# CHEMISTRY
## JEE-MAIN (July-Attempt) 25 July
## (Shift-1) Paper

## SECTION –A

**1.** The ionic radii of $K^+, Na^+, Al^{3+}$ and $Mg^{2+}$ are in the order:

(1) $Al^{3+} < Mg^{2+} < K^+ < Na^+$      (2) $K^+ < Al^{3+} < Mg^{2+} < Na^+$

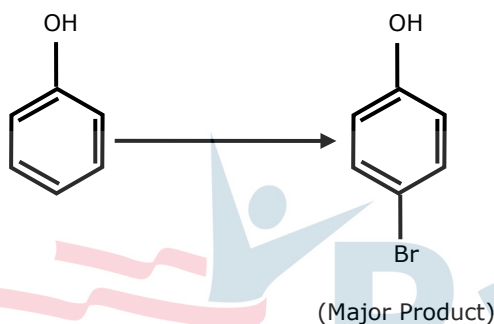(3) $Na^+ < K^+ < Mg^{2+} < Al^{3+}$      (4) $Al^{3+} < Mg^{2+} < Na^+ < K^+$

**Sol.** **(4)**

$Al^{3+}$, $Mg^{2+}$ and $Na^+$ are isoelectronic ionic species. For monoatomic ionic isoelectronic species as positive charge increases ionic size decrease.

The order of size of $Na^+$ & $K^+$ is $Na^+ < K^+$,

$\therefore$ order of ionic radii is : $Al^{3+} < Mg^{2+} < Na^+ < K^+$

**2.** The given reaction can occur in the presence of:



(Major Product)

(1) Bromine water      (2) $Br_2$ in $CS_2$, 273 K

(3) $Br_2$/ $FeBr_3$      (4) $Br_2$ in $CHCl_3$, 273 K

Choose the correct answer from the options given below:

(1) (a) and (c) only      (2) (b), (c) and (d) only

(3) (a), (b) and (d) only      (4) (b) and (d) only
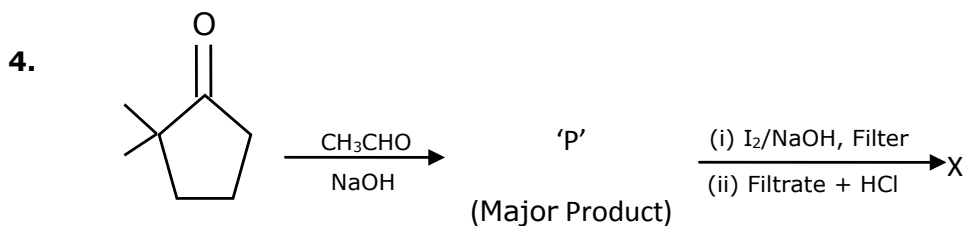
**Sol.** **(2)**

Bromine water gives tribromo products, other gives monbromo products in which para is major product.

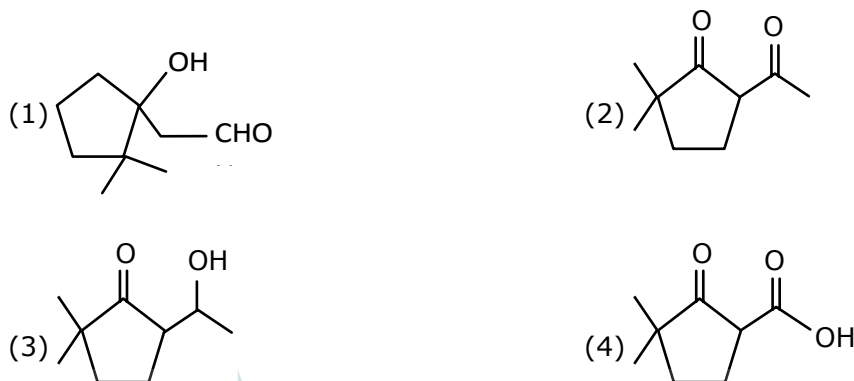**3.** Which one of the following compounds of Group-14 elements is not known?

(1) $\left[GeCl_6\right]^{2-}$      (2) $\left[SiCl_6\right]^{2-}$

(3) $\left[Sn(OH)_6\right]^{2-}$      (4) $\left[SiF_6\right]^{2-}$

**Sol.** **(2)**

$\left[SiCl_6\right]^{2-}$ does not exist due to steric crowding of surrounding atoms.

**4.**



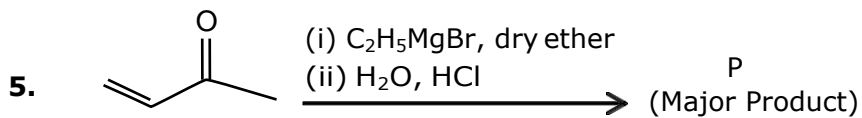$\xrightarrow[\text{NaOH}]{\text{CH}_3\text{CHO}}$ 'P'  (Major Product) $\xrightarrow[\text{(ii) Filtrate + HCl}]{\text{(i) I}_2\text{/NaOH, Filter}}$ X
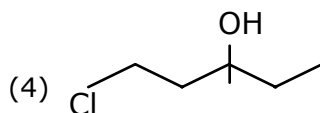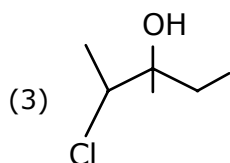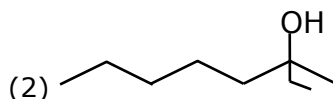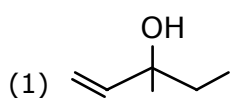
Consider the given reaction, the product 'X' is:
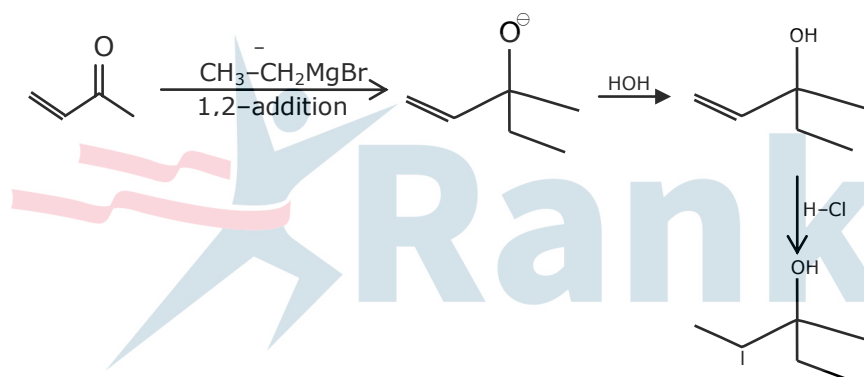
(1) 

(2) 

(3) 

(4) 

**Sol.** **(4)** Aldol reaction and than iodo form reaction.

**5.**
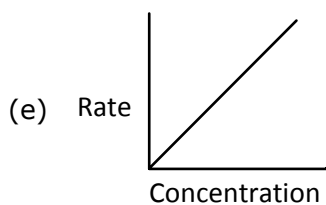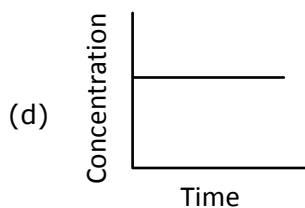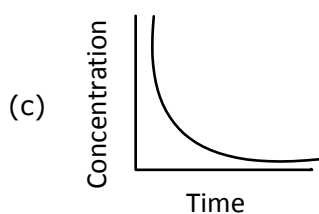


(i) C$_2$H$_5$MgBr, dry ether
(ii) H$_2$O, HCl
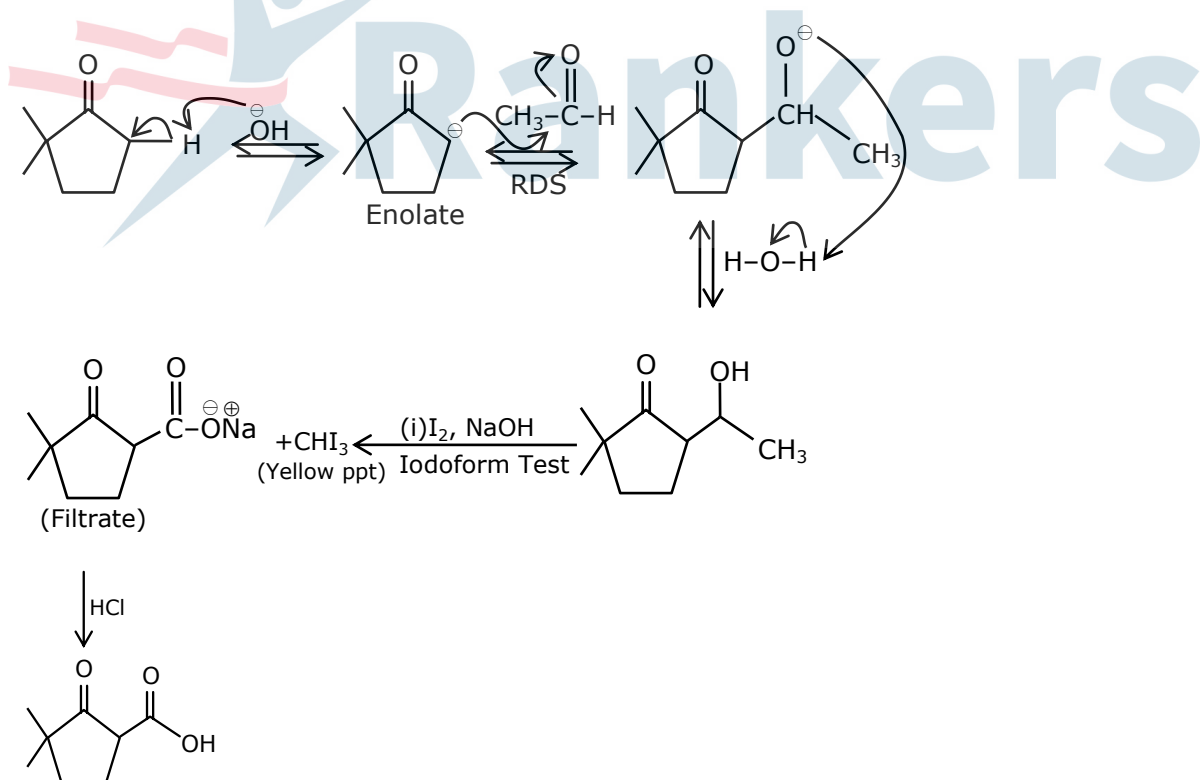
→ P (Major Product)

Consider the above reaction, the major product 'P' is:–

(1) 

(2) 

(3) 

(4) 

**Sol.** **(3)**



**6.** For the following graphs,

(a) 

(b) 

(c) 

(d) 

(e)
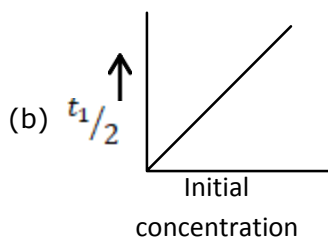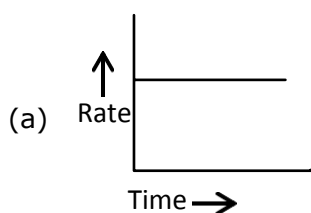
Choose from the options given below, the correct one regarding order of reaction is:

(1) (b) and (d) Zero order (e) First order

(2) (a) and (b) Zero order (c) and (e) First order

(3) (a) and (b) Zero order (e) First order

(4) (b) Zero order (c) and (e) First order

**Sol.** **(3)**

For zero order reactions'

Rate = K [Reactant]°

$\Rightarrow r = k$
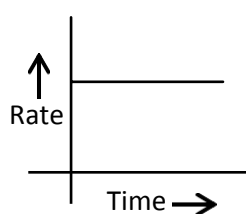


$t_{1/2} = \dfrac{[A]_0}{2K}$ for zero order



For first order reaction $\rightarrow$

r = K [Concentration]



Reactant concentration after time t $\rightarrow$

$C_1 = C_0 \ e^{-k1}$
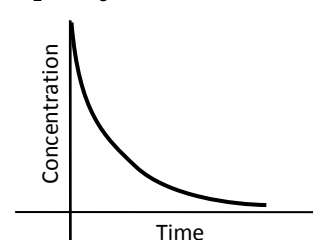
**7.** Given below are two statements, one is labeled as Assertion (A) and other is labeled as:-
**Reason (R).**
**Assertion (A):** Gabriel phthalimide synthesis cannot be used to prepare aromatic primary amines.
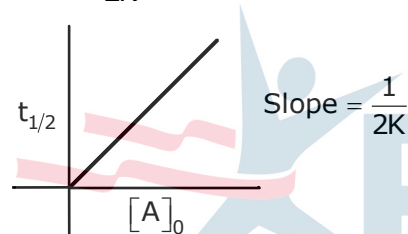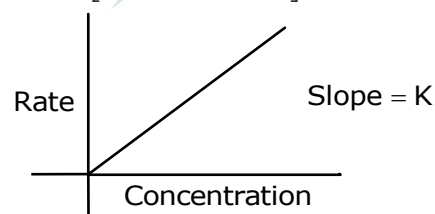**Reason (R):** Aryl halides do not undergo nucleophilic substitution reaction.
In the light of the above statements, choose the correct answer form the options given below.
(1) (A) is true but (R) is flase
(2) (A) is false but (R) is true
(3) Both (A) and (R) are true but (R) is not the correct explanation of (A).
(4) Both (A) and (R) are true and (R) is correct explanation of (A).

**Sol. (4)**

Gabriel pthalamide synthesis



$+R-NH_2$
(primary aliphatic amine)

Aromatic halide does not gives $SN_2$ reaction

**8.** An Organic compound 'A' $C_4H_8$ on treatment with $KMnO_4/H^+$ yields compound 'B' $C_3H_6O$.
Compound 'A' also yields compound 'B' an ozonolysis. Compound 'A' is :
(1) But-2-ene
(2) 2-Methylpropene
(3) Cyclobutane
(4) 1-Methylcyclopropane

**Sol. (2)**
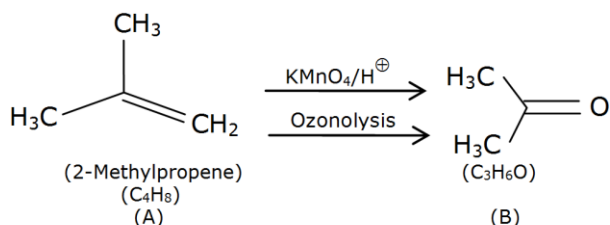
**9.** Sodium stearate $CH_3(CH_2)_{16}COO^-Na^+$ is an anionic surfactant which forms micelles in oil. Choose the correct statement for it from the following:

(1) It forms spherical micelles with $CH_3(CH_2)_{16}$– group pointing towards the center of sphere.

(2) It forms non–spherical micelles with $CH_3(CH_2)_{16}$– group pointing towards the center.
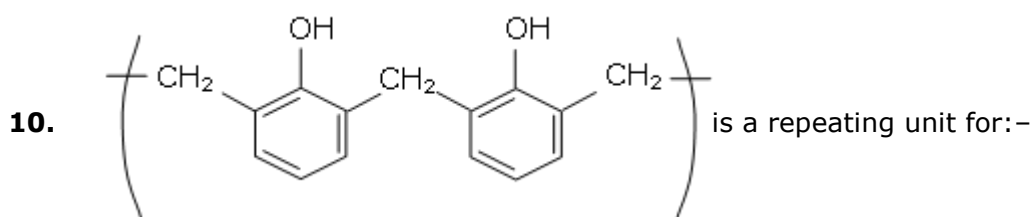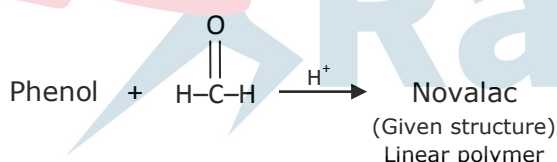
(3) It forms spherical micelles with $CH_3(CH_2)_{16}$– group pointing towards the surface of sphere.

(4) It forms non–spherical micelles with $—COO^\ominus$ group pointing outwards on the surface.

**Sol.** **(1)**

Forms spherical micelles with $CH_3(CH_2)_{16}$ group pointing towards the center of sphere

**10.**



is a repeating unit for:–

(1) Novolac

(2) Acrilan

(3) Buna–N

(4) Neoprene

**Sol.** **(1)**



Phenol + H–C–H $\xrightarrow{H^+}$ Novalac (Given structure) Linear polymer

**11.** Which one of the following compounds will liberate $CO_2$, when treated with $NaHCO_3$?

(1) $(CH_3)_4 \overset{\oplus}{N}\overset{\ominus}{O}H$

(2) $(CH_3)_3 \overset{\oplus}{N}H\overset{\ominus}{C}l$

(3) $CH_3NH_2$

(4) $CH_3— \overset{\overset{O}{\|}}{C} — NH_2$

**Sol.** **(2)**

$(CH_3)_3\overset{\oplus}{N}H\overset{\ominus}{C}l + \overset{\oplus}{Na}H\overset{\ominus}{C}O_3 \longrightarrow H_2CO_3 + (CH_3)_3N + NaCl$

$\downarrow$

$CO_2 + H_2O$
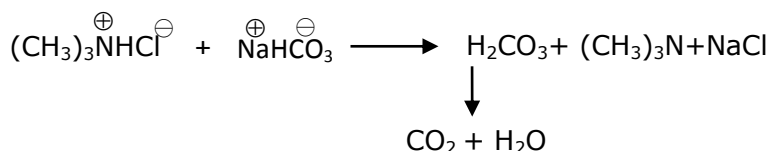
**12.** In the leaching of alumina from bauxite, the ore expected to leach out in the process by reacting with NaOH is:

(1) $TiO_2$          (2) $SiO_2$          (3) $Fe_2O_3$          (4) $ZnO$

**Sol.** **(2)**

In bauxite impurities of $Fe_2O_3$, $TiO_2$ and $SiO_2$ are present, $Fe_2O_3$ and $TiO_2$ are basic oxides therefore does not reacts with or dissolve in NaOH whereas $SiO_2$ is acidic oxide it gets dissolve in NaOH, hence leach out

$SiO_2 + 2NaOH \rightarrow Na_2SiO(aq.) + H_2O$
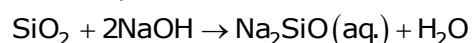
**13.** At 298.2 K the relationship between enthalpy of bond dissociation (in kJ mol$^{-1}$) for hydrogen ($E_H$) and its isotope, deuterium ($E_D$), is best described by:

(1) $E_H = \dfrac{1}{2}E_D$  (2) $E_H = E_D$  (3) $E_H = 2E_D$  (4) $E_H \simeq E_D - 7.5$

**Sol.** **(4)**

Enthalpy of bond dissociation (kJ/mole) at 298.2K

For, hydrogen = 4.35.88

For, Deuterium = 443.35

$\therefore$ $E_H \simeq E_D - 7.5$

**14.** Which one among the following resonating structures is not correct?



**Sol.** **(4)**
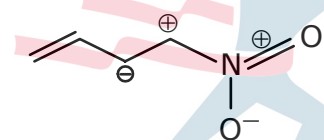


**15.** Which one of the following chemical agent is not being used for dry-cleaning of clothes?

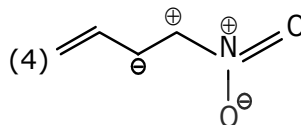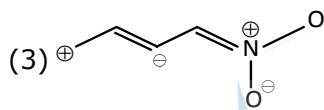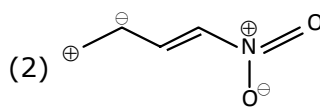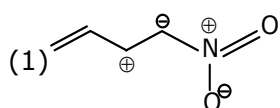(1) $H_2O_2$  (2) $Cl_2C = CCl_2$  (3) $CCl_4$  (4) Liquid $CO_2$

**Sol.** **(3)**

$CO_2$, $CCl_4$ and $Cl_2C = CCl_2$ are used as dry cleaning agents for clothes.

$H_2O_2$ is used as bleaching agent in laundry.

**16.** Given below are two statements:

**Statement I :** None of the alkaline earth metal hydroxides dissolve in alkali.

**Statement II :** Solubility of alkaline earth metal hydroxides in water increases down the group.

In the light of the above statements, choose the **most appropriate** answer from the options given below:

(1) **Statement I** is correct but **Statement II** is incorrect.

(2) **Statement I** and **Statement II** both are incorrect.

(3) **Statement I** is incorrect but **Statement II** is correct.

(4) **Statement I** and **Statement II** both are correct.

**Sol.** **(3)**

**Statement–I** is incorrect

Be(OH)$_2$ dissolve in alkali due to it's amphoteric nature.

**Statement–II** is correct

Solubility of alkaline earth metal hydroxide in water increases down the group due to rapid decreases in lattice energy as compared to hydration energy.

**17.** Which one of the products of the following reactions does not react with Hinsburg reagent to form sulphonamide?
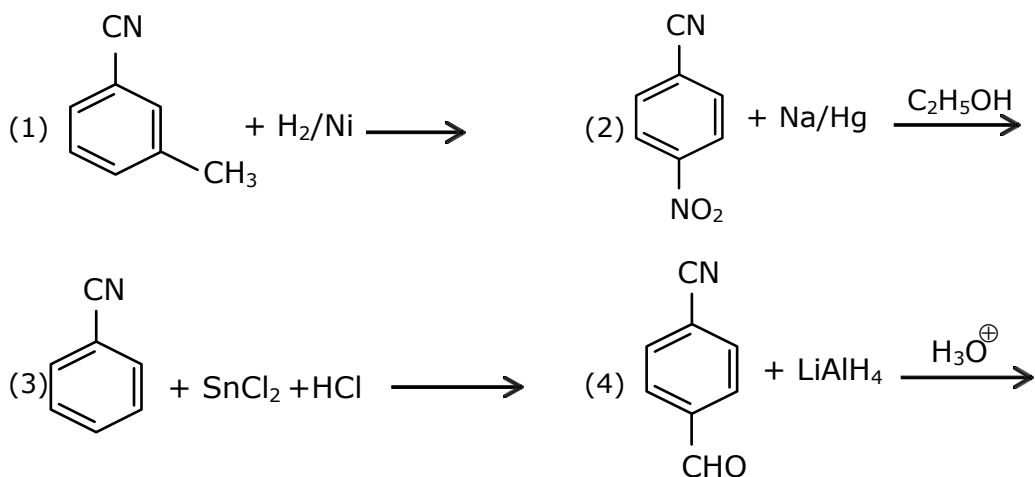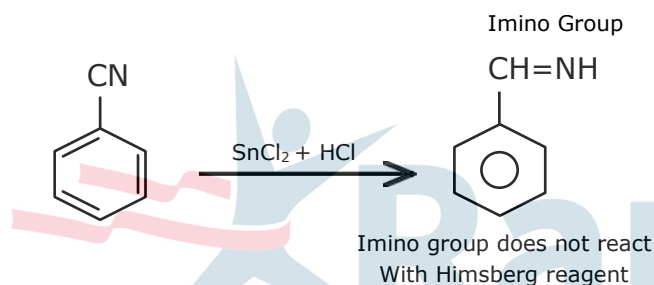
(1) [structure: benzene ring with CN at top and CH₃ at bottom-right] + H₂/Ni ⟶

(2) [structure: benzene ring with CN at top and NO₂ at bottom] + Na/Hg $\xrightarrow{C_2H_5OH}$

(3) [structure: benzene ring with CN] + SnCl₂ + HCl ⟶

(4) [structure: benzene ring with CN at top and CHO at bottom] + LiAlH₄ $\xrightarrow{H_3O^{\oplus}}$

**Sol.** **(3)**

Imino Group

[structure: benzene ring with CN] $\xrightarrow{SnCl_2 + HCl}$ [structure: benzene ring with CH=NH]

CH=NH

Imino group does not react
With Himsberg reagent

**18.** Which one of the following species responds to an external magnetic field?

(1) $\left[Fe(H_2O)_6\right]^{3+}$     (2) $\left[Ni(CO)_4\right]$     (3) $\left[Co(CN)_6\right]^{3-}$     (4) $\left[Ni(CN)_4\right]^{2-}$

**Sol.** **(1)**

1. $[\overset{+3}{Fe}(H_2O)_6]^{3+}$

$Fe^{3+} : \left[Ar\right]3d^5$
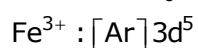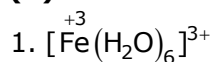
Hybridisation : $sp^3d^2$

Magnetic nature : Paramagnetic (so this complex response to external magnetic field)

2. $\left[Ni(CN)_4\right]^{2-}$

$Ni^{2+} : \left[Ar\right]3d^8$
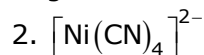
Hybridisation : $dsp^2$

Magnetic nature : diamagnetic

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

$Co^{3+} : \left[Ar\right]3d^6$
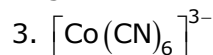
Hybridisation : $d^2sp^3$

Magnetic nature: diamagnetic

4. $\left[Ni(CO)_4\right]$

$Ni : \left[Ar\right]3d^8 4s^2$
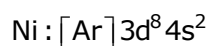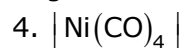
Hybridisation : $sp^3$

Magnetic nature : diamagnetic

**19.** The correct order of following 3d metal oxides, according to their oxidation numbers is :

(a) $CrO_3$        (b) $Fe_2O_3$        (c) $MnO_2$        (d) $V_2O_5$        (e) $Cu_2O$

(1) (a) > (c) > (d) > (b) > (e)

(2) (d) > (a) > (b) > (c) > (e)

(3) (a) > (d) > (c) > (b) > (e)

(4) (c) > (a) > (d) > (e) > (b)

**Sol.** **(3)**

(a) $\overset{+6}{C}rO_3$                    (d) $\overset{+5}{V_2}O_5$

(b) $\overset{+3}{Fe_2}O_3$                (e) $\overset{+1}{Cu_2}O$

(c) $\overset{+4}{Mn}O_2$

So order of oxidation state

a > d > c > b > e

**20.** The water soluble protein is :

(1) Fibrin        (2) Albumin        (3) Collagen        (4) Myosin

**Sol.** **(2)**

Albumin is water soluble.

# SECTION –B

**1.** A source of monochromatic radiation of wavelength 400 nm provides 1000 J of energy in 10 seconds. When this radiation falls on the surface of sodium, $x \times 10^{20}$ electrons are ejected per second. Assume that wavelength 400 nm is sufficient for ejection of electron from the surface of sodium metal. The value of x is _____. (Nearest integer)

(h = $6.626 \times 10^{-34}$ Js)

**Sol.** **(2)**

Total energy provided by

Source per second $= \dfrac{1000}{10} = 100J$

Energy required to eject electron $= \dfrac{hc}{\lambda}$

$= \dfrac{6.626 \times 10^{-34}}{400 \times 10^{-9}} \times 3 \times 10^8$

Number of electrons ejected

$= \dfrac{100}{\dfrac{6.626 \times 10^{-34} \times 3 \times 10^8}{400 \times 10^{-9}}}$

$= \dfrac{400 \times 10^{-7} \times 10^{26}}{6.626 \times 3}$

$= \dfrac{40 \times 10^{-20}}{6.626 \times 3}$

$= 2.01 \times 10^{20}$

**2.** When 10 mL of an aqueous solution of $Fe^{2+}$ ions was titrated in the presence of dil $H_2SO_4$ using diphenylamine indicator, 15 mL of 0.02 M solution of $K_2Cr_2O_7$ was required to get the end point. The molarity of the solution containing $Fe^{2+}$ ions is X× $10^{-2}$ M. The value of x is_____. (Nearest integer)

**Sol.** **(18)**

$Fe^{+2} + Cr_2O_7^{-2} \rightarrow Fe^{+3} + Cr^{+3}$
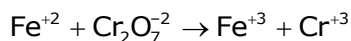
Milli–equivalents of $Fe^{2+}$ = milli–equivalents of

$K_2Cr_2O_7$

M×10×1 = 0.02×15×6

M = 0.18 = 18 ×$10^{-2}$M

**3.** At 298 K, the enthalpy of fusion of a solid (X) is 2.8 kJ $mol^{-1}$ and the enthalpy of vaporisation of the liquid (X) is 98.2 kJ $mol^{-1}$. The enthalpy of sublimation of the substance (X) in kJ $mol^{-1}$ is _____. (in nearest integer)

**Sol.** **(101)**
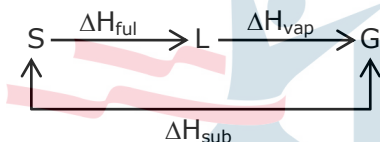


$\Delta H_{sub} = \Delta H_{fus.} + \Delta H_{vap.}$

= 2.8+98.2

= 101 KJ/mol

**4.** Consider the complete combustion of butane, the amount of butane utilized to produce 72.0 g of water is _____ × $10^{-1}$ g. (in nearest integer)

**Sol.** **(464)**

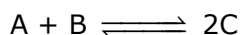$C_4H_{10} + \dfrac{13}{2}O_2 \longrightarrow 4CO_2 + 5H_2O$

Moles of $H_2O$ = $\dfrac{72}{18} = 4$

Moles of $C_4H_{10}$ used = $\dfrac{1}{5} \times 4$

Weight of $C_4H_{10}$ used = $\dfrac{4}{5} \times 58$

= 46.4 gm $\Rightarrow$ 464 × $10^{-1}$ gm

**5.** For the reaction

A + B $\rightleftharpoons$ 2C

the value of equilibrium constant is 100 at 298 K. If the initial concentration of all the three species is 1 M each, then the equilibrium concentration of C is X × $10^{-1}$ M. The value of x is _____. (Nearest integer)

**Sol. (25)**

$$\begin{array}{cccc} A & + & B & \rightleftharpoons & 2C \\ 1 & & 1 & & 1 \\ -x & & -x & & 2x \\ \hline 1-x & & 1-x & & 1+2x \end{array}$$
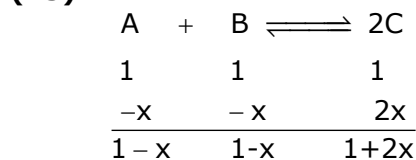
$$K = \frac{[C]_{eq}^2}{[A]_{eq}[B]_{eq}} = \frac{(1+2x)^2}{(1-x)(1-x)}$$

$$100 = \left(\frac{1+2x}{1-x}\right)^2$$

$$\left(\frac{1+2x}{1-x}\right) = 10$$

$$x = \frac{3}{4}$$

$[C]_{eq.} = 1 + 2x$

$$= 1 + 2\left(\frac{3}{4}\right)$$

= 2.5 M

25 × $10^{-1}$ M

**6.** $CO_2$ gas is bubbled through water during a soft drink manufacturing process at 298 K. If $CO_2$ exerts a partial pressure of 0.835 bar then x m mol of $CO_2$ would dissolve in 0.9 L of water. The value of x is _____. (Nearest integer)

(Henry's law constant for $CO_2$ at 298 K is $1.67 \times 10^3$ bar)

**Sol. (25)**

From Henry's Law

$$0.835 = 1.67 \times 10^3 \times \frac{n(CO_2)}{\dfrac{0.9 \times 1000}{18}}$$

$n(CO_2)$ = 0.025

Millimoles of $CO_2$ = 0.025×1000 = 25

**7.** A home owner uses $4.00 \times 10^3$ m$^3$ of methane ($CH_4$) gas, (assume $CH_4$ is an ideal gas) in a year to heat his home. Under the pressure of 1.0 atm and 300 K, mass of gas used is X×$10^5$ g. The value of x is _____. (Nearest integer)

(Given R = 0.083 L atm K$^{-1}$mol$^{-1}$)
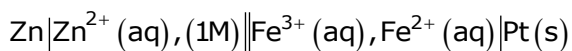
**Sol. (26)**

$$n(CH_4) = \frac{PV}{RT}$$

$$= \frac{1 \times 4 \times 10^3 \times 1000}{0.083 \times 300}$$

Weight of $CH_4$

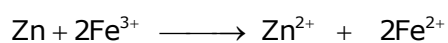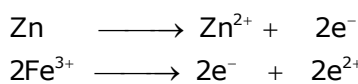$$= \frac{40 \times 16 \times 10^5}{0.083 \times 300} \text{ gm}$$

= 25.7 × $10^5$gm

**8.** Consider the cell at 25°C

$$Zn \mid Zn^{2+}(aq), (1M) \parallel Fe^{3+}(aq), Fe^{2+}(aq) \mid Pt(s)$$

The fraction of total iron present as $Fe^{3+}$ ion at the cell potential of 1.500 V is $X \times 10^{-2}$. The value of x is _____. (Nearest integer).

(Given $E^o_{Fe^{3+}/Fe^{2+}} = 0.77$ V, $E^o_{Zn^{2+}/Zn} = -0.76$ V )

**Sol. (24)**

$$Zn \longrightarrow Zn^{2+} + 2e^-$$
$$\underline{2Fe^{3+} \longrightarrow 2e^- + 2e^{2+}}$$

$$\underline{Zn + 2Fe^{3+} \longrightarrow Zn^{2+} + 2Fe^{2+}}$$

$$E^0_{cell} = 0.77 - (0.76)$$

$$= 1.53 \text{ V}$$

$$1.50 = 1.53 - \frac{0.06}{2} \log \left( \frac{Fe^{2+}}{Fe^{3+}} \right)^2$$

$$\log \left( \frac{Fe^{2+}}{Fe^{3+}} \right) = \frac{0.03}{0.06} = \frac{1}{2}$$

$$\frac{[Fe^{2+}]}{[Fe^{3+}]} = 10^{1/2} = \sqrt{10}$$

$$\frac{[Fe^{3+}]}{[Fe^{2+}]} = \frac{1}{\sqrt{10}}$$
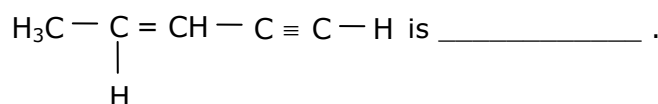
$$\frac{[Fe^{3+}]}{[Fe^{2+}] + [Fe^{3+}]} = \frac{1}{1 + \sqrt{10}} = \frac{1}{4.16}$$

$$= 0.2402$$

$$= 24 \times 10^{-2}$$
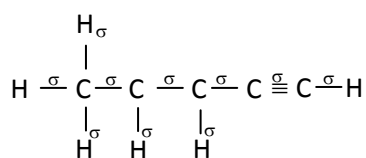
**9.** The number of sigma bonds in

$$H_3C - \underset{\underset{H}{|}}{C} = CH - C \equiv C - H \text{ is } \underline{\hspace{3cm}} .$$

**Sol. (10)**

$$H \overset{\sigma}{-} \underset{\underset{H}{\overset{|}{\sigma}}}{C} \overset{\sigma}{-} \underset{\underset{H}{\overset{|}{\sigma}}}{\overset{\overset{H}{|}_\sigma}{C}} \overset{\sigma}{-} \underset{\underset{H}{\overset{|}{\sigma}}}{C} \overset{\sigma}{-} C \overset{\sigma}{\equiv} C \overset{\sigma}{-} H$$
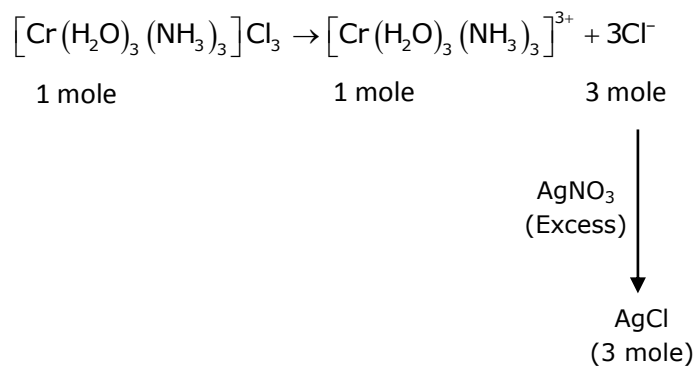
Numbers of $\sigma$ bonds = 10

**10.** Three moles of AgCl get precipitated when one mole of an octahedral co−ordination compound with empirical formula $CrCl_3.3NH_3.3H_2O$ reacts with excess of silver nitrate. The number of chloride ions satisfying the secondary valency of the metal ion is _____.

**Sol.** **(0)**

Mole of AgCl precipitated is equal the mole of $Cl^-$ present in ionization sphere.

$$\left[Cr(H_2O)_3(NH_3)_3\right]Cl_3 \rightarrow \left[Cr(H_2O)_3(NH_3)_3\right]^{3+} + 3Cl^-$$

    1 mole               1 mole              3 mole

AgNO₃ (Excess)

AgCl (3 mole)

Since none of $Cl^-$ is present in the co−ordination sphere. Therefore answer is zero.