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 :

31. Identify the product formed (A and E)

(1) A = , E =

(2) A = , E =

(3) A = , E =

(4) A = , E =

Answer (2)

Sol.
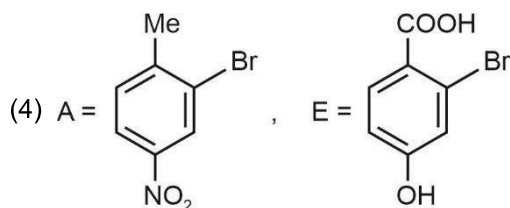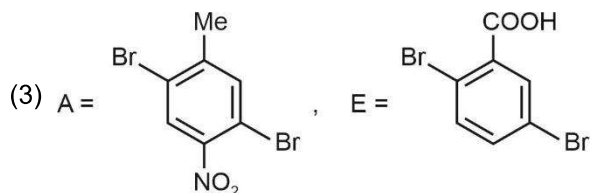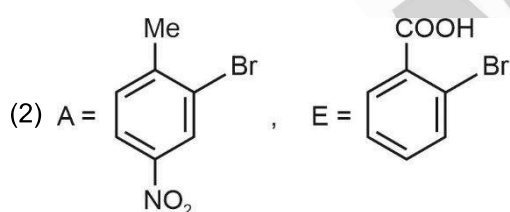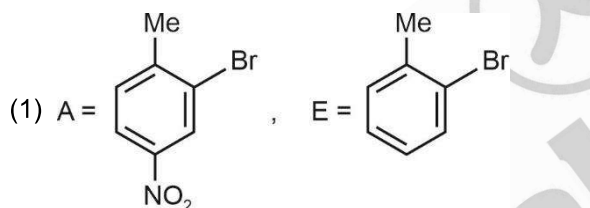
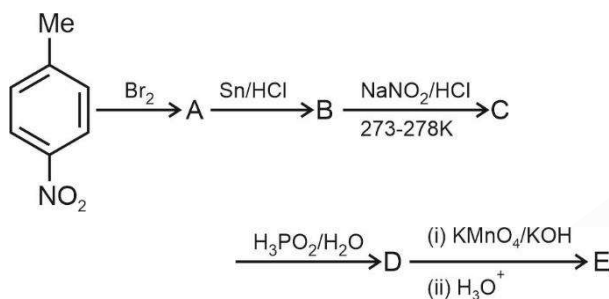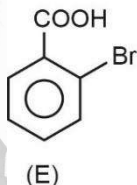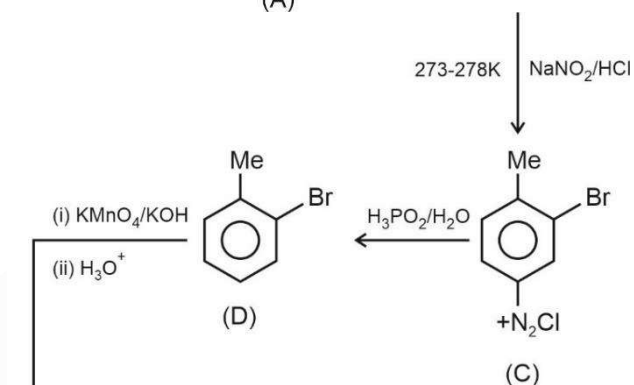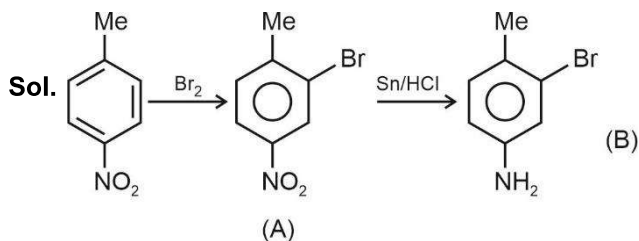32. A cubic solid is made up of two elements X and Y. Atoms of X are present on every alternate corner and one at the center of cube. Y is at $\frac{1}{3}$rd of the total faces. The empirical formula of the compound is

(1) $XY_{2.5}$ (2) $X_{1.5}Y_2$

(3) $X_2Y_{1.5}$ (4) $X_{2.5}Y$

Answer (No answer is correct)

Sol. Number of X particles = $4 \times \frac{1}{8} + 1 = 1.5$

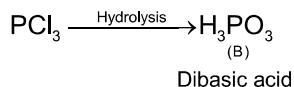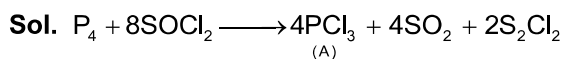Number of Y particles = $6 \times \frac{1}{3} \times \frac{1}{2}$ = 1

∴ Empirical formula = $X_{1.5}Y_1 = X_3Y_2$

No answer is correct

33. Reaction of thionyl chloride with white phosphorus forms a compound [A], which on hydrolysis gives [B], a dibasic acid. [A] and [B] are respectively

(1) $POCl_3$ and H_3PO_4 (2) PCl_3 and H_3PO_3

(3) PCl_5 and H_3PO_4 (4) P_4O_6 and H_3PO_3

Answer (2)

Sol. $P_4 + 8SOCl_2 \longrightarrow \underset{(A)}{4PCl_3} + 4SO_2 + 2S_2Cl_2$

$PCl_3 \xrightarrow{\text{Hydrolysis}} \underset{\substack{(B)\\ \text{Dibasic acid}}}{H_3PO_3}$

34. '25 volume' hydrogen peroxide means

    (1) 1 L marketed solution contains 250 g of H_2O_2.

    (2) 100 mL marketed solution contains 25 g of H_2O_2.

    (3) 1 L marketed solution contains 25 g of H_2O_2.
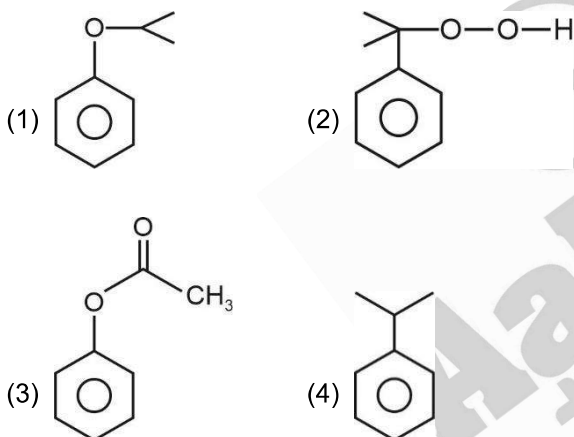
    (4) 1 L marketed solution contains 75 g of H_2O_2.

Answer (4)

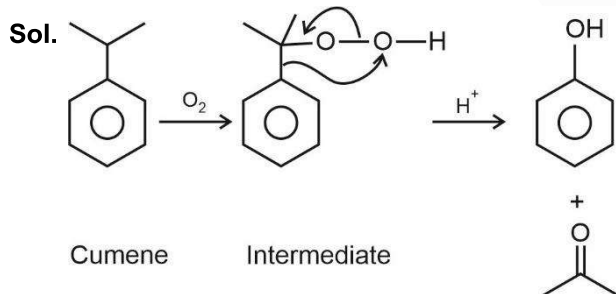**Sol.** Molarity of H_2O_2 soln = $\dfrac{\text{volume strength}}{11.2}$

$= \dfrac{25}{11.2} = 2.23\ M$

$\therefore$ amount of H_2O_2 in one litre = $2.23 \times 34 = 75$ gm

35. In the cumene to phenol preparation in presence of air, the intermediate is

Answer (2)

Sol.

Cumene   Intermediate

36. The radius of the 2nd orbit of Li^{2+} is x. The expected radius of the 3rd orbit of Be^{3+} is

    (1) $\dfrac{9}{4}x$

    (2) $\dfrac{16}{27}x$

    (3) $\dfrac{27}{16}x$

    (4) $\dfrac{4}{9}x$

Answer (3)

Sol. $r_{Li^{2+}} = r_0 \times \dfrac{2^2}{3} = x \Rightarrow r_0 = \dfrac{3x}{4}$

$r_{Be^{3+}} = r_0 \times \dfrac{3^2}{4}$

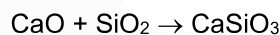$r_{Be^{3+}} = \dfrac{3x}{4} \times \dfrac{3^2}{4} = \dfrac{27x}{16}$

37. Which one of the following reactions does **not** occur during extraction of copper?

    (1) $CaO + SiO_2 \rightarrow CaSiO_3$

    (2) $FeO + SiO_2 \rightarrow FeSiO_3$

    (3) $2Cu_2S + 3O_2 \rightarrow 2Cu_2O + 2SO_2$

    (4) $2FeS + 3O_2 \rightarrow 2\ FeO + 2SO_2$

Answer (1)

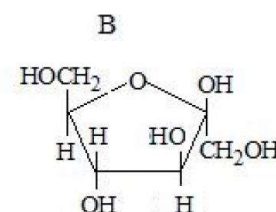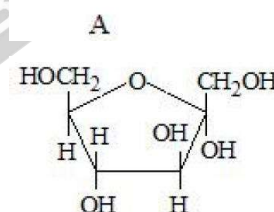**Sol.** In the extraction of copper FeO is removed as slag $FeSiO_3$

Hence the reaction

$CaO + SiO_2 \rightarrow CaSiO_3$

does not occur during extraction of copper

38. Match items of Row I with those of Row II.

    Row I :
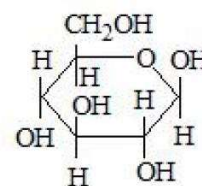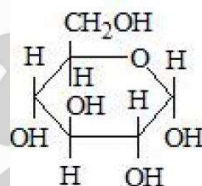
    Row II :

    (i) α-D-(–)-Fructofuranose

    (ii) β-D-(–)-Fructofuranose

    (iii) α-D-(–) Glucopyranose,

    (iv) β-D-(–)-Glucopyranose

    Correct match is

    (1) A $\rightarrow$ iii, B $\rightarrow$ iv, C $\rightarrow$ i, D $\rightarrow$ ii

    (2) A $\rightarrow$ i, B $\rightarrow$ ii, C $\rightarrow$ iii, D $\rightarrow$ iv

    (3) A $\rightarrow$ iii, B $\rightarrow$ iv, C $\rightarrow$ ii, D $\rightarrow$ i

    (4) A $\rightarrow$ iv, B $\rightarrow$ iii, C $\rightarrow$ i, D $\rightarrow$ ii

Answer (1)

Sol. (i) α-D-(–)-Fructofuranose –

(C)

(ii) β-D-(–)-Fructofuranose –

(D)

(iii) α-D-(–)-Glucopyranose –

(A)

(iv) β-D-(–)-Glucopyranose –

(B)
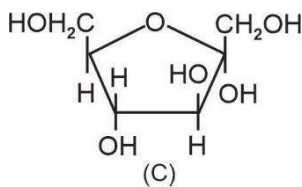
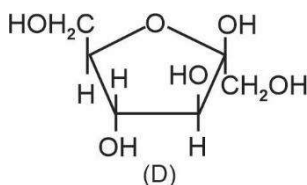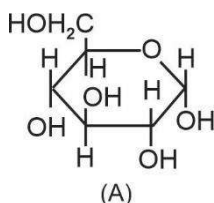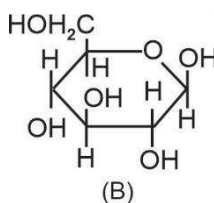39. Which of the following statements is incorrect for antibiotics?

   (1) An antibiotic should promote the growth or survival of microorganisms.

   (2) An antibiotic is a synthetic substance produced as a structural analogue of naturally occurring antibiotic.

   (3) An antibiotic should be effective in low concentrations.

   (4) An antibiotic must be a product of metabolism.

Answer (1)

Sol. An antibiotic inhibit the growth or survival of microorganism.

   Except (1) all the statement are correct

40. Match List I with List II

	LIST I Elements		LIST II Colour imparted to the flame
A.	K	I.	Brick Red
B.	Ca	II.	Violet
C.	Sr	III.	Apple Green
D.	Ba	IV.	Crimson Red

Choose the correct answer from the options given below :

(1) A-II, B-I, C-IV, D-III   (2) A-IV, B-III, C-II, D-I

(3) A-II, B-IV, C-I, D-III   (4) A-II, B-I, C-III, D-IV

Answer (1)

Sol.

	Element	Colour imparted to the flame
(A)	K	Violet
(B)	Ca	Brick red
(C)	Sr	Crimson red
(D)	Ba	Apple green

41. The compound which will have the lowest rate towards nucleophilic aromatic substitution on treatment with OH^- is

(1)

(2)

(3)

(4)
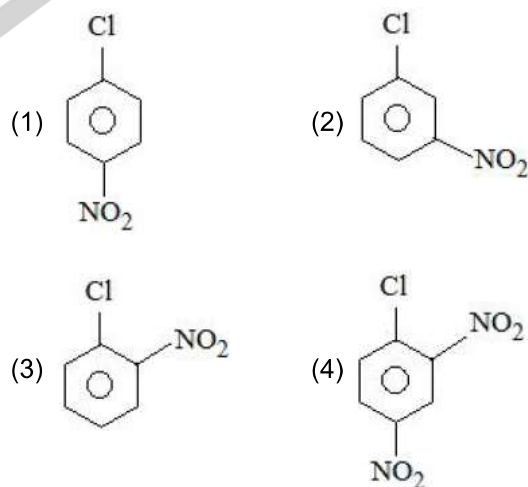
Answer (2)

Sol. Aryl halides having E.W.G at O-or P-position have greater rate than the m-isomers towards nucleophilic aromatic substitution.

   Hence the correct answer is (2)

42.

The correct sequence of reagents for the preparation of Q and R is:

(1) (i) $KMnO_4$, OH^-; (ii) Mo_2O_3, Δ; (iii) NaOH; (iv) H_3O^+

(2) (i) Cr_2O_3, 770 K, 20 atm; (ii) CrO_2Cl_2, H_3O^+; (iii) NaOH; (iv) H_3O^+
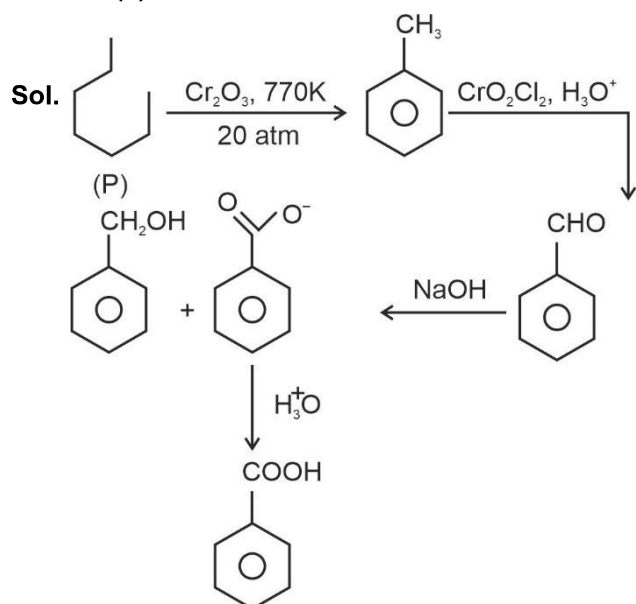
(3) (i) CrO_2Cl_2, H_3O^+; (ii) Cr_2O_3, 770 K, 20 atm; (iii) NaOH; (iv) H_3O^+

(4) (i) Mo_2O_3, Δ; (ii) Mo_2O_3, Δ; (iii) NaOH; (iv) H_3O^+

Answer (2)

Sol.

43. Given below are two statements: one is labelled as **Assertion A** and the other is labelled as **Reason R**:

Assertion A: Acetal/Ketal is stable in basic medium.

**Reason R**: The high leaving tendency of alkoxide ion gives the stability to acetal/ketal in basic medium.

In the light of the above statements, choose the correct answer from the options given below:

(1) Both A and R are true but R is NOT the correct explanation of A

(2) Both A and R are true and R is the correct explanation of A

(3) A is false but R is true

(4) A is true but R is false

Answer (4)

Sol. Acetal/Ketal are known to be quite stable under basic conditions but readily hydrolyse to the corresponding carbonyl compound (aldehyde/keton) and alcohol under acidic condition

44. Which of the following conformations will be the most stable?
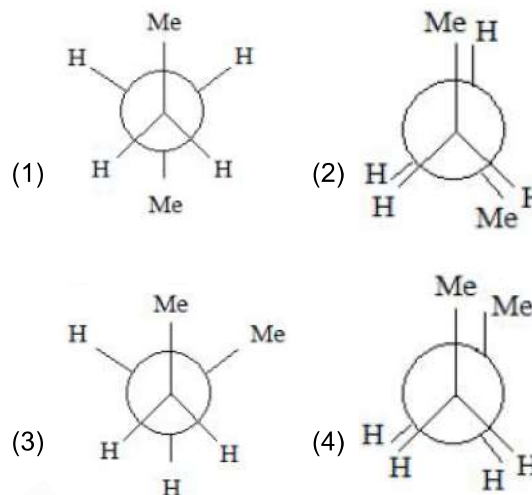

Answer (1)

Sol. Correct stability order of butane is

Anti > Gauche > Partially eclipsed > Fully eclipsed

Hence the correct answer is (1)

45. The correct order in aqueous medium of basic strength in case of methyl substituted amines is:

(1) $Me_2NH > MeNH_2 > Me_3N > NH_3$

(2) $Me_3N > Me_2NH > MeNH_2 > NH_3$

(3) $NH_3 > Me_3N > MeNH_2 > Me_2NH$

(4) $Me_2NH > Me_3N > MeNH_2 > NH_3$

Answer (1)

Sol. The correct order of basic strength in aqueous medium is

$Me_2NH > MeNH_2 > Me_3N > NH_3$
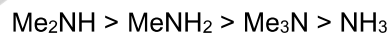
46. Compound A reacts with NH_4Cl and forms a compound B. Compound B reacts with H_2O and excess of CO_2 to form compound C which on passing through or reaction with saturated NaCl solution forms sodium hydrogen carbonate. Compound A, B and C, are respectively

(1) $Ca(OH)_2$, $NH_4^\oplus$, $(NH_4)_2CO_3$

(2) $Ca(OH)_2$, NH_3, NH_4HCO_3

(3) $CaCl_2$, $NH_4^\oplus$, $(NH_4)_2CO_3$

(4) $CaCl_2$, NH_3, NH_4HCO_3

Answer (2)

Sol. $\underset{(A)}{Ca(OH)_2} + NH_4Cl \longrightarrow CaCl_2 + \underset{(B)}{NH_3} + H_2O$

$NH_3 + H_2O + \underset{Excess}{CO_2} \longrightarrow \underset{(C)}{NH_4HCO_3}$

$NH_4HCO_3 + NaCl \longrightarrow NH_4Cl + NaHCO_3$
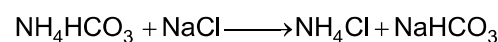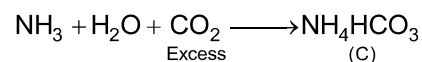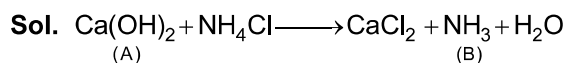
47. Match the **List-I** with **List-II** :

| **List-I**		**List-II**
Cations		**Group reagents**
A.	Pb^{2+}, Cu^{2+}	(i) H_2S gas in presence of dilute HCl
B.	Al^{3+}, Fe^{3+}	(ii) $(NH_4)_2CO_3$ in presence of NH_4OH
C.	Co^{2+}, Ni^{2+}	(iii) NH_4OH in presence of NH_4Cl
D.	Ba^{2+}, Ca^{2+}	(iv) H_2S in presence of NH_4OH

Correct match is

(1) A → i; B → iii; C → iv; D → ii
(2) A → i; B → iii; C → ii; D → iv
(3) A → iv; B → ii; C → iii; D → i
(4) A → iii; B → i; C → iv; D → ii

Answer (1)

Sol.

	Cations		Group reagents
A.	Pb^{2+}, Cu^{2+}	(i)	H_2S gas in presence of dilute HCl
B.	Al^{3+}, Fe^{3+}	(iii)	NH_4OH in presence of NH_4Cl
C.	Co^{2+}, Ni^{2+}	(iv)	H_2S in presence of NH_4OH
D.	Ba^{2+}, Ca^{2+}	(ii)	$(NH_4)_2CO_3$ in presence of NH_4OH

48. The variation of the rate of an enzyme catalyzed with substrate concentration is correctly represented by graph
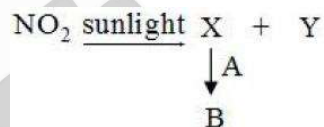

(1) (b) (2) (a)
(3) (d) (4) (c)
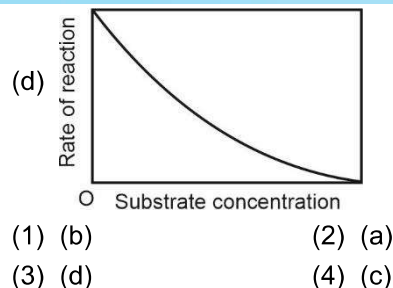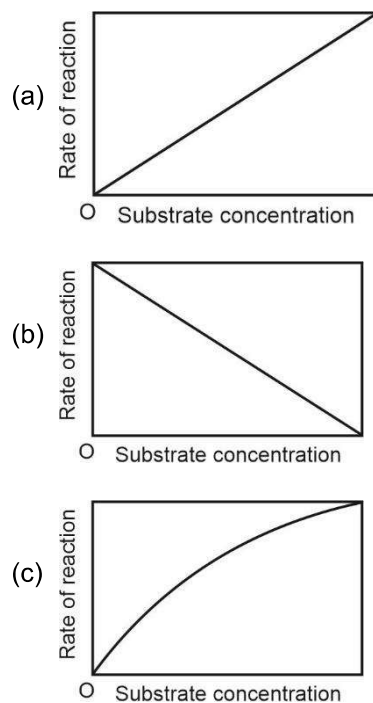
Answer (4)

Sol. The correct plot for enzyme catalysed reaction is
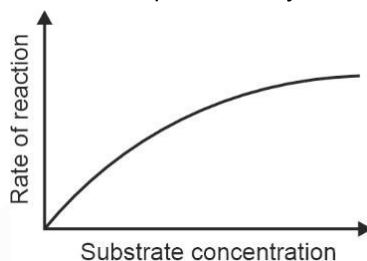
Hence, correct answer is option (4).

49. Some reactions of NO_2 relevant to photochemical smog formation are

$$NO_2 \xrightarrow{sunlight} X + Y$$
$$\downarrow A$$
$$B$$

Identify A, B, X and Y.

(1) X = NO, Y = [O], A = O_2, B = N_2O_3
(2) X = [O], Y = NO, A = O_2, B = O_3
(3) X = $\frac{1}{2}O_2$, Y = NO_2, A = O_3, B = O_2
(4) X = N_2O, Y = [O], A = O_3, B = NO

Answer (2)

Sol. $NO_2 \xrightarrow{h\nu}$ O + NO
            (X) (Y)

$\downarrow O_2$ (A)

O_3
(B)
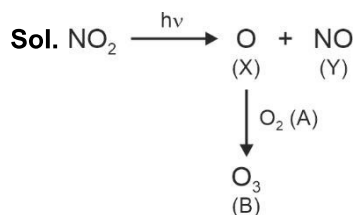
50. Inert gases have positive electron gain enthalpy. Its correct order is

(1) He < Xe < Kr < Ne   (2) Xe < Kr < Ne < He
(3) He < Kr < Xe < Ne   (4) He < Ne < Kr < Xe

Answer (1)

Sol.

Electron gain	He	Ne	Ar	Kr	Xe
Enthalpy/ kJ mol^{-1}	48	116	96	96	77

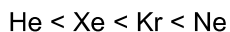Hence, correct order of positive electron gain enthalpy is

He < Xe < Kr < Ne

SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE.** For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, –00.33, –00.30, 30.27, –27.30) using the mouse andw the on-screen virtual numeric keypad in the place designated to enter the answer.

51. The osmotic pressure of solutions of PVC in cyclohexanone at 300 K are plotted on the graph.

The molar mass of PVC is _____ g mol^{-1} (Nearest integer)
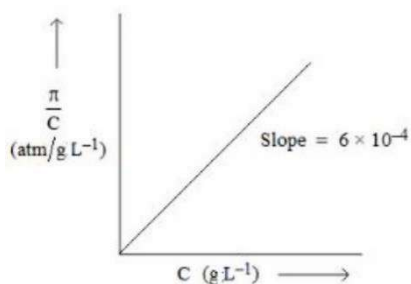
(Given : R = 0.083 L atm K^{-1} mol^{-1})

Answer (41500)

Sol.
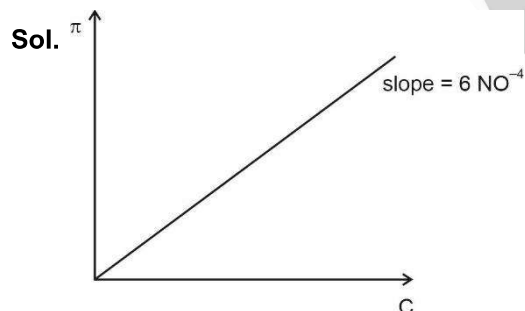
$\pi = CRT$

$\pi = \dfrac{\text{mole}}{\text{volume}} \times RT$

$\pi = \dfrac{\text{mole}}{\text{volume}} \times \dfrac{\text{mw}}{\text{mw}} \times RT$

$\pi = \dfrac{\text{mass}}{\text{volume}} \times \dfrac{RT}{\text{mw}}$

$\pi(\text{atm}) = \dfrac{RT}{\text{mw}} \times C(\text{gm lit}^{-1})$

$\text{slope} = \dfrac{RT}{\text{mw}} = 6 \times 10^{-4}$

mw = 41500

52. The density of a monobasic strong acid (Molar mass 24.2 g/mol) is 1.21 kg/L. The volume of its solution required for the complete neutralization of 25 mL of 0.24 M NaOH is _____ × 10^{-2} mL (Nearest integer)

Answer (12)

Sol. m.eq of NaOH = m.eq of monobasic acid

$25 \times 0.24 \times 1 = 1 \times V \times \text{molarity}$

$\text{Molarity} = \dfrac{1.21 \times 10^3}{24.2} = 50\ M$

$\therefore V = \dfrac{25 \times 0.24}{50} = 0.12\ \text{mL}$

$= 12 \times 10^{-2}\ \text{mL}$

53. A litre of buffer solution contains 0.1 mole of each of NH$_3$ and NH$_4$Cl. On the addition of 0.02 mole of HCl by dissolving gaseous HCl, the pH of the solution is found to be _____ × 10^{-3} (Nearest integer)
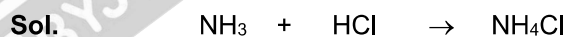
[Given : pK$_b$(NH$_3$) = 4.745

log 2 = 0.301

log 3 = 0.477

T = 298 K]

Answer (9079)

Sol.

	NH$_3$	+	HCl	→	NH$_4$Cl
At initial	0.1		0		0.1
At time t	0.1 – 0.02				0.1 + 0.02

$\text{pOH} = \text{pK}_b + \log\left[\dfrac{0.1 + 0.02}{0.1 - 0.02}\right]$

$= 4.745 + \log\left(\dfrac{3}{2}\right) = 4.745 + [0.477 - 0.301]$

$= 4.745 + 0.176$

pOH = 4.921

pH = 14 – pOH

= 14 – 4.921 = 9.079

pH = 9079 × 10^{-3}

54. The number of paramagnetic species from the following is _____.

$[Ni(CN)_4]^{2-}, [Ni(CO)_4], [NiCl_4]^{2-}$,

$[Fe(CN)_6]^{4-}, [Cu(NH_3)_4]^{2+}$

$[Fe(CN)_6]^{3-}$ and $[Fe(H_2O)_6]^{2+}$
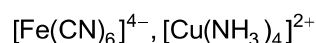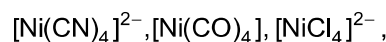
Answer (04)

Sol.

Species	Magnetic property
$[Ni(CN)_4]^{2-}$	Diamagnetic
$[Ni(CO)_4]$	Diamagnetic
$[NiCl_4]^{2-}$	Paramagnetic
$[FeCN)_6]^{4-}$	Diamagnetic
$[Fe(CN)_6]^{3-}$	Paramagnetic
$Fe(H_2O)_6]^{2+}$	Paramagnetic
$[Cu(NH_3)_4]^{2+}$	Paramagnetic

55. In sulphur estimation, 0.471 g of an organic compound gave 1.4439 g of barium sulphate. The percentage of sulphur in the compound is _____ (Nearest Integer)

(Given: Atomic mass Ba: 137 u, S: 32 u, O:16 u)

Answer (42)

Sol. S% = $\dfrac{32}{233} \times \dfrac{1.4439}{0.471} \times 100 = 42\%$

56. For the first order reaction A → B, the half life is 30 min. The time taken for 75% completion of the reaction is_____ min. (Nearest integer)

Given : log 2 = 0.3010

log 3 = 0.4771

log 5 = 0.6989

Answer (60)

Sol. Time taken for 75% completion

= 2 × $t_{1/2}$

= 2 × 30

= 60 min

57. How many of the following metal ions have similar value of spin only magnetic moment in gaseous state? _____

(Given : Atomic number : V, 23; Cr, 24; Fe, 26; Ni, 28)

V^{3+}, Cr^{3+}, Fe^{2+}, Ni^{3+}

Answer (02)
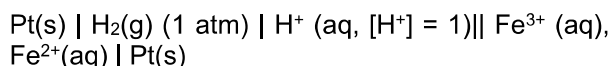
Sol.

Ion	Spin only magnetic moment
V^{3+}	$\sqrt{8}$
Cr^{3+}	$\sqrt{15}$
Fe^{2+}	$\sqrt{24}$
Ni^{3+}	$\sqrt{15}$

58. Consider the cell

Pt(s) | H_2(g) (1 atm) | H^+ (aq, $[H^+]$ = 1)|| Fe^{3+} (aq), Fe^{2+}(aq) | Pt(s)

Given $E^o_{Fe^{3+}/Fe^{2+}} = 0.771\,V$ and $E^{0+}_{H/1/2\,H_2} = 0\,V$,

T = 298 K

If the potential of the cell is 0.712 V, the ratio of concentration of Fe^{2+} to Fe^{3+} is _____ (Nearest integer)

Answer (10)

Sol. Reaction at anode $\dfrac{1}{2}H_2 \longrightarrow H^+ + e^-$

Reaction at Cathode $Fe^{3+}_{(aq)} + e^- \rightarrow Fe^{2+}_{(aq)}$
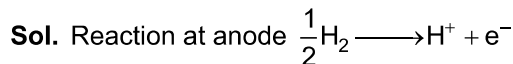
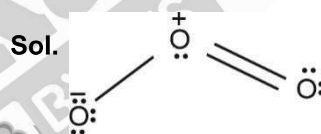$E_{cell} = E^o_{cell} - \dfrac{0.0591}{1}\log\left[\dfrac{[H^+][Fe^{2+}]}{[Fe^{3+}][pH_2]^{1/2}}\right]$

$0.712 = 0.771 - \dfrac{0.0591}{1}\log\left(\dfrac{[Fe^{2+}]}{[Fe^{3+}]}\right)$

$-0.059 = -0.0591\log\left(\dfrac{[Fe^{2+}]}{[Fe^{3+}]}\right)$

$\therefore \dfrac{[Fe^{2+}]}{[Fe^{3+}]} = 10^1 = 10$

59. The total number of lone pairs of electrons on oxygen atoms of ozone is_____

Answer (06)

Sol.

60. An athlete is given 100 g of glucose ($C_6H_{12}O_6$) for energy. This is equivalent to 1800kJ of energy. The 50% of this energy gained is utilized by the athlete for sports activities at the event. In order to avoid storage of energy, the weight of extra water he would need to perspire is_____ g (Nearest integer)

Assume that there is no other way of consuming stored energy.

Given : The enthalpy of evaporation of water is 45 kJ mol⁻¹

Molar mass of C, H & O are 12, 1 and 16 g mol⁻¹

Answer (360)

Sol. wt of extra water he would need to perspire

= $\dfrac{1800}{2} \times \dfrac{18}{45}$

= 20 × 18 = 360 gm