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PREVIOUS YEAR PAPER · 2019

OLYMPIAD · STAGE I

# NSEC

## National Standard Examination in Chemistry

# 2019

Question paper, answer key and Zigyan solutions

| 80 | 240 | 120 min | 31 |
|---|---|---|---|
| Questions | Maximum marks | Time | Paper code |

Question paper and official answer key: Indian Association of Physics Teachers (IAPT), NSEC 2019, paper code 31.
Solutions and notes: Zigyan. This booklet is not an IAPT publication.

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**Rahul Kaushik Sir**
Founder & Director, Zigyan Eduvision
23 years of teaching



## Saksham Bishnoi

4 YEARS CLASSROOM

| JEE ADVANCED 2026 | JEE MAIN 2026 |
|---|---|
| AIR 168 | AIR 811 |
| | 99.95 percentile |



## Sulokya Bibhuty

3 YEARS CLASSROOM

| JEE ADVANCED 2026 | JEE MAIN 2026 |
|---|---|
| AIR 1,315 | AIR 1,095 |
| | 99.94 percentile |

## OLYMPIAD RESULTS

Above the Minimum Admissible Score - the national band for the subject

**CHEMISTRY**

- Sulokya Bibhuty — 3 Years Classroom
- Anay Gupta — 3 Years Classroom
- Akshat Khator — 3 Years Classroom
- Harshit Goyal — 4 Years Classroom
- Hardik Sharma — 3 Years Classroom
- Aarush Kumar — 1 Year Classroom

**PHYSICS**

- Sulokya Bibhuty — 3 Years Classroom
- Saksham Bishnoi — 4 Years Classroom

**ASTRONOMY**

- Sulokya Bibhuty — 3 Years Classroom

**MATHEMATICS (IOQM)**

- Priyanshi — 4 Years Classroom

**Saksham Bishnoi** qualified the Chemistry Olympiad twice and was selected for the Orientation-cum-Selection Camp at HBCSE, Mumbai.

| 16 selections | 16 of 35 | AIR 168 |
|---|---|---|
| in JEE Advanced 2026 | students of the batch selected | best JEE Advanced rank |

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**Given in the question paper**

## Useful constants

Charge of electron, $e = 1.602 \times 10^{-19} C$

Mass of electron, $m_e = 9.1 \times 10^{-31} kg$

Planck's constant, $h = 6.626 \times 10^{-34} J\,s$

Speed of light, $c = 3.0 \times 10^{8} ms^{-1}$

Avogadro constant, $N_A = 6.022 \times 10^{23} mol^{-1}$

Molar gas constant, $R = 0.082\, L\, atm\, mol^{-1} K^{-1}$

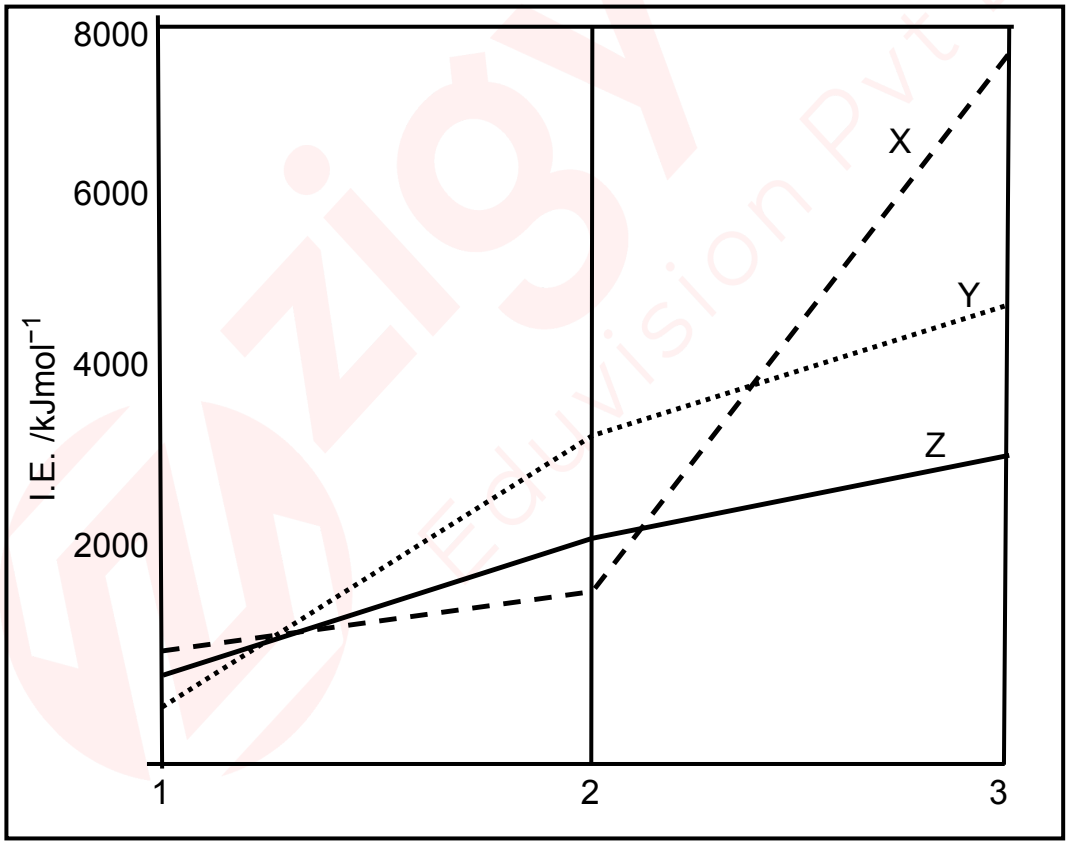
$= 8.314\, J\, mol^{-1}\, K^{-1}$

Faraday's constant, $\mathrm{F} = 96487\ C\ mol^{-1}$

## PART A-1 · ONE CORRECT OPTION

**Q. 1 – 80 · +3 for a correct answer, –1 for a wrong one**

**1.** The following qualitative plots depict the first, second and third ionization energies (I.E.) of Mg, Al and K. Among the following, the correct match of I.E. and the metal is




(A) X-Al ; Y-Mg ; Z-K

(B) X-Mg ; Y-Al ; Z-K

(C) X-Mg ; Y-K ; Z-Al

(D) X-Al; Y-K; Z-Mg

**Solution · Q1** **Answer: (C)**

Mg has the highest third ionisation energy, as this electron leaves a noble gas core.

∴ X is Mg.

K has the highest second ionisation energy, as this electron leaves a noble gas core.

∴ Y is K and Z is Aℓ.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**2.** A solid comprises of three types of elements, 'P', 'Q' and 'R'. 'P' forms an FCC lattice in which 'Q' and 'R' occupy all the tetrahedral voids and half the octahedral voids respectively. The molecular formula of the solid is

(A) $P_2Q_4R$ (B) $PQ_2R_4$ (C) $P_4Q_2R$ (D) $P_4QR$

**Solution · Q2** **Answer: (A)**

For one FCC unit cell of P:

$$P = 4$$

Q fills all the tetrahedral voids.

$$Q = 8$$

R fills half the octahedral voids.

$$R = 4/2 = 2$$

$$\Rightarrow P : Q : R = 4 : 8 : 2$$

$$\Rightarrow P : Q : R = 2 : 4 : 1$$

∴ The formula is $P_2Q_4R$.

**IAPT answer:** (A) | **Zigyan answer:** (A)

**3.** The set in which all the species are diamagnetic is

(A) $B_2$, $O_2$, NO

(B) $O_2$, $O_2^+$, CO

(C) $N_2$, $O_2^-$, $CN^-$

(D) $C_2$, $O_2^{2-}$, $NO^+$

**Solution · Q3** **Answer: (D)**

By molecular orbital theory, a diamagnetic species has no unpaired electron.

$C_2$ (12 $e^-$), $O_2^{2-}$ (18 $e^-$) and $NO^+$ (14 $e^-$) have all electrons paired.

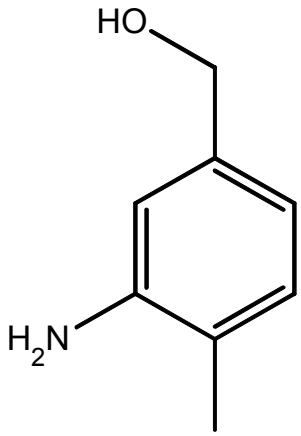
$B_2$, $O_2$, NO, $O_2^+$ and $O_2^-$ are paramagnetic.

**IAPT answer:** (D) | **Zigyan answer:** (D)

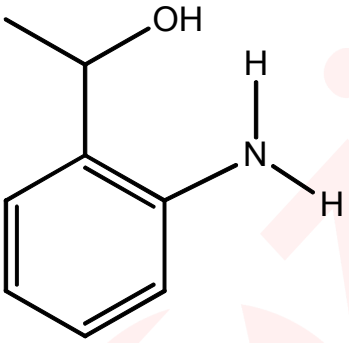
**4.** The structure of compound 'X' ($C_8H_{11}NO$) based on the following tests and observations is

| Reagent/s | Observation |
|---|---|
| Neutral $FeCl_3$ | No coloration |
| Lucas reagent | Turbidity |
| $NaNO_2$/HCl at 273 K | Yellow oil |

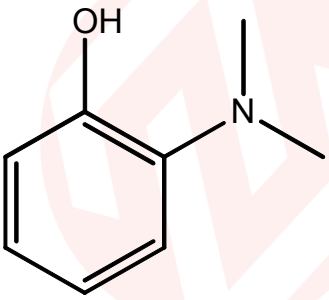
(A)



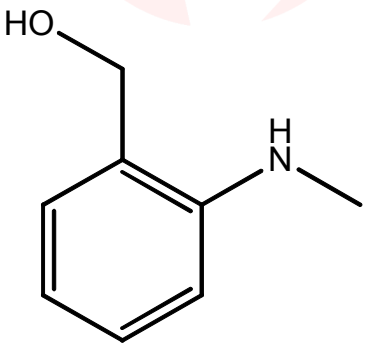

(B)




(C)




(D)



**Solution · Q4** **Answer: (D)**

No colour with neutral $FeC\ell_3$: there is no phenolic –OH group.

Turbidity with Lucas reagent: an alcoholic –OH group is present.

Yellow oil with $NaNO_2/HC\ell$: a secondary amine forms an N-nitrosamine.

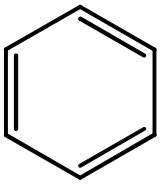
$ArNHCH_3 + HNO_2 \rightarrow ArN(NO)CH_3 + H_2O$

Only (D) has both a benzylic $-CH_2OH$ group and a secondary amine group ($-NHCH_3$).

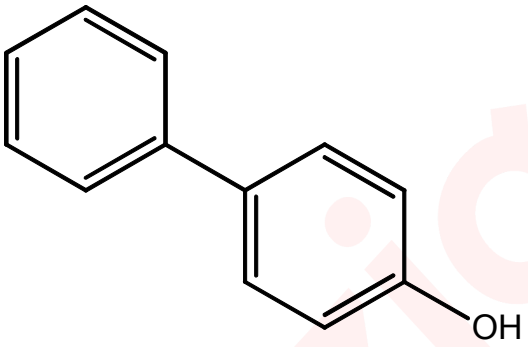
**IAPT answer:** (D) | **Zigyan answer:** (D)

**5.** Reaction of $C_6H_5MgBr$ with phenol gives

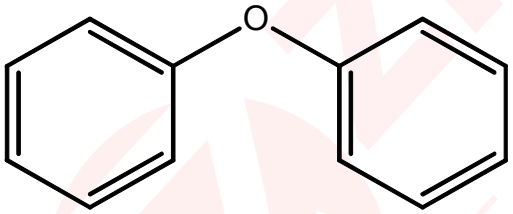
(A)



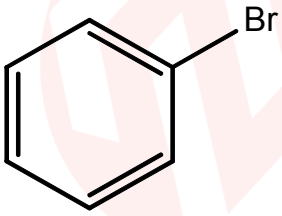
(B)




(C)




(D)




**Solution · Q5** **Answer: (A)**

The O–H hydrogen of phenol is acidic, so the Grignard reagent acts as a base.

$C_6H_5MgBr + C_6H_5OH \rightarrow C_6H_6 + C_6H_5OMgBr$

$\therefore$ Benzene is formed.

**IAPT answer:** (A) | **Zigyan answer:** (A)

**6.** The work done (kJ) in the irreversible isothermal compression of 2.0 moles of an ideal gas from 1 bar to 100 bar at 25°C at constant external pressure of 500 bar is

(A) 2452 (B) 490 (C) 2486 (D) – 490

**Solution · Q6** **Answer: (A)**

Work done on the gas against a constant external pressure:

$$w = -P_{ext}(V_2 - V_1)$$

$$w = P_{ext}nRT\left[\frac{1}{P_1} - \frac{1}{P_2}\right]$$

$$\Rightarrow w = 500 \times 2 \times 8.314 \times 298 \times \left[\frac{1}{1} - \frac{1}{100}\right] J$$

$$\Rightarrow w \approx 2.4528 \times 10^6 \text{ J}$$

$$\therefore w \approx 2452.8 \text{ kJ}$$

The matching option is 2452.

**IAPT answer:** (A) | **Zigyan answer:** (A)

**7.** The power and wavelength emitted by a laser pointer commonly used in Power Point presentations are 1.0 mW and 670 nm respectively. Number of photons emitted by this pointer during a presentation of 5 minutes is

(A) $1.01 \times 10^9$ (B) $1.01 \times 10^{21}$ (C) $1.6 \times 10^{16}$ (D) $1.01 \times 10^{18}$

**Solution · Q7** **Answer: (D)**

Energy emitted in 5 minutes:

$$E = 1.0 \times 10^{-3} \times 300 = 0.30 \text{ J}$$

Number of photons:

$$n = \frac{E\lambda}{hc}$$

$$\Rightarrow n = \frac{0.30 \times 670 \times 10^{-9}}{6.626 \times 10^{-34} \times 3.0 \times 10^8}$$

$$\Rightarrow n \approx 1.01 \times 10^{18}$$

**IAPT answer:** (D) | **Zigyan answer:** (D)

**8.** The number of stereoisomers is maximum for

(A) $[Co(en)_3]^{3+}$ (B) $[Co(en)_2ClBr]^+$

(C) $[Co(NH_3)_4Cl_2]^+$ (D) $[Co(NH_3)_4ClBr]^+$

**Solution · Q8** **Answer: (B)**

$[Co(en)_3]^{3+}$: two optical isomers, total 2.

$[Co(en)_2C\ell Br]^+$: the cis form exists as two enantiomers and the trans form is achiral, total 3.

$[Co(NH_3)_4C\ell_2]^+$ and $[Co(NH_3)_4C\ell Br]^+$: only cis and trans forms, 2 each.

**IAPT answer:** (B) | **Zigyan answer:** (B)

**9.** Which of the following is NOT correct about hydrides?

I. Saline hydrides are stoichiometric and metallic hydrides are non-stoichiometric

II. $BeH_2$ is monomeric whereas $MgH_2$ is polymeric

III. Hydrides of the elements of Group 13 are electron deficient and those of Group15 are electron rich

IV. NaH reacts with water and liberates $H_2$ whereas $B_2H_6$ does not react with water

(A) IV only (B) I and III (C) III only (D) II and IV

**Solution · Q9** **Answer: (D)**

I and III are correct statements.

II is wrong: $BeH_2$ is polymeric, not monomeric.

IV is wrong: $B_2H_6$ is readily hydrolysed by water.

$B_2H_6 + 6H_2O \rightarrow 2B(OH)_3 + 6H_2$

$\therefore$ II and IV are not correct.

**IAPT answer:** (D) | **Zigyan answer:** (D)

**10.** Atropine ($C_{17}H_{23}O_3N$) is a naturally occurring compound used to treat certain types of poisoning. The degree of unsaturation in atropine is

(A) 7 (B) 6 (C) 5 (D) 4

**Solution · Q10** **Answer: (A)**

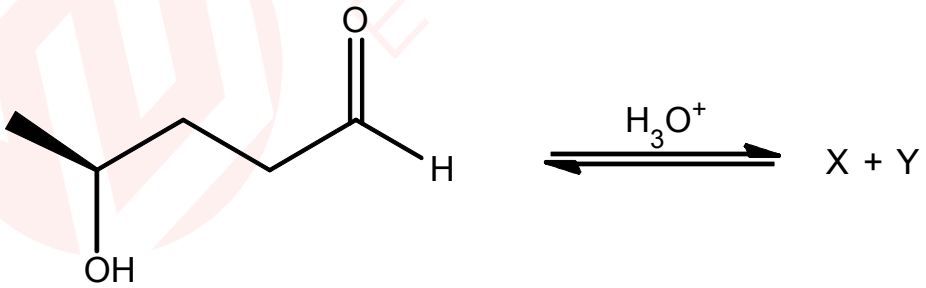
Degree of unsaturation (DU), where oxygen is not counted:

$$DU = \frac{2C + 2 + N - H}{2}$$

$$\Rightarrow DU = \frac{2 \times 17 + 2 + 1 - 23}{2} = 7$$

**IAPT answer:** (A) | **Zigyan answer:** (A)

**11.** The compounds 'X' and 'Y' formed in the following reaction are




(A) hemiacetals with identical physical and chemical properties

(B) acetals with identical physical and chemical properties

(C) hemiacetals with different physical and chemical properties

(D) acetals with different physical and chemical properties

**Solution · Q11** **Answer: (C)**

The –OH group at C-4 attacks the protonated –CHO group, giving a five-membered cyclic hemiacetal.

C-1 becomes a new chiral centre, while the configuration at C-4 is unchanged.

∴ X and Y are diastereomers.

So they differ in physical and chemical properties.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**12.** In which of the following, is a new C-C bond formed in the product?

I. $CH_3CHO \xrightarrow{\text{dil. NaOH}}$

II. $CH_3MgCl + C_2H_5OH \xrightarrow{\text{heat}}$

III. $CO_2 + CH_3MgBr \xrightarrow{H_3O^+}$

IV. $C_2H_2 + NaNH_2 \xrightarrow{CH_3Br}$

(A) I, III and IV (B) II and III (C) III only (D) III and IV

**Solution · Q12** **Answer: (A)**

I. Aldol reaction forms a new C–C bond.

$2CH_3CHO \rightarrow CH_3CH(OH)CH_2CHO$

II. This is only an acid-base reaction.

$CH_3MgC\ell + C_2H_5OH \rightarrow CH_4 + C_2H_5OMgC\ell$

III. Carboxylation, followed by acid work-up, forms a new C–C bond.

$CO_2 + CH_3MgBr \rightarrow CH_3COOMgBr$

$CH_3COOMgBr + H_3O^+ \rightarrow CH_3COOH + Mg^{2+} + Br^- + H_2O$

IV. Alkylation of the acetylide ion forms a new C–C bond.

$HC{\equiv}CH + NaNH_2 \rightarrow HC{\equiv}CNa + NH_3$

$HC{\equiv}CNa + CH_3Br \rightarrow HC{\equiv}C{-}CH_3 + NaBr$

∴ I, III and IV

**IAPT answer:** (A) | **Zigyan answer:** (A)

**13.** Aqueous solution of slaked lime, $Ca(OH)_2$, is extensively used in municipal waste water treatment. Maximum pH possible in an aqueous solution of slaked lime is

($K_{sp}$ of $Ca(OH)_2 = 5.5 \times 10^{-6}$)

(A) 1.66 (B) 8.14 (C) 12.04 (D) 12.34

**Solution · Q13** **Answer: (D)**

Maximum pH is that of the saturated solution, of solubility s.

$Ca(OH)_2 \rightleftharpoons Ca^{2+} + 2OH^-$

$$K_{sp} = 4s^3 = 5.5 \times 10^{-6}$$

$$\Rightarrow s = 1.11 \times 10^{-2}\ M$$

$$\Rightarrow [OH^-] = 2s = 2.22 \times 10^{-2}\ M$$

$$\Rightarrow pOH = 1.653$$

$$\therefore pH = 14 - 1.653 = 12.347$$

The matching option is 12.34.

**IAPT answer:** (D) | **Zigyan answer:** (D)

**14.** An electron present in the third excited state of a H atom returns to the first excited state and then to the ground state. If $\lambda_1$ and $\lambda_2$ are the wavelengths of light emitted in these two transitions respectively, $\lambda_1 : \lambda_2$ is

(A) 4:1 (B) 5: 9 (C) 3: 1 (D) 2:1

**Solution · Q14** **Answer: (A)**

Levels involved, in order:

$$n = 4, 2 \text{ and } 1$$

$$\frac{1}{\lambda_1} = R\left(\frac{1}{2^2} - \frac{1}{4^2}\right) = \frac{3R}{16}$$

$$\frac{1}{\lambda_2} = R\left(\frac{1}{1^2} - \frac{1}{2^2}\right) = \frac{3R}{4}$$

$$\therefore \lambda_1 : \lambda_2 = 4 : 1$$

**IAPT answer:** (A) | **Zigyan answer:** (A)

**15.** $MnCl_2.4H_2O$ (molar mass =198 g $mol^{-1}$) when dissolved in water forms a complex of $Mn^{2+}$. An aqueous solution containing 0.400 g of $MnCl_2.4H_2O$ was passed through a column of a cation exchange resin and the acid solution coming out was neutralized with 10 mL of 0.20 M NaOH. The formula of the complex formed is

(A) $[Mn(H_2O)_4Cl_2]$ (B) $[Mn(H_2O)_6]Cl_2$

(C) $[Mn(H_2O)_5Cl]Cl$ (D) $Na[Mn(H_2O)_3Cl_3]$

**Solution · Q15** **Answer: (C)**

Moles of salt taken:

$$n = \frac{0.400}{198} = 2.02 \times 10^{-3} \text{ mol}$$

Moles of $H^+$ released, from the NaOH used:

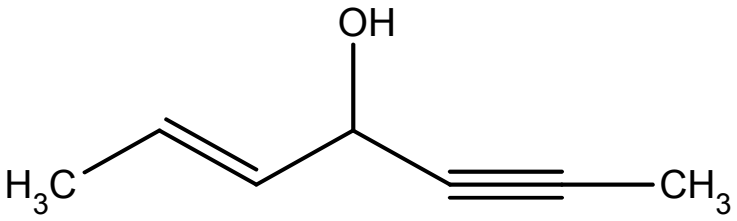
$$n(H^+) = 0.010 \times 0.20 = 2.0 \times 10^{-3} \text{ mol}$$

So one $H^+$ is released per Mn, and the complex cation has charge +1.

The complex is $[Mn(H_2O)_5C\ell]C\ell$.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**16.** IUPAC name of the following molecule is




(A) 4-hydroxyhept2-en-5-yne
(B) hept-2-en-5-yn-4-ol
(C) hept-5-en-2-yn-4-ol
(D) 4-hydroxyhept-5-en-2-yne

**Solution · Q16** **Answer: (B)**

The –OH group gets C-4 from either end.

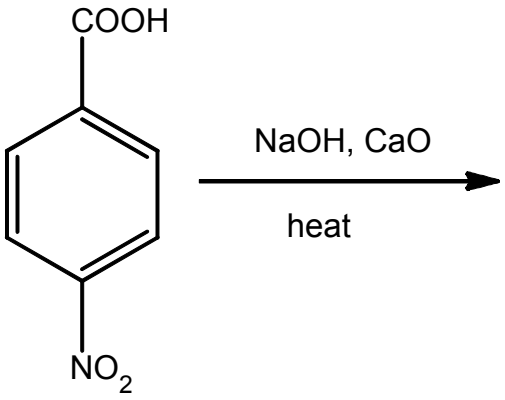
The multiple bonds get locants 2 and 5 from either end, so the double bond takes the lower one.

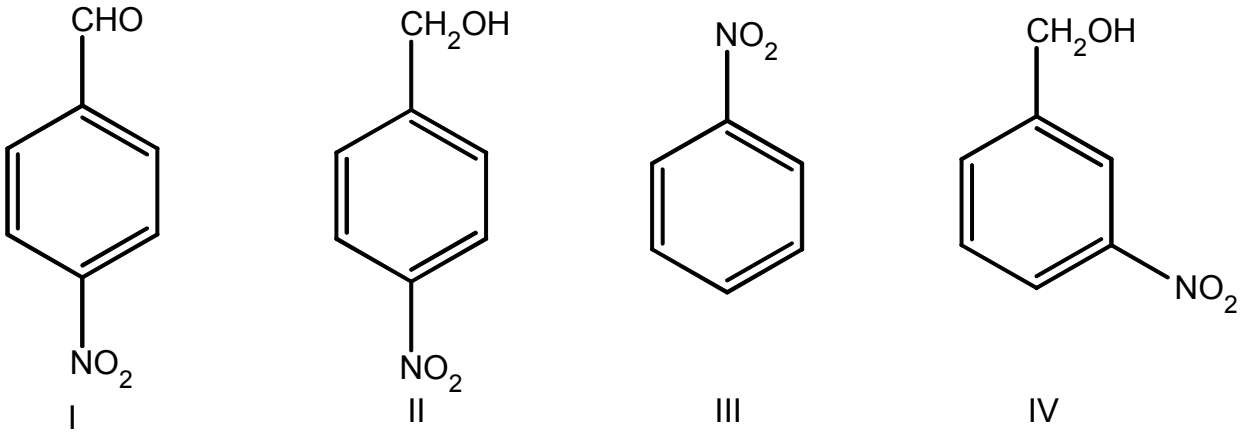
$$CH_3–CH=CH–CH(OH)–C\equiv C–CH_3$$

Name: hept-2-en-5-yn-4-ol

**IAPT answer:** (B) | **Zigyan answer:** (B)

**17.** The product/s of the following reaction is/are




(A) I and II
(B) II
(C) III
(D) IV

**Solution · Q17** **Answer: (C)**

Heating with soda lime causes decarboxylation. The $–NO_2$ group is unchanged.

$$O_2N–C_6H_4–COOH + 2NaOH \rightarrow C_6H_5NO_2 + Na_2CO_3 + H_2O$$

The product is nitrobenzene, III.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**18.** The percentage dissociation of 0.08 M aqueous acetic acid solution at 25°C is

($K_a$ of acetic acid at 25°C = $1.8 \times 10^{-5}$)

(A) 2. 92 (B) 1.5 (C) 1.2 (D) 4.8

**Solution · Q18** **Answer: (B)**

For a weak acid with very small α,

$$\alpha = \sqrt{\frac{K_a}{C}}$$

$$\Rightarrow \alpha = \sqrt{\frac{1.8 \times 10^{-5}}{0.08}} = 0.015$$

Percentage dissociation:

$$100\alpha = 1.5\%$$

**IAPT answer:** (B) | **Zigyan answer:** (B)

**19.** For which of the following processes, carried out in free space, energy will be absorbed?

I. Separating an electron from an electron

II. Removing an electron from a neutral atom

III. Separating a proton from a proton

IV. Separating an electron from a proton

(A) I only (B) II and IV (C) I and III (D) II only

**Solution · Q19** **Answer: (B)**

I and III separate like charges. These repel, so energy is released.

II is ionisation: the electron is pulled away from the positive ion left behind, so energy is absorbed.

IV separates opposite charges, which attract, so energy is absorbed.

**IAPT answer:** (B) | **Zigyan answer:** (B)

**20.** Decay of radioisotopes follows first order kinetics. Radioisotope $U^{238}$ undergoes decay to a stable isotope, $Th^{234}$. The ratio of the number of atoms of $U^{238}$ to that of $Th^{234}$ after *three* half lives is

(A) 1/3 (B) 3/4 (C) 1/4 (D) 1/7

**Solution · Q20** **As per Zigyan: (D)**

$Th^{234}$ is treated as the stable end product, as stated in the question.

Fraction of $U^{238}$ left after three half lives:

$$\left(\frac{1}{2}\right)^3 = \frac{1}{8}$$

Fraction changed into $Th^{234}$:

$$1 - \frac{1}{8} = \frac{7}{8}$$

$$\therefore U^{238} : Th^{234} = 1 : 7$$

**Reference:** NCERT Chemistry Class XII (Part I), Unit 3 'Chemical Kinetics', sections 3.3.2 and 3.3.3: radioactive decay follows first order kinetics, and a first order half-life stays constant.

**IAPT answer:** (D) | **Zigyan answer:** (D)

**21.** Myoglobin, (Mb), an oxygen storage protein, contains 0.34 % Fe by mass and in each molecule of myoglobin one ion of Fe is present. Molar mass of Mb (g $mol^{-1}$) is (Molar mass of Fe = 55.845 g $mol^{-1}$)

(A) 16407 (B) 164206 (C) 16425 (D) 164250

**Solution · Q21** **Answer: (C)**

One mole of Mb contains one mole of Fe. Molar mass of Mb:

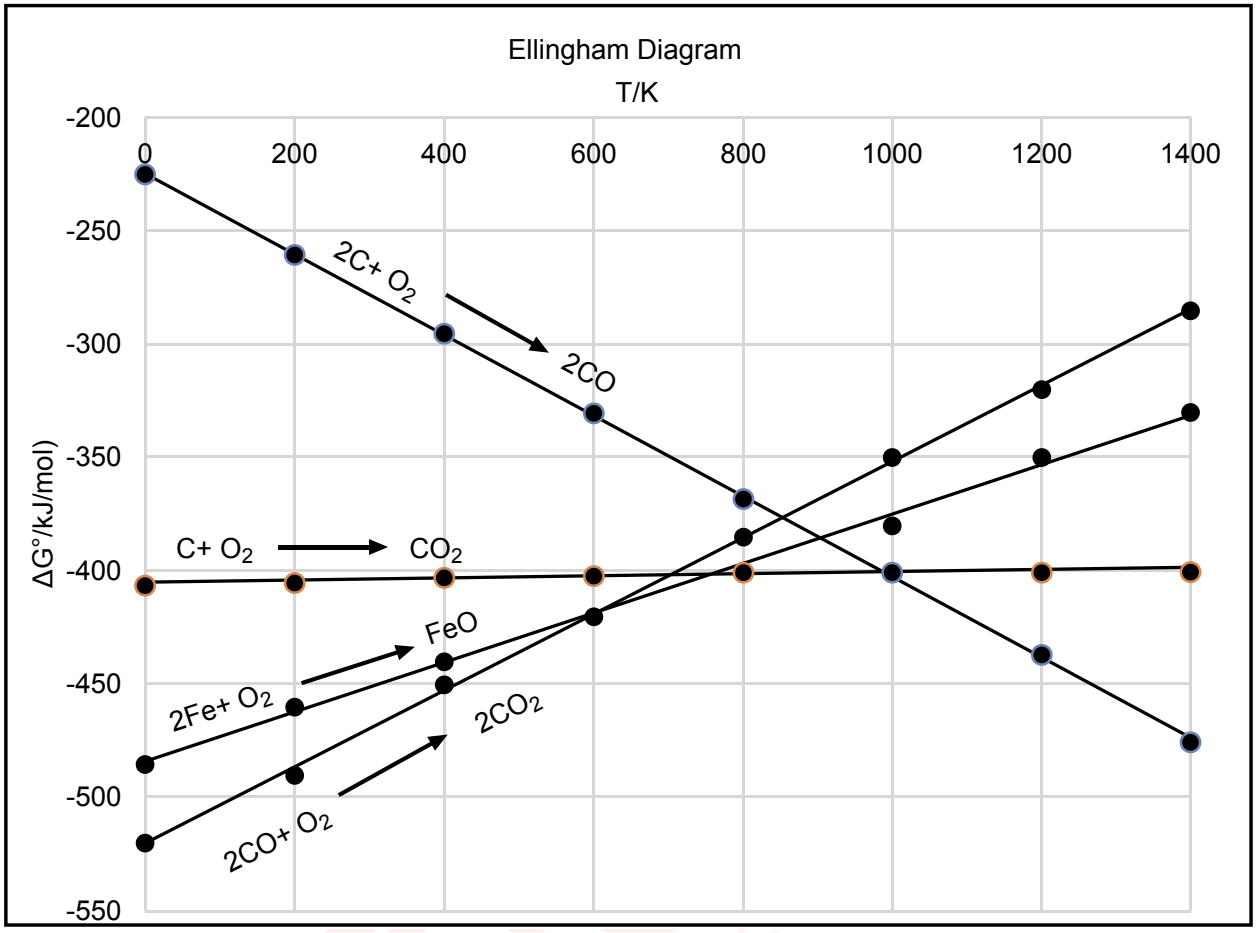
$$M = \frac{55.845 \times 100}{0.34}$$

$$\Rightarrow M = 16425 \text{ g mol}^{-1}$$

**IAPT answer:** (C) | **Zigyan answer:** (C)

**22.** The following Ellingham diagram depicts the oxidation of 'C', 'CO' and 'Fe'.

Which of the following is correct?




I. FeO can be reduced by C below 600 K

II. FeO can be reduced by CO below 600 K

III. FeO can be reduced by C above 1000 K

IV. FeO can be reduced by CO above 1000 K

(A) II and III (B) I and IV (C) I and III (D) II and IV

**Solution · Q22** **Answer: (A)**

A reductant can reduce FeO where its oxidation line lies below the line for Fe → FeO.

Below 600 K, the CO → $CO_2$ line is lower, so II is true.

Both carbon lines lie higher there, so I is false.

Above 1000 K, the C → CO line is lower, so III is true.

The CO → $CO_2$ line is higher there, so IV is false.

**IAPT answer:** (A) | **Zigyan answer:** (A)

**23.** $N^{3-}$, $F^{-}$, $Na^{+}$ and $Mg^{2+}$ have the same number of electrons. Which of them will have the smallest and the largest ionic radii respectively?

(A) $Mg^{2+}$ and $N^{3-}$ (B) $Mg^{2+}$ and $Na^{+}$ (C) $N^{3-}$ and $Na^{+}$ (D) $F^{-}$ and $N^{3-}$

**Solution · Q23** **Answer: (A)**

All four ions have 10 electrons. In an isoelectronic series, radius falls as nuclear charge rises.

Nuclear charges: N 7, F 9, Na 11, Mg 12

$$N^{3-} > F^{-} > Na^{+} > Mg^{2+}$$

So $Mg^{2+}$ is the smallest and $N^{3-}$ the largest.

**IAPT answer:** (A) | **Zigyan answer:** (A)

**24.** The reaction of 2,4-hexadiene with *one* equivalent of bromine at 0°C gives a mixture of two compounds 'X' and 'Y'. If 'X' is 4,5-dibromohex-2-ene, 'Y' is

(A) 2,5-dibromohex-2-ene (B) 2,5-dibromohex-3-ene

(C) 2,3-dibromohex-3-ene (D) 3,4- dibromohex-3-ene

**Solution · Q24** **Answer: (B)**

Bromine adds first at one end of the diene, giving a resonance-stabilised allylic cation:

$$CH_3CHBr{-}CH^{+}{-}CH{=}CHCH_3 \leftrightarrow CH_3CHBr{-}CH{=}CH{-}CH^{+}CH_3$$

$Br^{-}$ attack on the first form (1,2-addition) gives X.

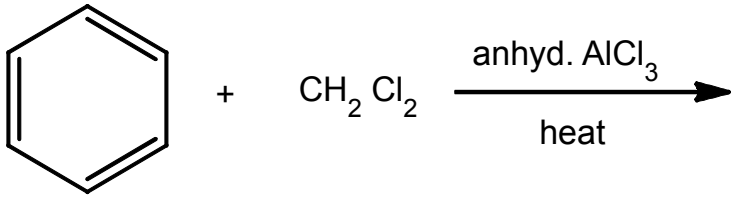
Attack on the second form (1,4-addition) gives Y:

$$CH_3CHBr{-}CH{=}CH{-}CHBrCH_3$$

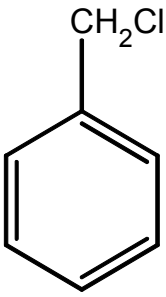
Y is 2,5-dibromohex-3-ene.

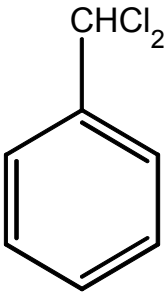
**IAPT answer:** (B) | **Zigyan answer:** (B)

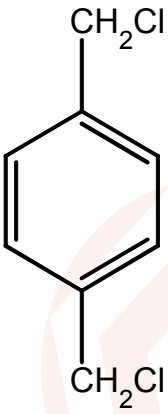
**25.** The major product of the following reaction is

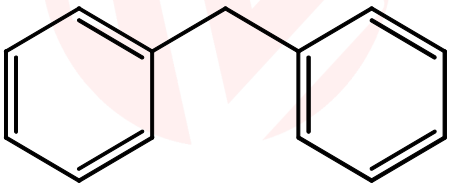



Excess

(A) 


(B) 


(C) 


(D) 

**Solution · Q25** **Answer: (D)**

With anhydrous $A\ell C\ell_3$ and excess benzene, both C–$C\ell$ bonds undergo Friedel–Crafts alkylation:

$C_6H_6 + CH_2C\ell_2 \rightarrow C_6H_5CH_2C\ell + HC\ell$

$C_6H_5CH_2C\ell + C_6H_6 \rightarrow C_6H_5CH_2C_6H_5 + HC\ell$

∴ The major product is diphenylmethane.

**IAPT answer:** (D) | **Zigyan answer:** (D)

**26.** The kinetic energy of the photoelectrons ejected by a metal surface increased from 0.6 eV to 0.9 eV when the energy of the incident photons was increased by 20 %. The work function of the metal is

(A) 0.66 eV (B) 0.72 eV (C) 0.90 eV (D) 0.30 eV

**Solution · Q26** **Answer: (C)**

By Einstein's photoelectric equation, with E as the first photon energy:

$$0.6 = E - \phi$$

$$0.9 = 1.2E - \phi$$

$$\Rightarrow 0.2E = 0.3$$

$$\Rightarrow E = 1.5 \text{ eV}$$

$$\Rightarrow \phi = 1.5 - 0.6$$

$$\Rightarrow \phi = 0.9 \text{ eV}$$

**IAPT answer:** (C) | **Zigyan answer:** (C)

**27.** An electrochemical cell was constructed with $Fe^{2+}/Fe$ and $Cd^{2+}/Cd$ at 25°C with initial concentrations of $[Fe^{2+}] = 0.800$ M and $[Cd^{2+}] = 0.250$ M. The EMF of the cell when $[Cd^{2+}]$ becomes 0.100 M is

| Half cell | $E^0$ (V) |
|---|---|
| $Fe^{2+}(aq) / Fe(s)$ | − 0.44 |
| $Cd^{2+}(aq) / Cd(s)$ | − 0.40 |

(A) 0.013 V (B) 0.011 V (C) 0.051 V (D) 0.022 V

**Solution · Q27** **Answer: (B)**

Cd is the cathode and Fe is the anode.

$Fe + Cd^{2+} \rightarrow Fe^{2+} + Cd$

$$E^\circ_{cell} = -0.40 - (-0.44) = 0.04 \text{ V}$$

Taking equal volumes of the two solutions,

$$[Fe^{2+}] = 0.800 + (0.250 - 0.100) = 0.950 \text{ M}$$

By the Nernst equation,

$$E = 0.04 - \frac{0.0591}{2}\log\left(\frac{0.950}{0.100}\right)$$

$$\Rightarrow E = 0.04 - 0.0289$$

$$\Rightarrow E = 0.011 \text{ V}$$

**IAPT answer:** (B) | **Zigyan answer:** (B)

**28.** The alkene ligand ($\pi$ -$C_2R_4$) is both a 'σ' donor and a 'π' acceptor, similar to the CO ligand in metal carbonyls, and exhibits synergic bonding with metals. Correct order of C-C bond length in $K[PtCl_3(\pi\text{-}C_2R_4)]$ complexes in which R = H, F or CN is

(A) H > F > CN (B) H > CN > F (C) CN > F > H (D) F > H > CN

**Solution · Q28** **Answer: (C)**

Back donation from the metal into the π* orbital of the alkene weakens and lengthens the C–C bond.

A more electron-withdrawing R lowers this orbital, so back donation increases.

Electron-withdrawing power: CN > F > H

∴ C–C bond length: CN > F > H

**IAPT answer:** (C) | **Zigyan answer:** (C)

**29.** The correct order of CFSE among $[Zn(NH_3)_4]^{2+}$, $[Co(NH_3)_6]^{2+}$ and $[Co(NH_3)_6]^{3+}$ is

(A) $[Co(NH_3)_6]^{3+} > [Co(NH_3)_6]^{2+} > [Zn(NH_3)_4]^{2+}$

(B) $[Zn(NH_3)_4]^{2+} > [Co(NH_3)_6]^{2+} > [Co(NH_3)_6]^{3+}$

(C) $[Co(NH_3)_6]^{3+} > [Zn(NH_3)_4]^{2+} > [Co(NH_3)_6]^{2+}$

(D) $[Co(NH_3)_6]^{2+} > [Co(NH_3)_6]^{3+} > [Zn(NH_3)_4]^{2+}$

**Solution · Q29** **Answer: (A)**

$[Zn(NH_3)_4]^{2+}$: $d^{10}$, tetrahedral

$$CFSE = 0$$

$[Co(NH_3)_6]^{2+}$: $d^7$, high spin, $t_{2g}^5\, e_g^2$

$$CFSE = -0.8\Delta_o$$

$[Co(NH_3)_6]^{3+}$: $d^6$, low spin, $t_{2g}^6\, e_g^0$

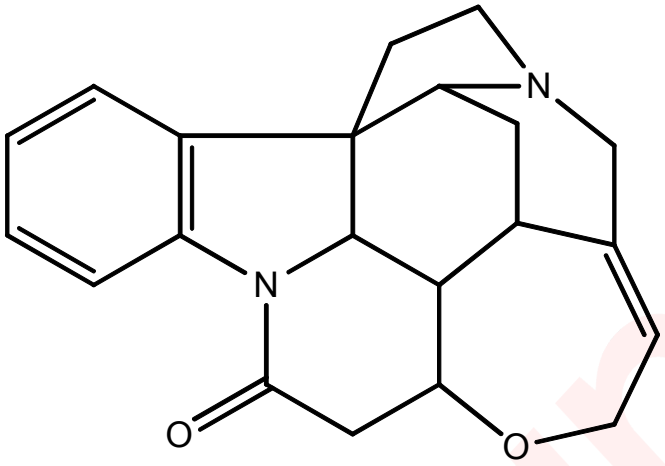
$$CFSE = -2.4\Delta_o + 2P$$

$\Delta_o$ is also larger for $Co^{3+}$.

$$\therefore [Co(NH_3)_6]^{3+} > [Co(NH_3)_6]^{2+} > [Zn(NH_3)_4]^{2+}$$

**IAPT answer:** (A) | **Zigyan answer:** (A)

**30.** The number of asymmetric carbon atoms in strychnine, whose structure given below is




Strychnine

(A) 5 (B) 4 (C) 6 (D) 7

**Solution · Q30** **Answer: (C)**

Count the $sp^3$ carbons carrying four different groups:

(i) the carbon bonded to four other carbons

(ii) the CH between carbon (i) and the upper N

(iii) the CH between carbon (i) and the amide N

(iv) the CH bonded to the ether O

(v) the CH joined to carbons (iii) and (iv)

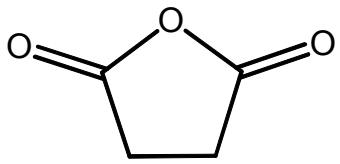
(vi) the CH next to the C=C bond

∴ There are 6 asymmetric carbons.

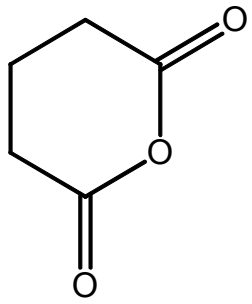
**IAPT answer:** (C) | **Zigyan answer:** (C)

**31.** When acid 'X' is heated to 230°C, along with $CO_2$ and $H_2O$, a compound 'Y' is formed. If 'X' is $HOOC(CH_2)_2CH(COOH)_2$, the structure of 'Y' is

(A) $HOOC(CH_2)_3COOH$

(B) 

(C) $CH_3CH_2CH(COOH)_2$

(D) 

**Solution · Q31** **Answer: (D)**

The two –COOH groups on the same carbon lose one $CO_2$ on heating:

$HOOC(CH_2)_2CH(COOH)_2 \rightarrow HOOC(CH_2)_3COOH + CO_2$

Glutaric acid then loses water to form a six-membered cyclic anhydride:

$HOOC(CH_2)_3COOH \rightarrow C_5H_6O_3 + H_2O$

∴ Y is glutaric anhydride.

**IAPT answer:** (D) | **Zigyan answer:** (D)

**32.** Number of products formed (ignoring stereoisomerism) in the monochlorination of ethylcyclohexane is

(A) 6 (B) 8 (C) 5 (D) 4

**Solution · Q32** **Answer: (A)**

Count the different types of hydrogen in ethylcyclohexane.

Ethyl group ($CH_2$ and $CH_3$): 2 positions

Ring (C-1, C-2 or C-6, C-3 or C-5, C-4): 4 positions

∴ 6 monochloro products are formed.

**IAPT answer:** (A) | **Zigyan answer:** (A)

**33.** Molten NaCl is electrolysed for 35 minutes with a current of 3.50 A at 40°C and 1 bar pressure. Volume of chlorine gas evolved in this electrolysis is

(A) 0.016 L (B) 0.98 L (C) 9.8 L (D) 1.96 L

**Solution · Q33** **Answer: (B)**

Charge passed:

$$Q = 3.50 \times 35 \times 60 = 7350\ C$$

At the anode:

$2C\ell^- \rightarrow C\ell_2 + 2e^-$

$$n_{C\ell_2} = \frac{7350}{2 \times 96500} = 0.0381 \text{ mol}$$

At 313 K and 1 bar:

$$V = nRT/P$$

$$\Rightarrow V = 0.0381 \times 0.083 \times 313$$

$$\Rightarrow V = 0.99 \text{ L}$$

$\therefore$ The nearest option is 0.98 L.

**IAPT answer:** (B) | **Zigyan answer:** (B)

**34.** A balance having a precision of 0.001 g was used to measure a mass of a sample of about 15 g. The number of significant figures to be reported in this measurement is

(A) 2 (B) 3 (C) 5 (D) 1

**Solution · Q34** **Answer: (C)**

A precision of 0.001 g means the mass is recorded up to the third decimal place, for example:

15.000 g

All five digits are significant.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**35.** Which of the following pairs of compounds can be stable while retaining the identity of each compound in the pair over a period of time?

I. $FeCl_3$, $SnCl_2$

II. $HgCl_2$, $SnCl_2$

III. $FeCl_2$, $SnCl_2$

IV. $FeCl_3$, KI

(A) I only (B) I and III (C) III only (D) II and IV

**Solution · Q35** **Answer: (C)**

A pair stays unchanged only if no redox reaction occurs.

I: $2FeC\ell_3 + SnC\ell_2 \rightarrow 2FeC\ell_2 + SnC\ell_4$

II: $2HgC\ell_2 + SnC\ell_2 \rightarrow Hg_2C\ell_2 + SnC\ell_4$

III: $FeC\ell_2$ and $SnC\ell_2$ do not react.

IV: $2FeC\ell_3 + 2KI \rightarrow 2FeC\ell_2 + I_2 + 2KC\ell$

$\therefore$ Only pair III is stable.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**36.** Which of the following is correct about the isoelectronic species, $Li^+$ and $H^-$ ?

I. $H^-$ is larger in size than $Li^+$

II. $Li^+$ is a better reducing agent than $H^-$

III. It requires more energy to remove an electron from $H^-$ than from $Li^+$

IV. The chemical properties of the two ions are the same

(A) I only (B) II and III (C) I, II and IV (D) I and II

**Solution · Q36** **Answer: (A)**

Both ions have 2 electrons. The nuclear charge is +3 in $Li^+$ and +1 in $H^-$.

I: $H^-$ is larger, so true.

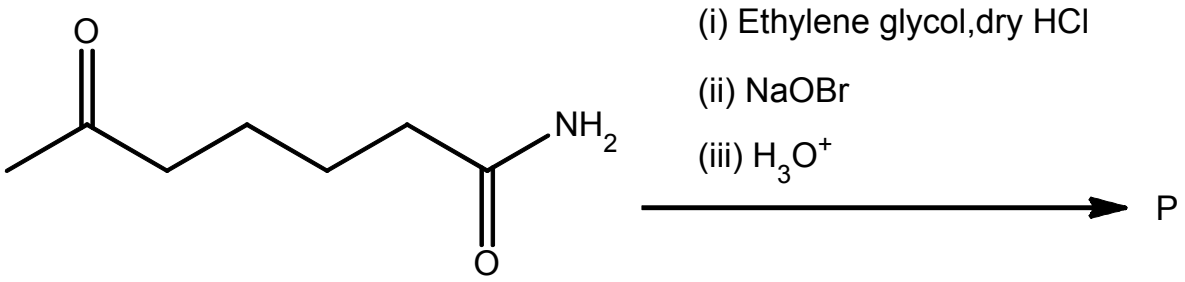
II: $H^-$ gives up an electron easily and is the better reducing agent, so false.

III: $Li^+$ holds its electrons more tightly, so false.

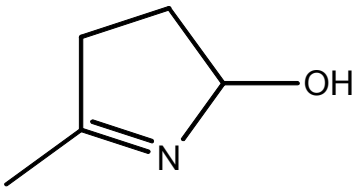
IV: Their chemical properties differ, so false.

**IAPT answer:** (A) | **Zigyan answer:** (A)

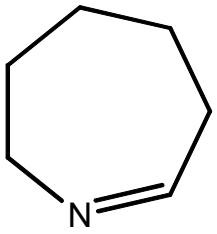
**37.** The major product 'P' formed in the following sequence of reactions is



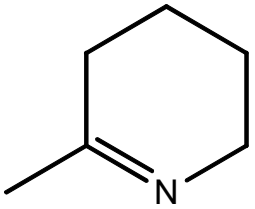

(A)



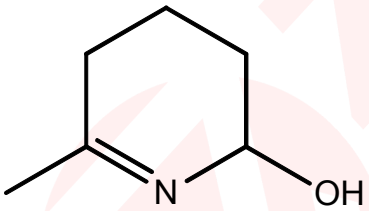

(B)




(C)




(D)




**Solution · Q37** **Answer: (C)**

(i) The keto group is protected as a cyclic ketal.

(ii) By Hofmann bromamide degradation, $-CONH_2$ changes to $-NH_2$ with loss of one carbon.

(iii) $H_3O^+$ removes the ketal:

$CH_3CO(CH_2)_4NH_2$

The $-NH_2$ group condenses with C=O inside the molecule, losing water.

P is the six-membered cyclic imine, 2-methyl-3,4,5,6-tetrahydropyridine.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**38.** Sodium lauryl sulphate (SLS) is a surface active agent, which is adsorbed on water surface. The number of molecules of SLS that can be adsorbed on the surface of a spherical water droplet of diameter 3.5 mm is

(effective area of one molecule of SLS = 4.18 $nm^2$)

(A) $9.20 \times 10^{12}$ (B) $9.20 \times 10^{18}$ (C) $1.15 \times 10^{12}$ (D) $3.68 \times 10^{13}$

**Solution · Q38** **Answer: (A)**

Surface area of the droplet:

$$A = \pi d^2 = \pi \times (3.5 \times 10^6 \text{ nm})^2$$

$$\Rightarrow A = 3.85 \times 10^{13} \text{ nm}^2$$

Number of molecules:

$$N = \frac{3.85 \times 10^{13}}{4.18}$$

$$\Rightarrow N = 9.2 \times 10^{12}$$

**IAPT answer:** (A) | **Zigyan answer:** (A)

**39.** The reaction $xX(g) \rightleftharpoons yY(g) + zZ(g)$ was carried out at a certain temperature with an initial pressure of X= 30 bar. Initially 'Y' and 'Z' were not present. If the equilibrium partial pressures of 'X', 'Y' and 'Z' are 20, 5 and 10 bar respectively x: y: z is

(A) 4:1:2 (B) 2:1:2 (C) 1:2:1 (D) 1:1:2

**Solution · Q39** **Answer: (B)**

Fall in pressure of X:

$$30 - 20 = 10 \text{ bar}$$

Y and Z formed are 5 bar and 10 bar.

Pressure changes are in the ratio of the coefficients:

$$x : y : z = 10 : 5 : 10$$

$$\Rightarrow x : y : z = 2 : 1 : 2$$

**IAPT answer:** (B) | **Zigyan answer:** (B)

**40.** The unit of Planck's constant, 'h', is the same as that of

(A) angular momentum (B) energy (C) wavelength (D) frequency

**Solution · Q40** **Answer: (A)**

By Planck's relation,

$$h = E/v$$

Unit of h:

$$J/s^{-1} = J\ s = kg\ m^2\ s^{-1}$$

Unit of angular momentum, mvr:

$kg\ m^2\ s^{-1}$

**IAPT answer:** (A) | **Zigyan answer:** (A)

**41.** A commercial sample of oleum ($H_2S_2O_7$) labeled as '106.5 % oleum' contains 6.5 g of water. The percentage of free $SO_3$ in this oleum sample is

(A) 2.88 (B) 28.8 (C) 0.029 (D) 0.28

**Solution · Q41** **As per Zigyan: (B)**

The label 106.5 % means that 100 g of this oleum needs 6.5 g of water to give 106.5 g of $H_2SO_4$.

This water reacts with the free $SO_3$:

$SO_3 + H_2O \rightarrow H_2SO_4$

Mass of $SO_3$ in 100 g of oleum:

$$m = \frac{6.5 \times 80}{18}$$

$$\Rightarrow m = 28.9 \text{ g}$$

$\therefore$ free $SO_3$ is about 28.9 %, listed as 28.8 in option (B).

**Check:** the other 71.1 g is $H_2SO_4$; 28.9 g of $SO_3$ gives about 35.4 g more acid, a total of 106.5 g.

**IAPT answer:** (B) | **Zigyan answer:** (B)

**42.** Among the following, the complex ion/s that will have a magnetic moment of 2.82 B.M. is /are

I. $[Ni(CO)_4]$

II. $[NiCl_4]^{2-}$

III. $[Ni(H_2O)_6]^{2+}$

IV. $[Ni(CN)_4]^{2-}$

(A) I and IV (B) II only (C) II and III (D) II, III and IV

**Solution · Q42** **Answer: (C)**

Spin-only magnetic moment:

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

For 2.82 B.M.,

$$n = 2$$

I. Ni(0), $3d^{10}$:

$$n = 0$$

II. $Ni^{2+}$, $3d^8$, tetrahedral with weak field $C\ell^-$:

$$n = 2$$

III. $Ni^{2+}$, octahedral:

$$t_{2g}^6 e_g^2, \; n = 2$$

IV. $Ni^{2+}$, square planar with strong field $CN^-$:

$$n = 0$$

∴ II and III

**IAPT answer:** (C) | **Zigyan answer:** (C)

**43.** A suboxide of carbon, $C_3O_2$, has a linear structure. Which of the following is correct about $C_3O_2$?

I. Oxidation state of all three C atoms is +2

II. Oxidation state of the central C atom is zero

III. The molecule contains 4 σ and 4 π bonds

IV. Hybridization of the central carbon atom is $sp^2$

(A) I and IV (B) II and III (C) II and IV (D) III only

**Solution · Q43** **Answer: (B)**

Structure: O=C=C=C=O

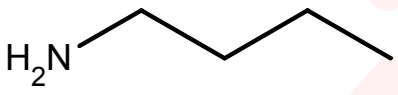
Each end C is +2 and the central C is 0, so I is false and II is true.

The four double bonds give 4 σ and 4 π bonds, so III is true.

The central C has two σ bonds and no lone pair, so it is sp; IV is false.

**IAPT answer:** (B) | **Zigyan answer:** (B)

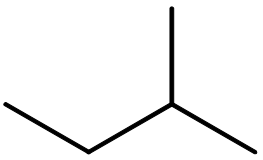
**44.** Among the following, the compounds with highest and lowest boiling points respectively are



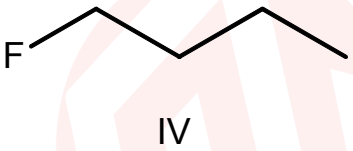

I



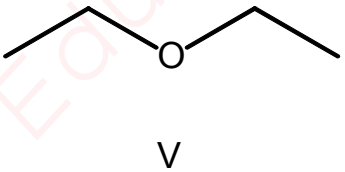

II



III




IV




V

(A) I and III (B) II and III (C) I and IV (D) II and V

**Solution · Q44** **Answer: (B)**

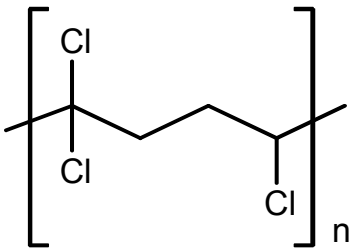
II (butan-1-ol) has the strongest intermolecular hydrogen bonding, since O–H is more polar than the N–H bond in I. Its boiling point is the highest.

III (2-methylbutane) is a non-polar, branched alkane with only weak van der Waals forces. Its boiling point is the lowest.

**IAPT answer:** (B) | **Zigyan answer:** (B)

**45.** Saran wrap, a polymer used in food packaging is a copolymer of 1, 1-dichloroethene and vinyl chloride. In the chain initiation step, 1, 1-dichloroethene generates a free radical which reacts with vinyl chloride. Structure of Saran wrap is

(A)

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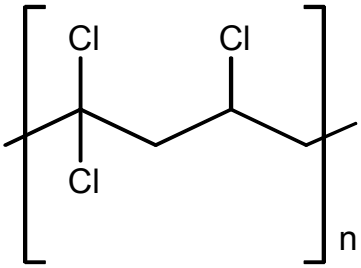
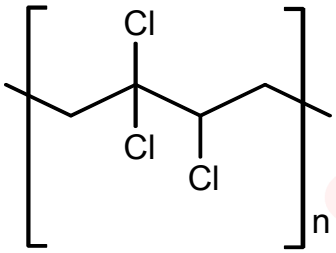
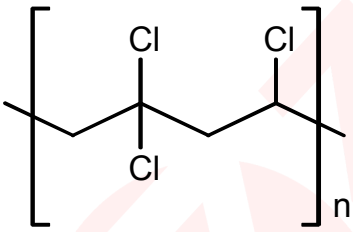



(C)




(D)




**Solution · Q45** **As per Zigyan: (D)**

A radical R• adds to the $CH_2$ end of 1,1-dichloroethene, giving the more stable radical:

$R–CH_2–CC\ell_2•$

This radical adds to the $CH_2$ end of vinyl chloride:

$R–CH_2–CC\ell_2–CH_2–CHC\ell•$

Repeating unit, written from the initiation end:

$–[CH_2–CC\ell_2–CH_2–CHC\ell]_n–$

**Reference:** OpenStax Organic Chemistry, section 8.10 'Radical Additions to Alkenes: Chain-Growth Polymers': when a radical adds to an unsymmetrical vinyl monomer, the more highly substituted radical is formed.

**IAPT answer:** (D) | **Zigyan answer:** (D)

**46.** At 25°C $K_a$ of $HPO_4^{2-}$ and $HSO_3^-$ are $4.8 \times 10^{-13}$ and $6.3 \times 10^{-8}$ respectively. Which of the following is correct?

(A) $HPO_4^{2-}$ is a stronger acid than $HSO_3^-$ and $PO_4^{3-}$ is a weaker base than $SO_3^{2-}$

(B) $HPO_4^{2-}$ is a weaker acid than $HSO_3^-$ and $PO_4^{3-}$ is a weaker base than $SO_3^{2-}$

(C) $HPO_4^{2-}$ is a weaker acid than $HSO_3^-$ and $PO_4^{3-}$ is a stronger base than $SO_3^{2-}$

(D) $HPO_4^{2-}$ is a stronger acid than $HSO_3^-$ and $PO_4^{3-}$ is a stronger base than $SO_3^{2-}$

**Solution · Q46** **Answer: (C)**

A smaller $K_a$ means a weaker acid:

$$4.8 \times 10^{-13} < 6.3 \times 10^{-8}$$

So $HPO_4^{2-}$ is a weaker acid than $HSO_3^-$.

The weaker acid has the stronger conjugate base, so $PO_4^{3-}$ is a stronger base than $SO_3^{2-}$.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**47.** The change in internal energy ($\Delta U$) for the reaction $H_2(g) + Br_2(g) \rightarrow 2HBr(l)$ when 2.0 moles each of $Br_2$ (g) and $H_2$ (g) react is

($H_2$ (g) + $Br_2$ (g) → 2HBr (g); $\Delta H_{reaction} = -109$ kJ; $\Delta H_{vap}$ of HBr = 213 kJ $mol^{-1}$)

(A) − 644 kJ (B) 644 kJ (C) − 322 kJ (D) − 1070 kJ

**Solution · Q47** **As per Zigyan: no option is correct**

Condensing each mole of HBr releases 213 kJ. For the formation of liquid HBr:

$$\Delta H = -109 - 2 \times 213 = -535 \text{ kJ}$$

For 2 mol each of $H_2$ and $Br_2$:

$$\Delta H = 2 \times (-535) = -1070 \text{ kJ}$$

Gaseous moles change from 4 to 0:

$$\Delta n_g = -4$$

At 298 K:

$$\Delta U = \Delta H - \Delta n_g RT$$

$$\Delta U = -1070 + 4 \times 8.314 \times 10^{-3} \times 298$$

$$\Rightarrow \Delta U \approx -1060 \text{ kJ}$$

The value −1070 kJ is ΔH, not ΔU.

**Reference:** NCERT Chemistry Class XI (Part I), Unit 5 'Thermodynamics', section 5.2.2: for reactions involving gases, ΔH exceeds ΔU by $\Delta n_g RT$, where $\Delta n_g$ is the gaseous moles of products minus those of reactants.

**IAPT answer:** question dropped by IAPT | **Zigyan answer:** none of the options is correct

**48.** About sea water, which of the following statement/s is/are correct?

I. Frozen sea water melts at a lower temperature than pure ice

II. Boiling point of sea water increases as it evaporates

III. Sea water boils at a lower temperature than fresh water

IV. Density of sea water at STP is same as that of fresh water

(A) I only (B) I and II (C) I, II and III (D) III only

**Solution · Q48** **Answer: (B)**

Dissolved salts lower the freezing point, so frozen sea water melts at a lower temperature than pure ice. I is true.

As water evaporates, the salt concentration rises and so does the boiling point. II is true.

Sea water boils at a higher temperature than fresh water, so III is false.

Dissolved salts make sea water denser, so IV is false.

**IAPT answer:** (B) | **Zigyan answer:** (B)

**49.** Which of the following species has *one* lone pair of electrons on the central atom?

(A) $ClF_3$ (B) $I_3^-$ (C) $I_3^+$ (D) $SF_4$

**Solution · Q49** **Answer: (D)**

Lone pairs on the central atom:

$C\ell F_3$: $(7 - 3)/2 = 2$

$I_3^-$: $(7 + 1 - 2)/2 = 3$

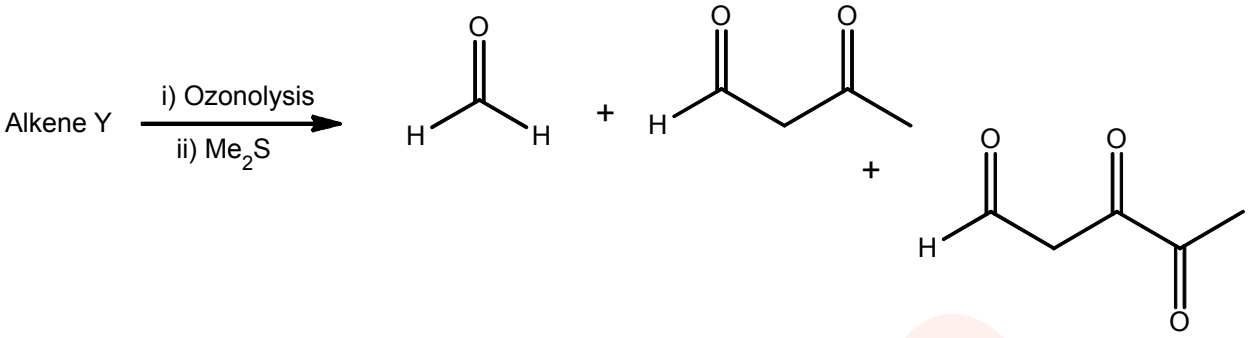
$I_3^+$: $(7 - 1 - 2)/2 = 2$

$SF_4$: $(6 - 4)/2 = 1$

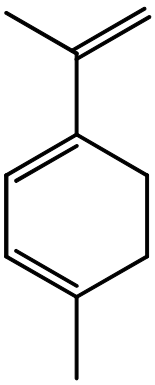
$\therefore$ Only $SF_4$ has one lone pair.

**IAPT answer:** (D) | **Zigyan answer:** (D)

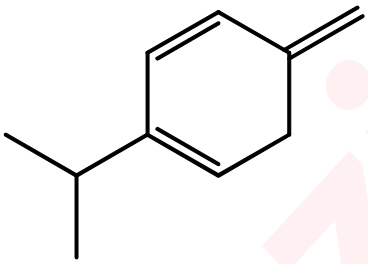
**50.** The alkene 'Y' in the following reaction is



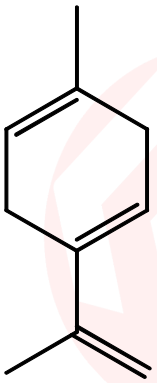

(A)



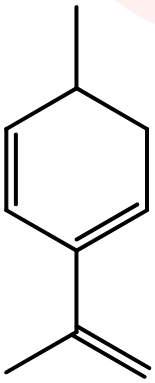
(B)



(C)



(D)



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**Solution · Q50** **Answer: (C)**

Ozonolysis cuts every C=C bond and puts an O atom on each of the two carbons.

In (C), the side-chain double bond gives HCHO and leaves a $CH_3CO$ group.

Cutting the two ring double bonds splits the ring into:

$OHC–CH_2–COCH_3$

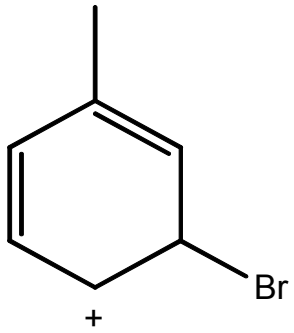
$OHC–CH_2–CO–COCH_3$

∴ All three given products are obtained, so Y is (C).

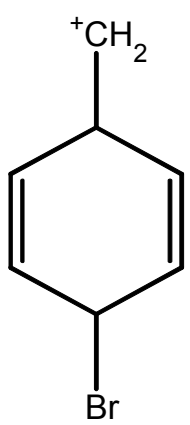
**IAPT answer:** (C) | **Zigyan answer:** (C)

**51.** The structure that represents the major intermediate formed in the bromination of toluene is

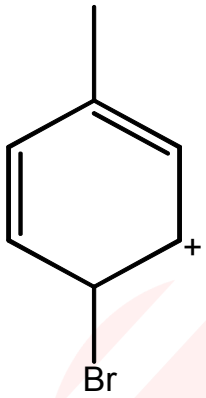
(A)



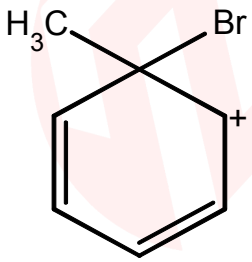

(B)




(C)




(D)




**Solution · Q51** **Answer: (C)**

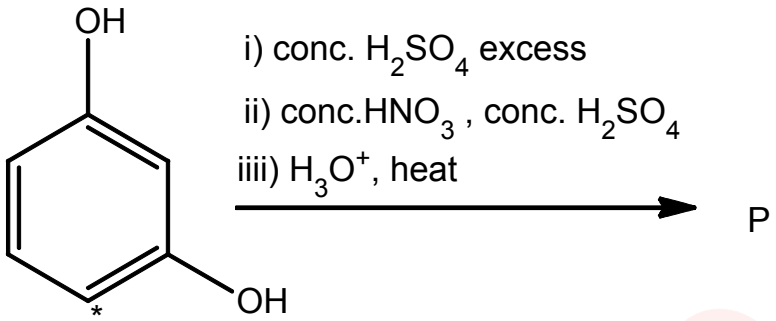
$CH_3$ is ortho/para directing, so $Br^+$ attacks mainly at the para position.

In the arenium ion formed, the positive charge is shared by both carbons ortho to Br and by the carbon carrying $CH_3$.

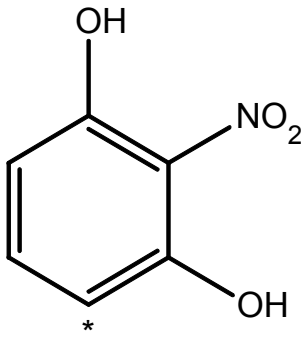
∴ (C) is a resonance structure of this para intermediate.

**IAPT answer:** (C) | **Zigyan answer:** (C)

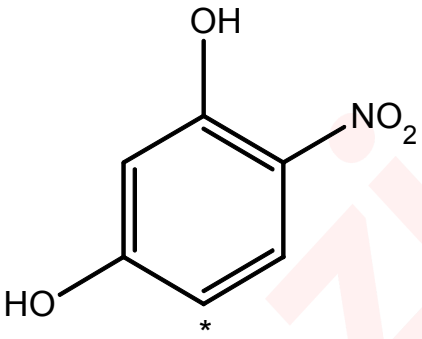
**52.** The major product 'P' formed in the following reaction is (* denotes radioactive carbon)



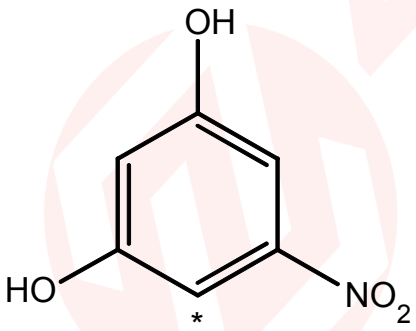

(A)



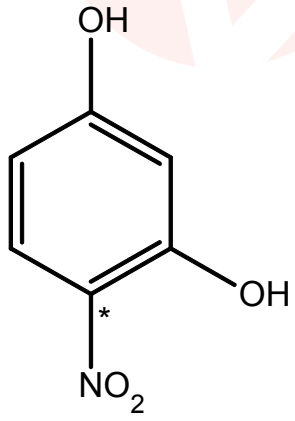

(B)




(C)




(D)

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**Solution · Q52** **Answer: (A)**

(i) Excess conc. $H_2SO_4$ sulphonates C4 and C6; each is ortho to one OH and para to the other.

(ii) With these sites blocked, $NO_2$ enters C2, between the two OH groups.

(iii) $H_3O^+$ on heating removes both $SO_3H$ groups.

The labelled carbon stays at C4.

∴ P is 2-nitrobenzene-1,3-diol with the label at C4.

**IAPT answer:** (A) | **Zigyan answer:** (A)

**53.** If the standard electrode potentials of $Fe^{3+}$/ Fe and $Fe^{2+}$/ Fe are – 0.04V and – 0.44 V respectively, then that of $Fe^{3+}$/ $Fe^{2+}$ is

(A) 0.76 V (B) – 0.76 V (C) 0.40 V (D) – 0.40 V

**Solution · Q53** **Answer: (A)**

For each half reaction,

$$\Delta G^\circ = -nFE^\circ$$

The required half reaction is:

$Fe^{3+} + e^- \rightarrow Fe^{2+}$

It equals ($Fe^{3+} \rightarrow Fe$) minus ($Fe^{2+} \rightarrow Fe$), so their $\Delta G^\circ$ values subtract.

$$-FE^\circ = -3F(-0.04) + 2F(-0.44)$$

$$\Rightarrow E^\circ = 3(-0.04) - 2(-0.44)$$

$$\therefore E^\circ = 0.76\ V$$

**IAPT answer:** (A) | **Zigyan answer:** (A)

**54.** Given below is the data for the reaction $2NO\ (g) \rightleftharpoons N_2\ (g) + O_2\ (g)$

where '$k_f$' and '$k_b$' are rate constants of the forward and reverse reactions respectively

| Temperature (K) | $k_f (mol^{-1}\ dm^3\ s^{-1})$ | $k_b\ (mol^{-1}\ dm^3\ s^{-1})$ |
|---|---|---|
| 1400 | 0.20 | $1.1 \times 10^{-6}$ |
| 1500 | 1.3 | $1.4 \times 10^{-5}$ |

The reaction is

(A) exothermic and $K_{eq}$ at 1400 K = $3.79 \times 10^{-6}$

(B) endothermic and $K_{eq}$ at 1400 K = $2.63 \times 10^{-5}$

(C) exothermic and $K_{eq}$ at 1400 K = $1.8 \times 10^{5}$

(D) endothermic and $K_{eq}$ at 1500 K = $9.28 \times 10^{-4}$

**Solution · Q54** **Answer: (C)**

At equilibrium,

$$K_{eq} = \frac{k_f}{k_b}$$

At 1400 K:

$$K_{eq} = \frac{0.20}{1.1 \times 10^{-6}} \approx 1.8 \times 10^{5}$$

At 1500 K:

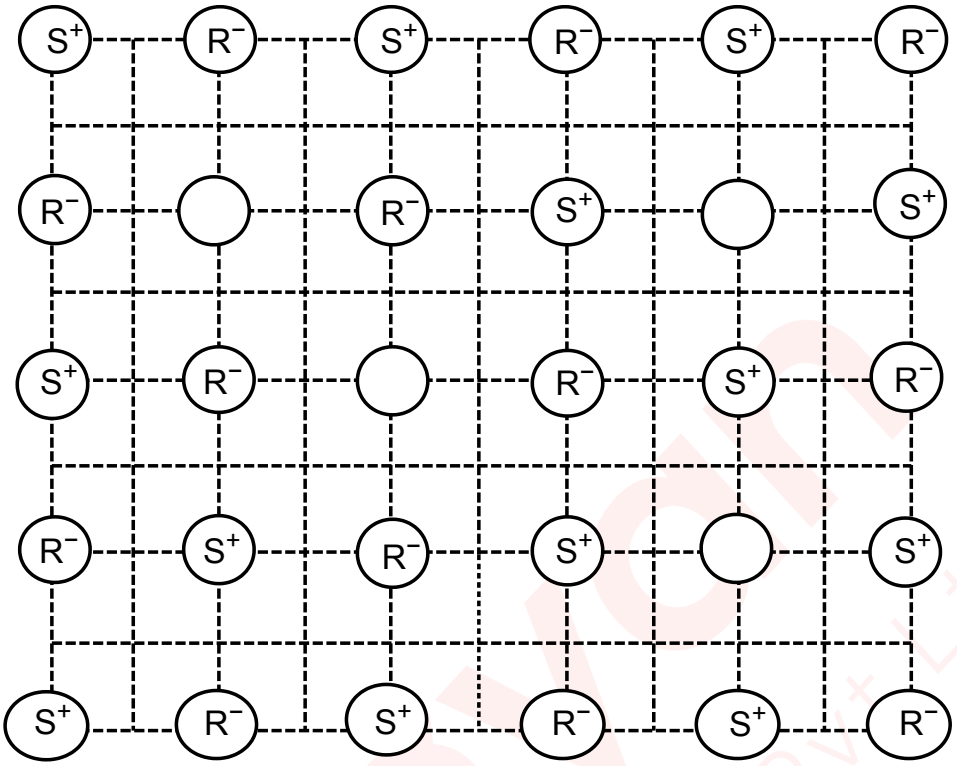
$$K_{eq} = \frac{1.3}{1.4 \times 10^{-5}} \approx 9.3 \times 10^{4}$$

$K_{eq}$ decreases as temperature increases.

$\therefore$ The forward reaction is exothermic.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**55.** The crystal defect indicated in the diagram below is




(A) Frenkel defect
(B) Schottky defect
(C) Frenkel and Schottky defects
(D) Interstitial defect

**Solution · Q55** **Answer: (B)**

Two $S^+$ sites and two $R^-$ sites are vacant.

No ion is present at an interstitial site.

Cations and anions are missing in equal numbers.

∴ It is a Schottky defect.

**IAPT answer:** (B) | **Zigyan answer:** (B)

**56.** In solid state, $PCl_5$ exists as $[PCl_4]^+ [PCl_6]^-$. The hybridization of P atoms in this solid is/are

(A) $sp^3d$ ($d = d_{x^2-y^2}$)

(B) $sp^3d$ ($d = d_{z^2}$)

(C) $sp^3$ and $sp^3d^2$ ($d = d_{x^2-y^2}, d_{z^2}$)

(D) $sp^3d$ and $dsp^3$ ($d = d_{z^2}$)

**Solution · Q56** **Answer: (C)**

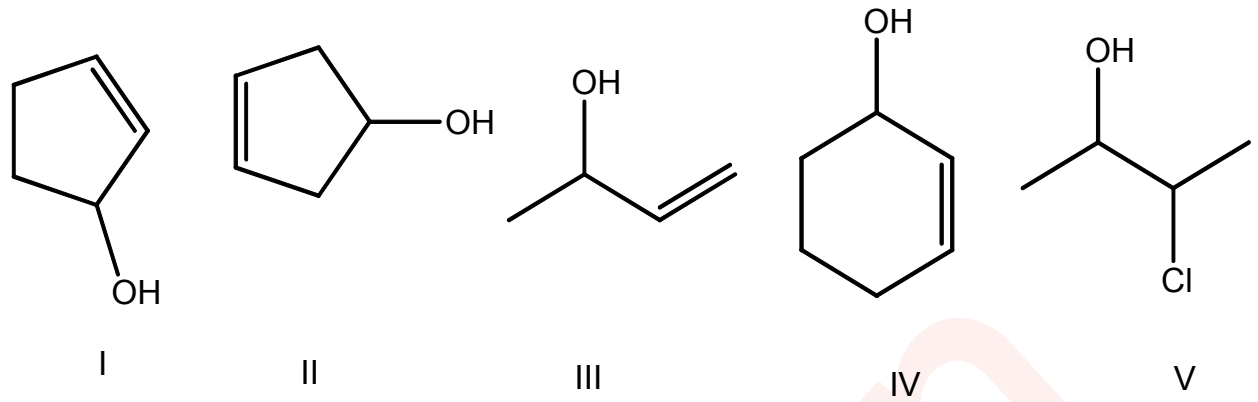
$[PC\ell_4]^+$: 4 bond pairs and no lone pair; $sp^3$, tetrahedral.

$[PC\ell_6]^-$: 6 bond pairs and no lone pair; $sp^3d^2$, octahedral.

The d orbitals used in $sp^3d^2$ are $d_{x^2-y^2}$ and $d_{z^2}$.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**57.** Which of the following compounds have chiral carbon atom/s?




I II III IV V

(A) I and II (B) I, III, IV and V (C) II, IV and V (D) II, III and IV

**Solution · Q57** **Answer: (B)**

A chiral carbon carries four different groups.

I, III and IV: the carbon bearing OH is chiral.

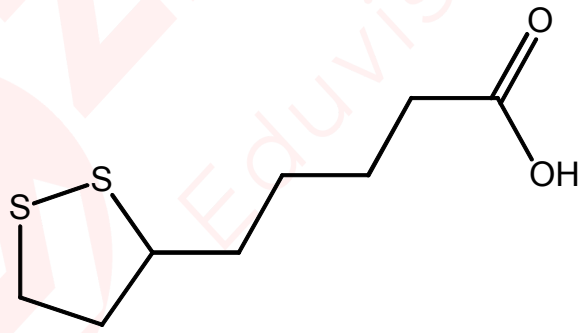
V: both the carbon bearing OH and the carbon bearing Cℓ are chiral.

II: the two ring paths from the carbon bearing OH are identical, so it is achiral.

∴ I, III, IV and V have chiral carbon atoms.

**IAPT answer:** (B) | **Zigyan answer:** (B)

**58.** Lipoic acid with the following structure is a growth factor required by many organisms. Percentages of 'S' and 'O' in lipoic acid respectively are (atomic masses of 'S' and 'O' are 32.065 g $mol^{-1}$ and 15.999 g $mol^{-1}$ respectively)




**Lipoic acid**

(A) 33.03, 16.48 (B) 31.11 , 18.24 (C) 31.11 ,15.52 (D) 31.42 , 15.68

**Solution · Q58** **Answer: (C)**

From the structure, the molecular formula is $C_8H_{14}O_2S_2$.

Taking the atomic masses of C and H as 12 and 1:

$$M = 8(12) + 14(1) + 2(15.999) + 2(32.065)$$

$$\Rightarrow M = 206.128 \text{ g mol}^{-1}$$

$$S\,\% = \frac{2 \times 32.065}{206.128} \times 100 = 31.11$$

$$O\,\% = \frac{2 \times 15.999}{206.128} \times 100 = 15.52$$

**IAPT answer:** (C) | **Zigyan answer:** (C)

**59.** Among the halides $NCl_3$ (I), $PCl_3$ (II) and $AsCl_3$ (III), more than one type of acid in aqueous solution is formed with

(A) I, II and III (B) II only (C) I and II (D) II and III

**Solution · Q59** **Answer: (D)**

$NC\ell_3 + 3H_2O \rightarrow NH_3 + 3HOC\ell$

$PC\ell_3 + 3H_2O \rightarrow H_3PO_3 + 3HC\ell$

$AsC\ell_3 + 3H_2O \rightarrow H_3AsO_3 + 3HC\ell$

$NC\ell_3$ gives only one acid, $HOC\ell$, since $NH_3$ is a base.

$PC\ell_3$ (II) and $AsC\ell_3$ (III) each give two acids.

**IAPT answer:** (D) | **Zigyan answer:** (D)

**60.** A helium cylinder in which the volume of gas = 2.24 L at STP (1 atm, 273 K) developed a leak and when the leak was plugged the pressure in the cylinder was seen to have dropped to 550 mm of Hg. The number of moles of He gas that had escaped due to this leak is

(A) 0.028 (B) 0.072 (C) 0.972 (D) 0.099

**Solution · Q60** **Answer: (A)**

Initial moles of He:

$$n_1 = \frac{2.24}{22.4} = 0.1$$

At constant volume and temperature (273 K), $n \propto P$.

$$n_2 = 0.1 \times \frac{550}{760} \approx 0.0724$$

Moles of He escaped:

$$\Delta n = 0.1 - 0.0724$$

$$\therefore \Delta n \approx 0.028 \text{ mol}$$

**IAPT answer:** (A) | **Zigyan answer:** (A)

**61.** The anhydride of $HNO_3$ is

(A) NO (B) $NO_2$ (C) $N_2O$ (D) $N_2O_5$

**Solution · Q61** **Answer: (D)**

The anhydride is obtained by removing water from the acid, with the oxidation state of N unchanged at +5.

$2HNO_3 \rightarrow N_2O_5 + H_2O$

**IAPT answer:** (D) | **Zigyan answer:** (D)

**62.** An excess of aqueous ammonia is added to three different flasks ($F_1$, $F_2$, $F_3$) containing aqueous solutions of $CuSO_4$, $Fe_2(SO_4)_3$ and $NiSO_4$ respectively. Which of the following is correct about this addition?

I. A precipitate will be formed in all three flasks

II. Ammonia acts as a base as well as a ligand exchange reagent in $F_1$ and $F_3$

III. A soluble complex of $NH_3$ and the metal ion is formed in $F_1$ and $F_3$

IV. A precipitate will be formed only in $F_2$

(A) I only (B) IV only (C) II and IV (D) II, III and IV

**Solution · Q62** **Answer: (D)**

In $F_1$ and $F_3$, $NH_3$ first precipitates the hydroxide as a base. Excess $NH_3$ then dissolves it as a ligand.

$Cu(OH)_2 + 4NH_3 \rightarrow [Cu(NH_3)_4]^{2+} + 2OH^-$

$Ni(OH)_2 + 6NH_3 \rightarrow [Ni(NH_3)_6]^{2+} + 2OH^-$

In $F_2$, the precipitate stays even in excess $NH_3$.

$Fe^{3+} + 3NH_3 + 3H_2O \rightarrow Fe(OH)_3\downarrow + 3NH_4^+$

$\therefore$ II, III and IV are correct, and I is wrong.

**IAPT answer:** (D) | **Zigyan answer:** (D)

**63.** The mass (g) of NaCl that has to be dissolved to reduce the vapour pressure of 100 g of water by 10 % (Molar mass of NaCl = 58.5 g $mol^{-1}$) is

(A) 36.11 g (B) 17.54 g (C) 81.25 g (D) 3.61 g

**Solution · Q63** **As per Zigyan: no option is correct**

NaCℓ dissociates completely into two ions.

$$i = 2$$

For water (1) and NaCℓ (2):

$$n_1 = 100/18 = 5.556 \text{ mol}$$

Relative lowering of vapour pressure equals the mole fraction of solute particles.

$$\frac{in_2}{n_1 + in_2} = 0.10$$

$$\Rightarrow i\,n_2 = 0.6173 \text{ mol}$$

$$\Rightarrow n_2 = 0.3086 \text{ mol}$$

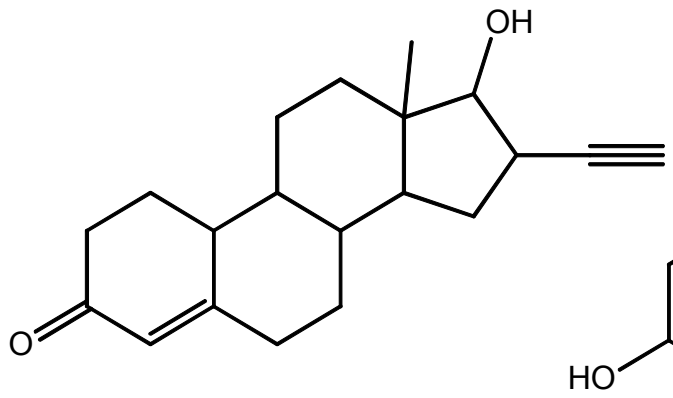
$$\therefore w = 0.3086 \times 58.5 = 18.06 \text{ g}$$

Why Zigyan differs from IAPT: 17.54 g is only 0.300 mol of NaCℓ. A 10 % lowering with this amount needs i of about 2.06, but NaCℓ cannot give more than two ions per formula unit.

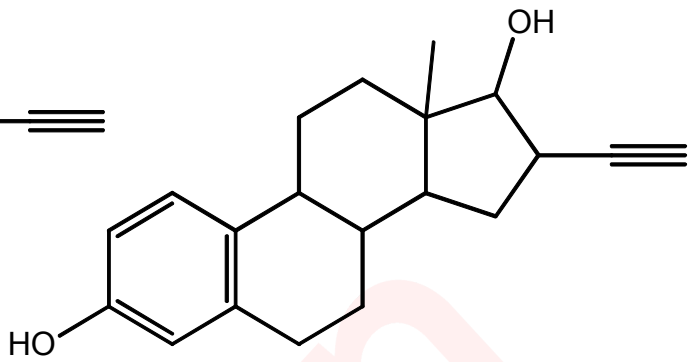
**Reference:** NCERT Chemistry Class XII (Part I), Unit 1 'Solutions', section 1.6.1 and Table 1.4: relative lowering of vapour pressure equals the solute mole fraction; the van't Hoff factor of NaCℓ is 2.00 for complete dissociation, and the listed values for its real solutions are lower.

**IAPT answer:** (B) | **Zigyan answer:** none of the options is correct

**64.** The reagent/s that can be used to separate norethindrone and novestrol from their mixture is/are




Norethindrone




Novestrol

I. HCl

II. NaOH

III. $NaHCO_3$

IV. $NaNH_2$

(A) III (B) I and IV (C) I,II and III (D) II

**Solution · Q64** **Answer: (D)**

Novestrol has an acidic phenolic OH, while norethindrone has only an alcoholic OH and a ketone group.

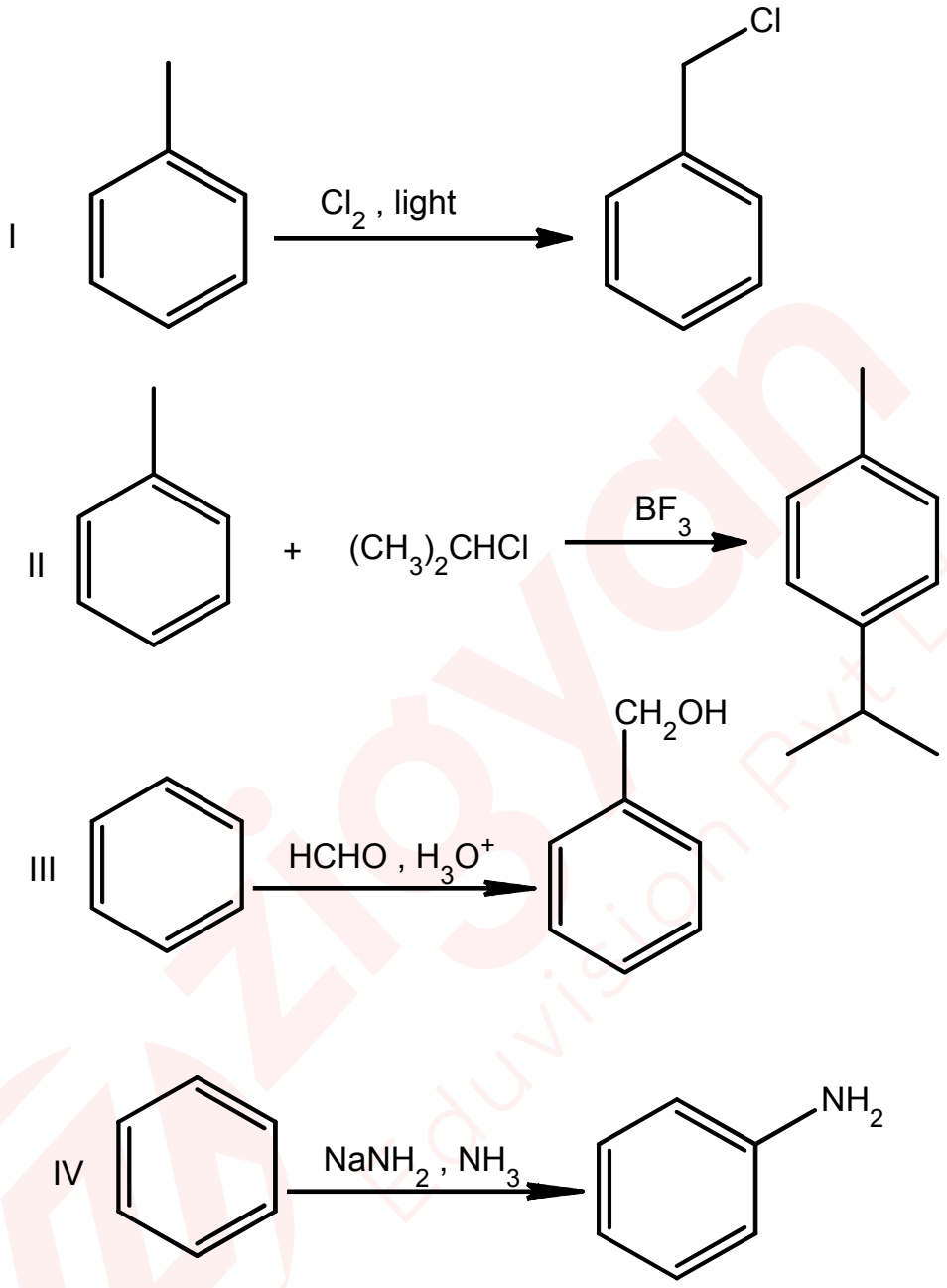
NaOH dissolves novestrol as its sodium phenoxide and leaves norethindrone undissolved. Acidifying the aqueous layer gives novestrol back.

$NaHCO_3$ is too weak a base for a phenol, and HCℓ finds no basic group.

$NaNH_2$ reacts with both, as each has a terminal alkyne.

**IAPT answer:** (D) | **Zigyan answer:** (D)

**65.** Which of the following is/are electrophilic aromatic substitution reaction/s?




(A) II, III and IV (B) II and III (C) I, II and III (D) II only

**Solution · Q65** **Answer: (B)**

I: free radical substitution in the side chain.

II: Friedel–Crafts alkylation of the ring by $(CH_3)_2CH^+$, so it is electrophilic substitution.

III: protonated formaldehyde attacks the ring (hydroxymethylation), so it is electrophilic substitution.

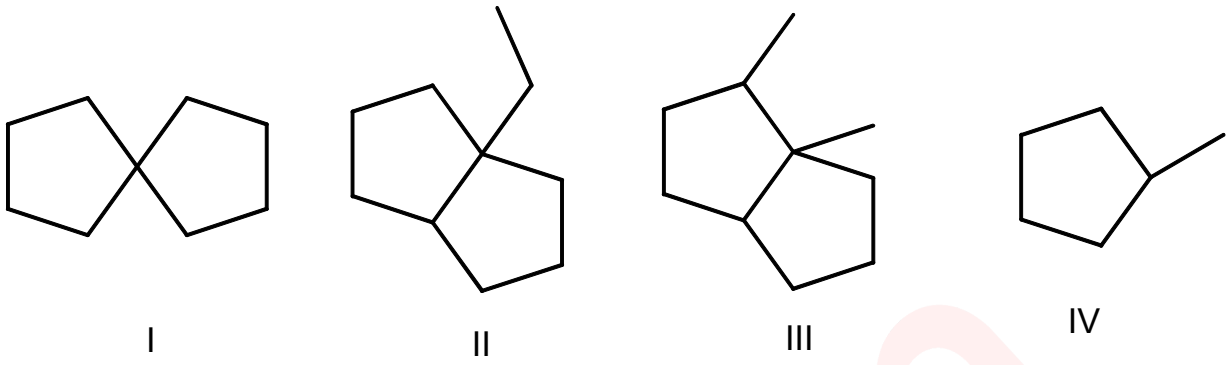
$$CH_2{=}O + H^+ \rightarrow {}^+CH_2OH$$

IV: no electrophile is formed, and benzene does not give aniline with $NaNH_2/NH_3$.

$\therefore$ only II and III.

**IAPT answer:** (B) | **Zigyan answer:** (B)

**66.** All *four* types of carbon (1°,2°,3° and 4°) are present in




(A) I, II and III (B) II, III and IV (C) I, II and IV (D) II and III

**Solution · Q66** **Answer: (D)**

I: it has only 2° carbons and one 4° (spiro) carbon.

II: $CH_3$ is 1°, each $CH_2$ is 2°, the fusion CH is 3° and the fusion carbon carrying ethyl is 4°.

III: each $CH_3$ is 1°, each $CH_2$ is 2°, both CH carbons are 3° and the fusion carbon carrying $CH_3$ is 4°.

IV: it has no 4° carbon.

∴ II and III.

**IAPT answer:** (D) | **Zigyan answer:** (D)

**67.** The normal boiling point and $\Delta H_{vap}$ of a liquid 'X' are 400 K and 40 kJ $mol^{-1}$ respectively. Assuming $\Delta H_{vap}$ to be constant, which of the following is correct?

I. $\Delta S_{vap} > 100$ J $K^{-1}$ $mol^{-1}$ at 400 K and 0.5 atm

II. $\Delta S_{vap} < 100$ J $K^{-1}$ $mol^{-1}$ at 400 K and 1 atm

III. $\Delta S_{vap} < 100$ J $K^{-1}$ $mol^{-1}$ at 400 K and 2 atm

IV. $\Delta S_{vap} = 100$ kJ $K^{-1}$ $mol^{-1}$ at 400 K and 1 atm

(A) II and IV (B) II only (C) I and III (D) I, III and IV

**Solution · Q67** **Answer: (C)**

At 400 K and 1 atm, liquid and vapour are in equilibrium.

$$\Delta S_{vap} = \frac{\Delta H_{vap}}{T_b} = \frac{40000}{400}$$

$$\Rightarrow \Delta S_{vap} = 100 \text{ J } K^{-1} \text{ mol}^{-1}$$

So II is false. IV is also false, as its unit is in kJ.

For ideal vapour formed at pressure p (in atm):

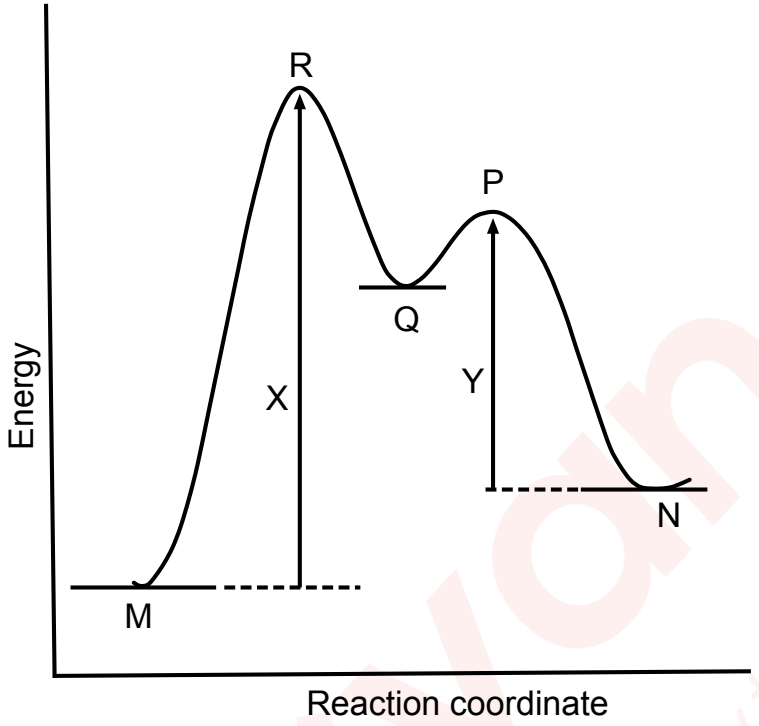
$$\Delta S_{vap}(p) = 100 - R \ln p$$

At 0.5 atm the value is above 100, and at 2 atm it is below 100.

∴ I and III are correct.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**68.** About the energy level diagram given below, which of the following statement/s is/are correct?




I. The reaction is of two steps and 'R' is an intermediate

II. The reaction is exothermic and step 2 is rate determining

III. 'Q' is an intermediate and 'R' is the transition state for the reaction M → Q

IV. 'P' is the transition state for the reaction Q → N

(A) III and IV (B) I, III and IV (C) I, II and IV (D) III only

**Solution · Q68** **Answer: (A)**

The curve has two maxima, so the reaction has two steps. R and P are transition states, and the minimum Q is an intermediate.

N lies above M, so the overall reaction is endothermic.

The barrier from M to R is much higher than that from Q to P, so the first step is rate determining.

∴ only III and IV are correct.

**IAPT answer:** (A) | **Zigyan answer:** (A)

**69.** Mercury is highly hazardous and hence its concentration is expressed in the units of ppb (micrograms of Hg present in 1 L of water). Permissible level of Hg in drinking water is 0.0335 ppb. Which of the following is an alternate representation of this concentration?

(A) $3.35 \times 10^{-2}$ mg $dm^{-3}$ (B) $3.35 \times 10^{-5}$ mg $dm^{-3}$

(C) $3.35 \times 10^{-5}$ mg $m^{-3}$ (D) $3.35 \times 10^{-4}$ g $L^{-1}$

**Solution · Q69** **Answer: (B)**

One microgram is $10^{-3}$ mg, and 1 L is 1 $dm^3$.

$$0.0335 \text{ ppb} = 0.0335 \times 10^{-3} \text{ mg dm}^{-3}$$

$\Rightarrow 3.35 \times 10^{-5}$ mg dm$^{-3}$

**IAPT answer:** (B) | **Zigyan answer:** (B)

**70.** Which of the following is correct?

I. Sodium (Na) is present as metal in nature

II. $Na_2O_2$ is paramagnetic

III. $NaO_2$ is paramagnetic

IV. Na reacts with $N_2$ to form $Na_3N$

(A) III only (B) II and IV (C) I, III and IV (D) II, III and IV

**Solution · Q70** **Answer: (A)**

I: false, as sodium is too reactive to occur free in nature.

II: false, as $O_2^{2-}$ has no unpaired electron.

III: true, as $O_2^-$ has one unpaired electron.

IV: false, as among alkali metals only lithium combines directly with $N_2$ to give the nitride on heating.

**IAPT answer:** (A) | **Zigyan answer:** (A)

**71.** The F– X– F bond angle is the smallest in (X is the central atom)

(A) $CF_4$ (B) $NF_3$ (C) $OF_2$ (D) $XeF_5^-$

**Solution · Q71** **Answer: (D)**

$CF_4$ is tetrahedral with an angle of 109.5°. In $NF_3$ and $OF_2$, lone pairs reduce it to about 102° to 103°.

$XeF_5^-$ has 5 bond pairs and 2 lone pairs, so it is pentagonal planar. Angle between adjacent F atoms:

$$360°/5 = 72°$$

**IAPT answer:** (D) | **Zigyan answer:** (D)

**72.** The correct sequence of reactions which will yield 4-nitrobenzoic acid from benzene is

(A) $CH_3Cl$; $HNO_3$ /$H_2SO_4$; $KMnO_4/OH^-$

(B) $HNO_3$ /$H_2SO_4$; $CH_3Cl/AlCl_3$; $KMnO_4/OH^-$

(C) $CH_3Cl/AlCl_3$; $KMnO_4/OH^-$; $HNO_3/H_2SO_4$

(D) $CH_3Cl/AlCl_3$; $HNO_3$ /$H_2SO_4$; $KMnO_4/OH^-$

**Solution · Q72** **Answer: (D)**

$CH_3$ is put on the ring first, since it directs the nitro group to ortho and para positions and can later be oxidised to COOH.

Alkylation with $CH_3C\ell/A\ell C\ell_3$:

$C_6H_6 \rightarrow C_6H_5CH_3$

Nitration with $HNO_3/H_2SO_4$, taking the para isomer:

$C_6H_5CH_3 \rightarrow 4\text{-}O_2NC_6H_4CH_3$

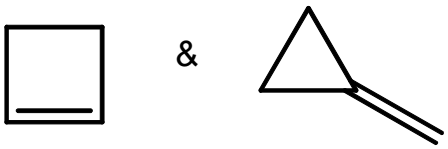
Oxidation with $KMnO_4/OH^-$, then acidification:

$4\text{-}O_2NC_6H_4CH_3 \rightarrow 4\text{-}O_2NC_6H_4COOH$

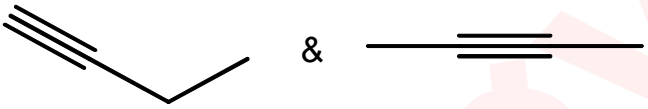
**IAPT answer:** (D) | **Zigyan answer:** (D)

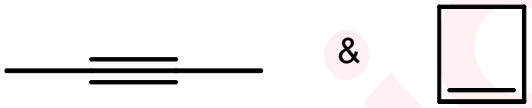
**73.** Two isomeric hydrocarbons 'X' and 'Y' ($C_4H_6$), give the same product ($C_4H_8O$) on catalytic hydration with dilute acid. However, they form different products but with same molecular formula ($C_4H_6Br_4$) when treated with excess bromine.

'X' and 'Y' are

(A) 

(B) 

(C) 

(D) 

**Solution · Q73** **Answer: (C)**

On acid-catalysed ($Hg^{2+}$) hydration, both butynes give the same ketone:

$CH{\equiv}CCH_2CH_3 + H_2O \rightarrow CH_3COCH_2CH_3$

$CH_3C{\equiv}CCH_3 + H_2O \rightarrow CH_3COCH_2CH_3$

With excess bromine they give different tetrabromides:

$CH{\equiv}CCH_2CH_3 + 2Br_2 \rightarrow CHBr_2CBr_2CH_2CH_3$

$CH_3C{\equiv}CCH_3 + 2Br_2 \rightarrow CH_3CBr_2CBr_2CH_3$

So X and Y are but-1-yne and but-2-yne.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**74.** Morphine, a pain killer is basic with the molecular formula $C_{17}H_{19}NO_3$. The conjugate acid of morphine is

(A) $C_{17}H_{19}NO_3^+$ (B) $C_{17}H_{18}NO_3$ (C) $C_{17}H_{19}NO_3^-$ (D) $C_{17}H_{20}NO_3^+$

**Solution · Q74** **Answer: (D)**

A conjugate acid is formed when a base accepts one $H^+$.

$C_{17}H_{19}NO_3 + H^+ \rightarrow C_{17}H_{20}NO_3^+$

**IAPT answer:** (D) | **Zigyan answer:** (D)

**75.** The correct IUPAC name of the compound, $[Pt(py)_4][Pt(Br)_4]$ is

(A) tetrapyridineplatinum(II) tetrabromidoplatinate(II)
(B) tetrabromidoplatinum(IV) tetrapyridineplatinate(II)
(C) tetrabromidoplatinate(II) tetrapyridineplatinum(II)
(D) tetrapyridineplatinum(IV) tetrabromidoplatinate(IV)

**Solution · Q75** **Answer: (A)**

Pyridine is neutral and each bromido ligand is −1. For the same oxidation state x of both Pt atoms,

$$x + (x - 4) = 0$$

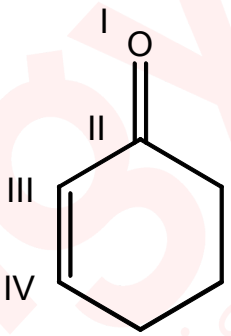
$$\Rightarrow x = +2$$

The ions are $[Pt(py)_4]^{2+}$ and $[PtBr_4]^{2-}$.

The cation is named first, and the name of the anionic complex ends in "platinate".

**IAPT answer:** (A) | **Zigyan answer:** (A)

**76.** Which atom/s will have a $\delta^+$ charge in the following molecule?




(A) I and III (B) II only (C) II and III (D) II and IV

**Solution · Q76** **Answer: (D)**

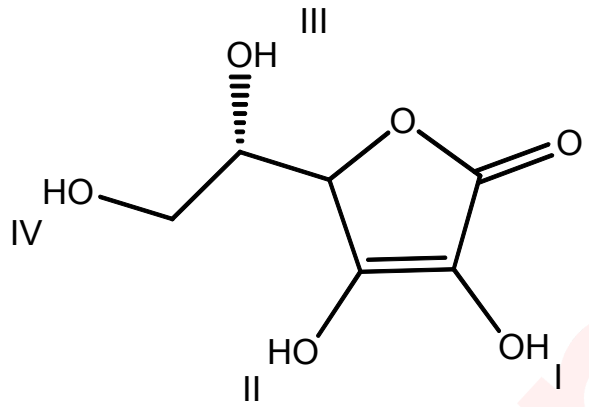
The C=O group is conjugated with C=C, so it pulls electron density towards oxygen:

$$O{=}C{-}CH{=}CH \leftrightarrow {}^{-}O{-}C^{+}{-}CH{=}CH \leftrightarrow {}^{-}O{-}C{=}CH{-}CH^{+}$$

Positive charge appears on the carbonyl carbon (II) and on the β-carbon (IV).

**IAPT answer:** (D) | **Zigyan answer:** (D)

**77.** The most acidic hydrogen in the following molecule is




(A) I (B) II (C) III (D) IV

**Solution · Q77** **Answer: (B)**

The molecule is ascorbic acid. Loss of $H^+$ from O–H (II) gives an anion conjugated with the C=O group through C=C:

$$^{-}O–C=C–C=O \leftrightarrow O=C–C=C–O^{-}$$

The charge is shared by two oxygen atoms. The anions from I, III and IV cannot pass their charge to the C=O oxygen.

**IAPT answer:** (B) | **Zigyan answer:** (B)

**78.** In which of the following species the octet rule is NOT obeyed?

I. $I_3^-$

II. $N_2O$

III. $OF_2$

IV. $NO^+$

(A) I and IV (B) II and III (C) I only (D) IV only

**Solution · Q78** **Answer: (C)**

In $I_3^-$, the central I atom has 2 bond pairs and 3 lone pairs, that is, 10 electrons.

In $N_2O$ ($N{\equiv}N^+–O^-$), $OF_2$ and $NO^+$ (triple bond), every atom has 8 electrons.

So only I does not obey the octet rule.

**IAPT answer:** (C) | **Zigyan answer:** (C)

**79.** The volume of *one* drop of aqueous solution from an eyedropper is approximately 0.05 mL. One such drop of 0.2 M HCl is added to 100 mL of distilled water. The pH of the resulting solution will be

(A) 4.0 (B) 7.0 (C) 3.0 (D) 5.5

**Solution · Q79** **Answer: (A)**

Moles of HCℓ in one drop:

$$n = 0.2 \times 0.05 \times 10^{-3} = 10^{-5} \text{ mol}$$

The final volume is nearly 100 mL, that is, 0.1 L.

$$[H^+] = 10^{-5}/0.1 = 10^{-4}\ M$$

$$\Rightarrow pH = 4.0$$

**IAPT answer:** (A) | **Zigyan answer:** (A)

**80.** 2.0 moles of an ideal gas expands isothermally (27°C) and reversibly from a pressure of 1 bar to 10 bar. The heaviest mass that can be lifted through a height of 10 m by the work of this expansion is

(A) 50.8 kg (B) 50.8 g (C) 117.1 kg (D) 117.1 g

**Solution · Q80** **As per Zigyan: (C)**

An expansion lowers the pressure, so the gas goes from 10 bar to 1 bar.

For reversible isothermal expansion:

$$|w| = 2.303\ nRT \log(p_1/p_2)$$

$$\Rightarrow |w| = 2.303 \times 2.0 \times 8.314 \times 300 \times \log 10$$

$$\Rightarrow |w| = 11488\ J$$

This work lifts the mass through 10 m:

$$mgh = |w|$$

$$\Rightarrow m = \frac{11488}{9.81 \times 10}$$

$$\Rightarrow m = 117.1\ kg$$

**Reference:** NCERT Chemistry Class XI (Part I), Unit 5 'Thermodynamics', section 5.2.1, equation (5.5): reversible isothermal work on an ideal gas is $-2.303\ nRT \log(V_f/V_i)$, derived with the gas pressure written as nRT/V.

**Check:** At fixed temperature a larger volume means a smaller pressure. Raising 117.1 kg through 10 m against gravity takes about 11.49 kJ, the work of this expansion.

**IAPT answer:** question dropped by IAPT | **Zigyan answer:** (C)

# ANSWER KEY

NSEC 2019 · PAPER CODE 31

**80**
QUESTIONS · 240 MARKS

IAPT final answer key for paper code 31. ★ marks an answer given as per Zigyan.

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 1 | (C) | 2 | (A) | 3 | (D) | 4 | (D) | 5 | (A) |
| 6 | (A) | 7 | (D) | 8 | (B) | 9 | (D) | 10 | (A) |
| 11 | (C) | 12 | (A) | 13 | (D) | 14 | (A) | 15 | (C) |
| 16 | (B) | 17 | (C) | 18 | (B) | 19 | (B) | 20 | (D)★ |
| 21 | (C) | 22 | (A) | 23 | (A) | 24 | (B) | 25 | (D) |
| 26 | (C) | 27 | (B) | 28 | (C) | 29 | (A) | 30 | (C) |
| 31 | (D) | 32 | (A) | 33 | (B) | 34 | (C) | 35 | (C) |
| 36 | (A) | 37 | (C) | 38 | (A) | 39 | (B) | 40 | (A) |
| 41 | (B)★ | 42 | (C) | 43 | (B) | 44 | (B) | 45 | (D)★ |
| 46 | (C) | 47 | —★ | 48 | (B) | 49 | (D) | 50 | (C) |
| 51 | (C) | 52 | (A) | 53 | (A) | 54 | (C) | 55 | (B) |
| 56 | (C) | 57 | (B) | 58 | (C) | 59 | (D) | 60 | (A) |
| 61 | (D) | 62 | (D) | 63 | —★ | 64 | (D) | 65 | (B) |
| 66 | (D) | 67 | (C) | 68 | (A) | 69 | (B) | 70 | (A) |
| 71 | (D) | 72 | (D) | 73 | (C) | 74 | (D) | 75 | (A) |
| 76 | (D) | 77 | (B) | 78 | (C) | 79 | (A) | 80 | (C)★ |

**★ Answers as per Zigyan**

- **Q20** — As per Zigyan: (D); IAPT key (D).
- **Q41** — As per Zigyan: (B); IAPT key (B).
- **Q45** — As per Zigyan: (D); IAPT key (D).
- **Q47** — As per Zigyan: no option is correct; dropped by IAPT.
- **Q63** — As per Zigyan: no option is correct; IAPT key (B).
- **Q80** — As per Zigyan: (C); dropped by IAPT.

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OLYMPIADS · 2026

# Olympiad results



TOP ACHIEVEMENT · CHEMISTRY

## Qualified the Chemistry Olympiad twice, and selected for the HBCSE camp.

**Saksham Bishnoi** reached the national stage of the Chemistry Olympiad in two consecutive years and was selected for the Orientation-cum-Selection Camp at HBCSE, Mumbai. 4 Years Classroom - the same student who took AIR 168 in JEE Advanced 2026.

Qualified twice | HBCSE selection camp | Only student from Faridabad

**Above MAS** means above the **Minimum Admissible Score**: clearing it puts a student in the national band for their subject. It is a real threshold, not a participation marker.

## CHEMISTRY · ABOVE MAS



**Sulokya Bibhuty**
Class XII
3 Years Classroom
Above MAS



**Anay Gupta**
Class XI
3 Years Classroom
Above MAS



**Akshat Khator**
Class XI
3 Years Classroom
Above MAS



**Harshit Goyal**
Class XII
4 Years Classroom
Above MAS



**Hardik Sharma**
Class XI
3 Years Classroom
Above MAS



**Aarush Kumar**
Class XII
1 Year Classroom
Above MAS

## PHYSICS · ASTRONOMY · MATHEMATICS

PHYSICS



**Sulokya Bibhuty**
Class XII
3 Years Classroom
Above MAS

PHYSICS



**Saksham Bishnoi**
Class XII
4 Years Classroom
Above MAS

ASTRONOMY



**Sulokya Bibhuty**
Class XI
3 Years Classroom
Above MAS

MATHEMATICS · IOQM



**Priyanshi**
Class XI
4 Years Classroom
IOQM Qualifier

## OLYMPIADS WE PREPARE STUDENTS FOR

| NSEP | NSEC | NSEB | NSEA | IOQM | NSEJS |
|---|---|---|---|---|---|
| Physics | Chemistry | Biology | Astronomy | Mathematics | Class X and below |

## The olympiad pathway starts in Class 8.

NSEJS is open to Class 10 and below - the habit of staying with one hard problem is the one JEE Advanced rewards.



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RESULTS · 2021 – 2026

# Our toppers, year by year

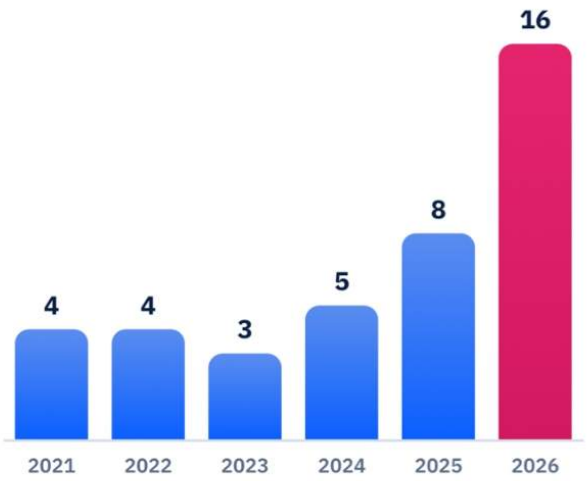
**40**
JEE Advanced selections in 6 years

**AIR 168**
best rank — Saksham Bishnoi, 2026

**16 of 35**
students selected, JEE Advanced 2026

**14 of 35**
above 98 percentile, JEE Main 2026

## JEE ADVANCED SELECTIONS PER YEAR




## BEST RANK EACH YEAR

| YEAR | JEE ADVANCED | JEE MAIN |
|---|---|---|
| 2026 | **Saksham Bishnoi**<br>AIR 168 · 4 Years Classroom | **Saksham Bishnoi**<br>AIR 811 · 99.95 %ile |
| 2025 | **Chakshu**<br>AIR 4,233 · 2 Years Classroom | **Chakshu**<br>AIR 8,538 · 99.44 %ile |
| 2024 | **Harshit**<br>AIR 777 · 2 Years Classroom | **Harshit**<br>AIR 1,473 · 99.91 %ile |
| 2023 | **Aditya Jain**<br>AIR 2,373 · 2 Years Classroom | **Aditya Jain**<br>AIR 2,503 · 99.79 %ile |
| 2022 | **Rachit Sharma**<br>AIR 698 · 1 Year Classroom | **Rachit Sharma**<br>AIR 1,016 · 99.90 %ile |
| 2021 | **Sparsh Mittal**<br>AIR 2,237 · 1 Year Classroom | **Sparsh Mittal**<br>AIR 1,562 |

## JEE ADVANCED 2026 — THIRTEEN NAMED SELECTIONS



**Saksham Bishnoi**
AIR 168
4 Years Classroom



**Sulokya Bibhuty**
AIR 1,315
3 Years Classroom



**Aarush**
AIR 2,699
1 Year Classroom



**Manishka**
AIR 2,869
4 Years Classroom



**Oojit Kumar**
AIR 5,765
4 Years Classroom



**Harshit Goyal**
AIR 6,407
4 Years Classroom



**Pranab Sharma**
AIR 6,750
3 Years Classroom



**Aditya Dhar**
AIR 15,183
3 Years Classroom



**Arpit Anshuman**
AIR 19,308
4 Years Classroom



**Lokesh**
AIR 22,857
3 Years Classroom



**Arjun**
AIR 24,674
3 Years Classroom



**Sanyam Gulyani**
AIR 25,123
1 Year Classroom



**Saket**
AIR 27,628
3 Years Classroom

Sixteen students of the 2026 batch were selected in JEE Advanced; the thirteen above are named with their All India Rank.

## JEE MAIN 2026 — TOP SIX, WITH PERCENTILE



**Saksham Bishnoi**
AIR 811
99.95 %ile
4 Years Classroom



**Sulokya Bibhuty**
AIR 1,095
99.94 %ile
3 Years Classroom



**Harshit Goyal**
AIR 2,662
99.83 %ile
4 Years Classroom



**Manishka**
AIR 4,817
99.70 %ile
4 Years Classroom



**Oojit Kumar**
AIR 5,040
99.69 %ile
4 Years Classroom



**Aarush**
AIR 5,276
99.67 %ile
1 Year Classroom

14 of the 35 students in the 2026 batch scored above the 98th percentile in JEE Main.



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