FINAL JEE–MAIN EXAMINATION – JANUARY, 2023

(Held On Wednesday 25th January, 2023) **TIME : 3 : 00 PM to 6 : 00 PM**

| CHEMISTRY | TEST PAPER WITH SOLUTION |

SECTION-A

31. 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

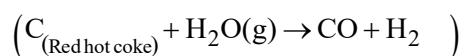Choose the correct answer from the options given below :-

(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

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Cobalt catalyst $\rightarrow$ Methanol production

Syn gas $\rightarrow$ Coal gasification

$\left(C_{(Red\,hot\,coke)} + H_2O(g) \rightarrow CO + H_2 \right)$

Nickel catalyst $\rightarrow$ Water gas production

Brine solution $\rightarrow$ Production

(aq. NaCl) $\begin{pmatrix} H_2 \rightarrow Cathode \\ Cl_2 \rightarrow anode \end{pmatrix}$

32. 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) Both Statement I and Statement II are true

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

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

(4) Both Statement I and Statement II are false

Official Ans. by NTA (2)

Allen Ans. (2)

Sol. In froth floatation method a rotating paddle draws in air and stirs the pulp.

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

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

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

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. Metallic character increases down the group and decreases along the period.

34. 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 form the options given below

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

(2) A is correct but R is not correct.

(3) A is not correct but R is correct

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

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. The alkali metals and their salts impart characteristic colour to **oxidizing** flame.

35. 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 molar aqueous solution ?

(1) 1 : 1   (2) 3 : 1

(3) 2 : 1   (4) 1 : 2

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Assume : Mass of solvent ≈ Mass of solution

Case I :-

$$0.25 = \frac{W_1}{62} \times \frac{1000}{500}$$

Case II :-

$$0.25 = \frac{W_2}{62} \times \frac{1000}{250}$$

$$\frac{W_1}{W_2} = \frac{2}{1}$$

36. **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 symbolizes 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) Both Statement I and Statement II are correct.

(2) Statement I is incorrect but Statement II is correct.

(3) Both Statement I and Statement II are incorrect.

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

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Statement II : The corssed arrow symbolises the direction of the shift of electron density in the molecule.

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

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

Reason R :- Butylated hydroxyl 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 and R is the correct explanation of A.

(2) A is correct but R is not correct.

(3) A is not correct but R is correct.

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

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. Butylated hydroxyl anisole is an antioxidant.

38. 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, B and C only

(2) B and C only

(3) A and D only

(4) A and C only

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. B. $\overset{\bullet}{Cl} + O_3 \longrightarrow O_2 + \overset{\bullet}{ClO}$

D. 'Blue baby' syndrome occurs due to the presence of excess of nitrate ions in water.
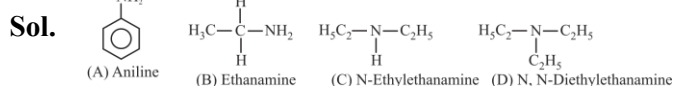
39. Match List I with List II

	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-I, B-IV, C-II, D-III

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

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

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

Official Ans. by NTA (4)

Allen Ans. (4)

Sol.

$$\text{Basic Strength } \alpha \ \frac{1}{pK_b}$$

Order for pK$_b$: A > B > D > C

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

(1) K

(2) Rb

(3) Na

(4) Li

Official Ans. by NTA (3)

Allen Ans. (3)

Sol. Sodium have lowest oxidation potential in alkali metals. Hence it is weakest reducing agent among alkali metals.

41. 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	II.	Positional

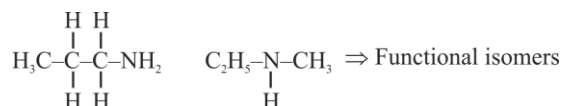|			isomers
C.	Ethanamide and Hydroxyethanimine	III.	Functional isomers
D.	o-nitrophenol and p-nitrophenol	IV.	Tautomers

Choose the correct answer from the options given below :-

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

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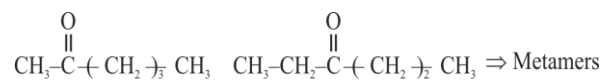
(3) A-II, B-III, C-I, D-IV

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

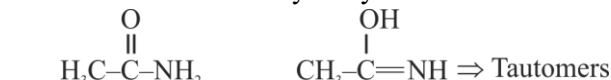**Official Ans. by NTA (4)**

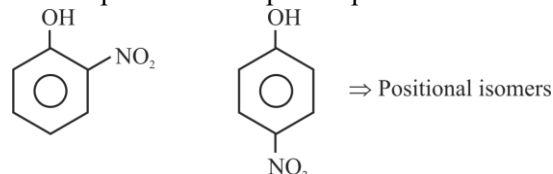**Allen Ans. (4)**

Sol. A. Propanamine   N–Methylethanamine

B. Hexan–2–one   Hexan–3–one

C. Ethanamide   Hydroxyethanimine

D. o–Nitrophenol   p–nitrophenol

42. 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-II, C-IV, D-I

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

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

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

Official Ans. by NTA (2)

Allen Ans. (2)

43. 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 but R is NOT the correct explanation of A.

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

(3) A is not correct but R is correct.

(4) A is correct but R is not correct.

Official Ans. by NTA (2)
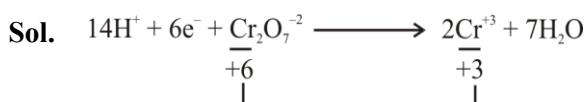
Allen Ans. (2)

Sol. The oxide which form acid on dissolving in water is acidic oxide.

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

(1) + 3 to + 1   (2) + 6 to + 3

(3) + 2 to + 1   (4) + 6 to + 2

Official Ans. by NTA (2)

Allen Ans. (2)

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

45. 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 3 units

(3) decreases by 2 units

(4) increases by 2 units

Official Ans. by NTA (4)

Allen Ans. (2)

Sol. $\Delta[H^+] = 1000$

$\Delta pH = -\log\Delta[H^+] = -\log 10^3$

$= -3$

46. 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$_2$O)$_4$]$^{2+}$	IV.	600

Choose the correct answer from the options given below :-

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

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

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

(4) A- II, B-III, C-IV, D-I
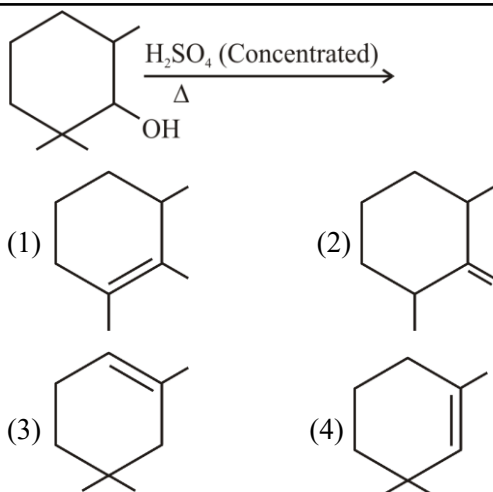
Official Ans. by NTA (2)

Allen Ans. (2)

Sol.

	List I Coordination entity		List II Wavelength of light absorbed in nm
A.	[CoCl(NH$_3$)$_5$]$^{2+}$	I.	535
B.	[Co(NH$_3$)$_6$]$^{3+}$	II.	475
C.	[Co(CN)$_6$]$^{3-}$	III.	310
D.	[Cu(H$_2$O)$_4$]$^{2+}$	IV.	600

$$E = \frac{hc}{\lambda} \Rightarrow E \propto \frac{1}{\lambda}$$

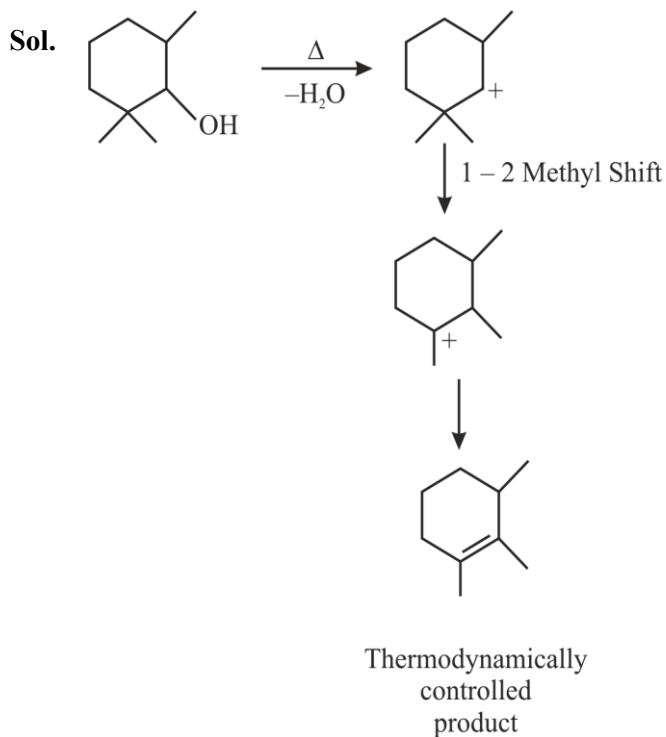$$\Rightarrow \Delta(CFSE) \propto \frac{1}{\lambda_{absorb}} \propto \text{strength of ligand.}$$

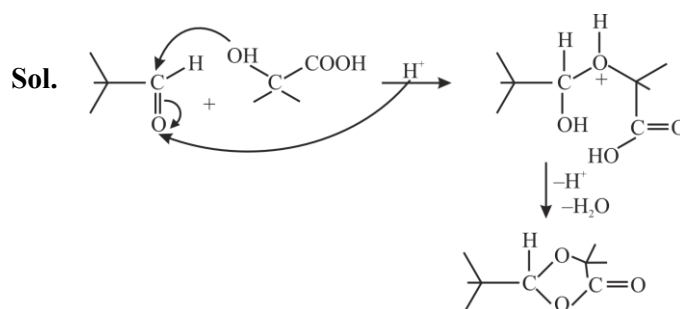**47.** Find out the major product from the following reaction.

(1)

(2)

(3)
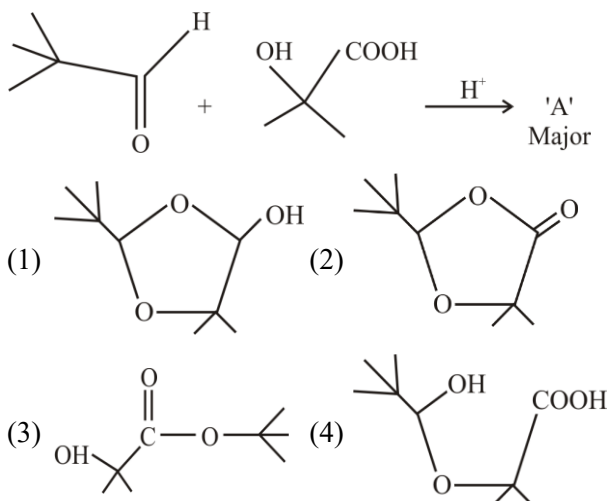
(4)

Official Ans. by NTA (1)

Allen Ans. (1)

Sol.

Official Ans. by NTA (2)

Allen Ans. (2)

Sol.

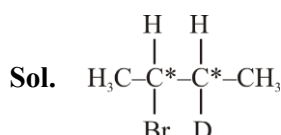**48.** 'A' in the given reaction is

(1)

(2)

(3)

(4)

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

(1) 2–Bromo–1–deuterobutane

(2) 2–Bromo–2–deuterobutane

(3) 2–Bromo–3–deuterobutane

(4) 2–Bromo–1–deutero–2–methylpropane
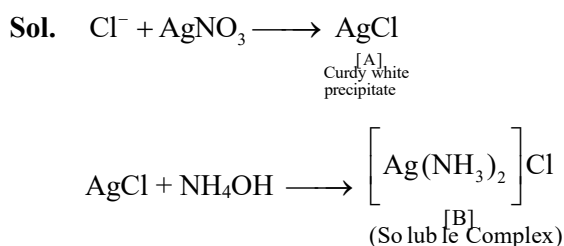
Official Ans. by NTA (3)

Allen Ans. (3)

Sol.

$$H_3C-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle Br}{|}}{C}}*-\overset{\overset{\displaystyle H}{|}}{\underset{\underset{\displaystyle D}{|}}{C}}*-CH_3$$

50. 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.

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

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

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

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

Official Ans. by NTA (3)

Allen Ans. (3)

Sol.

$$Cl^- + AgNO_3 \longrightarrow \underset{\substack{[A]\\ \text{Curdy white}\\ \text{precipitate}}}{AgCl}$$

$$AgCl + NH_4OH \longrightarrow \underset{\substack{[B]\\ (\text{Soluble Complex})}}{\left[Ag(NH_3)_2\right]Cl}$$

SECTION-B

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

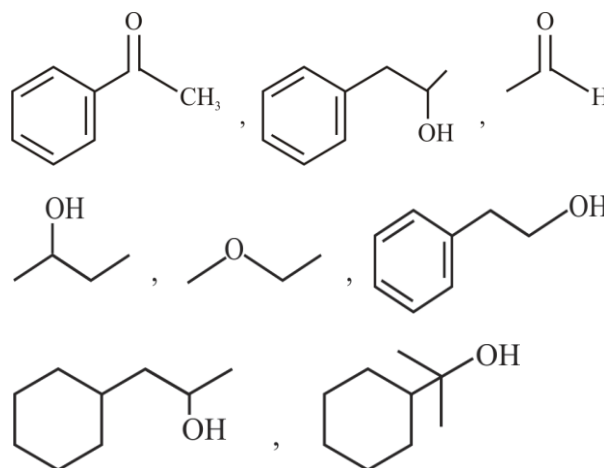$$p_x, p_y, p_z, d_{xy}, d_{yz}, d_{xz}, d_{z^2}, d_{x^2-y^2}$$
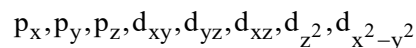
Official Ans. by NTA (5.00)

Allen Ans. (5.00)

Sol. p_x, p_y, p_z, d_{z^2} & $d_{x^2-y^2}$ are axial orbitals.
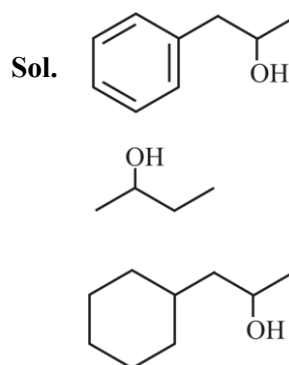
52. Number of compounds giving (i) red colouration with ceric ammonium nitrate and also

(ii) positive iodoform test from the following is _____

Official Ans. by NTA (3.00)

**Allen Ans. (3.00)**

Sol.

53. The number of pairs of the solution 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)

Official Ans. by NTA (4.00)

Allen Ans. (4.00)

Sol. $\pi = iCRT$

$\pi \propto iC$
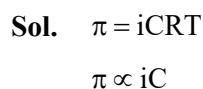
A, B, D and E have same value of osmatic pressure.

54. 28.0 L of CO_2 is produced on complete combustion of 16.8 L gaseous mixture of ethene and methane at 25ºC and 1 atm. Heat evolved during the combustion process is _____ kJ.
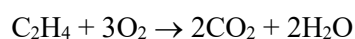
Given : ΔH_C (CH_4) = –900 kJ mol^{-1}

ΔH_C (C_2H_4) = –1400 kJ mol^{-1}

Official Ans. by NTA (925.00)

Allen Ans. (847.00)

Sol. Let, Volume of C_2H_4 is x litre

$$C_2H_4 + 3O_2 \rightarrow 2CO_2 + 2H_2O$$

Initial   x

Final   –   2x

$$CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$$
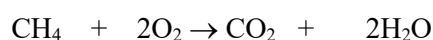
Initial   (16.8 – x)

Final   –   (16.8 – x)

Total volume of CO_2 = 2x + 16.8 – x

$\Rightarrow$ 28 = 16.8 + x

     x = 11.2 L

$$n_{CH_4} = \frac{PV}{RT} = \frac{1 \times 5.6}{0.082 \times 298} = 0.229 \text{ mole}$$

$$n_{C_2H_2} = \frac{11.2}{0.082 \times 298} = 0.458 \text{ mole}$$

$\therefore$ Heat evolved = 0.229 × 900 + 0.458 × 1400

     = 206.1 + 641.2

     = 847.3 kJ

55. 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

Official Ans. by NTA (5.00)

Allen Ans. (5.00)

Sol. $[Co(NH_3)_4Cl_2]Cl \Rightarrow$ Gives 1 mole AgCl

$[Ni(H_2O)_6]Cl_2 \Rightarrow$ Gives 2 moles AgCl

$[Pt(NH_3)_2Cl_2] \Rightarrow$ Gives No AgCl

$[Pd(NH_3)_4]Cl_2 \Rightarrow$ Gives 2 moles AgCl

Total number of moles of AgCl = 5 mole.

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

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

Official Ans. by NTA (12.00)

Allen Ans. (12.00)

Sol.

Element	Percentage	Mole	Mole ratio
C	85.8	$\frac{85.8}{12} = 7.15$	1
H	14.2	$\frac{14.2}{1} = 14.2$	2

Empirical formula (CH_2)

$$14 \times n = 84$$

$$n = 6$$

$\therefore$ Molecular formula C_6H_{12}

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

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

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

Official Ans. by NTA (3.00)

Allen Ans. (3.00)

Sol. Overall reaction :–

$$H_{2(g)} + M^{3+}_{(aq)} \longrightarrow M^+_{(aq)} + 2H^+_{(aq)}$$
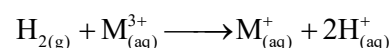
$$E_{Cell} = E^o_{Cathode} - E^o_{anode} - \frac{0.059}{2} \log \frac{[M^+] \times 1^2}{[M^{+3}] 1}$$

$$0.1115 = 0.2 - \frac{0.059}{2}\log\frac{[M^+]}{[M^{+3}]}$$

$$3 = \log\frac{[M^+]}{[M^{+3}]}$$

$$\therefore \quad a = 3$$

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

Liquid molecule on the surface

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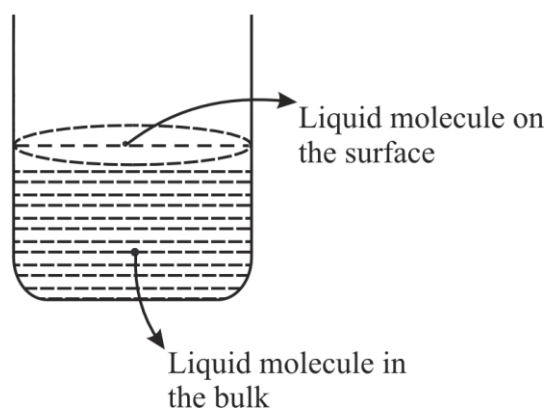
A. Surface tension is the outcome of equal attractive and repulsion forces acting on the liquid molecule in bulk.

B. Surface tension is due to uneven forces 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.

Official Ans. by NTA (2.00)

Allen Ans. (2.00)

Sol. B and D options are correct.

59. A first order reaction has the rate constant, k = 4.6 × 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.

Official Ans. by NTA (2.00)

Allen Ans. (2.00)

Sol. $t_{10\%} = \frac{1}{K}\ln\left(\frac{a}{a-x}\right) = \frac{1}{K}\ln\left(\frac{100}{90}\right)$

$t_{10\%} = \frac{2.303}{K}(\log 10 - \log 9)$

$t_{10\%} = \frac{2.093}{K} \times (0.04)$

Similarly

$t_{90\%} = \frac{1}{K}\ln\left(\frac{100}{10}\right)$

$t_{90\%} = \frac{2.303}{K}$

$\frac{t_{90\%}}{t_{10\%}} = \frac{1}{0.04} = 25$

$e^{kt} = \frac{a}{a-x}$

$\frac{a-x}{a} = e^{-kt}$

$1 - \frac{x}{a} = e^{-kt}$

$x = a(1 - e^{-kt})$

$\alpha = \frac{x}{a} = \left(1 - e^{-kt}\right)$

60. 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.

Official Ans. by NTA (2.00)

Allen Ans. (2.00)

Sol. 'A' water vapours are absorbed by calcium chloride.

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