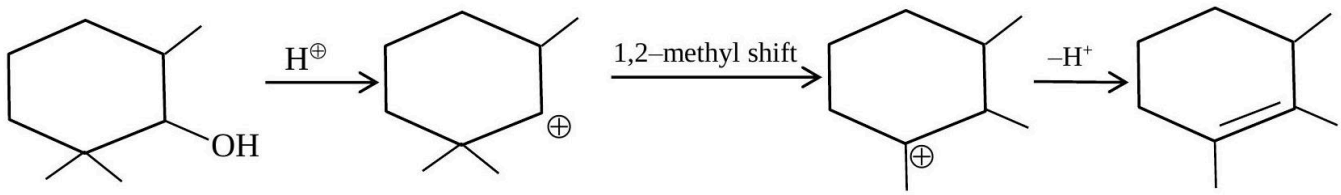


D.



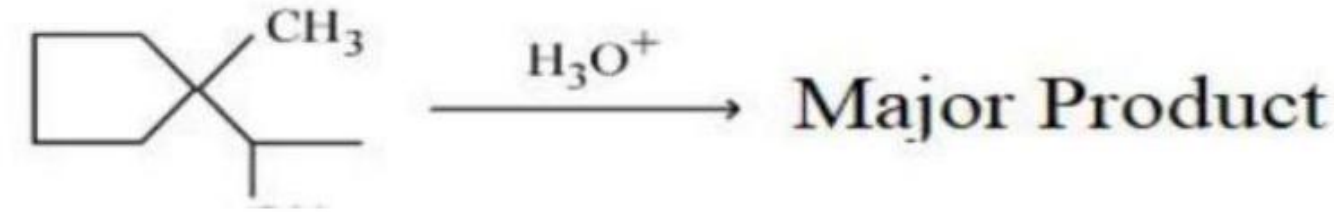
Correct answer: D

Source solution



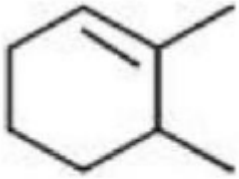
Question 251

Find out the major product for the following reaction.



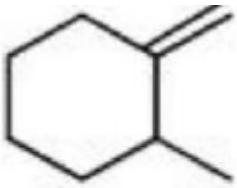


A.

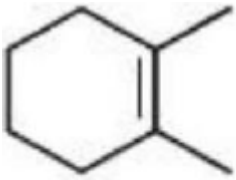


B.

3.



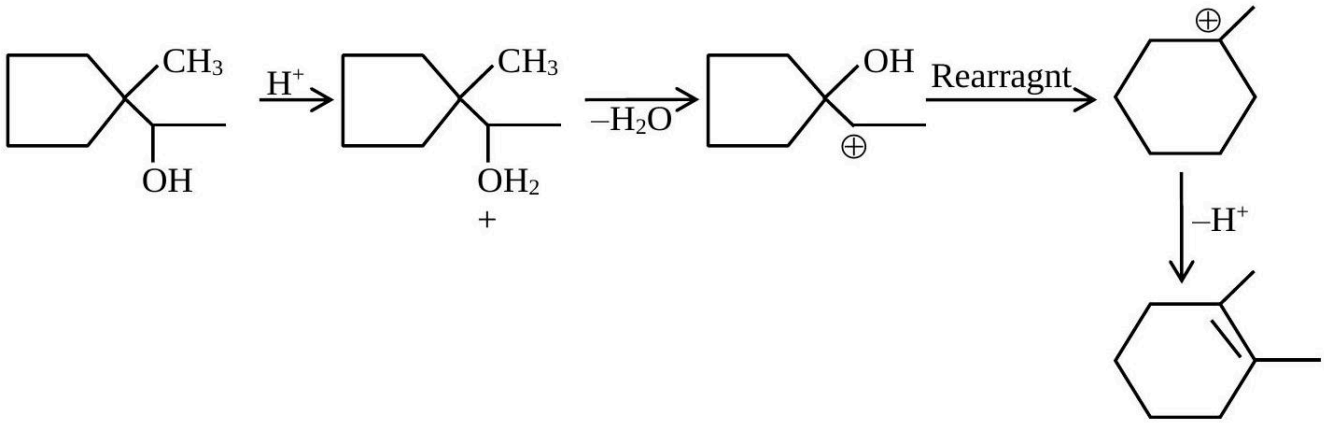
C.



D.

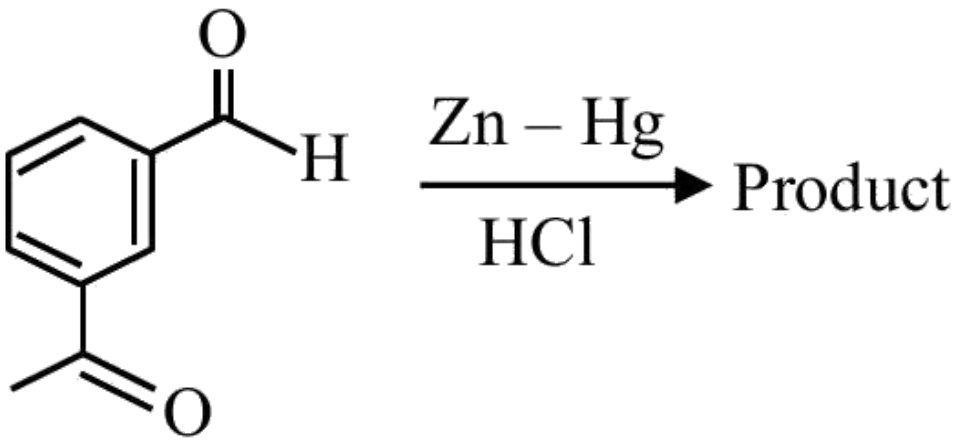
Correct answer: D

Source solution

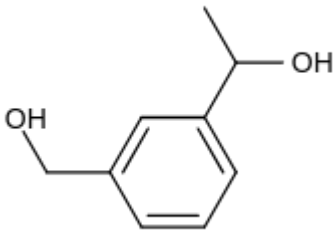


Question 252

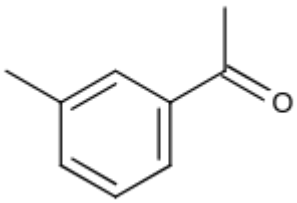
Identify the product in the following reaction :



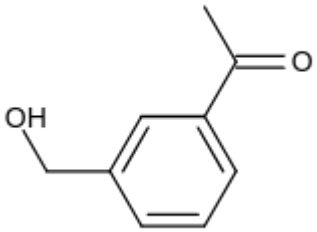
A.



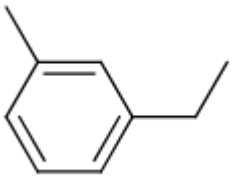
B.



C.



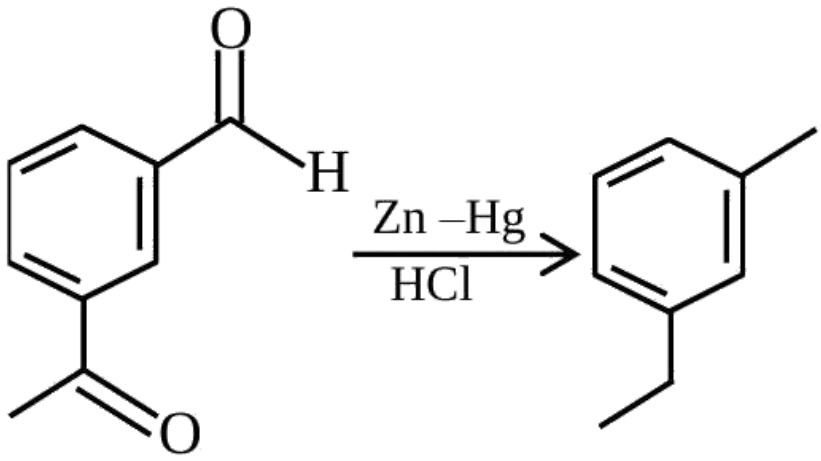
D.



Correct answer: D

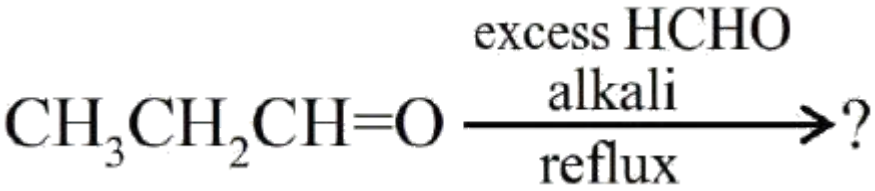
Source solution

Sol.
(Clemmensen reduction)

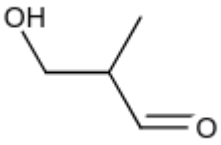

O
H
Zn –Hg
HCl
O

Question 253

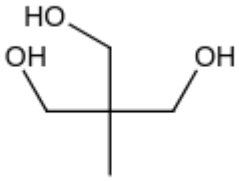
The major product of the following reaction is :



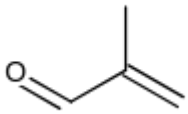
A. $CH_3 - CH_2 - CH_2 - OH$



B.



C.



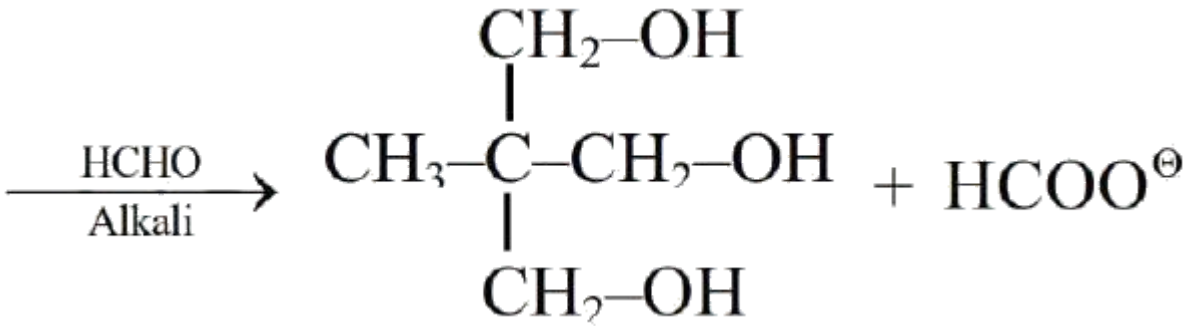
D.

Correct answer: C

Source solution

Sol. (3)

This is an example of Tollen's reaction i.e. multiple cross aldol followed by cross Cannizaro reaction



Question 254

The major product of the following reaction is

$$CH_3CH=CHCO_2CH_3 \xrightarrow{LiAlH_4}$$

A. $CH_3CH_2CH_2CH_2OH$

B. $CH_3CH_2CH_2CHO$

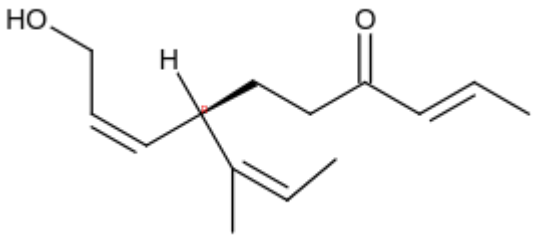
C. $CH_3CH_2CH_2CO_2CH_3$

D. $CH_3CH=CHCH_2OH$

Correct answer: D

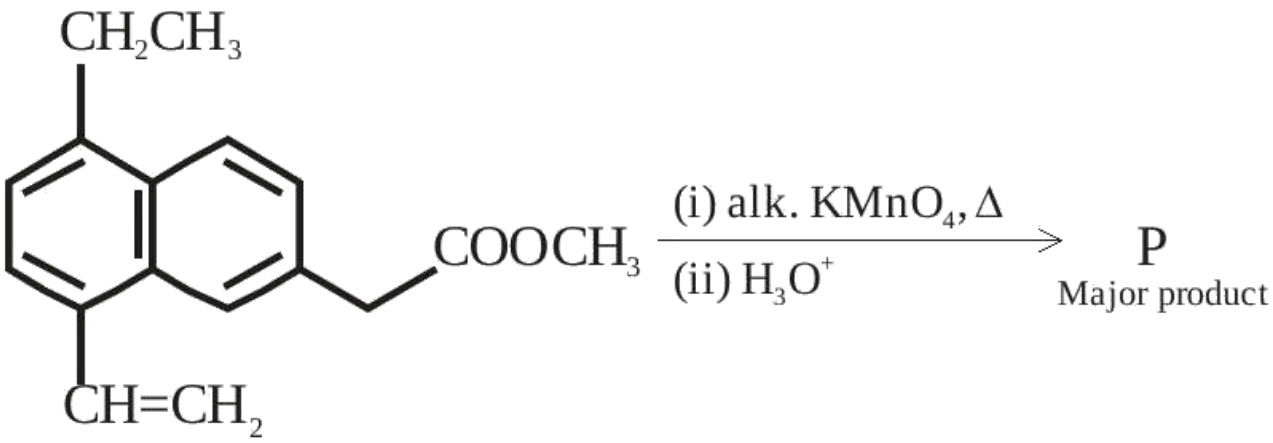
Source solution

Sol. $LiAlH_4$ reduces esters to alcohols but does not reduce $C=C$.

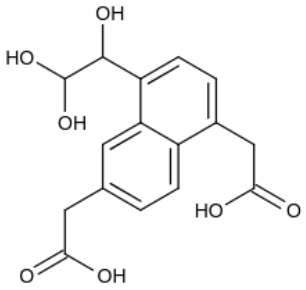


Question 255

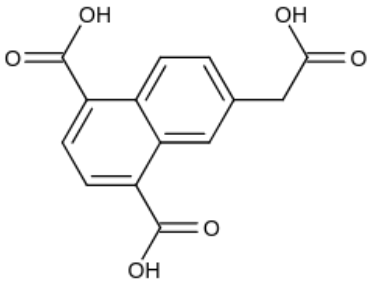
The major product ' P ' formed in the given reaction is



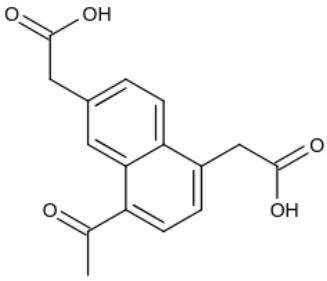
A.



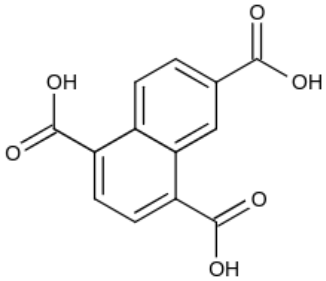
B.



C.



D.

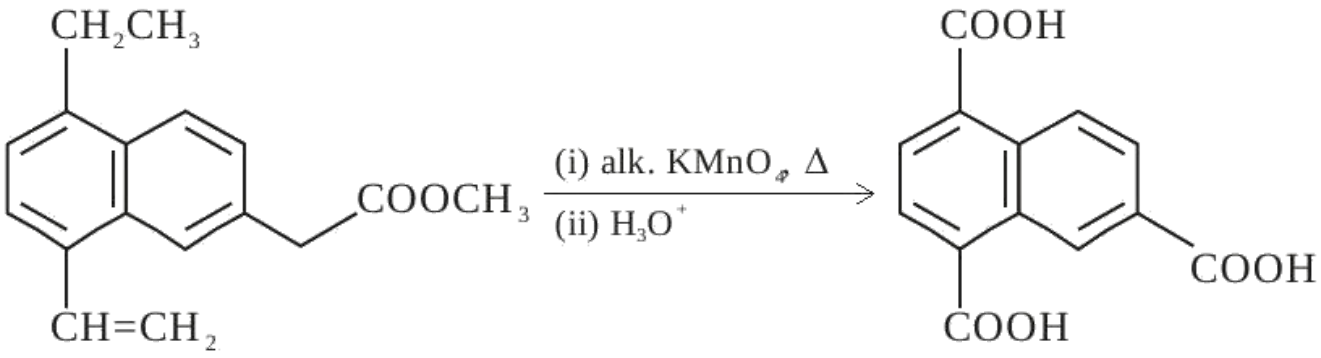


Correct answer: D

Source solution

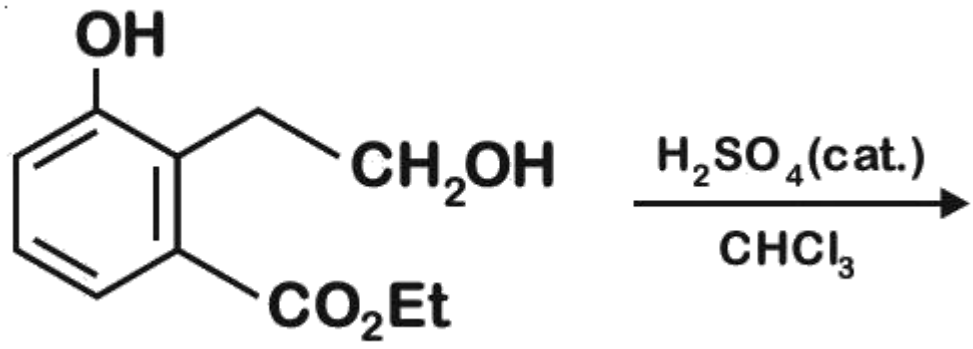
Sol.}

$\mathbf{KMnO_4}$ oxidises benzylic carbon containing atleast one α-hydrogen atom to -COOH .

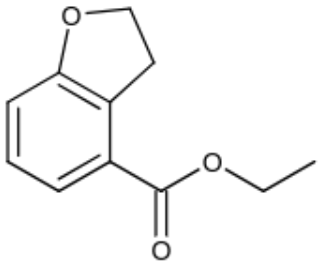

CH2CH3
COOCH3
CH=CH2
(i) alk. KMnO4, Δ
(ii) H3O+
COOH
COOH
COOH

Question 256

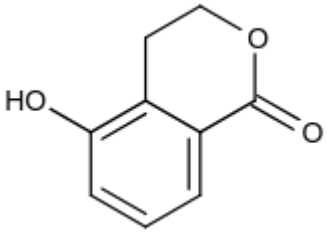
The major product of the following reaction is :



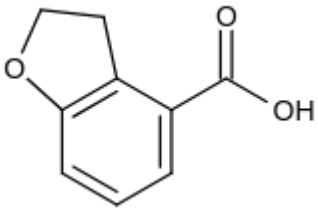
A.



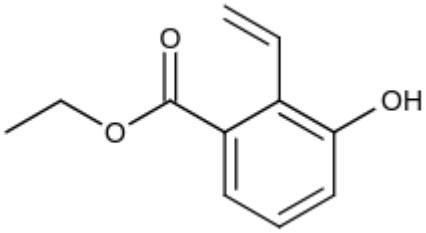
B.



C.



D.

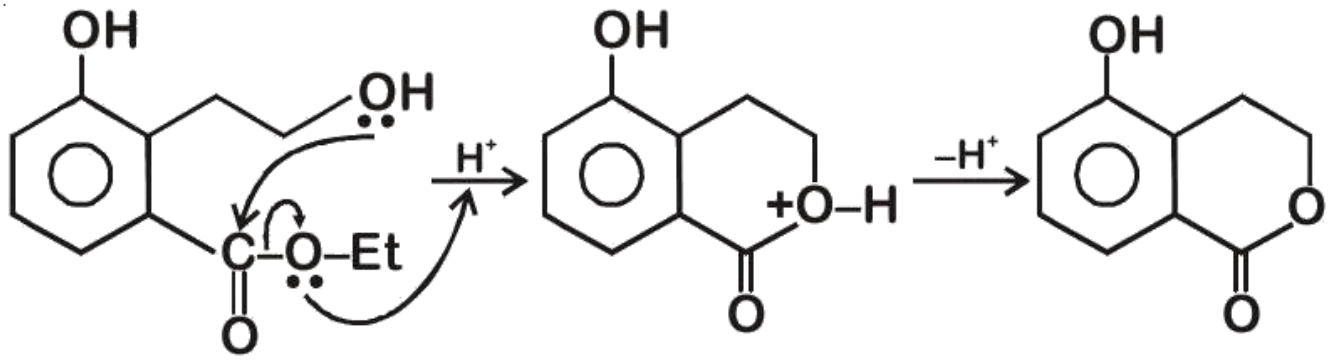


Correct answer: B

Source solution

Sol.

Acid catalysed intramolecular esterification

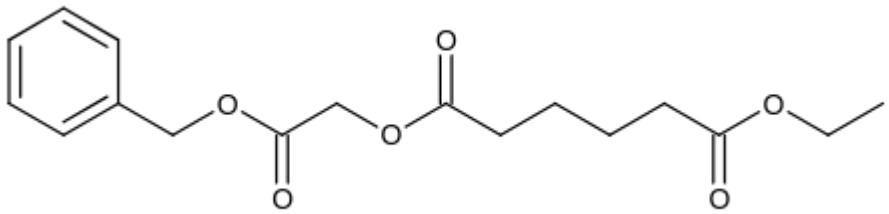

OH
OH
C–O–Et
O
H+
OH
+O–H
O
–H+
OH
O
O

Question 257

Match List - I with List -II.

List - I (Reactions)		List - II (Reagents)	
(B)	$C_6H_5COC_6H_5 \rightarrow C_6H_5CH_2C_6H_5$	(II)	$Zn(Hg)$ and conc. HCl
(C)	$C_6H_5CHO \rightarrow C_6H_5CH(OH)CH_3$	(III)	$NaBH_4, H^+$

Choose the correct answer from options given below:



A. A-(III), (B)-(IV), (C)-(I), (D)-(II)

B. A-(IV), (B)-(II), (C)-(I), (D)-(III)

C. A-(IV), (B)-(II), (C)-(III), (D)-(I)

D. A-(III), (B)-(IV), (C)-(II), (D)-(I)

Correct answer: B

Source solution

Sol. $CH_3(CH_2)_5COOC_2H_5 \xrightarrow{\text{DIBAL-H, } H_2O} CH_3(CH_2)_5CHO$

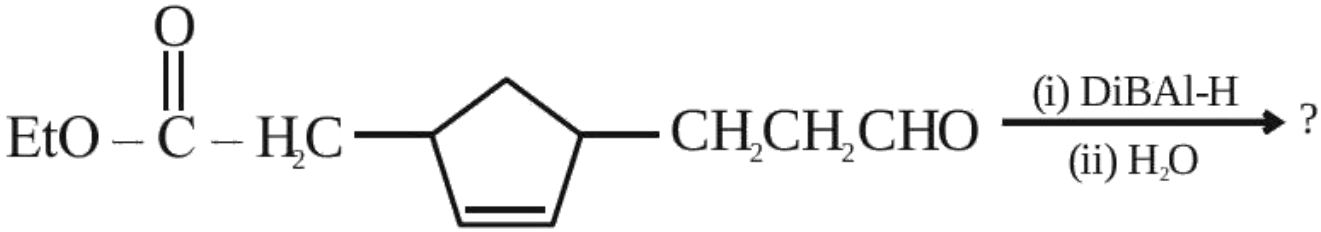
$C_6H_5COC_6H_5 \xrightarrow{Zn(Hg)\& \text{ conc. HCl}} C_6H_5CH_2C_6H_5$

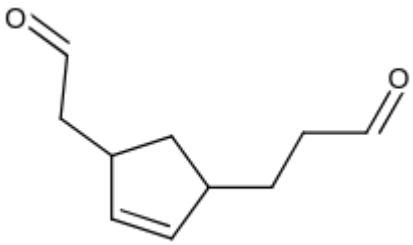
$C_6H_5CHO \xrightarrow[H_2O]{CH_3MgBr} C_6H_5CH(OH)CH_3$

$CH_3COCH_2COOC_2H_5 \xrightarrow{NaBH_4, H^+} CH_3CH(OH)CH_2COOC_2H_5$

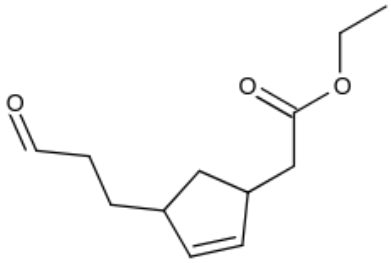
Question 258

Consider the above reaction and predict the major product.

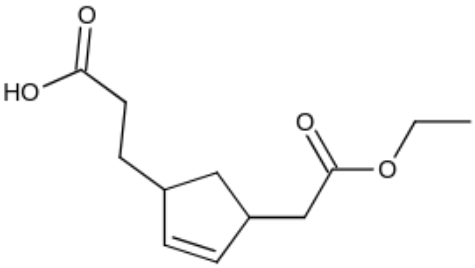




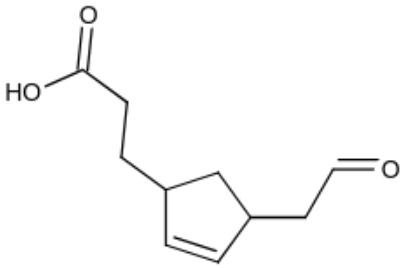
A.



B.



C.



D.

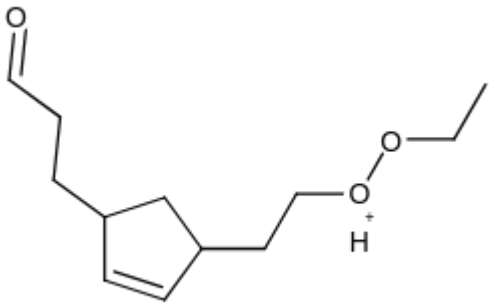
Correct answer: A

Source solution

Sol.

(i) $\mathbf{DiBAL - H}$

(ii) $\mathbf{H_2O}$


O
O
O
H
+

Question 259

Match List I with List II

List I (Compound)		List II (pK_a value)	
A.	Ethanol	I.	10.0
B.	Phenol	II.	15.9
C.	m-Nitrophenol	III.	7.1
D.	p-Nitrophenol	IV.	8.3

Choose the correct answer from the options given below :-

A. A-I, B-II, C-III, D-IV

B. A-IV, B-I, C-II, D-III

C. A-III, B-IV, C-I, D-II

D. A-II, B-I, C-IV, D-III

Correct answer: D

Source solution

Sol. Ethanol $\rightarrow$ $\mathbf{15.9}$
Phenol $\rightarrow$ $\mathbf{10}$
M-Nitrophenol $\rightarrow$ $\mathbf{8.3}$
P-Nitrophenol $\rightarrow$ $\mathbf{7.1}$

Question 260

Match List I with List II

\multirow{2}{*}{}	LIST I	LIST II	
	Isomeric pairs		Type of isomers
A.	Propanamine and N-Methylethanamine	I.	Metamers
B.	Hexan-2-one and Hexan-3-one	II.	Positional isomers
C.	Ethanamide and Hydroxyethanimine	III.	Functional isomers
D.	o-nitrophenol and p-nitrophenol	IV.	Tautomers

Choose the correct answer from the options given below:

A. A-II, B-III, C-I, D-IV

B. A-III, B-I, C-IV, D-II

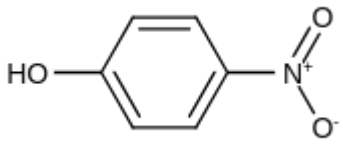
C. A-III, B-IV, C-I, D-II

D. A-IV, B-III, C-I, D-II

Correct answer: B

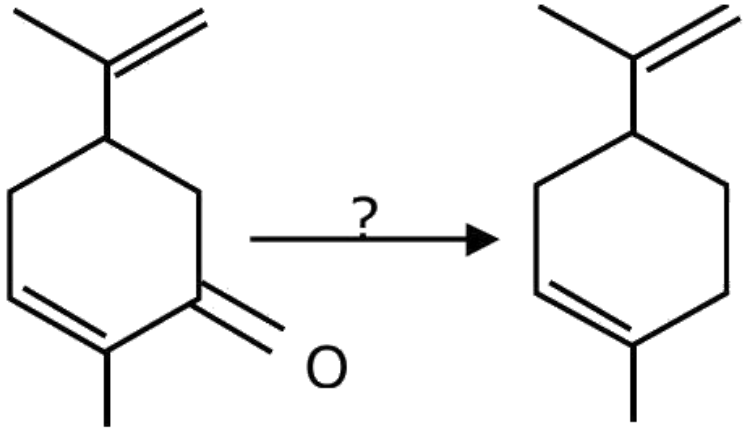
Source solution

Sol. 2}
(A) $C-C-C-NH_2 \& C-NH-C-C$: functional isomer (III)
(B)
(C)
&
(D)
: Position isomer (II)


HO
O
N+
O-

Question 261

Which of the following reagent is suitable for the preparation of the product in the above reaction.



A. Red $P + Cl_2$

B. $NH_2 - NH_2/C_2H_5 \overset{\ominus\oplus}{O} Na$

C. Ni/H_2

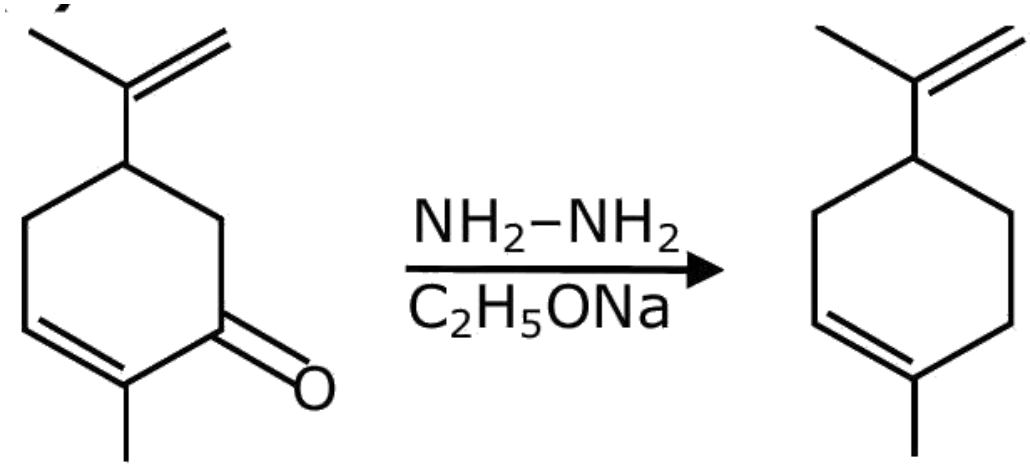
D. $NaBH_4$

Correct answer: B

Source solution

Sol.

It is wolf-kishner reduction of carbonyl compounds.



Question 262

Match List-I and List-II.

List - I

List-II

(a) $\overset{O}{\overset{||}{}}-C-Cl \rightarrow R-CHO$

(i) $Br_2/NaOH$

(b)

(ii) $H_2/Pd-BaSO_4$

(c) $\underset{||}{O}-\underset{|}{C}-NH_2 \rightarrow R-NH_2$

(iii) $Zn(Hg)/$ Conc. HCl

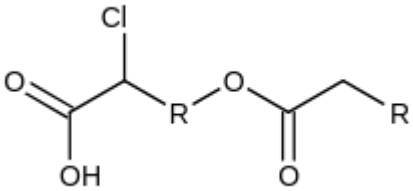
O

II

O

(d) $R-C-CH_3 \rightarrow R-CH_2-CH_3$ (iv) $Cl_2/$ Red P, H_2O

Choose the correct answer from the options given below :



A. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

B. (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

C. (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

D. (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

Correct answer: D

Source solution

Sol.

(a)

(b)

O

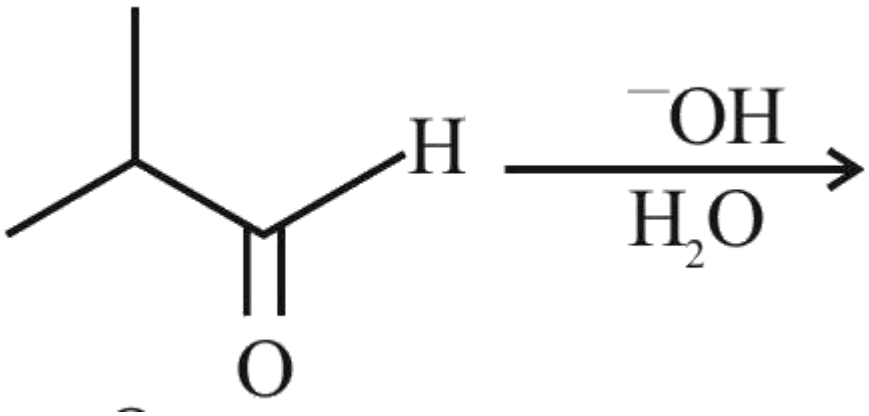
(c) $\mathbf{R-C-NH_2} \xrightarrow{\mathbf{Br_2/NaOH}} \mathbf{R-NH_2}$ (Hoffmann Bromamide reaction)

(d) $\mathbf{R-C-CH_3} \xrightarrow{\mathbf{On(Hg)/\ conc.\ HCl}} \mathbf{R-CH_2-CH_3}$ (Clemmensen reaction)

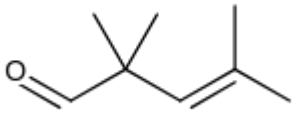
$$R-CH_2-COOH \xrightarrow{Cl_2/Red\ P,\ H_2O} R-\underset{\displaystyle Cl}{\underset{|}{CH}}-COOH \quad \text{(HVZ reaction)}$$

Question 263

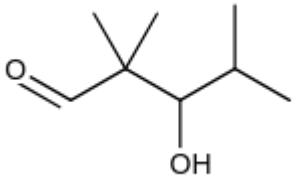
What is the major product of the following reaction?



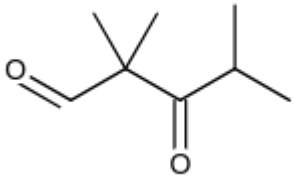
A.



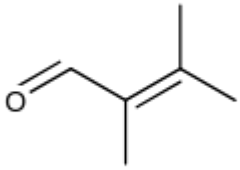
B.



C.



D.

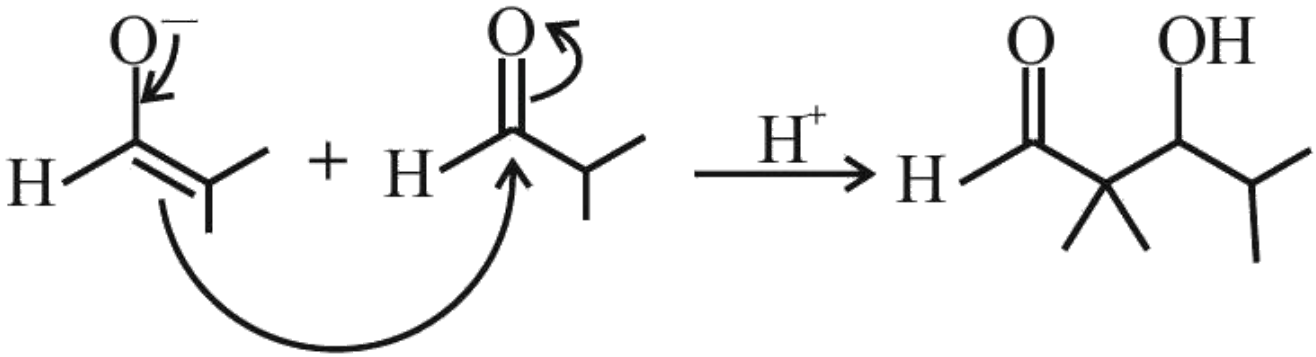


Correct answer: B

Source solution

Sol.

Aldol formation takes place.

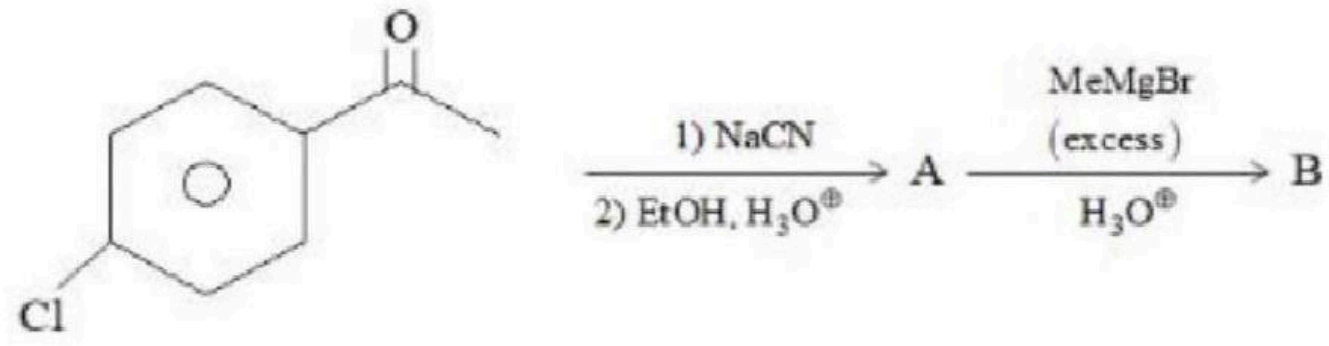

O
H
+
O
H
H+
O
OH
H

Aldehydes, Ketones and Carboxylic Acids

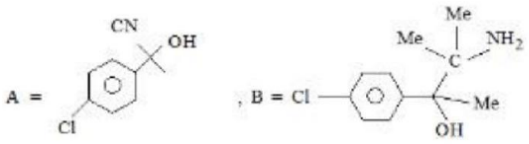
Questions 264-267 / 4 selected / 1.3% practice weight / Consolidate

Question 264

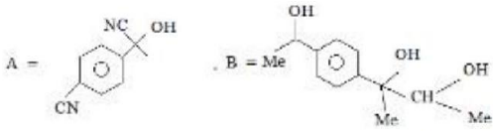
Find out the major products from the following reaction sequence.



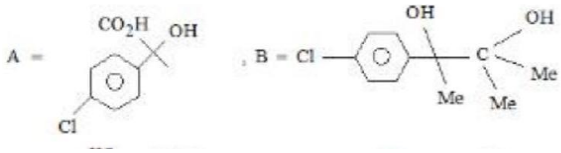
A.



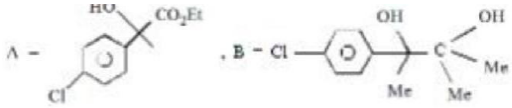
B.



C.

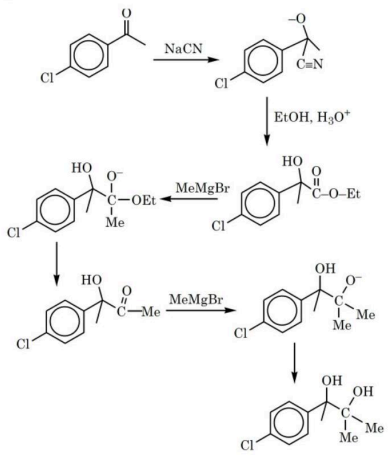


D.



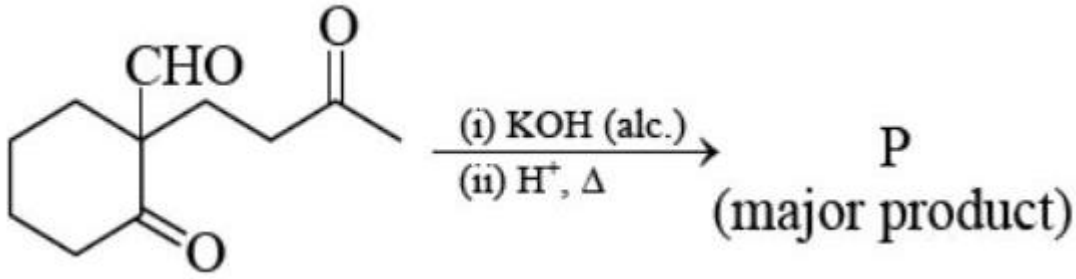
Correct answer: D

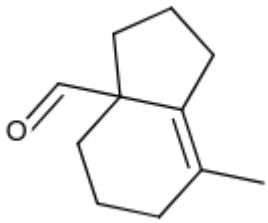
Source solution


NaCN
EtOH, H_3O^+
MeMgBr
MeMgBr
Cl
HO
OH
OEt
Me
C≡N
C–O–Et

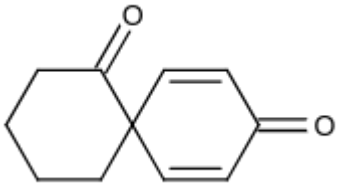
Question 265

The major product (P) in the following reaction is

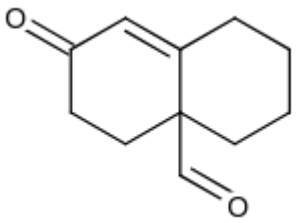




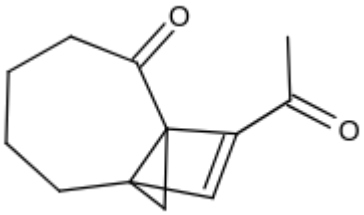
A.



B.



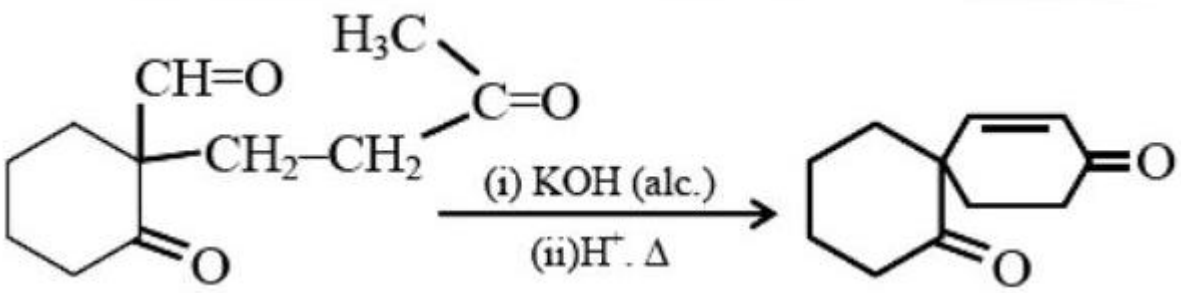
C.



D.

Correct answer: B

Source solution



Intramolecular Aldol condenstion (Major Product)

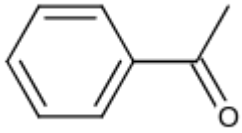
Question 266

The increasing order of the reactivity of the following compounds towards electrophilic aromatic substitution reactions is :

(I)

(II)

(III)



A. $\mathrm{I} < \mathrm{III} < \mathrm{II}$

B. $\mathrm{III} < \mathrm{II} < \mathrm{I}$

C. $\mathrm{II} < \mathrm{I} < \mathrm{III}$

D. $\mathrm{III} < \mathrm{I} < \mathrm{II}$

Correct answer: D

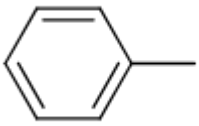
Source solution

Sol. $\mathbf{CH_3}$ group when bonded to benzene increases the electron density of benzene by $+I$ and hyper conjugation effects and hence makes the compound more reactive towards EAS. CI group decreases the electron density of benzene by -1 effect, and $\mathbf{CH_3CO}$ group strongly decreases the electron density of benzene by $-I$ and $-R$ effects. Therefore, correct increasing order the given compounds towards EAS is

(III)

(I)

(II)



Question 267

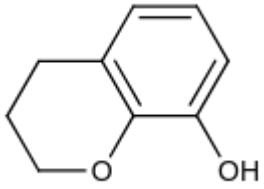
Arrange the following compounds in increasing order of rate of aromatic electrophilic substitution reaction

(a)

(b)

(c)

(d)



A. d, b, c, a

B. b, c, a, d

C. c, a, b, d

D. d, b, a, c

Correct answer: C

Source solution

Sol. Benzene becomes more reactive towards EAS when any substituent raises the electron density.

a

$-\mathrm{CH_2}$ has +H effect

b

-OH has +R while $-\mathrm{CH_2}-$ group has +H effect.

c

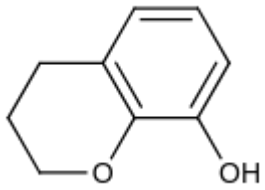
d

-OH and $-\mathrm{O}-$ both

show +R effect

Correct order

$$c < a < b < d$$


O
OH

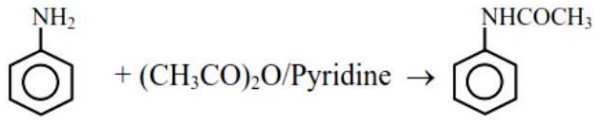
Amines

Questions 268-274 / 7 selected / 2.3% practice weight / Next

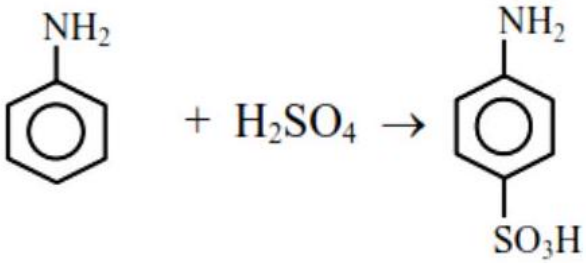
Question 268

Which one of the following reactions does not occur?

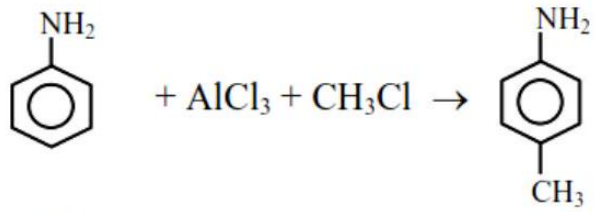
A.



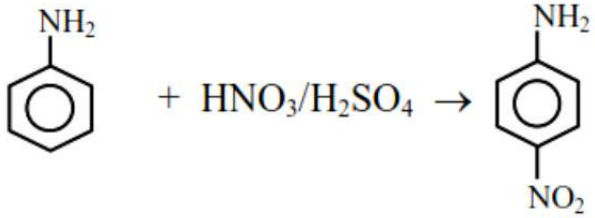
B.



C.

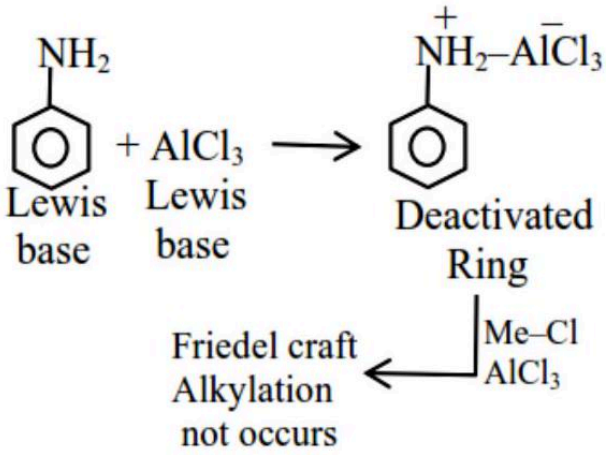


D.



Correct answer: C

Source solution



Aniline is lewis base give acid base reaction with $AlCl_3$ and form Anilinium ion Anilinium ion has strongest deactivated ring so further Friedel craft Alkylation not occurs.

Question 269

Match List I with List II

LIST I (Amines)		LIST II pK_b)	
A.	Aniline	I.	3.25
B.	Ethanamine	II.	3.00
C.	N-Ethylethanamine	III	9.38
D.	N. N-Diethylethanamine	IV.	3.29

Choose the correct answer from the options given below:

A. A-III, B-IV, C-II, D-I

B. A-III, B-II, C-I, D-IV

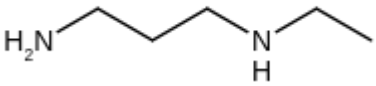
C. A-I, B-IV, C-II, D-III

D. A-III, B-II, C-IV, D-I

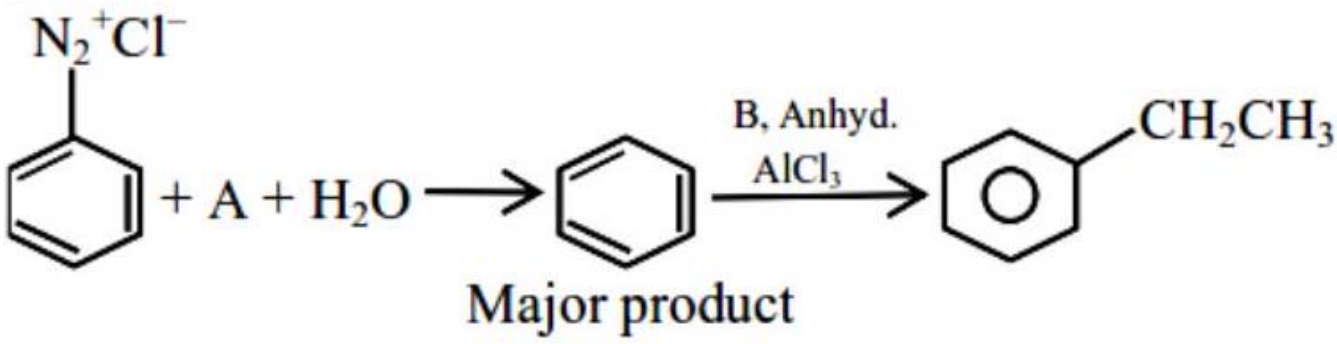
Correct answer: A

Source solution

Sol. 1}
Basicity order
pKb : 3.00, pKb : **3.25** pKb : **3.29** pKb : 9.38



Question 270



In the chemical reactions given above A and B respectively are :

A. H_3PO_2 and CH_3CH_2Cl

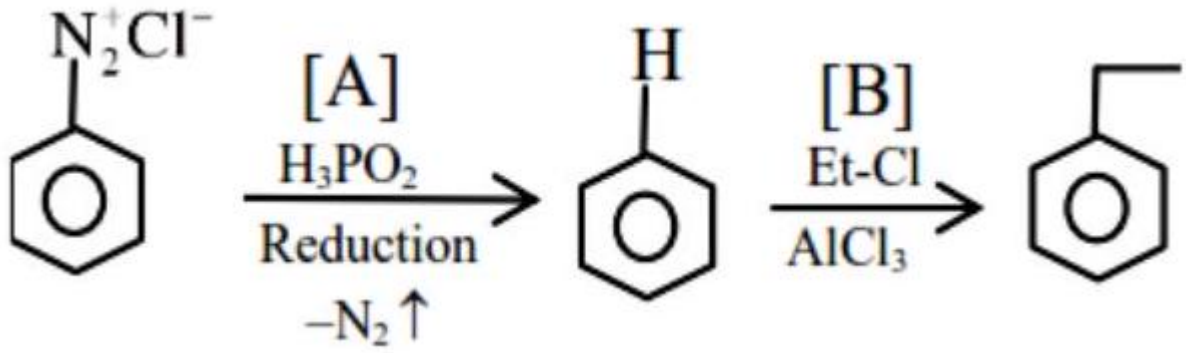
B. CH_3CH_2OH and H_3PO_2

C. H_3PO_2 and $CH_3CH_2PO_2$

D. CH_3CH_2Cl and H_3PO_2

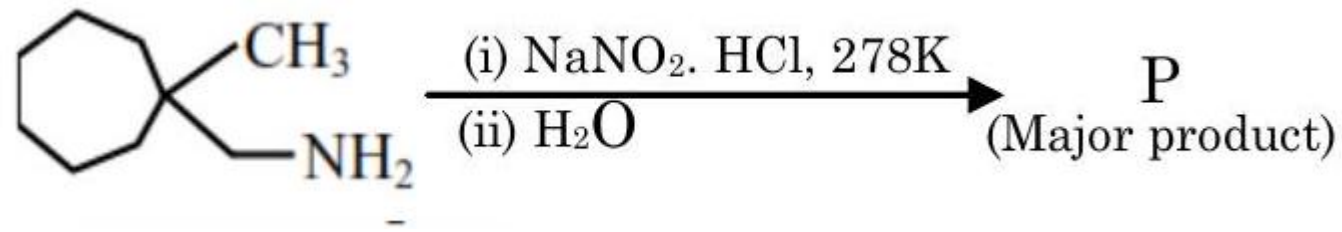
Correct answer: A

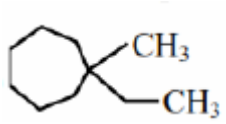
Source solution

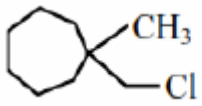


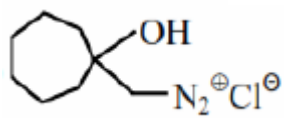
Question 271

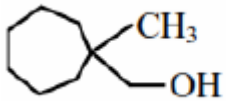
What is the major product "P" of the following reaction ?



A. 

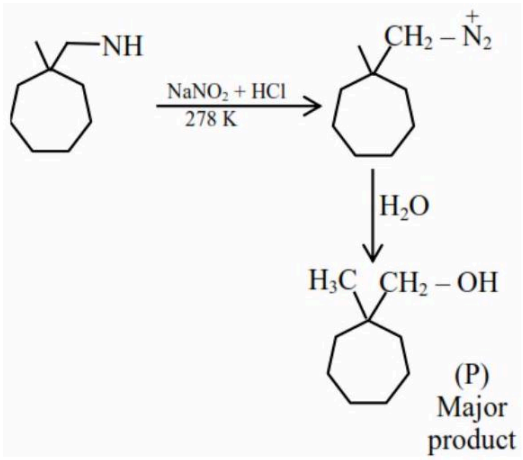
B. 

C. 

D. 

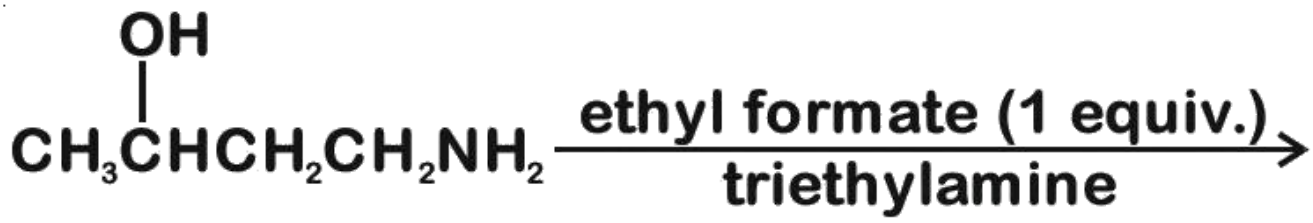
Correct answer: D

Source solution



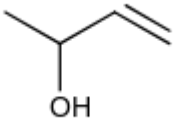
Question 272

The major product of the following reaction is:

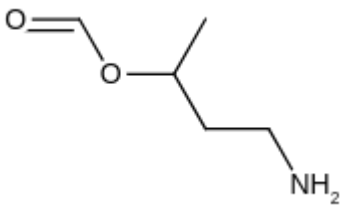


A. $CH_3CH = CH - CH_2NH_2$

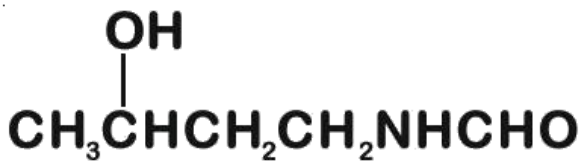
B.



C.



D.

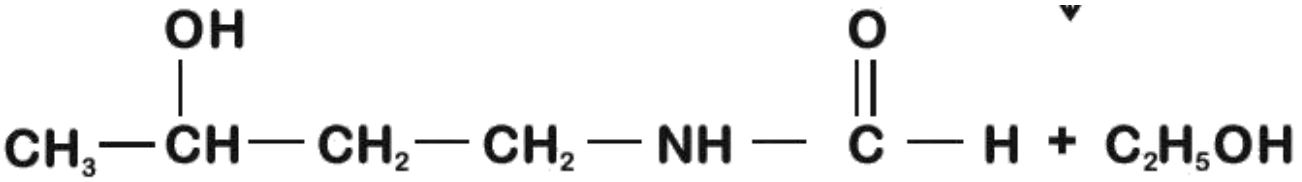


Correct answer: D

Source solution

Sol.

The acylation of NH_2 group takes place and not of OH group due to lower electronegativity of N -atom.



Question 273

Match List - I with List - II

	List - I		List - II
(A)	Sphalerite	(I)	$FeCO_3$
(B)	Calamine	(II)	PbS
(C)	Galena	(III)	$ZnCO_3$
(D)	Siderite	(IV)	ZnS

Choose the most appropriate answer from the options given below:

A. - (IV), (B) - (III), (C) - (II), (D) - (I)

B. (A) - (IV), (B) - (I), (C) - (II), (D) - (III)

C. (A) - (II), (B) - (III), (C) - (I), (D) - (IV)

D. (A) - (III), (B) - (IV), (C) - (II), (D) - (I)

Correct answer: A

Source solution

	List - I		List - II
(A)	Sphalerite	(IV)	ZnS
(B)	Calamine	(III)	$ZnCO_3$
(C)	Galena	(II)	PbS
(D)	Siderite	(I)	$FeCO_3$

Question 274

Match List I with List II

List I	List II
A. Benzenesulphonyl chloride	I. Test for primary amines
B. Hoffmann bromamide reaction	II. Anti Saytzeff
C. Carbylamine reaction	III. Hinsberg reagent
D. Hoffmann orientation	IV. Known reaction of Isocyanates.

Choose the correct answer from the options given below:

A. A-IV, B -III, C-II, D-I

B. A-IV, B -II, C-I, D-III

C. (2) Hoffmann bromamide reaction $\rightarrow$ known reaction of isocynates

$$\mathbf{R-CO-NH_2 + X_2 + 4NaOH \rightarrow R-NH_2 + 2NaX + Na_2CO_3 + 2H_2O}$$

Intermediate : $\mathbf{R-N=C=O}$ (isocyanate)

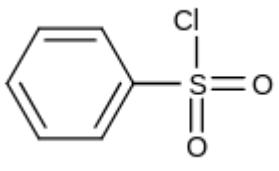
D. (3) A-III, B -IV, C-I, D-II

Correct answer: C

Source solution

Sol. (1)

Benzen sulphonyl chloride



Biomolecules

Questions 275-285 / 11 selected / 3.7% practice weight / Focus first

Question 275

Match List-I with List-II.

	List-I Reaction		List-II Catalyst
(A)	$4NH_3(g) + 5O_2(g) \rightarrow 4NO(g) + 6H_2O(g)$	(I)	NO(g)
(B)	$N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$	(II)	$H_2SO_4(l)$
(C)	$C_{12}H_{22}O_{11}(aq) + H_2O(l) \rightarrow C_6H_{12}O_6(\text{Glucose}) + C_6H_{12}O_6(\text{Fructose})$	(III)	Pt(s)
(D)	$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$	(IV)	Fe(s)

Choose the correct answer from the options given below:

A. - (II), (B) - (III), (C) - (I), (D) - (IV)

B. (A) - (III), (B) - (II), (C) - (I), (D) - (IV)

C. (A) - (III), (B) - (IV), (C) - (II), (D) - (I)

D. (A) - (III), (B) - (II), (C) - (IV), (D) - (I)

Correct answer: C

Source solution

(a) $4NH_3(g) + 5O_2(g) \xrightarrow{Pt(s)} 4NO(g) + 6H_2O(g)$ Ostwald process 500 K

(b) $N_2 + 3H_2 \xrightarrow{Fe(s)} 2NH_3(g)$

Haber's process

(c) $C_{12}H_{22}O_{11}$ (aq.) $+H_2O(\ell) \xrightarrow{H^+} \underset{\text{(glu cose)}}{C_6H_{12}O_6} + \underset{\text{(fructose)}}{C_6H_{12}O_6}$

Inversion of sugar cane

(d) $2SO_2(g) + O_2(g) \xrightarrow{NO(g)} 2SO_3(g)$

Question 276

The correct match between item 'I' and item 'II' is :

Item 'I'	Item 'II' (compound)	(reagent)

(A) Lysine
(P) 1-naphthol
(B) Furfural
(Q) ninhydrin
(C) Benzyl alcohol
(R) $KMnO_4$
(D) Styrene
(S) Ceric ammonium nitrate

A. $(A) \to (Q), (B) \to (P), (C) \to (S), (D) \to (R)$

B. $(A) \to (Q), (B) \to (R), (C) \to (S), (D) \to (P)$

C. $(A) \to (Q), (B) \to (P), (C) \to (R), (D) \to (S)$

D. $(A) \to (R), (B) \to (P), (C) \to (Q), (D) \to (S)$

Correct answer: A

The source provides a brief answer only. A detailed worked solution is not available for this question.

Source solution

Question 277

Match List I with List II}

List I Enzymatic reaction		List II Enzyme	
A	Sucrose $\rightarrow$ Glucose and Fructose	I.	Zymase
B	Glucose $\rightarrow$ ethyl alcohol and CO_2	II.	Pepsin
C	Starch $\rightarrow$ Maltose	III.	Invertase
D	Proteins $\rightarrow$ Amino acids	IV.	Diastase

Choose the correct answer from the options given below:

A. A-III, B-I, C-II, D-IV

B. A-I, B-IV, C-III, D-II

C. A-III, B-I, C-IV, D-II

D. A-I, B-II, C-IV, D-III

Correct answer: C

The source provides a brief answer only. A detailed worked solution is not available for this question.

Source solution

Sol. Factual

Question 278

Match List I with List II

	LIST I		LIST II
A.	α - Glucose and α-Galactose	I.	Functional isomers
B.	α - Glucose and β-Glucose	II.	Homologous
C.	α - Glucose and α-Fructose	III.	Anomers
D.	α - Glucose and α-Ribose	IV.	Epimers

Choose the correct answer from the options given below:

A. A-III, B-IV, C-II, D-I

B. A-III, B-IV, C-I, D-II

C. A-IV, B-III, C-I, D-II

D. A-IV, B-III, C-II, D-I

Correct answer: C

Source solution

Sol. Based on biomolecules theory and structure of these named compounds -
(A) α-Glucose and α-Galactose (IV) Epimers.
(B) α-Glucose and β-Glucose (III) Anomers
(C) α-Glucose and α-Fructose (I) Functional isomers
(D) α-Glucose and α-Ribose (II) Homologous

Question 279

Match List I with List II.

List I Enzyme	c Conversion of
A. Invertase	I. Starch into maltose
B. Zymase	II. Maltose into glucose
C. Diastase	III. Glucose into ethanol
D. Maltase	IV. Cane sugar into glucose

Choose the most appropriate answer from the options given below :

A. A-III, B-IV. C-II. D-I

B. A-III. B-II. C-I. D-IV

C. A-IV, B-IIL C-I. D-II

D. A-IV, B-II. C-III. D-I

Correct answer: C

Source solution

Sol. Invertase : Cane sugar $\rightarrow$ Glucose and fructose
Zymase : Glucose $\rightarrow$ Ethanol and CO_2
Diastase : Starch $\rightarrow$ Maltose
Maltase : Maltose $\rightarrow$ Glucose

Question 280

Match List I with List II

LIST-I		LIST-II	
A.	Glucose/$NaHCO_3/\Delta$	I.	Gluconic acid
B.	Glucose/ HNO_3	II.	No reaction
C.	Glucose/HI/ Δ	III.	n-hexane
D.	Glucose/Bromine water]	IV.	Saccharic acid

Choose the correct answer from the options given below:

A. A-IV, B-I, C-III, D-II

B. A-II, B-IV, C-III, D-I

C. A-III, B-II, C-I, D-IV

D. A-I, B-IV, C-III, D-II

Correct answer: B

Source solution

Sol. Glucose $\xrightarrow[\Delta]{NaHCO_3}$ no reaction

Glucose $\xrightarrow[\Delta]{HNO_3}$ saccharic acid

Glucose $\xrightarrow[\Delta]{HI}$ n-hexane

Glucose $\xrightarrow[\Delta]{Br_2}$ Gluconic acid

Question 281

Match List I with List II

List I Bio Polymer)		List II (Monomer)	
A.	Starch	I.	nucleotide
B.	Cellulose	II.	α-glucose
C.	Nucleic acid	III.	β-glucose
D.	Protein	IV.	α-amino acid

Choose the correct answer from the options given below :-

A. A-II, B-I, C-III, D-IV

B. A-IV, B-II, C-I, D-III

C. A-I, B-III, C-IV, D-II

D. A-II, B-III, C-I, D-IV

Correct answer: D

Source solution

Sol. A-II, B-III, C-I, D-IV
Fact based.

Question 282

Identify the correct statement among the following:

A. All naturally occurring amino acids except glycine contain one chiral centre.

B. All naturally occurring amino acids are optically active.

C. Glutamic acid is the only amino acid that contains a -COOH group at the side chain.

D. Amino acid, cysteine easily undergo dimerization due to the presence of free SH group.

Correct answer: D

Source solution

Sol. Isoleucine has 2 chiral centre
Glycine is optically inactive
Aspartic acid also contain COOH group at the side chain.
Cysteine easily dimmerise due to free SH group

Question 283

The correct statement among the following is :

A. $(SiH_3)_3\ N$ is planar and less basic than $(CH_3)_3\ N$

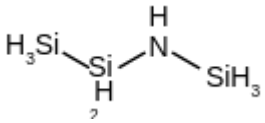
B. $(SiH_3)_3\ N$ is pyramidal and more basic than $(CH_3)_3\ N$

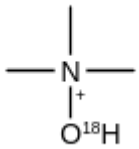
C. $(SiH_3)_3\ N$ is pyramidal and less basic than $(CH_3)_3\ N$

D. $(SiH_3)_3\ N$ is planar and more basic than $(CH_3)_3\ N$

Correct answer: A

Source solution





Trisilylamine is planar, due to backbonding of lone pairs of nitrogen into vacant d-orbitals of Si . In trimethylamine, there is no such delocalisation and hence it is more basic.

Question 284

Identify the incorrect statement from the following

A. Amylose is a branched chain polymer of glucose

B. Starch is a polymer of $\alpha - \mathbf{D}$ glucose

C. β-Glycosidic linkage makes cellulose polymer

D. Glycogen is called as animal starch

Correct answer: A

Source solution

Amylose is a linear chain polymer of α-D-glucose while amylopectine is branched chain polymer of α-D-glucose.

Question 285

Match List - I with List - II.

List - I
(Carbohydrate)}
List - II
(Linkage}
Source)}
(A) Amylose
(B) Cellulose
(C) Glycogen
(D) Amylopectin
(I) $\beta - C_1 - C_4$, plant
(II) $\alpha - C_1 - C_4$, animal
(III) $\alpha - C_1 - C_4$,
$\alpha - C_1 - C_6$, plant
(IV) $\alpha - C_1 - C_4$, plant

Choose the correct answer form the options given below:

A. (A)-(III), (B)-(II), (C)-(I), (D)-(IV)

B. (A)-(IV), (B)-(I), (C)-(II), (D)-(III)

C. (A)-(II), (B)-(III), (C)-(I), (D)-(IV)

D. (A)-(IV), (B)-(I), (C)-(III), (D)-(II)

Correct answer: B

Source solution

Sol. Informative

Practical Chemistry (NCERT Laboratory Manual)

Questions 286-289 / 4 selected / 1.3% practice weight / Consolidate

Question 286

For reaction: $SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g)$
$K_p = 2 \times 10^{12}$ at $27°C$ and 1 atm pressure. The K_c for the same reaction is $\times 10^{13}$. (Nearest integer) (Given $R = 0.082\ L\ atm\ K^{-1}\ mol^{-1}$)

Numerical answer: _____

Enter the requested value (an integer; 0 decimal places). Use the units and scaling stated in the question.

Correct answer: 1

Source solution

$K_c = 1 \times 10^{13}$
$SO_2(g) + \frac{1}{2}O_2 \rightleftharpoons SO_3(g)$
$\Delta n = \frac{-1}{2}$
$K_P = 2 \times 10^{12}$
$K_P = K_C(RT)^{\Delta ng}$
$P = 1\ atm$
$2 \times 10^{12} = K_C(0.082 \times 300)^{-1/2}$
$T = 27°C$
$K_c = 1 \times 10^{13}$

Question 287

Match the List-I with List-II

List-I	List-II
Cations	Group reagents
$A \rightarrow Pb^{2+}, Cu^{2+}$	i) H_2S gas in presence of dilute HCl
$B \rightarrow Al^{3+}, Fe^{3+}$	ii) $(NH_4)_2CO_3$ in presence of NH_4OH
$C \rightarrow Co^{2+}, Ni^{2+}$	iii) NH_4OH in presence of NH_4Cl
$D \rightarrow Ba^{2+}, Ca^{2+}$	iv) H_2S in presence of NH_4OH

Correct match is -

A. A $\rightarrow$ iii, B $\rightarrow$ i, C $\rightarrow$ iv, D $\rightarrow$ ii

B. $A \rightarrow$ i, $B \rightarrow$ iii, $C \rightarrow$ ii, $D \rightarrow$ iv

C. $A \rightarrow$ iv, $B \rightarrow$ ii, $C \rightarrow$ iii, $D \rightarrow$ i

D. A $\rightarrow$ i, B $\rightarrow$ iii, C $\rightarrow$ iv, D $\rightarrow$ ii

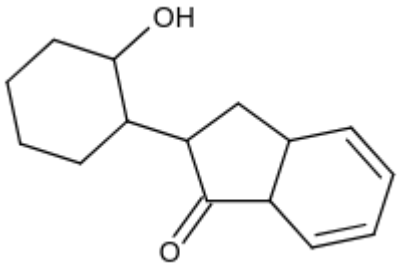
Correct answer: D

Source solution

Cations	Group No.	Group reagents
Pb^{2+}, Cu^{2+}	II	$H_2S + HCl$
Al^{3+}, Fe^{3+}	III	$NH_4Cl + NH_4OH$
Co^{2+}, Ni^{2+}	IV	$NH_4OH + H_2S$
Ba^{2+}, Ca^{2+}	V	NH_4OH, Na_2CO_3

Question 288

Match items of column I and II

Column I (Mixture of compounds)	Column II (Separation Technique)
A. H_2O/CH_2Cl_2	i. Crystallization
	ii. Differential solvent extraction
C. Kerosene /Naphthalene	iii. Column chromatography
D. $C_6H_{12}O_6/NaCl$	iv. Fractional Distillation

Correct match is

A. A-(ii), B-(iii), C-(iv), D-(i)

B. A-(i), B-(iii), C-(ii), D-(iv)

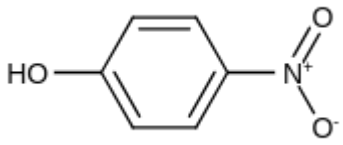
C. A -(ii), B -(iv), C -(i), D -(iii)

D. A-(iii), B-(iv), C-(ii), D-(i)

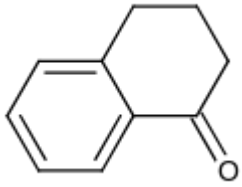
Correct answer: A

Source solution

A-(ii),
Density of CH_2Cl_2 > Density of H 2 O
(Can separated by differential solvent extraction
B-(iii),



Having intermolecular H -Bond so can be separated from



through column chromatography

C-(iv),

Due to difference in B.P. of kerosene and Naphthalene, it can be separated by fractional distillation D-(i)

$\mathbf{NaCl} \rightarrow$ ionic compound

$\mathbf{C_6H_{12}O_6} \rightarrow$ Non ionic compound

so NaCl can by crystallized.

Question 289

Match List I with List II:

List I (Mixture)		List II (Separation Technique)	
A.	$CHCl_3 + C_6H_5NH_2$	I.	Steam distillation
B.	$C_6H_{14} + C_5H_{12}$	II.	Differential extraction
C.	$C_6H_5NH_2 + H_2O$	III.	Distillation
D.	Organic compound in H_2O	IV.	Fractional distillation

A. A-IV, B-I, C-III, D-II

B. A-III, B-IV, C-I, D-II

C. A-III, B-I, C-IV, D-II

D. A-II, B-I, C-III, D-IV

Correct answer: B

Source solution

A. $CHCl_3 + C_6H_5NH_2 \rightarrow$ Distillation (III)
B. $C_6H_{14} + C_5H_{12} \rightarrow$ fractional distillation (IV)
C. $C_6H_5NH_2 \rightarrow H_2O \rightarrow$ Steam distillation (I)
D. Organic compound in $H_2O \rightarrow$ Differential extraction (II)

States of Matter

Questions 290-292 / 3 selected / 1.0% practice weight / Historical appendix

Question 290

Which of the following is a correct statement?

A. Brownian motion destabilises sols.

B. Any amount of dispersed phase can be added to emulsion without destabilising it.

C. Mixing two oppositely charged sols in equal amount neutralises charges and stabilises colloids.

D. Presence of equal and similar charges on colloidal particles provides stability to the colloidal solution.

Correct answer: D

Source solution

Sol. As equal & similar charge particle will repel each other, hence will never precipitate.

Question 291

Which statement is correct?

A. Buna-S is a synthetic and linear thermosetting polymer

B. Neoprene is addition copolymer used in plastic bucket manufacturing

C. Synthesis of Buna-S needs nascent oxygen

D. Buna-N is a natural polymer

Correct answer: C

Source solution

Synthesis of Buna-S needs nascent oxygen.

Question 292

Correct statement is:

A. An average human being consumes nearly 15 times more air than food

B. An average human being consumes 100 times more air than food

C. An average human being consumes equal amount of food and air

D. An average human being consumes more food than air

Correct answer: A

Source solution

Sol. 1}
An average human being requires. hearly $12 - 15$ times more air than the food.

Hydrogen

Questions 293-295 / 3 selected / 1.0% practice weight / Historical appendix

Question 293

In basic medium, $\mathbf{H_2O_2}$ exhibits which of the following reactions ?
(A) $\mathbf{Mn^{2+} \rightarrow Mn^{4+}}$
(B) $\mathbf{I_2 \rightarrow I^-}$
(C) $\mathbf{PbS \rightarrow PbSO_4}$

Choose the most appropriate answer from the options given below :

A. , (C) only

B. (A) only

C. (B) only

D. (A), (B) only

Correct answer: D

Source solution

In basic medium, oxidising action of $\mathbf{H_2O_2}$. $\mathbf{Mn^{2+} + H_2O_2 \rightarrow Mn^{+4} + 2OH^-}$
In basic medium, reducing action of $\mathbf{H_2O_2}$ $\mathbf{I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2}$
In acidic medium, oxidising action of $\mathbf{H_2O_2}$. $\mathbf{PbS(s) + 4H_2O_2(aq) \rightarrow PbSO_4(\ s) + 4H_2O(\ell)}$ Hence correct option (4)

Question 294

Match List I with List II

LIST I		LIST II	
A.	Cobalt catalyst	I.	$(H_2 + Cl_2)$ production
B.	Syngas	II.	Water gas production
C.	Nickel catalyst	III.	Coal gasification
D.	Brine solution	IV.	Methanol production

Choose the correct answer from the options given below:

A. A-IV, B-I, C-II, D-III

B. A-IV, B-III, C-II, D-I

C. A-II, B-III, C-IV, D-I

D. A-IV, B-III, C-I, D-II

Correct answer: B

Source solution

(a) Cobalt catalyst $\rightarrow$ methanol production.
(b) Syngas $\rightarrow$ coal gasification
(c) Nickel Catalyst $\rightarrow$ water gas production .
(d) Brine solution $\rightarrow H_2 + Cl_2$ production.

Question 295

Match List I with List II

LIST I Type of Hydride				LIST II Example
A.	Electron deficient hydride	I.	MgH_2	
B.	Electron rich hydride	II.	HF	
C.	Electron precise hydride	III.	B_2H_6	
D.	Saline hydride	IV.	CH_4	

Choose the correct answer from the options given below :

A. A-III, B-II, C-IV, D-I

B. A-II, B-III, C-IV, D-I

C. A-II, B-III, C-I, D-IV

D. A-III, B-II, C-I, D-IV

Correct answer: A

Source solution

$B_2H_6 \Rightarrow e^-$ deficient hydride
$HF \Rightarrow e^-$ rich hydride
$CH_4 \Rightarrow e^-$ Precise hydride
$MgH_2 \Rightarrow$ Saline hydride

The s-Block Elements

Questions 296-296 / 1 selected / 0.3% practice weight / Historical appendix

Question 296

Match List I with List II :

	List-I Elements		List-II Properties
(a)	Li	(i)	Poor water solubility of I salt
(b)	Na	(ii)	Most abundant element in cell fluid
(c)	K	(iii)	Bicarbonate salt used in fire extinguisher
(d)	Cs	(iv)	Carbonate salt decomposes easily on heating

Choose the correct answer from the options given below :

A. (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

B. (a)-(i), (b)-(iii), (c)-(ii), (d)-(iv)

C. (a)-(iv), (b)-(ii), (c)-(iii), (d)-(i)

D. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

Correct answer: A

Source solution

(a) CsI salt is poor water soluble due to it's low hydration energy (b) $\mathbf{NaHCO_3}$ is used in fire extinguisher (c) K is most abundant element in cell fluid (d) $\mathbf{Li_2CO_3}$ decomposes easily due to high covalent character caused by small size $\mathbf{Li^+}$ cation.

Surface Chemistry

Questions 297-298 / 2 selected / 0.7% practice weight / Historical appendix

Question 297

Which of the following represent the Freundlich adsorption isotherms?

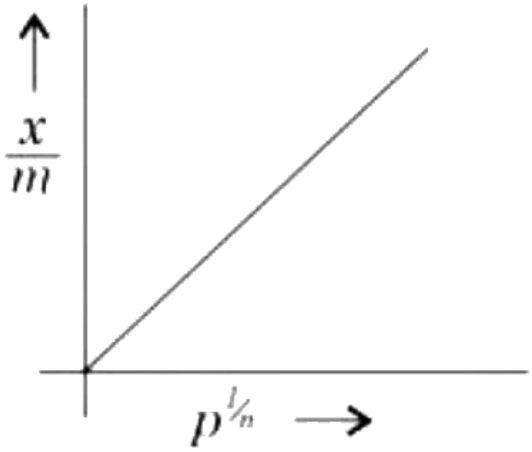
(A)

(B)

(C)

(D)

Choose the correct answer from the options given below:



A. B, C, D only

B. A, B, D only

C. A, B only

D. A, C, D only

Correct answer: B

Source solution

Sol. $\frac{x}{m} = kp^{1/n}$

and $\log \frac{x}{m} = \log k + \frac{1}{n}\log P$

Question 298

Match List I with List II

LIST I		LIST II	
A.	Physisorption	I.	Single Layer Adsorption
B.	Chemisorption	II.	$20 - 40\ \mathbf{kJ\ mol^{-1}}$
C.	$\mathbf{N_2(\ g) + 3H_2(\ g) \xrightarrow{Fe(s)} 2NH_3(\ g)}$	III.	Chromatography
D.	Analytical Application or Adsorption	IV.	Heterogeneous catalysis

Choose the correct answer from the options given below:

A. A - II, B - I, C - IV, D - III

B. A - IV, B - II, C - III, D - I

C. A - II, B - III, C - I, D - IV

D. A - III, B - IV, C - I, D - II

Correct answer: A

Source solution

Sol. 1}
Theory based

General Principles and Processes of Isolation of Elements

Questions 299-300 / 2 selected / 0.7% practice weight / Historical appendix

Question 299

Match List I with List II.

List I Ore	List II Composition
A. Siderite	I. Fe CO_3
B. Malachite	II. $CuCO_3 \cdot Cu(OH)_2$
C. Sphalerite	III. ZnS
D. Calamine	IV. $ZnCO_3$

Choose the correct answer from the options given below:

A. A-I, B-II, C-III, D-IV

B. A-III, B-IV, C-II, D-I

C. A-IV, B-III, C-I, D-II

D. A-I, B-II, C-IV, D-III

Correct answer: A

Source solution

Siderite $-FeCO_3$
Malachite $-CuCO_3 \cdot Cu(OH)_2$
Calamine - $ZnCO_3$
Sphalerite - ZnS

Question 300

Match List I with List II

LIST I		LIST II	
A.	Reverberatory furnace	I.	Pig Iron
B.	Electrolytic cell	II.	Aluminum
C.	Blast furnace	III.	Silicon
D.	Zone Refining furnace	IV.	Copper

Choose the correct answer from the options given below:

A. A-IV, B-II, C-I, D-III

B. A-I, B-III, C-II, D-IV

C. A-III, B-IV, C-I, D-II

D. A-I, B-IV, C-II, D-III

Correct answer: A

Source solution

Reverberatory furnance $\rightarrow$ Cr
Electrolysis cell $\rightarrow$ Ar
Blast furnance $\rightarrow$ Pig iron
Zone refining furnance $\rightarrow$ silicon