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. Which of the following represents the correct order of metallic character of the given elements?

(1) Be < Si < K < Mg (2) K < Mg < Be < Si

(3) Be < Si < Mg < K (4) Si < Be < Mg < K

Answer (4)

Sol. Metallic character of an element is directly proportional to its electropositivity. Of the given elements silicon is least electro positive and potassium is most electropositive whereas beryllium and magnesium have intermediate values in the increasing order. Therefore, correct order of metallic character is Si < Be < Mg < K.

32. Match List-I with List-II.

	LIST-I (Amines)		**LIST-II (pK_b)**
A.	Aniline	I.	3.25
B.	Ethanamine	II.	3.00
C.	N-Ethylethanamine	III.	9.38
D.	N, N-Diethylethanamine	IV.	3.29

Choose the correct answer from the options given below.

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

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

Answer (4)

Sol. Aromatic amines are less basic than aliphatic amines. Among given aliphatic amines, 2° amine is most basic, followed by 3° amine and 1° amine. Therefore the correct basic strength (K_b) order of the given amines is

$$\underset{(C)}{CH_3CH_2NHCH_2CH_3} > \underset{(D)}{(CH_3CH_2)_3N} > \underset{(B)}{CH_3CH_2NH_2} > \underset{(A)}{C_6H_5NH_2}$$

The pK_b order of the given amines will be just the opposite of their basic strength order. The correct matching is

A – III, B – IV, C – II, D – I

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

Assertion A : Carbon forms two important oxides – CO and CO_2. CO is neutral whereas CO_2 is acidic in nature.

Reason R : CO_2 can combine with water in a limited way to form carbonic acid, while CO is sparingly soluble in water.

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

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

(2) A is not correct but R is correct

(3) A is correct but R is not correct

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

Answer (1)

Sol. Carbon monoxide is neutral and CO_2 is acidic in nature because with the increase in oxidation state of carbon acidic strength increases. So, Assertion is correct.

CO_2 combines with water to form carbonic acid while CO is sparingly soluble in water. So, Reason is also correct and is the correct explanation of Assertion.

34. **Statement I :** Dipole moment is a vector quantity and by convention it is depicted by a small arrow with tail on the negative centre and head pointing towards the positive centre.

Statement II : The crossed arrow of the dipole moment symbolized the direction of the shift of charges in the molecules.

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

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

(2) Both Statement I and Statement II are incorrect

(3) Both Statement I and Statement II are correct

(4) Statement I is correct but Statement II is incorrect

Answer (1)

Sol. The dipole moment is a vector quantity and is depicted by an arrow with tail on the positive centre and head pointing towards the negative centre. So, Statement-I is incorrect. The crossed arrow of the dipole moment symbolizes the direction of the shift of charges in the molecules. So, Statement-II is correct.

35. Which one among the following metals is the weakest reducing agent?

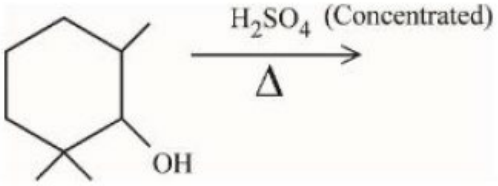
(1) Li (2) Rb

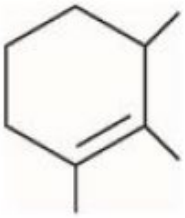
(3) Na (4) K

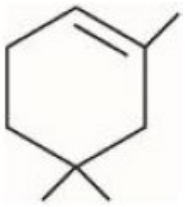
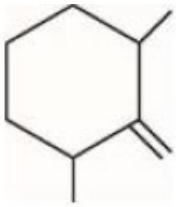
Answer (3)

Sol. Among the given alkali metals, sodium metal is the weakest reducing agent as its standard reduction potential $\left(E^{\circ}_{Na^+/Na} = -2.719\right)$ is least negative

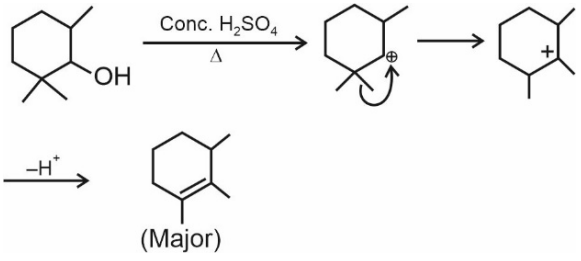
36. Find out the major product from the following reaction.



(1)  (2) 

(3)  (4) 

Answer (2)

Sol. 

37. A. Ammonium salts produce haze in atmosphere.

B. Ozone gets produced when atmospheric oxygen reacts with chlorine radicals.

C. Polychlorinated biphenyls act as cleansing solvents.

D. 'Blue baby" syndrome occurs due to the presence of excess of sulphate ions in water.

Choose the correct answer from the options given below.

(1) A and C only

(2) A, B and C only

(3) A and D only

(4) B and C only

Answer (1)

Sol. Ammonium salts produce haze in atmosphere. Ozone is produced when atmospheric oxygen reacts with oxygen atoms and not chlorine atoms.

Polychlorinated biphenyls have number of applications including their use as cleansing solvents.

'Blue baby' syndrome occurs due to the presence of excess of nitrate ions and not sulphate ions in water.

38. A chloride salt solution acidified with dil.HNO_3 gives a curdy white precipitate, [A], on addition of $AgNO_3$. [A] on treatment with NH_4OH gives a clear solution, B. A and B are respectively

(1) AgCl & $(NH_4)[Ag(OH)_2]$

(2) $H[AgCl_3]$ & $[Ag(NH_3)_2]Cl$

(3) AgCl & $[Ag(NH_3)_2]Cl$

(4) $H[AgCl_3]$ & $(NH_4)[Ag(OH)_2]$

Answer (3)

Sol. $Cl^-(aq) + AgNO_3(aq) \xrightarrow{\text{dil } HNO_3} \underset{(A)}{AgCl}\downarrow$

$AgCl\downarrow + 2NH_4OH(aq) \rightarrow \underset{(B)}{\left[Ag(NH_3)_2\right]}Cl(aq) + 2H_2O$

$\therefore$ (A) is AgCl and (B) is $[Ag(NH_3)_2]Cl$

39. Match **LIST-I** with **LIST-II.**

	LIST-I (Name of Polymer)		**LIST-II (Uses)**
A.	Glyptal	I.	Flexible pipes
B.	Neoprene	II.	Synthetic wool
C.	Acrilan	III.	Paints and Lacquers
D.	LDP	IV.	Gaskets

Choose the correct answer from the options given below.

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

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

Answer (2)

Sol. (A) Glyptal — (III) Paints and Lacquers

(B) Neoprene — (IV) Gaskets

(C) Acrilan — (II) Synthetic wool

(D) LDP — (I) Flexible pipes

40. Match **LIST-I** with **LIST-II.**

	LIST-I Isomeric pairs		**LIST-II Type of isomers**
A.	Propanamine and N-Methylethanamine	I.	Metamers
B.	Hexan-2-one and Hexan-3-one	II.	Positional isomers
C.	Ethanamide and Hydroxyethanimine	III.	Functional isomers
D.	o-ntrophenol and p-nitrophenol	IV.	Tautomers

Choose the correct answer from the options given below.

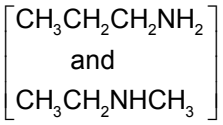
(1) A-III, B-I, C-IV, D-II

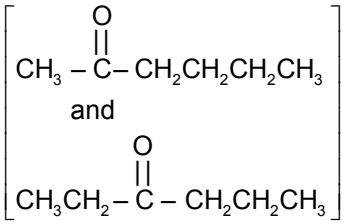
(2) A-IV, B-III, C-I, D-II

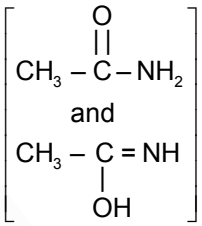
(3) A-II, B-III, C-I, D-IV

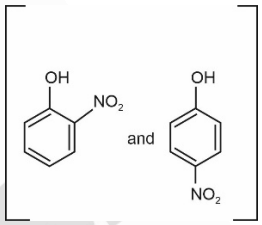
(4) A-III, B-IV, C-I, D-II

Answer (1)

Sol. (A)  — (III) Functional isomers

(B)  — (I) Metamers

(C)  — (IV) Tautomers

(D)  — (II) Positional isomers

41. Potassium dichromate acts as a strong oxidizing agent in acidic solution. During this process, the oxidation state changes from

(1) +2 to +1 (2) +6 to +2

(3) +3 to +1 (4) +6 to +3

Answer (4)

Sol. $K_2Cr_2O_7$ acts as a strong oxidising agent in acidic medium. During this process, oxidation state of Cr changes from +6 to +3.

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

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

Assertion A : Butylated hydroxy anisole when added to butter increases its shelf life.

Reason R : Butylated hydroxy anisole is more reactive towards oxygen than food.

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

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

(2) A is not correct but R is correct

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

(4) A is correct but R is not correct

Answer (3)

Sol. Butylated hydroxy anisole is added to butter to increase its shelf life from months to years as it is more reactive towards oxygen than food. Therefore, both Assertion and Reason are correct and Reason is the correct explanation of Assertion.

43. When the hydrogen ion concentration $[H^+]$ changes by a factor of 1000, the value of pH of the solution _____

(1) increases by 1000 units

(2) decreases by 2 units

(3) increases by 2 units

(4) decreases by 3 units

Answer (4)

Sol. Let the initial concentration of H^+ be 1

$\therefore \quad [H^+]_i = 1 \Rightarrow pH = 0$

It changes by 1000 units

$\therefore \quad [H^+]_f = 10^3 \Rightarrow pH = -3$

$\therefore$ pH decreases by 3 units

44. The isomeric deuterated bromide with molecular formula C_4H_8DBr having two chiral carbon atoms is

(1) 2–Bromo–2–deuterobutane

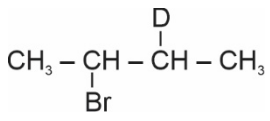
(2) 2–Bromo–1–deutero–2–methylpropane

(3) 2–Bromo–3–deuterobutane

(4) 2–Bromo–1–deuterobutane

Answer (3)

Sol. The isomeric deuterated bromide with molecular formula C_4H_8DBr having two chiral carbon atoms is



2–Bromo–3–deuterobutane

45. Match List I with List II.

LIST I Coordination entity		**LIST II Wavelength of light absorbed in nm**	
A.	$[CoCl(NH_3)_5]^{2+}$	I.	310
B.	$[Co(NH_3)_6]^{3+}$	II.	475
C.	$[Co(CN)_6]^{3-}$	III.	535
D.	$[Cu(H_2O)_4]^{2+}$	IV.	600

Choose the correct answer from the options given below:

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

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

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

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

Answer (4)

Sol. Co-ordination compounds absorb a particular wavelength following certain rules.

Wavelength of light absorbed

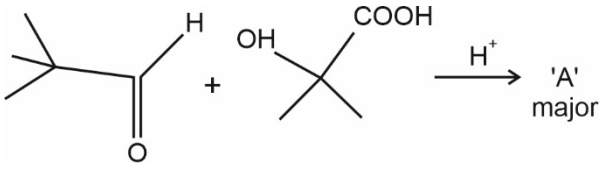
$$\propto \frac{1}{\text{Oxidation state of metal ion}}$$

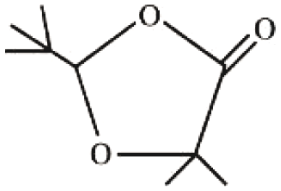
$$\propto \frac{1}{\text{Strength of ligand}}$$

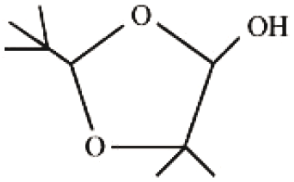
Ligand field strength : $CN^- > NH_3 > H_2O > Cl^-$

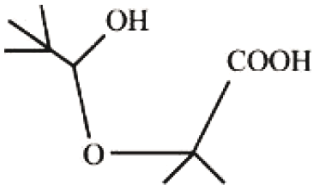
C.	$[Co^{III}(CN)_6]^{3-}$	I.	310 nm
B.	$[Co^{III}(NH_3)_6]^{3+}$	II.	475 nm
A.	$[Co^{III}Cl(NH_3)_5]^{2+}$	III.	535 nm
D.	$[Co^{II}(H_2O)_4]^{2+}$	IV.	600 nm

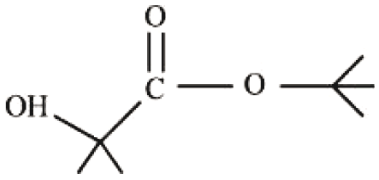
46. 'A' in the given reaction is



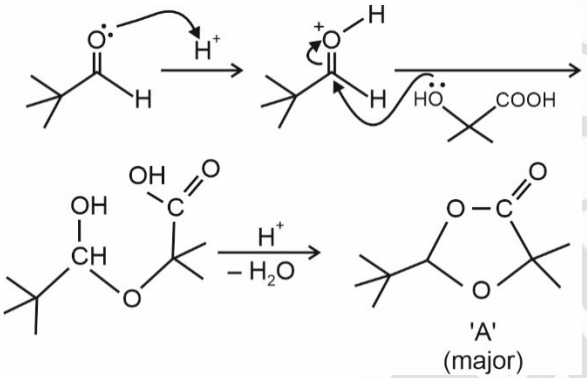
(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. 

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

Assertion A: The alkali metals and their salts impart characteristic colour to reducing flame.

Reason R: Alkali metals can be detected using flame tests.

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

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

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

(3) A is not correct but R is correct

(4) A is correct but R is not correct

Answer (3)

Sol. Assertion is not correct because alkali metals and their salts impart characteristic colour to oxidising part of flame and not reducing part of flame. Reason is correct because all alkali metals can be detected by their flame tests.

48. Match List I with List II

LIST I		LIST II	
A.	Cobalt catalyst	I.	(H_2 + Cl_2) production
B.	Syngas	II.	Water gas production
C.	Nickel catalyst	III.	Coal gasification
D.	Brine solution	IV	Methanol production

Choose the correct answer from the options given below:

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

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

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

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

Answer (4)

Sol. (A) Hydrogen reacts with carbon monoxide in presence of cobalt catalyst to give methanol

$$2H_2(g) + CO(g) \xrightarrow{\text{cobalt catalyst}} CH_3OH(l)$$

(B) Syn gas is produced from coal and the process is called coal gasification.

$$C(s) + H_2O(g) \xrightarrow{1270\ K} \underset{\text{(syn gas)}}{CO(g) + H_2(g)}$$

(C) Reaction of steam with hydrocarbons or coke at high temperature in presence of nickel catalyst gives a mixture of CO and H_2, called water gas

$$CH_4(g) + H_2O(g) \xrightarrow[Ni]{1270K} \underset{\text{(water gas)}}{CO(g) + 3H_2(g)}$$

(D) Electrolysis of brine solution produces H_2 gas at cathode and Cl_2 gas at anode

$$NaCl(aq) \longrightarrow Na^+(aq) + Cl^-(aq)$$

Cathode : $2H_2O(l) + 2e^- \longrightarrow H_2(g) + 2OH^-(aq)$

Anode : $2Cl^-(aq) \longrightarrow Cl_2(g) + 2e^-$

49. Given below are two statements:

Statement I : In froth floatation method a rotating paddle agitates the mixture to drive air out of it.

Statement II : Iron pyrites are generally avoided for extraction of iron due to environmental reasons.

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

(1) Statement I is false but Statement II is true

(2) Statement I is true but Statement II is false

(3) Both Statement I and Statement II are false

(4) Both Statement I and Statement II are true

Answer (1)

Sol. Statement I is false because the rotating paddle in froth floatation method agitates the mixture to generate froth and not to drive air out of it.

Statement II is true because iron is commercially extracted from haematite ore and not from iron pyrites to minimize environmental pollution.

50. What is the mass ratio of ethylene glycol ($C_2H_6O_2$, molar mass = 62 g/mol) required for making 500 g of 0.25 molal aqueous solution and 250 mL of 0.25 molal aqueous solution?

(1) 2 : 1 (2) 1 : 2

(3) 1 : 1 (4) 3 : 1

Answer (1)

Sol. Molality of aq. ethylene glycol solution = 0.25 m

Mass of ethylene glycol required for 1000 g water = $\frac{62}{4}$

= 15.5 gm

Mass of solution = 1015.5 gm

Mass of ethylene glycol in 500 gm solution = $\frac{15.5\times500}{1015.5}$

= 7.63 gm

Assuming density of solution as 1 gm/mL.

Mass of ethylenc glycol in 250 mL = $\frac{7.63}{2}$

= 3.815 gm

$\therefore$ Mass ratio of ethylene glycol for making 500 gm of 0.25 m solution and 250 mL of 0.25 m solution = 2 : 1

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. A first order reaction has the rate constant, $k = 4.6 \times 10^{-3}\ s^{-1}$. The number of correct statement/s from the following is/are_____

Given: log 3 = 0.48

A. Reaction completes in 1000 s.

B. The reaction has a half-life of 500 s.

C. The time required for 10% completion is 25 times the time required for 90% completion.

D. The degree of dissociation is equal to $(1 - e^{-kt})$

E. The rate and the rate constant have the same unit.

Answer (1)

Sol. $A \underset{1-\alpha}{A} \longrightarrow Products$

$k = 4.6 \times 10^{-3} s^{-1}$

$kt = \ln\frac{1}{1-\alpha}$

$\alpha = 1 - e^{-kt}$

Reaction completes at infinite time

Half-life = $\frac{0.693}{4.6\times10^{-3}} = 150.65$ s

$t_{10\%} = \frac{2.303}{k}\log\frac{100}{90} = \frac{2.303\times0.04}{k}$

$t_{90\%} = \frac{2.303}{k}\log\frac{100}{10} = \frac{2.303}{k}$

$t_{10\%} = 0.04 \times t_{90\%}$

Units of rate and rate constant are different

$\therefore$ Number of correct statements = 1

52. The number of incorrect statement/s from the following is/are_____

A. Water vapours are adsorbed by anhydrous calcium chloride.

B. There is a decrease in surface energy during adsorption.

C. As the adsorption proceeds, ΔH becomes more and more negative.

D. Adsorption is accompanied by decrease in entropy of the system.

Answer (2)

Sol. The correct statements are :

(A) Water vapours are adsorbed by anhydrous calcium chloride

(D) Adsorption is accompanied by decrease in entropy of the system.

53. Number of hydrogen atoms per molecule of a hydrocarbon A having 85.8% carbon is _____

(Given: Molar mass of A = 84 g mol^{-1})

Answer (12)

Sol. Molar mass of a hydrocarbon (A) = 84 g/mol

Mass of carbon in 1 mol of (A) = $\frac{85.8}{100} \times 84$

= 72 gm

Mass of hydrogen in 1 mol of (A) = 12 gm

$\therefore$ Number of H-atoms in a molecule of (A) = 12.

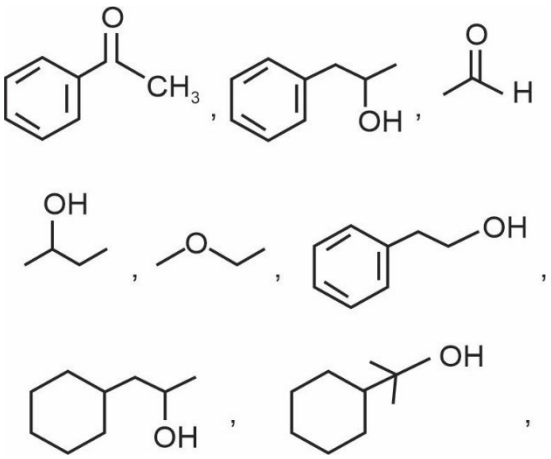
54. The number of given orbitals which have electron density along the axis is _____

p_x, p_y, p_z, d_{xy}, d_{yz}, d_{xz}, d_{z^2}, $d_{x^2-y^2}$

Answer (5)

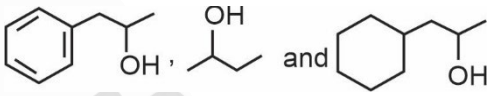
Sol. The orbitals having electron density along the axis are p_x, p_y, p_z, $d_{x^2-y^2}$ and d_{z^2}.

55. Number of compounds giving (i) red colouration with ceric ammonium nitrate and also (ii) positive iodoform test from the following is ____



Answer (3)

Sol. The compounds which give red colour with ceric ammonium nitrate and also give positive iodoform test are



56. The number of pairs of the solutions having the same value of the osmotic pressure from the following is _____.

(Assume 100% ionization)

A. 0.500 M C_2H_5OH (aq) and 0.25 M KBr (aq)

B. 0.100 M $K_4[Fe(CN)_6]$ (aq) and 0.100 M $FeSO_4(NH_4)_2SO_4$(aq)

C. 0.05 M $K_4[Fe(CN)_6]$ (aq) and 0.25 M NaCl (aq)

D. 0.15 M NaCl (aq) and 0.1 M $BaCl_2$ (aq)

E. 0.02 M KCl. $MgCl_2.6H_2O$ (aq) and 0.05 M KCl (aq)

Answer (4)

Sol. The following pairs of solutions have same value of osmotic pressure

(A) 0.500 M C_2H_5OH (aq) i = 1 and 0.25 M KBr(aq) i = 2

(B) 0.100 M $K_4[Fe(CN)_6]$ (aq) i = 5 and 0.100 M $FeSO_4(NH_4)_2$ (aq) i = 5

(D) 0.15 M NaCl (aq) i = 2 and 0.10 M $BaCl_2$ (aq) i = 3

(E) 0.02 M KCl.$MgCl_2.6H_2O$ (aq) i = 5 and 0.05 M KCl (aq) i = 2

57. 28.0 L of CO_2 is produced on complete combustion of 16.8 L gaseous mixture of ethene and methane at 25°C and 1 atm. Heat evolved during the combustion process is _____ kJ.

Given: $\Delta H_C(CH_4) = -900$ kJ mol^{-1}

$\Delta H_C(C_2H_4) = -1400$ kJ mol^{-1}

Answer (925)

Sol. $\underset{(16.8-x)}{CH_4(g)} + 2O_2(g) \rightarrow \underset{(16.8-x)}{CO_2(g)} + 2H_2O(l)$

$\underset{x}{C_2H_4(g)} + 3O_2(g) \rightarrow \underset{2x}{2CO_2(g)} + 2H_2O(l)$

$16.8 + x = 28 \quad \Rightarrow x = 11.2$ L

No. of moles of $CH_4 = 0.25$ and that of $C_2H_4 = 0.50$

$$|\text{Total heat evolved}| = \left|-\frac{900}{4} - \frac{1400}{2}\right| = 925 \text{ kJ mol}^{-1}$$

58. $Pt(s)|H_2(g)(1bar)|H^+(aq)(1M)||M^{3+}(aq),M^+(aq)|Pt(s)$

The E_{cell} for the given cell is 0.1115 V at 298 K when

$$\frac{[M^+(aq)]}{[M^{3+}(aq)]} = 10^a$$

The value of a is _____

Given : $E^{\theta}_{M^{3+}/M^+} = 0.2$ V

$$\frac{2.303RT}{F} = 0.059 \text{ V}$$

Answer (3)

Sol. $Pt(s)|H_2(g)(1bar)|H^+(aq)(1M)||M^{3+}(aq),M^+(aq)|Pt(s)$

$E_{cell} = 0.1115$ V at 298 K ; $E^{\circ}_{M^{3+}/M^+} = 0.2$ V

Cell reaction is $H_2 + M^{3+} \rightarrow 2H^+ + M^+$

$$E_{cell} = E^{\circ}_{cell} - \frac{0.059}{2}\log\frac{[H^+]^2[M^+]}{[M^{3+}]}$$

$$0.1115 = 0.2 - \frac{0.059}{2}\log 10^a$$

$a = 3$

59. Total number of moles of AgCl precipitated on addition of excess of $AgNO_3$ to one mole each of the following complexes $[Co(NH_3)_4Cl_2]Cl$, $[Ni(H_2O)_6]Cl_2$, $[Pt(NH_3)_2Cl_2]$ and $[Pd(NH_3)_4]Cl_2$ is _____

Answer (5)

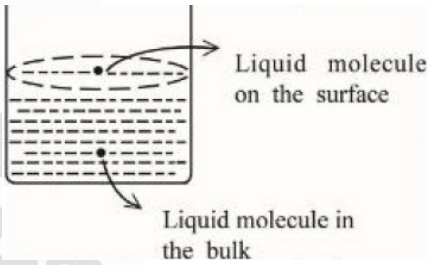
Sol. $[Co(NH_3)_4Cl_2]Cl \xrightarrow{AgNO_3} AgCl$

$[Ni(H_2O)_6]Cl_2 \xrightarrow{AgNO_3} 2AgCl$

$[Pd(NH_3)_4]Cl_2 \xrightarrow{AgNO_3} 2AgCl$

Total moles of AgCl precipitated = 5

60. Based on the given figure, the number of correct statement/s is/are _____



A. Surface tension is the outcome of equal attractive and repulsive forces acting on the liquid molecule in bulk.

B. Surface tension is due to uneven force acting on the molecules present on the surface.

C. The molecule in the bulk can never come to the liquid surface.

D. The molecules on the surface are responsible for vapour pressure if the system is a closed system.

Answer (2)

Sol. The correct statements are

(B) Surface tension is due to uneven forces acting on the molecules present on the surface

(D) The molecules on the surface are responsible for vapour pressure if the system is a closed system