CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer:

1. If EMF of Hydrogen electrode at 25°C is zero in pure water then pressure of H_2 in bar

   (1) 10^{-14} (2) 10^{-7}

   (3) 1   (4) 0.5

Answer (1)

Sol. $E_{SHE} = -\dfrac{0.0591}{2} \log \dfrac{P_{H_2}}{\left[H^+\right]^2} = 0$

   $\Rightarrow P_{H_2} = \left[H^+\right]^2$

   $P_{H_2} = \left(10^{-7}\right)^2$

   $= 10^{-14}$ bar

2. For which of the following element only one oxidation state is possible
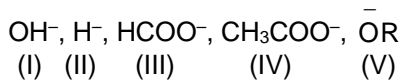
   (1) Sc   (2) Co

   (3) Ni   (4) Fe

Answer (1)

Sol. Only +3 oxidation state is possible for Sc

   For other options, more than one oxidation states are possible, correct answer is (1)

3. Among the following, decreasing order of basic strength will be

   OH^-, H^-, $HCOO^-$, CH_3COO^-, $\overset{-}{O}R$
    (I)   (II)   (III)   (IV)   (V)

   (1) II > V > III > I > IV   (2) II > V > I > IV > III

   (3) III > IV > I > V > II   (4) V > I > IV > II > III

Answer (2)

Sol. Basic strength $\propto \dfrac{1}{\text{Strength of conjugate acid}}$

   Acidic strength:

   $HCOOH > CH_3COOH > H_2O > ROH > H_2$

   Basic strength:

   $HCOO^- < CH_3COO^- < OH^- < RO^- < H^-$
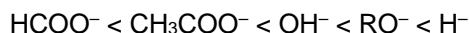
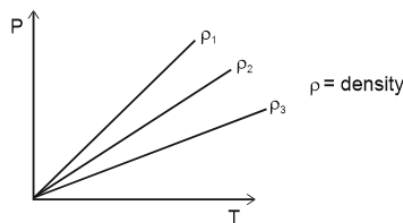4. We are given with the following graph between P and T

   Choose the correct option

   (1) $\rho_1 > \rho_2 > \rho_3$ (2) $\rho_1 < \rho_2 < \rho_3$

   (3) $\rho_1 = \rho_2 = \rho_3$ (4) $\rho_2 > \rho_1 > \rho_3$

Answer (1)

Sol. $\rho = \dfrac{P \times MW}{RT}$

   $P = \dfrac{\rho.R.T}{MW}$

   $P = \left(\dfrac{\rho.R}{MW}\right).T$

   $\text{Slope} = \dfrac{\rho.R}{MW}$

   Slope α ρ(density)

   $\Rightarrow \rho_1 > \rho_2 > \rho_3$

   $\Rightarrow$ Option (1) is correct

5. Which of the following have maximum dipole moment?

   (1) NH_3 (2) PF_5

   (3) NF_3 (4) PCl_5

Answer (1)

Sol.

NH$_3$ has greater dipole moment than NF$_3$

6.
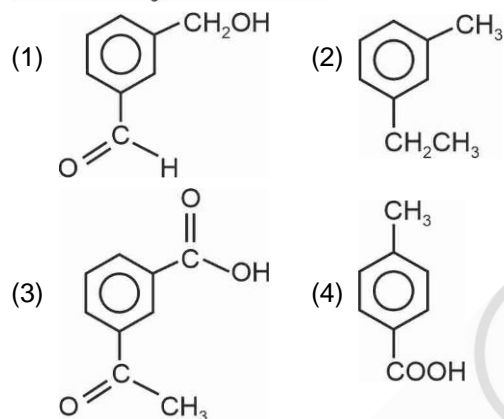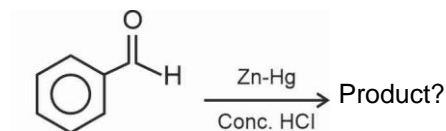
Answer (2)

Sol. This is an example of Clemmensen reduction reaction. In this reaction carbonyl group is reduced to methylene group.

7. Which of the following is the correct order of first ionization enthalpy?

   (1) Be < B < O < F < N

   (2) B < Be < O < N < F

   (3) B < Be < N < F < O

   (4) Be < B < N < O < F
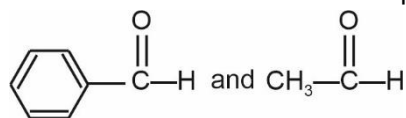
Answer (2)

Sol. Be has more value of first ionization enthalpy than B due to fully filled configuration and N has more value of first ionization enthalpy than O due to half filled configuration

The correct order is B < Be < O < N < F

8. Statement-1 : Aldol condensation is caused by acidity of α hydrogen

   Statement-2 : Cross aldol is not possible between

   (1) Both statement-1 and statement-2 are correct

   (2) Both statement-1 and statement-2 are incorrect

   (3) Statement-1 is correct but statement-2 is incorrect
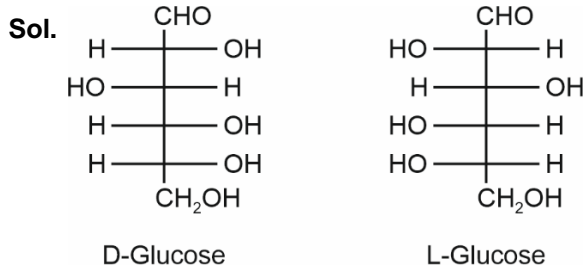
   (4) Statement-1 is incorrect but statement-2 is correct

Answer (3)

Sol. Aldol reaction is given by those carbonyl compounds which have at least one α hydrogen atom because α-hydrogen of carbonyl compounds is acidic. Benzaldehyde and acetaldehyde will form cross aldol because acetaldehyde has α-hydrogen atom.

9. Select the correct structure of L-glucose.
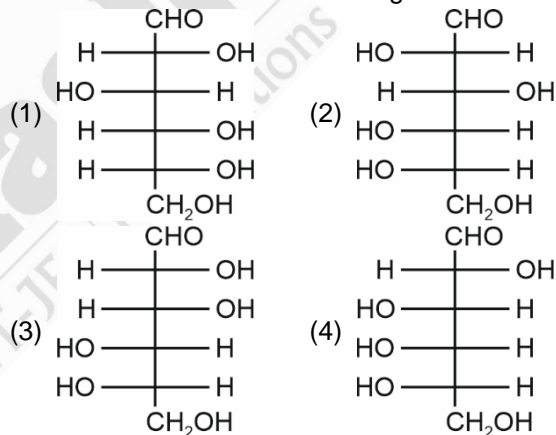
Answer (2)

Sol.

D-Glucose   L-Glucose

10. Decreasing order of the field strength of the following ligands will be:

$$CO, \overset{\ominus}{C}N, \overset{\ominus}{C}l, H_2O$$

(1) $CO > \overset{\ominus}{C}N > H_2O > Cl^-$ (2) $CO > \overset{\ominus}{C}N > Cl^- > H_2O$

(3) $\overset{\ominus}{C}N > CO > H_2O > Cl^-$ (4) $\overset{\ominus}{C}N > CO > Cl^- > H_2O$

Answer (1)

Sol. $CO > \overset{\ominus}{C}N > H_2O > \overset{\ominus}{C}l$
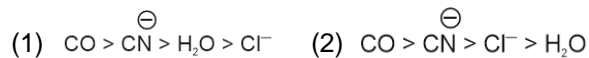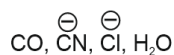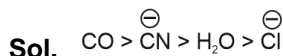
11. Calculate the molarity of NaCl solution, if 5.85 gm of NaCl is dissolved in 500 ml of solution.

(1) 0.1 M   (2) 0.2 M

(3) 0.32 M   (4) 0.4 M

Answer (2)

Sol. Molarity $= \dfrac{\text{Number of moles of solute}}{\text{Volume of solution (in L)}}$
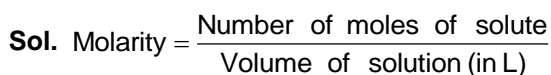
$= \dfrac{5.85 \times 1000}{58.5 \times 500} = 0.1 \times 2 = 0.2\, M$

12. Which of the following does not give Lassaigne's test?

(1) Urea   (2) Azobenzene

(3) Hydrazine   (4) Phenylhydrazine

Answer (3)

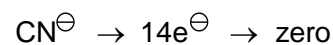**Sol.** Hydrazine ($NH_2 - NH_2$) does not contain carbon. On fusion with sodium metal, it cannot form NaCN. So hydrazine does not show Lassaigne's test.

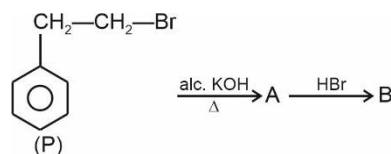13. Among the following, species that have one unpaired $e^\ominus$?

(1) $CN^\ominus$ (2) O_2^{2-}

(3) O_2^+ (4) $NO^\ominus$

Answer (3)

Sol.   Unpaired $e^\ominus$

$CN^\ominus \rightarrow 14e^\ominus \rightarrow$ zero

$O_2^{2-} \rightarrow 18e^\ominus \rightarrow$ zero

$O_2^+ \rightarrow 15e^\ominus \rightarrow$ one

$NO^\ominus \rightarrow 16e^\ominus \rightarrow$ two
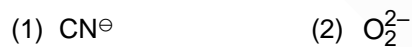
14. For a given reaction

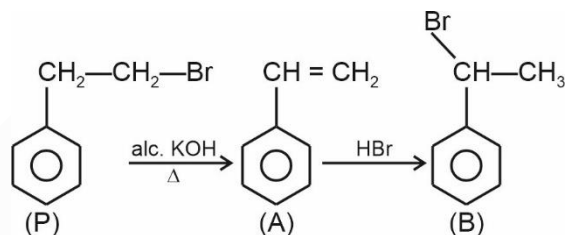$$CH_2-CH_2-Br$$

$$\xrightarrow[\Delta]{\text{alc. KOH}} A \xrightarrow{HBr} B$$

Relation between the molecules P and B are:

(1) Enantiomer   (2) Diastereomers

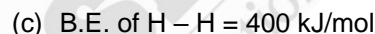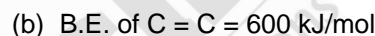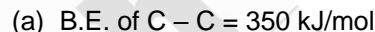(3) Positional isomers (4) Functional isomers

Answer (3)

Sol. Positional isomers.

15. From the given data, find enthalpy of hydrogenation of ethene in kJ/mol

(a) B.E. of C – C = 350 kJ/mol

(b) B.E. of C = C = 600 kJ/mol

(c) B.E. of H – H = 400 kJ/mol

(d) B.E. of C – H = 410 kJ/mol

(1) –170   (2) –580

(3) +170   (4) +580

Answer (1)

Sol.

$\Delta_r H = \Delta H(C = C) + \Delta H(H - H) - \Delta H(C - C)$
$- 2\Delta H(C - H)$

$= 600 + 400 - 350 - 2(410)$

$= -170$ kJ/mol
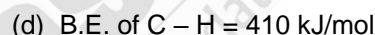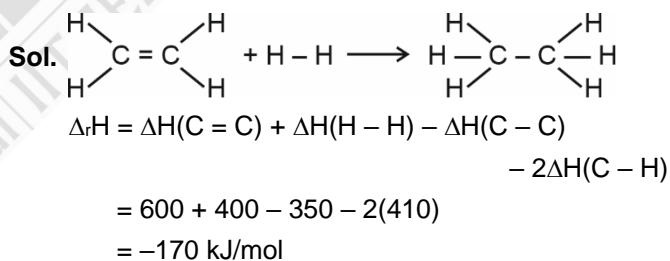
16. Find out wavelength of a photon having frequency equal to 900 sec^{-1}.

(1) 3.33×10^5 m   (2) 3.33×10^5 cm

(3) 3.33×10^7 m   (4) 3.33×10^4 m

Answer (1)

Sol. $\nu = \dfrac{C}{\lambda}$

$\lambda = \dfrac{C}{\nu}$

$\lambda = \dfrac{3 \times 10^8 \, m\,sec^{-1}}{900 \, sec^{-1}}$

$= \dfrac{3 \times 10^8}{900}$

$= \dfrac{3 \times 10^6}{9}$
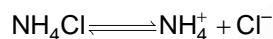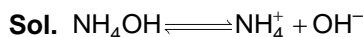
$= \dfrac{1}{3} \times 10^6$

$= 0.333 \times 10^6$

$= 3.33 \times 10^5 \, m$

17. Why NH_4Cl is added before NH_4OH for the ppt. of Fe^{3+} ions?

    (1) To decrease OH^- ion concentration

    (2) To increase Cl^- ion concentration

    (3) To increase NH_4^+ ion concentration

    (4) To decrease H^+ ion concentration

Answer (1)

Sol. $NH_4OH \rightleftharpoons NH_4^+ + OH^-$
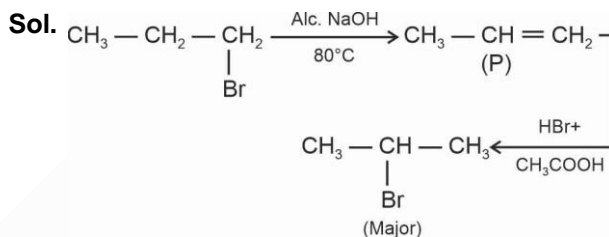
$NH_4Cl \rightleftharpoons NH_4^+ + Cl^-$

Solid NH_4Cl is added to NH_4OH solution to decrease the OH^- ion concentration due to common ion effect.

18. Consider the following sequence of reactions and identify the unknown reagents (A) and (B) respectively.
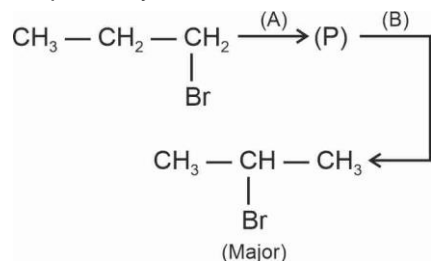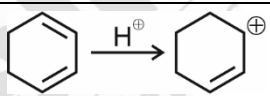

(1) (A) :Dil. aq NaOH at 20°C

    (B) :HBr, CH_3COOH

(2) (A) : Dil. aq NaOH at 20°C

    (B) : Br_2, $CHCl_3$

(3) (A) : Alc. NaOH at 80°C

    (B) : HBr, CH_3COOH

(4) (A) : Alc. NaOH at 80°C
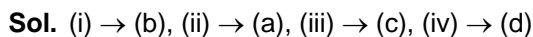
    (B) : Br_2, $CHCl_3$
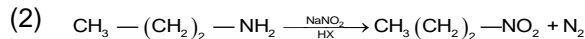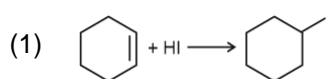
Answer (3)

Sol.

19. Match the following

(i)	Nitrobenzene	(a)	+R
(ii)	Aniline	(b)	–R
(iii)		(c)	+E
(iv)		(d)	–E

(1) (i) → (b), (ii) → (a), (iii) → (c), (iv) → (d)

(2) (i) → (a), (ii) → (b), (iii) → (c), (iv) → (d)

(3) (i) → (c), (ii) → (b), (iii) → (a), (iv) → (d)

(4) (i) → (d), (ii) → (c), (iii) → (a), (iv) → (b)

Answer (1)

Sol. (i) → (b), (ii) → (a), (iii) → (c), (iv) → (d)

20. Which of the following is not possible major product?

(1)

(2) $CH_3 - (CH_2)_2 - NH_2 \xrightarrow{\frac{NaNO_2}{HX}} CH_3(CH_2)_2 - NO_2 + N_2$

(3) $CH_3 — CH = CH_2 + HBr \longrightarrow CH_3 — \underset{\underset{Br}{|}}{CH} — CH_3$

(4)

Answer (2)

Sol. $CH_3 — CH_2 — CH_2 — NH_2$

$$\downarrow \underset{HX}{\overset{NaNO_2}{}}$$

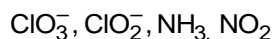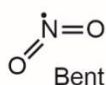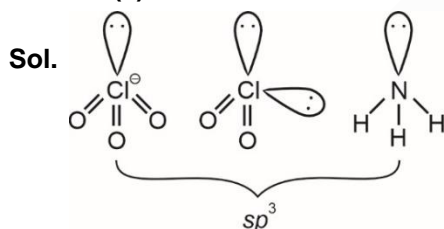$$CH_3 — \underset{\underset{}{\overset{|}{OH}}}{CH} — CH_3 + N_2$$
(Major)
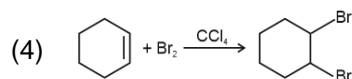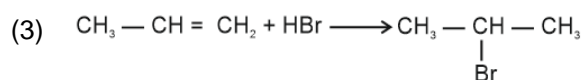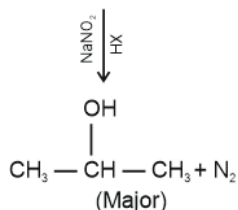
SECTION - B

Numerical Value Type Questions: This section contains 10 Numerical based questions. The answer to each question should be rounded-off to the nearest integer.

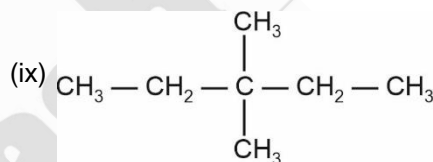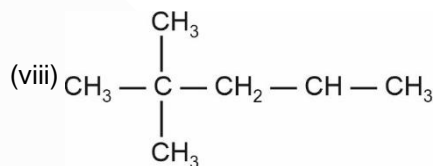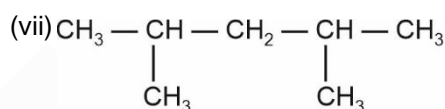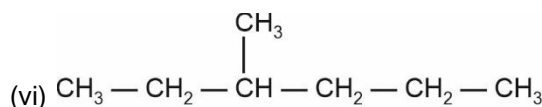21. How many of the following compounds are sp^3 hybridised?

    $ClO_3^-, ClO_2^-, NH_3, NO_2$

Answer (3)

Sol.

22. Total number of structural isomers possible for a compound with molecular formula C_7H_{16} are:

Answer (5)

Sol. C_7H_{16} has DoU = 0

(i) $CH_3—CH_2—CH_2—CH_2—CH_2—CH_2—CH_3$

(ii) $CH_3—\underset{\underset{CH_3}{|}}{CH}—CH_2—CH_2—CH_2—CH_3$

(iii) $CH_3—\underset{\underset{CH_3}{|}}{CH}—\underset{\underset{CH_3}{|}}{CH}—CH_2—CH_2$

(iv) $CH_3—CH_2—\underset{\underset{CH_2—CH_3}{|}}{CH}—CH_2—CH_3$

(v) $CH_3—\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}—\underset{\underset{CH_3}{|}}{CH}—CH_3$
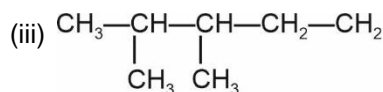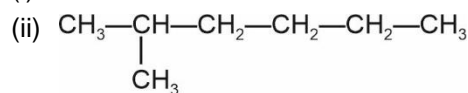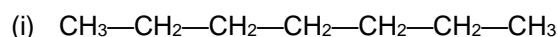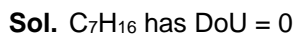
(vi) $CH_3—CH_2—\underset{\underset{\overset{|}{CH_3}}{|}}{CH}—CH_2—CH_2—CH_3$

(vii) $CH_3—\underset{\underset{CH_3}{|}}{CH}—CH_2—\underset{\underset{CH_3}{|}}{CH}—CH_3$

(viii) $CH_3—\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}—CH_2—CH—CH_3$

(ix) $CH_3—CH_2—\underset{\underset{CH_3}{|}}{\overset{\overset{CH_3}{|}}{C}}—CH_2—CH_3$
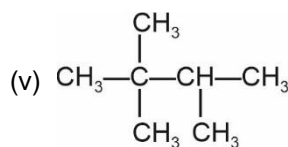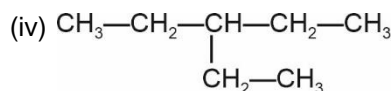
23. The de-Broglie wavelength of an electron in 4th orbit of hydrogen atom is _____ πa_0 (a_0 = Bohr radius).

Answer (8)

Sol. $\because \lambda_{de\text{-}Broglie} = \dfrac{2\pi r}{n} = \dfrac{2\pi}{n} \times 0.529 \dfrac{n^2}{z} \text{ Å}$

or, $\lambda_{de\text{-}Broglie} = 2\pi \times n \times a_0 \text{ Å}$

$= 2\pi \times 4 \times a_0 \text{ Å}$

$= 8\pi a_0 \text{ Å}$

24. 50 mL of KMnO$_4$ solution is used for titration with 20 mL of 2M oxalic acid solution in Acidic medium. The molarity of KMnO$_4$ solution is x × 10^{-2} M. The value of x is

Answer (32)

Sol. $\underset{\text{n.f. = 5}}{MnO_4^{\ominus}}$ (aq) $+ \underset{\text{n.f. = 2}}{C_2O_4^{2-}}$ (aq) $\xrightarrow{H^+}$ $Mn^{2+} + CO_2\uparrow$
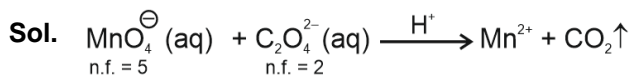
$5 \times M_{KMNO_4} \times 50 = 2 \times 20 \times 2$

$M_{KMnO_4} = \dfrac{8}{25} = 32 \times 10^{-2}M$

x = 32

25. A solution having non-volatile solute in water shows elevation in boiling point of 2°C. Find out vapour pressure of solution (in mm Hg) (Nearest integer)

Vapour pressure of pure water = 760 mm Hg

K_b of water = 0.52 K.kg mole^{-1}

Answer (711)

Sol. $\Delta T_b = (K_b)(m)$

2 = (0.52) (m)

m = 3.846

$X_{Solute} = \dfrac{m}{m+55.5} = 0.0648$

$\dfrac{760 - X}{760} = 0.0648$

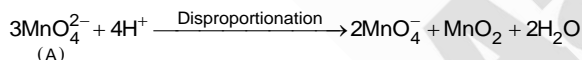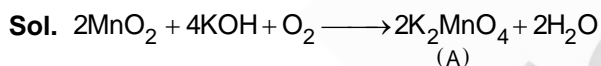$\Rightarrow P_{solution} = 710.74$ mm Hg

≈ 711 mm Hg

26. $MnO_2 + KOH + O_2 \longrightarrow A$

'A' disproportionate into 'B' and 'C'. Find the sum of magnetic moment (spin only) (in B.M.) of B and C (Nearest integer)

Answer (4)

Sol. $2MnO_2 + 4KOH + O_2 \longrightarrow \underset{(A)}{2K_2MnO_4} + 2H_2O$

$\underset{(A)}{3MnO_4^{2-}} + 4H^+ \xrightarrow{\text{Disproportionation}} 2MnO_4^- + MnO_2 + 2H_2O$

B and C are MnO_4^- and MnO_2

Mn in MnO_2 has +4 oxidation state hence it has $(n-1)d^3 ns^0$ electronic configuration

unpaired e = 3
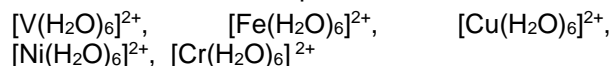
Mag. moment : 3.87 B.M. by $\sqrt{n(n+2)}$

$KMnO_4 / MnO_4^-$ is diamagnetic hence magnetic moment = 0 because it has no unpaired electron.

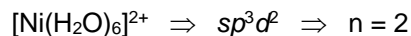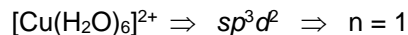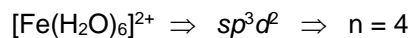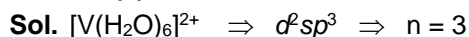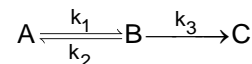Hence, sum of mag. moment = 3.87 B.M.

Nearest integer = 4

27. How many of the following coordination compounds have even number of unpaired electrons?

$[V(H_2O)_6]^{2+}$, $[Fe(H_2O)_6]^{2+}$, $[Cu(H_2O)_6]^{2+}$, $[Ni(H_2O)_6]^{2+}$, $[Cr(H_2O)_6]^{2+}$

Answer (3)

Sol. $[V(H_2O)_6]^{2+} \Rightarrow d^2sp^3 \Rightarrow n = 3$

$[Fe(H_2O)_6]^{2+} \Rightarrow sp^3d^2 \Rightarrow n = 4$

$[Cu(H_2O)_6]^{2+} \Rightarrow sp^3d^2 \Rightarrow n = 1$

$[Ni(H_2O)_6]^{2+} \Rightarrow sp^3d^2 \Rightarrow n = 2$

$[Cr(H_2O)_6]^{2+} \Rightarrow sp^3d^2 \Rightarrow n = 4$

28. Consider the following reaction sequence :

$A \underset{k_2}{\overset{k_1}{\rightleftharpoons}} B \xrightarrow{k_3} C$

Overall $k = \dfrac{k_1k_2}{k_3}$

if $E_{a_1} = 300$ kJ / mole

$E_{a_2} = 200$ kJ / mole

Overall, $(E_a)_{eff} = 400$ kJ/mole

Find out E_{a_3} (in kJ/mole)

Answer (100)

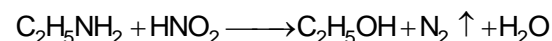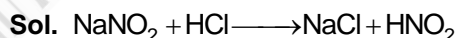**Sol.** $(E_a)_{eff} = E_{a_1} + E_{a_2} - E_{a_3}$

$400 = 300 + 200 - E_{a_3}$

$E_{a_3} = 100$ kJ/mole

29. x g of ethylamine on reaction with $NaNO_2$ and HCl, produces 2.24 L of $N_2(g)$ at NTP. The value of 2x will be

Answer (9)

Sol. $NaNO_2 + HCl \longrightarrow NaCl + HNO_2$

$C_2H_5NH_2 + HNO_2 \longrightarrow C_2H_5OH + N_2\uparrow + H_2O$

Mole of $N_2(g)$ produced $= \dfrac{2.24}{22.4} = 0.1$ mol

So, mole of $C_2H_5NH_2$ used = 0.1 mol

Mass of $C_2H_5NH_2 = 45 \times 0.1 = 4.5$ g

So, 2x = 2 × 4.5

= 9

30.