CHEMISTRY
JEE-MAIN (September-Attempt)
3 September (Shift-2) Paper

SECTION - A

1. The five successive ionization enthalpies of an element are 800, 2427, 3658, 25024 and 32824 kJ mol^{-1}. The number of valence electrons in the element is:
(1) 2 (2) 4 (3) 3 (4) 5

Sol. **3**
Fourth & Fifth I.E. are very high (periodic properties) indicating presence of three valence shell electrons

2. The incorrect statement is:
(1) Manganate and permanganate ions are tetrahedral
(2) In manganate and permanganate ions, the π-bonding takes place by overlap of p-orbitals of oxygen and d-orbitals of manganese
(3) Manganate and permanganate ions are paramagnetic
(4) Manganate ion is green in colour and permanganate ion is purple in colour

Sol. **3**

$\overset{+7}{Mn}O_4^-$ $d^0 \rightarrow$ dimagnetic

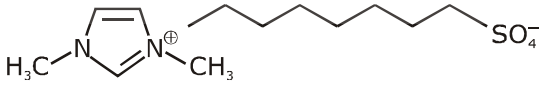
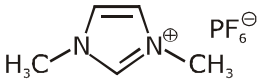
$\overset{+6}{Mn}O_4^{2-}$ $d^1 \rightarrow$ Paramagnetic

3. Match the following drugs with their therapeutic actions:

(i)	Ranitidine	(a)	Antidepressant
(ii)	Nardil (Phenelzine)	(b)	Antibiotic
(iii)	Chloramphenicol	(c)	Antihistamine
(iv)	Dimetane (Brompheniramine)	(d)	Antacid
		(e)	Analgesic

(1) (i)-(d); (ii)-(a); (iii)-(b); (iv)-(c) (2) (i)-(d); (ii)-(c); (iii)-(a); (iv)-(e)
(3) (i)-(a); (ii)-(c); (iii)-(b); (iv)-(e) (4) (i)-(e); (ii)-(a); (iii)-(c); (iv)-(d)

Sol. **1**

4. An ionic micelle is formed on the addition of:
(1) liquid diethyl ether to aqueous NaCl solution
(2) sodium stearate to pure toluene
(3) excess water to liquid 
(4) excess water to liquid 

Sol. **3**
ionic micelles formed by addition of water to soap {sodium stearate}
Ans. (3)

5. Among the statements (I–IV), the correct ones are:
(I) Be has smaller atomic radius compared to Mg.
(II) Be has higher ionization enthalpy than Al.
(III) Charge/radius ratio of Be is greater than that of Al.
(IV) Both Be and Al form mainly covalent compounds.
(1) (I), (II) and (IV) (2) (I), (II) and (III)
(3) (II), (III) and (IV) (4) (I), (III) and (IV)

Sol. **1**
Refer S-Block

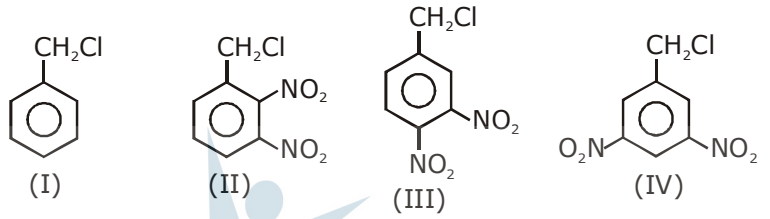
6. Complex A has a composition of $H_{12}O_6Cl_3Cr$. If the complex on treatment with conc.H_2SO_4 loses 13.5% of its original mass, the correct molecular formula of A is:
[Given: atomic mass of Cr = 52 amu and Cl = 35 amu]
(1) $[Cr(H_2O)_5Cl]Cl_2.H_2O$ (2) $[Cr(H_2O)_4Cl_2]Cl.2H_2O$
(3) $[Cr(H_2O)_3Cl_3].3H_2O$ (4) $[Cr(H_2O)_6]Cl_3$

Sol. **2**
Let x molecule of water are lost then

$$13.5 = \left[\frac{x \times 18}{6 \times 18 + 3 \times 35 + 52}\right] \times 100$$

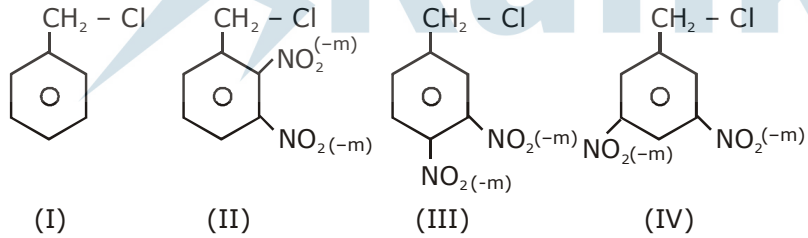
$x = 1.99 \simeq 2$
so, complex is $[Cr(H_2O)_4Cl_2].2H_2O$

7. The decreasing order of reactivity of the following compounds towards nucleophilic substitution (S_N2) is:



(1) (III) > (II) > (IV) > (I) (2) (IV) > (II) > (III) > (I)
(3) (II) > (III) > (IV) > (I) (4) (II) > (III) > (I) > (IV)

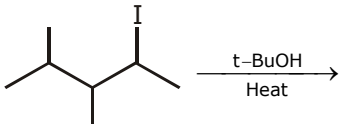
Sol. **3**

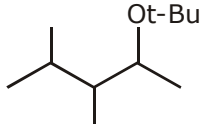


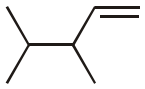
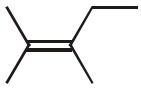
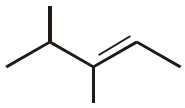
8. The increasing order of the reactivity of the following compounds in nucleophilic addition reaction is:
Propanal, Benzaldehyde, Propanone, Butanone
(1) Benzaldehyde < Propanal < Propanone < Butanone
(2) Propanal < Propanone < Butanone < Benzaldehyde
(3) Butanone < Propanone < Benzaldehyde < Propanal
(4) Benzaldehyde < Butanone < Propanone < Propanal

Sol. **3**
Rate of Nucleophilic addition $\Rightarrow$ Aldehyde > Ketone
Aliphatic aldehyde > Aromatic aldehyde

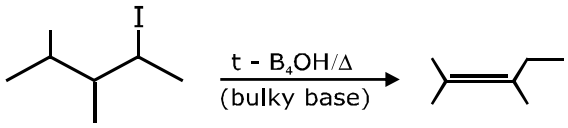
9. The major product in the following reaction is:



(1) 

(2) 
(3) 
(4) 

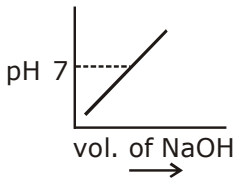
Sol. **3**

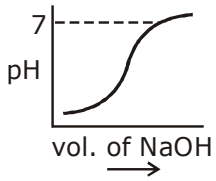


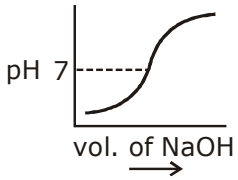
10. The incorrect statement(s) among (a) – (d) regarding acid rain is (are):
(a) It can corrode water pipes.
(b) It can damage structures made up of stone.
(c) It cannot cause respiratory ailments in animals
(d) It is not harmful for trees
(1) (a), (b) and (d) (2) (a), (c) and (d) (3) (c) and (d) (4) (c) only

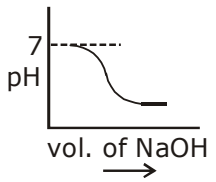
Sol. **3**
Acid rain can cause respiratory ailments in animals and also harmful for trees and plant.

11. 100 mL of 0.1 M HCl is taken in a beaker and to it 100 mL of 0.1 M NaOH is added in steps of 2 mL and the pH is continuously measured. Which of the following graphs correctly depicts the change in pH?

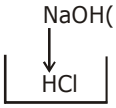
(1) 

(2) 

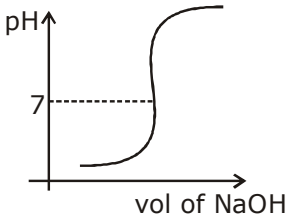
(3) 

(4) 

Sol. **3**



initially pH will be acidic < 7
at eq pH pH = 7
& finally pH will be basic > 7



option (3)

12. Consider the hypothetical situation where the azimuthal quantum number, l, takes values 0, 1, 2, ... n + 1, where n is the principal quantum number. Then, the element with atomic number:
(1) 13 has a half-filled valence subshell (2) 9 is the first alkali metal
(3) 8 is the first noble gas (4) 6 has a 2p-valence subshell

Sol. **1**
(1) $_{13}X = 1s^2\ 1p^6\ 1d^5$ - half filled
(2) $_{9}X = 1s^2\ 1p^6\ 1d^1$ - not alkali metal
(3) $_{8}X = 1s^2\ 1p^6$ - Second nobel gas
Option (1)

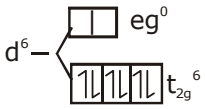
13. The d-electron configuration of $[Ru(en)_3]Cl_2$ and $[Fe(H_2O)_6]Cl_2$, respectively are:

(1) $t_{2g}^4 e_g^2$ and $t_{2g}^6 e_g^0$ (2) $t_{2g}^6 e_g^0$ and $t_{2g}^6 e_g^0$

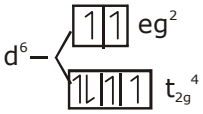
(3) $t_{2g}^4 e_g^2$ and $t_{2g}^4 e_g^2$ (4) $t_{2g}^6 e_g^0$ and $t_{2g}^4 e_g^2$

Sol. **4**

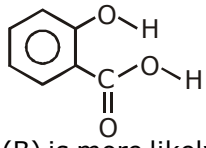
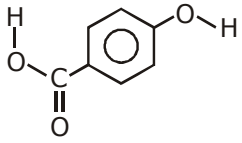
$[\overset{2+}{Ru}(en)_3]Cl_2$ — Low spin complex



$[\overset{2+}{Fe}(H_2O)_6]Cl_2$ — High spin complex



14. Consider the following molecules and statements related to them:

(A)  (B) 

(a) (B) is more likely to be crystalline than (A)
(b) (B) has higher boiling point than (A)
(c) (B) dissolves more readily than (A) in water
Identify the correct option from below:
(1) (a) and (c) are true (2) only (a) is true
(3) (b) and (c) are true (4) (a) and (b) are true

Sol. Bonus
All answer are correct

15. The strengths of 5.6 volume hydrogen peroxide (of density 1 g/mL) in terms of mass percentage and molarity (M), respectively, are:
(Take molar mass of hydrogen peroxide as 34 g/mol)
(1) 0.85 and 0.5 (2) 0.85 and 0.25
(3) 1.7 and 0.25 (4) 1.7 and 0.5

Sol. **4**
Volume strength = 5.6V

$$\text{molarity} = \frac{5.6}{11.2} = 0.5 \text{ mol / l}$$

$$\text{mass \%} = \left[\frac{0.5 \times 34}{10}\right] \times \frac{1}{1g/ml}$$

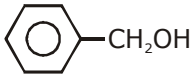
$$= 1.7\ \%$$

Ans. 1.7 & 0.5 option (4)

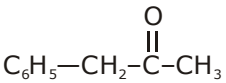
16. The compound A in the following reactions is:

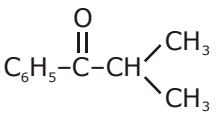
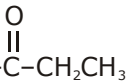
$$A \xrightarrow[(ii)\ Conc.\ H_2SO_4 / \Delta]{(i)\ CH_3MgBr / H_2O}$$

$$B \xrightarrow[(ii)\ Zn/H_2O]{(i)\ O_3} C + D$$

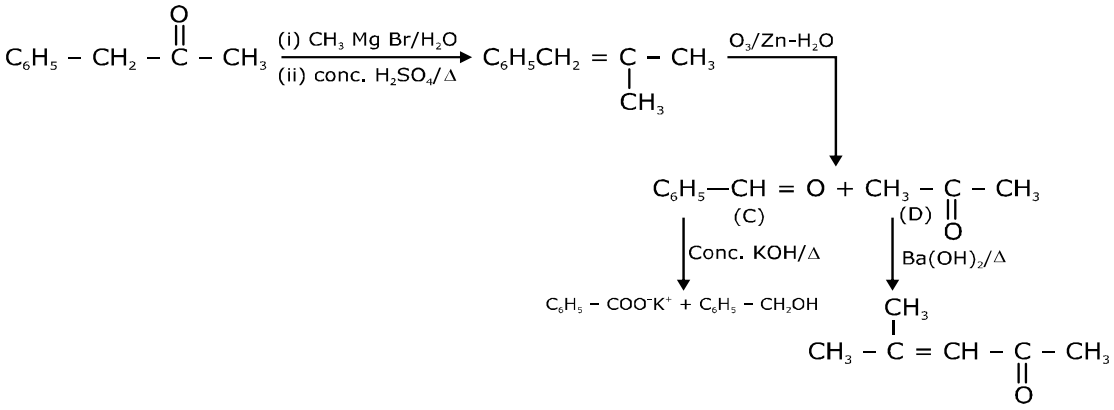
$$C \xrightarrow[(ii)\ \Delta]{(i)\ Conc.\ KOH} \text{  } + \text{  }$$

$$D \xrightarrow[\Delta]{Ba(OH)_2} H_3C-\overset{CH_3}{\overset{|}{C}}=CH-\overset{O}{\overset{||}{C}}-CH_3$$

(1)  (2) 

(3)  (4) 

Sol. **1**



17. A mixture of one mole each of H_2, He and O_2 each are enclosed in a cylinder of volume V at temperature T. If the partial pressure of H_2 is 2 atm, the total pressure of the gases in the cylinder is:
(1) 6 atm (2) 14 atm (3) 38 atm (4) 22 atm

Sol. **1**

$p_{H_2} = 2 \text{ atm} = xH_2 \times p_{total}$

$2 \text{ atm} = \frac{1}{1+1+1} \times P_{total}$

$P_{total} = 6 \text{ atm}$

Ans. option (1)

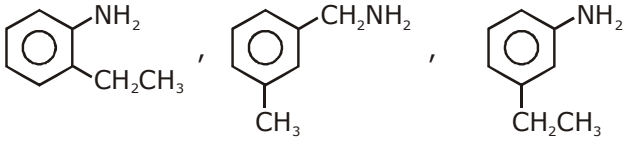
18. Three isomers A, B and C (mol. formula $C_8H_{11}N$) give the following results:

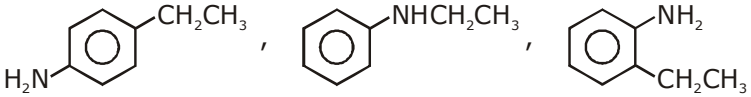
A and C $\xrightarrow{\text{Diazotizat ion}}$ P + Q $\xrightarrow[\text{(ii) Oxidation } (KMnO_4+H^+)]{\text{(i) Hydrolysis}}$ R (product of A) + S (product of C)

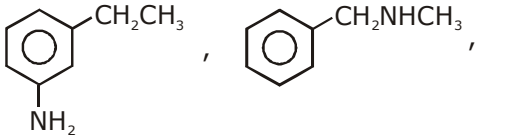
R has lower boiling point than S

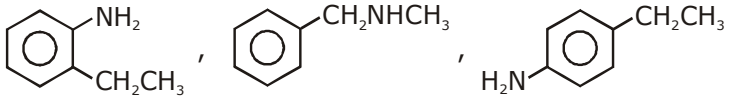
B $\xrightarrow{C_6H_5SO_2Cl}$ alkali-insoluble product

A, B and C, respectively are:

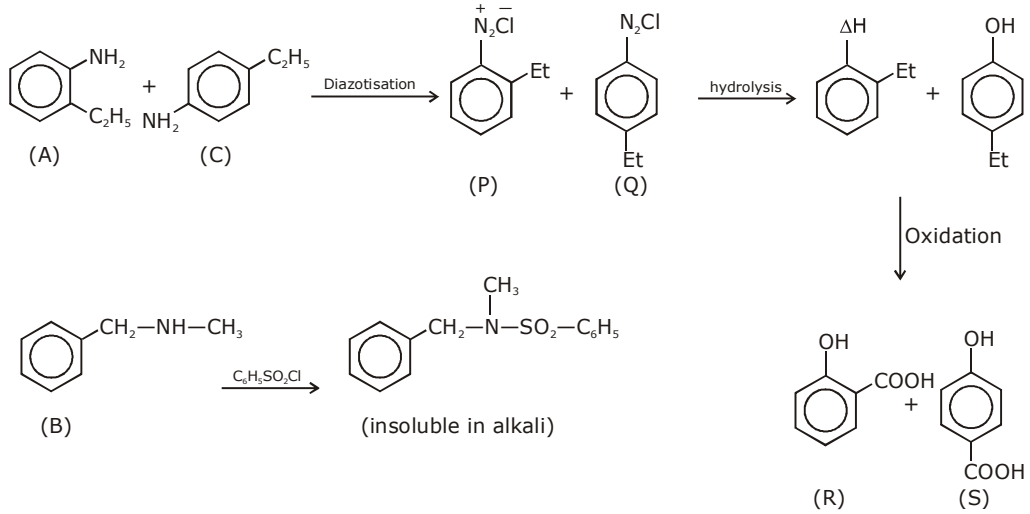
(1) 

(2) 

(3) 

(4) 

Sol. **2**



19. For the reaction $2A + 3B + \frac{3}{2}C \rightarrow 3P$,
which statement is correct?

(1) $\frac{dn_A}{dt} = \frac{dn_B}{dt} = \frac{dn_C}{dt}$ (2) $\frac{dn_A}{dt} = \frac{3}{2}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$

(3) $\frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{4}{3}\frac{dn_C}{dt}$ (4) $\frac{dn_A}{dt} = \frac{2}{3}\frac{dn_B}{dt} = \frac{3}{4}\frac{dn_C}{dt}$

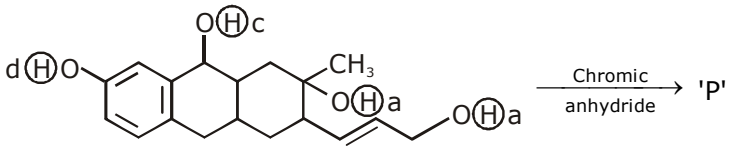
Sol. **3**

$$2A + 3B + \frac{3}{2}C \longrightarrow 3P$$

$$ROR = \frac{1}{2}\left[\frac{-d[n_A]}{dt}\right] = \frac{1}{3}\left[\frac{-d[n_B]}{dt}\right] = \frac{2}{3}\left[\frac{-d[n_c]}{dt}\right] = \frac{1}{3}\left[\frac{+d[n_e]}{dt}\right]$$

$$\left[\frac{-dn_A}{dt}\right] = \frac{2}{3}\left[\frac{-d[n_B]}{dt}\right] = \frac{4}{3}\left[\frac{-d[n_e]}{dt}\right]$$

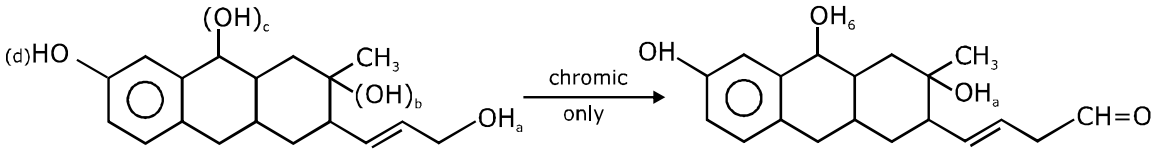
20. Consider the following reaction:



The product 'P' gives positive ceric ammonium nitrate test. This is because of the presence of which of these –OH group(s)?

(1) (b) only (2) (b) and (d) (3) (c) and (d) (4) (d) only

Sol. **1**



21. The volume (in mL) of 0.1 N NaOH required to neutralise 10 mL of 0.1 N phosphinic acid is _____.

Sol. **10 ml**

$NaOH + H_3PO_2 \longrightarrow NaH_2PO_2 + H_2O$

Phosphinic

Vol. × 0.1 = 0.1 × 10

vol = 10 ml Ans.

22. An acidic solution of dichromate is electrolyzed for 8 minutes using 2A current. As per the following equation

$Cr_2O_7^{2-} + 14H^+ + 6e^- \longrightarrow 2Cr^{3+} + 7H_2O$

The amount of Cr^{3+} obtained was 0.104 g. The efficiency of the process (in %) is (Take: F = 96000 C, At. mass of chromium = 52) _____.

Sol. **60 %**

$[\text{moles of } Cr^{3+}] \times 3 = \frac{8 \times 60 \times 2}{96000}$

$\text{moles of } Cr^{3+} = \frac{8 \times 4}{9600} = \frac{1}{300} \text{ mol}$

$\text{mass of } Cr^{3+} = \frac{52}{300} \text{ g}$

$\% \text{ efficiency} = \frac{\text{Actual obtained Amt}}{\text{Theo. obtained Amt}} \times 100$

$= \frac{\frac{0.104}{52}}{300} \times 100 \qquad = 30 \times \frac{104}{52} = 60\%$

23. If 250 cm^3 of an aqueous solution containing 0.73 g of a protein A is isotonic with one litre of another aqueous solution containing 1.65 g of a protein B, at 298 K, the ratio of the molecular masses of A and B is _____ × 10^{-2} (to the nearest integer).

Sol. **177**

$\frac{0.73}{M_A} \times \frac{1000}{250} = \frac{1.65}{M_B}$

$\frac{M_A}{M_B} = \frac{73 \times 4}{165} = 1.769$

$= 176.9 \times 10^{-2}$

$= 177 \times 10^{-2}$

24. 6.023×10^{22} molecules are present in 10 g of a substance 'x'. The molarity of a solution containing 5 g of substance 'x' in 2 L solution is _____ $\times 10^{-3}$.

Sol. **25**

Mol. wt of 'x' = $\frac{10}{6.023 \times 10^{22}} \times 6.023 \times 10^{23}$

$= 100$ g/mol

$M = \frac{5/100}{2} = \left(\frac{5}{200} \times 1000\right) \times 10^{-3}$

$M = 25 \times 10^{-3}$ mol/lit

25. The number of $>C=O$ groups present in a tripeptide Asp–Glu–Lys is ____.

Sol. **5**