JEE (ADVANCED) 2025 PAPER-2

[PAPER ANSWER KEY WITH SOLUTION]

HELD ON SUNDAY 18TH MAY 2025

CHEMISTRY

SECTION 1 (Maximum Marks : 12)

- This section contains **FOUR (04)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is the correct answer.
- For each question, choose the option corresponding to the correct answer.
- Answer to each question will be evaluated **according to the following marking scheme:**

  Full Marks : +3 If **ONLY** the correct option is chosen;

  Zero Marks : 0 If none of the options is chosen (i.e. the question is unanswered);

  Negative Marks : −1 In all other cases.

[:Q.1] During sodium nitroprusside test of sulphide ion in an aqueous solution, one of the ligands coordinate to the metal ion is converted to

[:A] NOS^- [:B] SCN^- [:C] SNO^- [:D] NCS^-

[:ANS] **A**

[:SOLN] Sodium nitroprusside test : $S^{2-}_{(aq)} + Na_2[Fe(CN)_5(NO)] \longrightarrow \underset{\text{violet}}{Na_4[Fe(CN)_5NOS]}$

Ligand exchange reaction : $S^{2-} + NO^+ \longrightarrow NOS^-$

[:Q.2] The complete hydrolysis of ICl, ClF_3 and BrF_5, respectively, gives

[:A] IO^-, ClO_2^- and BrO_3^- [:B] IO_3^-, ClO_2^- and BrO_3^-

[:C] IO^-, ClO^- and BrO_2^- [:D] IO_3^-, ClO_4^- and BrO_2^-

[:ANS] **A**

[:SOLN] **Hydrolysis:**

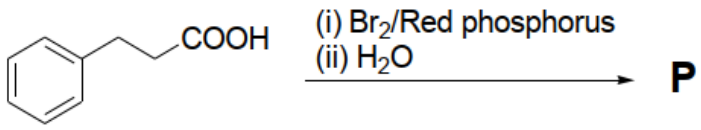
$$\text{Interhalogen compound} + H_2O \longrightarrow \underset{\text{Less EN}}{\text{Oxy Acid}} + \underset{\text{More EN}}{\text{Hydra Acid}}$$

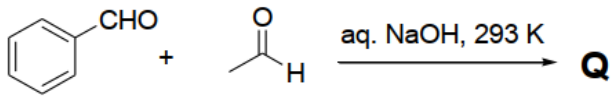
$$ICl + H_2O \longrightarrow \underset{(IO^-)}{HOI} + HCl$$

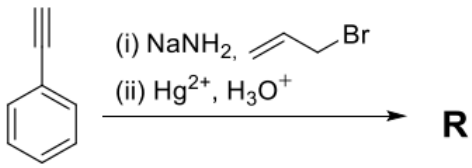
$$ClF_3 + 2H_2O \longrightarrow \underset{(ClO_2^-)}{HClO_2} + 3HF$$

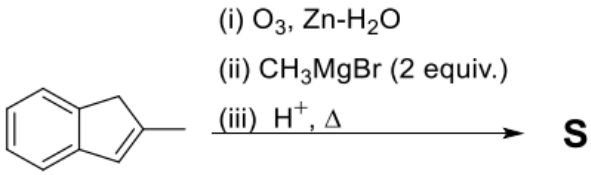
$$BrF_5 + 3H_2O \longrightarrow \underset{(BrO_3^-)}{HBrO_3} + 5HF$$

[:Q.3] Monocyclic compounds P, Q, R and S are the major product formed in the reaction sequences given below,







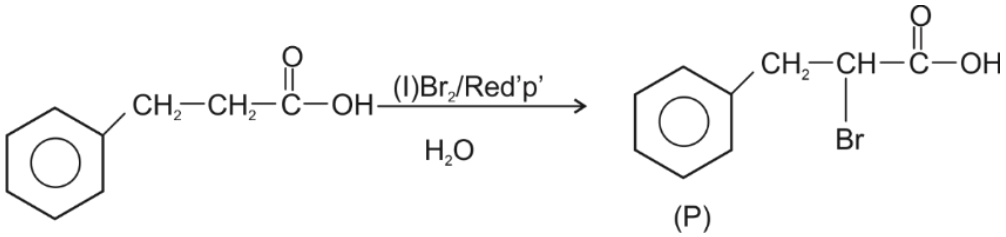


The product having the highest number of unsaturated carbon atom(s) is

[:A] P [:B] Q [:C] R [:D] S

[:ANS] **D**

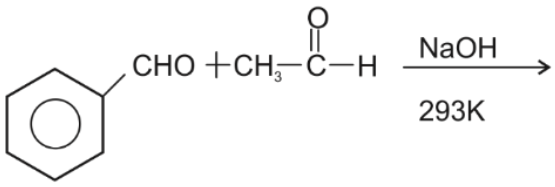
[:SOLN]

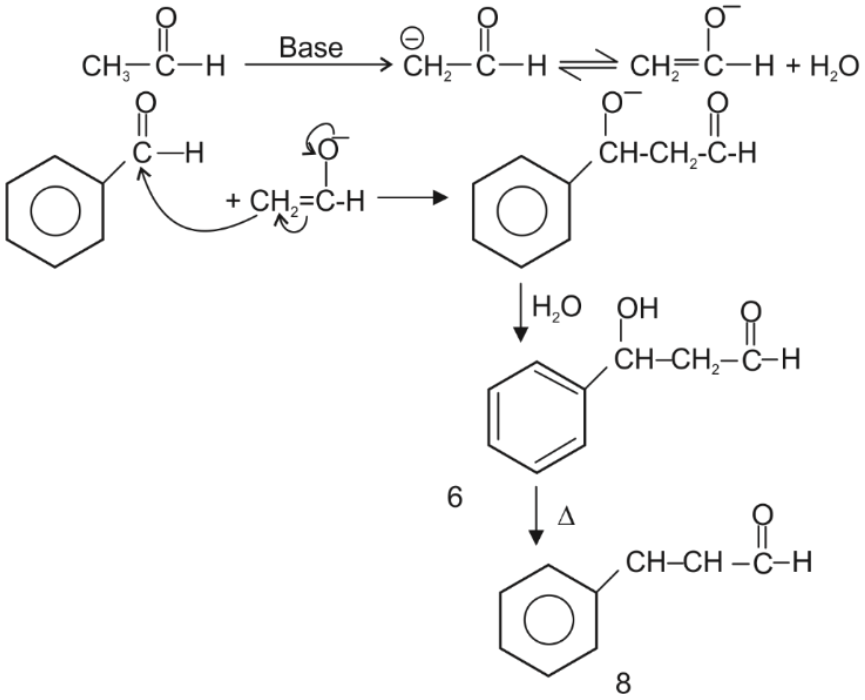


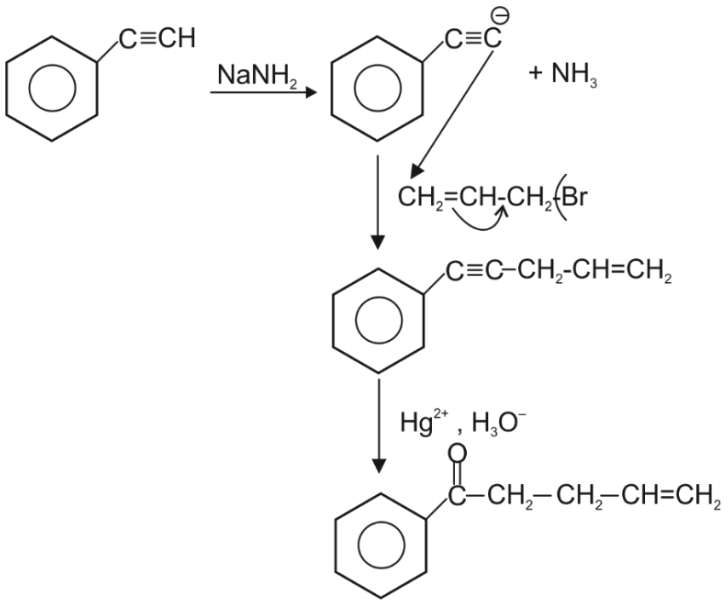
(P)

HVZ Reaction

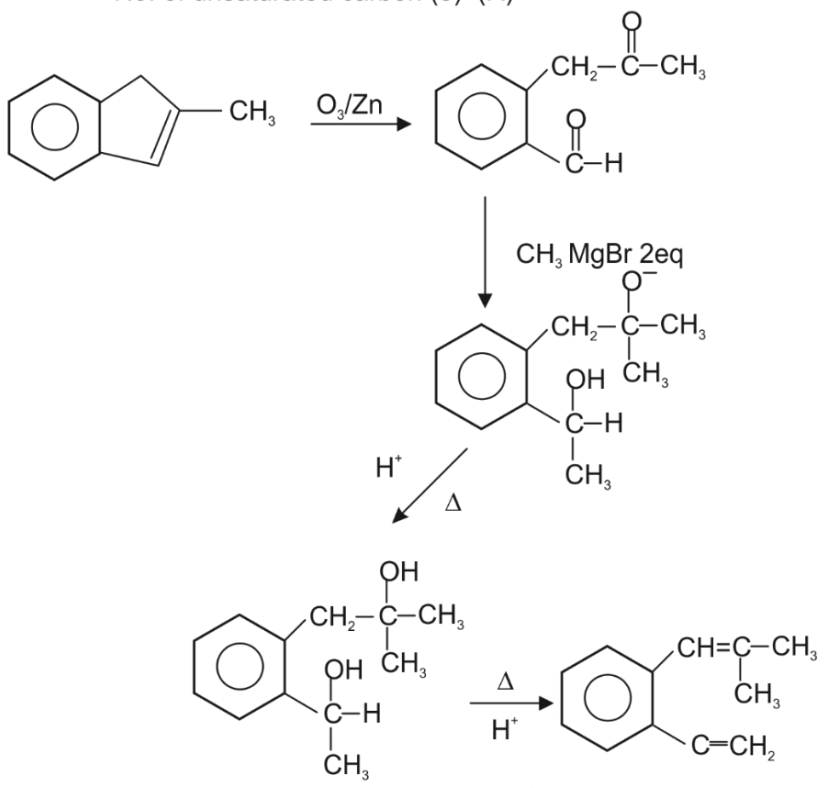
unsaturated carbon = 6





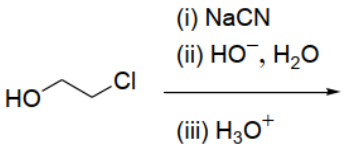


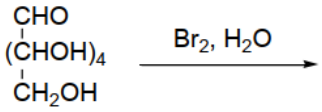
No. of unsaturated carbon (8) (R)

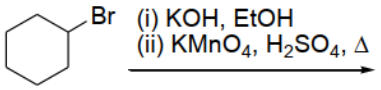


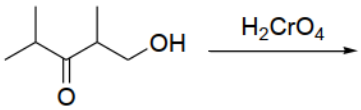
No. of unsaturated carbon = 10

[:Q.4] The correct reaction/reaction sequence that would produce a dicarboxylic acid as the major product is

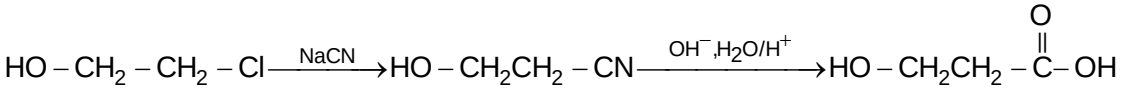
[:A] 

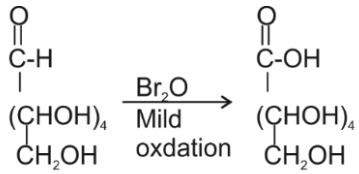
[:B] 

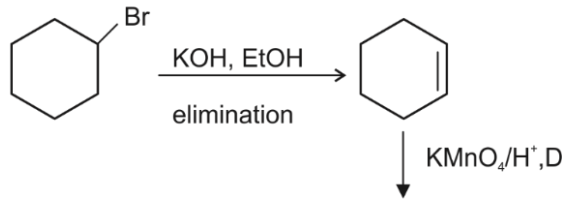
[:C] 

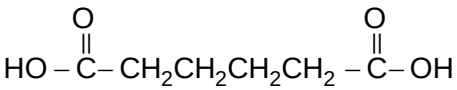
[:D] 

[:ANS] **C**

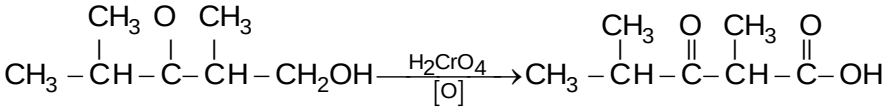
[:SOLN] (A) 

(B) 

(C) 



Dicarboxylic acid

(D) 

SECTION 2 (Maximum Marks : 16)

- This section contains **FOUR (04)** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct answer(s).
- For each question, choose the option(s) corresponding to (all) the correct answer(s).
- Answer to each question will be evaluated **according to the following marking scheme:**
  Full Marks : +4 **ONLY** if (all) the correct option(s) is(are) chosen;
  Partial Marks : +3 If all the four options are correct but **ONLY** three options are chosen;
  Partial Marks : +2 If three or more options are correct but **ONLY** two options are chosen, both of which are correct;
  Partial Marks : +1 If two or more options are correct but **ONLY** one option is chosen and it is a correct option;
  Zero Marks : 0 If none of the options is chose (i.e. the question is unanswered);
  Negative Marks : −2 In all other cases.
- For example, in a question, if (A), (B) and (D) are the ONLY three options corresponding to correct answers, then
  choosing ONLY (A), (B) and (D) will get +4 marks;
  choosing ONLY (A) and (B) will get +2 marks;
  choosing ONLY (A) and (D) will get +2 marks;
  choosing ONLY (B) and (D) will get +2 marks;
  choosing ONLY (A) will get +1 mark;
  choosing ONLY (B) will get +1 mark;
  choosing ONLY (D) will get +1 mark;
  choosing no option (i.e. the question is unanswered) will get 0 marks; and
  choosing any other combination of options will get –2 marks.

[:Q.5] The correct statement(s) about intermolecular forces is(are)

[:A] The potential energy between two point charges approaches zero more rapidly than the potential energy between a point dipole and a point charge as the distance between them approaches infinity.

[:B] The average potential energy of two rotating polar molecules that are separated by a distance r has $1/r^3$ dependence.

[:C] The dipole-induced dipole average interaction energy is independent of temperature.

[:D] Nonpolar molecules attract one another even though neither has a permanent dipole moment.

[:ANS] **CD**

[:SOLN] A. Due two point charge

(A) P.E. due two point charge $P.E = k\frac{q_1q_2}{r}$;

P. E due to point charge and dipole $P.E = \frac{Kq_1q_2}{r^2}$

r^2 – more rapid

(B) Avg. P.E of two rotating polar molecule $\propto \frac{1}{r^6}$

(C) $E = E_K + E_D$ [Hint: $E_K \propto \frac{1}{T}$]

The pair in which only one is polar and the other is nonpolar then E_K does not exist in the pair but E_D exits . E_D = Sum of distortion polarisatibility + orientation polarisatibility

Thus the E_D a consequence of the distortion effect is independent of temperature.

(D) Nonpolar molecule attract one another due to instantaneous developed dipole moment through the synchronization of charge cloud imbatance.

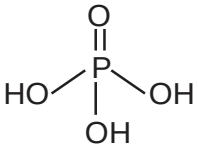
[:Q.6] The compound(s) with P-H bond (s) is (are)

[:A] H_3PO_4 [:B] H_3PO_3 [:C] $H_4P_2O_7$ [:D] H_3PO_2

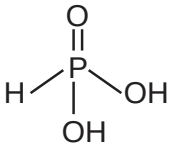
[:ANS] **BD**

[:SOLN] Compound with P–H bond:

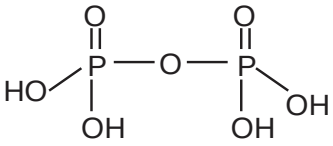
(A) H_3PO_4



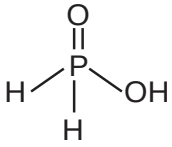
(B) H_3PO_3



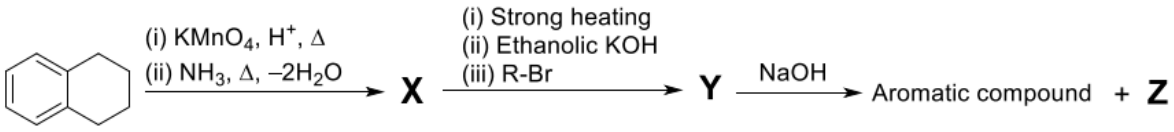
(C) $H_4P_2O_7$



(D) H_3PO_2



[:Q.7] For the reaction sequence given below, the correct statement(s) is(are)



[:A] Both X and Y are oxygen containing compounds

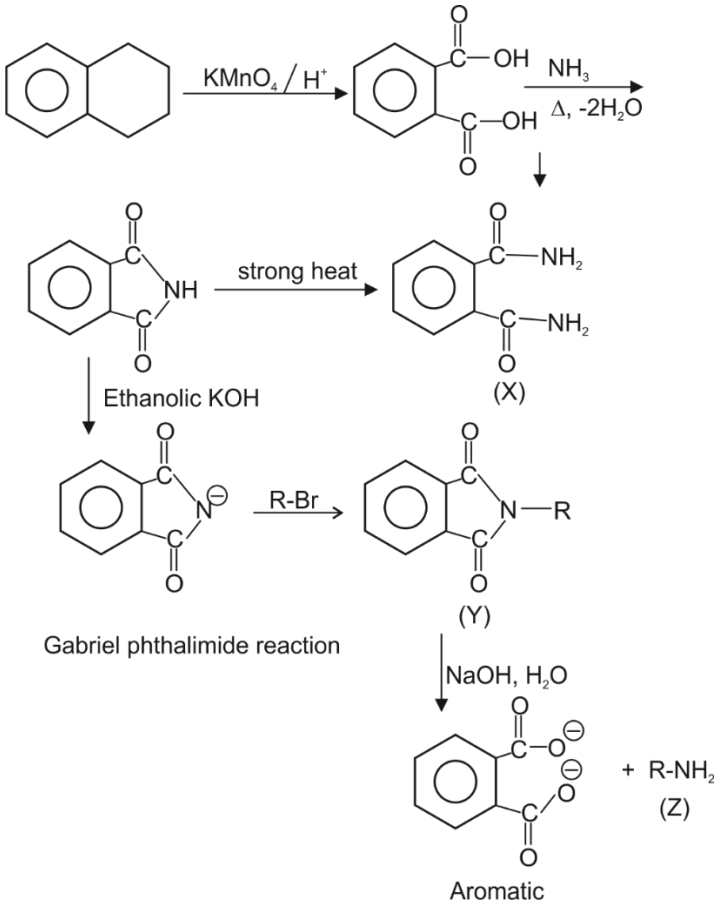
[:B] Y on heating with $CHCl_3$ / KOH forms isocyanide

[:C] Z react with Hinsberg's reagent.

[:D] Z is an aromatic primary amine.

[:ANS] **AC**

[:SOLN]

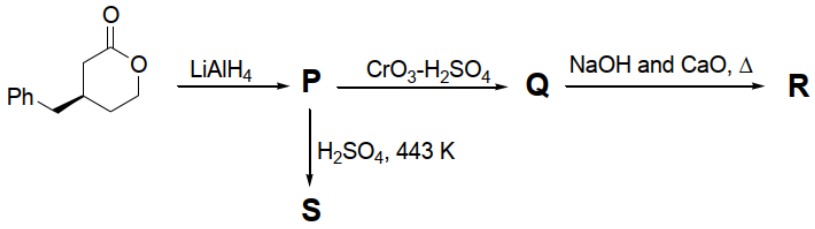


(A)Both 'X' and 'Y' contain oxygen

(C) Z react with hinsberg's reagent.

It gives is a test of 1°, 2° and 3° amine

[:Q.8] For the reaction sequence given below, the correct statement(s) is (are)



[:A] P is optically active

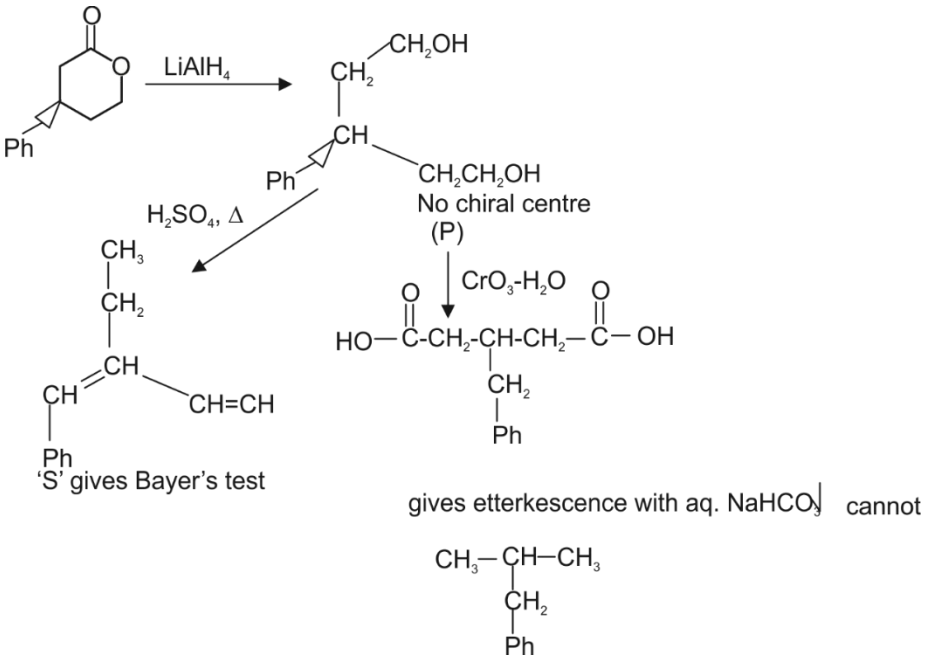
[:B] S gives Bayer's test

[:C] Q give effervescence with aq. $NaHCO_3$

[:D] R is an alkyne

[:ANS] **BC**

[:SOLN]



SECTION 3 (Maximum Marks : 32)

- This section contains **EIGHT (08)** questions.
- The answer to each question is a **NUMERICAL VALUE**.
- For each question, enter the correct numerical value of the answer using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.
- If the numerical value has more than two decimal places, **truncate/round-off** the value of to **TWO** decimal places.
- Answer to each question will be evaluated **according to the following marking scheme:**

  Full Marks : **+4** If ONLY the correct numerical value is entered in the designated place;

  Zero Marks **: 0** In all other cases.

[:Q.9] The density (in g cm^{-3}) of the metal which forms a cubic close packed (ccp) lattice with an axial distance (edge length) equal to 400 pm is_____

Use: Atomic mass of metal = 105.6 amu and Avogadro's constant = $6\times10^{23}mol^{-1}$

[:ANS] **11**

[:SOLN] ccp $\Rightarrow$ Rank $= 4$

$$\text{Given}\begin{cases} a = 400\,\text{pm} = 400\times10^{-10}\,\text{cm} = 4\times10^{-8}\,\text{cm} \\ \text{at mass} = 105.6 \\ N_A = 6\times10^{23} \end{cases}$$

$$d = \frac{Z\times M}{N_A\times a^3} = \frac{4\times105.6}{6\times10^{23}\times\left(4\times10^{-8}\right)^3} = \frac{4\times105.6}{6\times6.4} = 11\,\text{g/cc}$$

[:Q.10] The solubility of barium iodate in an aqueous solution prepared by mixing 200 mL of 0.010 M barium nitrate with 100 mL of 0.10 M sodium iodate is $X\times10^{-6}$ mol dm^{-3}. The value of X is _____.

Use: Solubility product constant $\left(K_{sp}\right)$ of barium iodate = 1.58×10^{-9}

[:ANS] **3.95**

[:SOLN] $Ba(NO_3)_2 + 2NaIO_3 \longrightarrow Ba(IO_3)_2 + 2NaNO_3$

	200	100 ml	0	0
	0.01M	0.10M	0	0
Initial	2 m mole (L.R)	10 m mol	2	4
Final	2- 2 =0	10- 4= 6		

$$[NaIO_3] = \left[IO_3^-\right] = \frac{6}{300} = 0.02\text{M}$$

$$Ba(IO_3)_2 \rightleftharpoons Ba^{2+} + 2IO_3^-$$

Initial	2/300	0	0.02
Final	-s	s	0.02+2s

$$K_{sp} = \left[Ba^{2+}\right]^1\left[IO_3^-\right]^2$$

$$1.58\times10^{-9} = s(0.02+2s)^2$$

$$1.58\times10^{-9} = s\times4\times10^{-4}$$

$$s \approx \frac{15.8\times10^{-10}}{4\times10^{-4}} = 3.95\times10^{-6} = x\times10^{-6}$$

$$x = 3.95$$

[:Q.11] Adsorption of phenol from its aqueous solution on to fly ash obeys Freundlich isotherm. At a given temperature, from 10 mg g^{-1} and 16 mg g^{-1} aqueous phenol solutions, the concentrations of adsorbed phenol are measured to be 4 mg g^{-1} and 10 mg g^{-1}, respectively. At this temperature, the concentration (in mg g^{-1}) of adsorbed phenol from 20 mg g^{-1} aqueous solution of phenol will be_____.

Use : $\log_{10} 2 = 0.3$

[:ANS] **16 or 15.62**

[:SOLN] A/C Frendlich isotherm

$$\frac{x}{m} = kc^{1/n}$$

A/q: $4 = k(10)^{1/n}$ .....(i)

$10 = k(16)^{1/n}$ .....(ii)

$(ii) \div (i)$

$$\frac{10}{4} = \left(\frac{16}{10}\right)^{1/n}$$

$$\log\frac{10}{4} = \frac{1}{n}\log\frac{16}{10}$$

$$1 - 0.6 = \frac{1}{n}(1.2 - 1)$$

$$n = \frac{0.2}{0.4} = \frac{1}{2}$$

$$\Rightarrow 10 = K(16)^2 = k \times 256$$

$$K = \frac{10}{256}$$

$$\Rightarrow \frac{x}{m} = \frac{10}{256}(C)^2 = \frac{10}{256}(20)^2 = \frac{10 \times 400}{256} = 15.62$$

[:Q.12] Consider a reaction A + R → Product. The rate of this reaction is measured to be k[A][R]. At the start of the reaction, the concentration of R, $[R]_o$, is 10-times the concentration of A, $[A]_o$. The reaction can be considered to be a pseudo first order reaction with assumption that k[R] = k' is constant. Due to this assumption, the relative error (in %) in the rate when this reaction is 40% complete, is _____.

[k and k' represent corresponding rate constants**]**

[:ANS] **4.16 or 4.17**

[:SOLN] $A + R \rightarrow Products$

Rate $= K[A][R]$

$[R]_0 = 10[A]_0$

Rate $= K'[A]$ where $K' = K[R]_0$

When reaction is 40% complete

$$[A] = [A]_0 - \frac{40}{100}[A]_0 = 0.6[A]_0$$

$$\text{Rate} = k' \times 0.6[A]_0 = K \times 10[A]_0 \times 0.6[A]_0 = 6K[A]_0^2$$

Without assuming pseudo order

	A	+	R	$\rightarrow$ Products
Initial	A_0		$R_0 = 10A_0$	
Final	$A_0 - 0.4A_0$		$10A_0 - 0.4A_0$	
	$0.6A_0$		$9.6A_0$	

$$\text{Rate} = k[R][A] = k \times 9.6[A]_0 \times 0.6[A]_0 = K \times 9.6 \times 0.6[A]_0^2$$

$$\%\text{ error in Rate} = \frac{6K[A]_0^2 - K \times 9.6 \times 0.6[A]_0^2}{K \times 0.6 \times 9.6[A]_0^2} \times 100 = \frac{0.24}{5.76} \times 100 = 4.16\%$$

[:Q.13] At 300 K, an ideal dilute solution of a macromolecule exerts osmotic pressure that is expressed in terms of the height (h) of the solution (density = 1.00 g cm^{-3}) where h is equal to 2.00 cm. If the concentration of the dilute solution of the macromolecule is 2.00 g dm^{-3}, the molar mass of the macromolecule is calculated to be $X \times 10^4\ g\,mol^{-1}$ .The value of X is

Use: Universal gas constant (R) = 8.3J $K^{-1}mol^{-1}$ and acceleration due to gravity (g) = 10m ms^{-2}

[:ANS] **2.49**

[:SOLN] ρ = 1 g/cc, h = 2.00 cm

Conc^n = 2 g/lit: Molar mass = $x \times 10^4\ g/mol$

$$\pi = \rho gh = [C]RT$$

$$\pi = 10^3 \times 10 \times \frac{2}{100} = \frac{2/M}{10^{-3}} \times 8.3 \times 300$$

$$10^3 \times \frac{2}{10} = \frac{2 \times 8.3 \times 300}{10^{-3}M}$$

$$M = \frac{8.3 \times 300 \times 10}{10^3 \times 10^{-3}} = 24.9 \times 10^3\ g = 2.490 \times 10^4\ g/mol$$

$$x = 2.490\ g$$

[:Q.14] An electrochemical cell is fueled by the combustion of butane at 1 bar and 298 K. Its cell potential is $\frac{X}{F}\times 10^3$ volts, where F is the faraday constant . The value of X is _____

Use: Standard Gibbs energies of formation at 298 K are :

$\Delta_f G^\circ_{CO_2} = -394 kJmol^{-1}; \Delta_f G^\circ_{water} = -237 kJmol^{-1}; \Delta_f G^\circ_{butane} = -18\, kJmol^{-1}$

[:ANS] **105.5**

[:SOLN] $C_4H_{10}(g) + \frac{13}{2}O_2(g) \longrightarrow 4CO_2(g) + 5H_2O(l)$

$\Delta G^\circ_r = \Delta G^\circ_F|_{prod} - \Delta G^\circ_F|_{reactants}$

$= \left\{4\Delta G^\circ_{FCO_2} + 5\Delta G^\circ_{FH_2O}\right\} - \left\{1.\Delta G^\circ_{FC_4H_{10}} + \frac{13}{2}\Delta G^\circ_{fO_2}\right\}$

$= 4\times(-394) + 5(-237) - (-18) = -2743 kJ$

$\Delta G^\circ = nF\varepsilon^\circ_{cell}$

$-2743\times 10^3 = -26\times F\times\frac{x}{F}\times 10^3$

X = 105.5

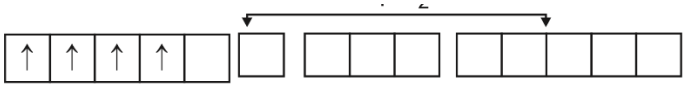
[:Q.15] The sum of the spin only magnetic moment values (in B.M.) of $\left[Mn(Br)_6\right]^{3-}$ and $\left[Mn(CN)_6\right]^{3-}$ is

[:ANS] **7.72-7.73**

[:SOLN] $\left[MnBr_6\right]^{3-}$

Mn^{3+} 3d 4 $4s^o$ $4p^o$

sp^3d^2

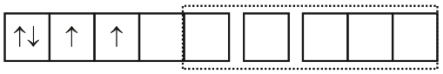


$\mu_s = \sqrt{24}$ B.M = 4.898 B.M

n = 4

$\left[Mn(CN)_6\right]^{3-}$

d^2sp^3



$\mu_s = \sqrt{8}$ B.M = 2.8288 B.M

n = 2

$(H_s)_T = 7.726 \simeq 7.73$ B.M

[:Q.16] A linear octasaccharide (molar mass = 1024 g mol^{-1}) on complete hydrolysis produces three monosaccharides: ribose, 2-deoxyribose and glucose. The amount of 2-deoxyribose formed is 58.26% (w/w) of the total amount of the monosaccharides produced in the hydrolyzed products. The number of ribose unit(s) present in one molecule of octasaccharide is_____

Use: Molar mass (in g mol^{-1}): ribose = 150, 2-deoxyribose = 134, glucose = 180: Atomic mass (in amu): H = 1, O = 16

[:ANS] **2**

[:SOLN]

$$\text{Octasaccharide} + 7H_2O$$

1024 126 = 1150

$$\downarrow$$

Ribose + 2-De-oxyribose + Glucose

Total mass of Monosacchanride

Mass of 2-De-oxyribose $= \frac{1150 \times 58.26}{100} = 670$ gram

Mass of glucose + Ribose = 1150- 670 = 480

So mass of Ribose = 480 – 180= 300

So. No. of Ribose = 350/150 = 2 unit