FINAL JEE–MAIN EXAMINATION – JULY, 2022

(Held On Wednesday 27th July, 2022) **TIME : 3 : 00 PM to 6 : 00 PM**

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

1. The correct decreasing order of energy, for the orbitals having, following set of quantum numbers:

(A) n = 3, l = 0, m = 0

(B) n = 4, l = 0, m = 0

(C) n = 3, l = 1, m = 0

(D) n = 3, l = 2, m = 1

(A) (D) > (B) > (C) > (A)

(B) (B) > (D) > (C) > (A)

(C) (C) > (B) > (D) > (A)

(D) (B) > (C) > (D) > (A)

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. (A) $n + \ell = 3 + 0 = 3$

(B) $n + \ell = 4 + 0 = 4$

(C) $n + \ell = 3 + 1 = 4$

(D) $n + \ell = 3 + 2 = 5$

Higher $n + \ell$ value, higher the energy & if same $n + \ell$ value, then higher n value, higher the energy.

Thus : D > B > C > A.

2. Match List-I with List-II

List-I	List-II
(A) $\Psi_{MO} = \Psi_A - \Psi_B$	(I) Dipole moment
(B) $\mu = Q \times r$	(II) Bonding molecular orbital
(C) $\frac{N_b - N_a}{2}$	(III) Anti-bonding molecualr orbital
(D) $\Psi_{MO} = \Psi_A + \Psi_B$	(IV) Bond order

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

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

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

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

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. (A) $\psi_{MO} = \psi_A - \psi_B$ (III) ABMO

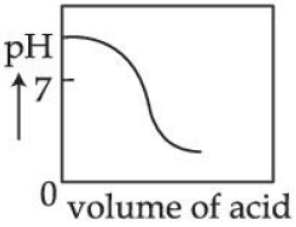
(B) $\mu = Q \times r$ (I) Dipole moment

(C) $\frac{N_b - N_a}{2}$ (IV) Bond order

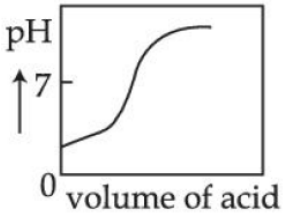
(D) $\psi_{MO} = \psi_A + \psi_B$ (II) BMO

3. The Plot of pH-metric titration of weak base NH_4OH vs strong acid HCl looks like:

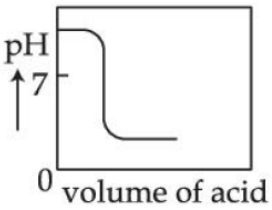
(A)



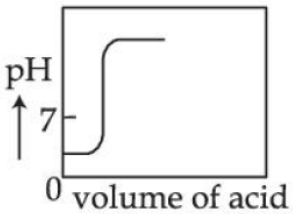
(B)



(C)



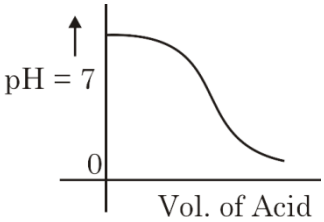
(D)



Official Ans. by NTA (A)

Allen Ans. (A)

Sol. Titration curve of NH_4OH vs HCl (WB + SA).



4. Given below are two statements:

Statement I: For KI, molar conductivity increases steeply with dilution.

Statement II: For carbonic acid, molar conductivity increases slowly with dilution.

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

(A) Both **Statement I** and **Statement II** are true

(B) Both **Statement I** and **Statement II** are false

(C) **Statement I** is true but **Statement II** is false

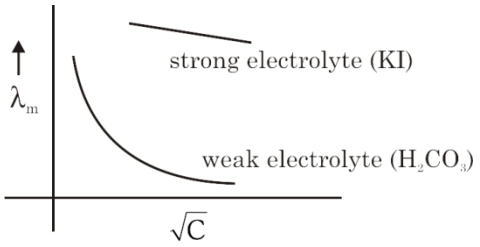
(D) **Statement I** is false but **Statement II** is true

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. **Statement I:** KI is strong electrolyte thus almost constant on dilution.

Statement II: In weak electrolyte it increases, sharply.



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

Assertion (A) : Dissolved substances can be removed from a colloidal solution by diffusion through a parchment paper.

Reason (R) : Particles in a true solution cannot pass through parchment paper but the collodial particles can pass through the parchment paper.

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

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

(B) Both **(A)** and **(R)** are correct but **(R)** is not the correct explanation of **(A)**

(C) **(A)** is correct but **(R)** is not correct

(D) **(A)** is not correct but **(R)** is correct

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. **Assertion (A):** Correct.

Reason(R): Incorrect.

Particles of true solution pass through parchment paper thus answer is (C).

6. Outermost electronic configurations of four elements A, B, C, D are given below:

(A) $3s^2$

(B) $3s^2 3p^1$

(C) $3s^2 3p^3$

(D) $3s^2 3p^4$

The **correct** order of first ionization enthalpy for them is:

(A) (A) < (B) < (C) < (D)

(B) (B) < (A) < (D) < (C)

(C) (B) < (D) < (A) < (C)

(D) (B) < (A) < (C) < (D)

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. (A) $3s^2 \rightarrow$ Mg

(B) $3s^2 3p^1 \rightarrow$ Al

(C) $3s^2 3p^3 \rightarrow$ P

(D) $3s^2 3p^4 \rightarrow$ S

$$\underbrace{P > S}_{\text{Half filled stability}} > \underbrace{Mg > Al}_{\text{Penetrating power of s>p.}}$$

C > D > A > B.

7. An element A of group 1 shows similarity to an element B belonging to group 2. If A has maximum hydration enthalpy in group 1 then B is:

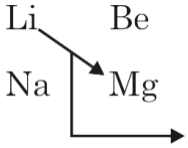
(A) Mg (B) Be

(C) Ca (D) Sr

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.



Diagonal relationship

$Li^+ \rightarrow$ Maximum hydration enthalpy in group 1 due to small size.

So 'B' is Mg.

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

Assertion (A) : Boron is unable to form BF_6^{3-}

Reason (R) : Size of B is very small.

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

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

(B) Both **(A)** and **(R)** are true but **(R)** is **not** the correct explanation of **(A)**

(C) **(A)** is true but **(R)** is false

(D) **(A)** is false but **(R)** is true

Official Ans. by NTA (B)

Allen Ans. (B)

Sol. **Assertion (A):** True

Reason (R): True but not correct explanation.

Correct explanation: Expansion of octet not possible for 'B'.

9. In neutral or alkaline solution, MnO_4^- oxidises thiosulphate to:

(A) $S_2O_7^{2-}$ (B) $S_2O_8^{2-}$

(C) SO_3^{2-} (D) SO_4^{2-}

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. $8MnO_4^- + 3S_2O_3^{2-} + H_2O \xrightarrow{\text{neutral or alk. solution}} 8MnO_2 + 6SO_4^{2-} + 2OH^-$

10. Low oxidation state of metals in their complexes are common when ligands:

(A) have good π -accepting character

(B) have good σ -donor character

(C) are havind good π -donating ability

(D) are havind poor σ -donating ability

Official Ans. by NTA (A)

Allen Ans. (A)

Sol. When metal is in low oxidation state then it forms complexes when ligands have good π -accepting character.

11. Given below are two statements:

Statement I : The non bio-degradable fly ash and slag from steel industry can be used by cement industry.

Statement II : The fuel obtained from plastic waste is lead free.

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

(A) Both **Statement I** and **Statement II** are correct

(B) Both **Statement I** and **Statement II** are incorrect

(C) **Statement I** is correct but **Statement II** is incorrect

(D) **Statement I** is incorrect but **Statement II** is correct

Official Ans. by NTA (A)

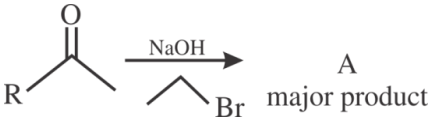
Allen Ans. (A)

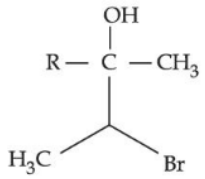
Sol. (I) Fly ash and slag from steel industry are utilised by cement industry.

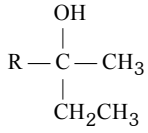
(II) Fuel obtained from plastic waste has high octane rating. It contains no lead and it is known as green fuel.

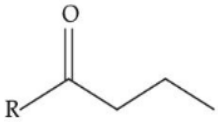
Both statement (I) & (II) are correct.

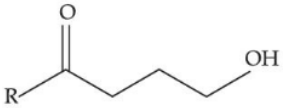
12. The structure of A in the given reaction is:



(A) 

(B) 

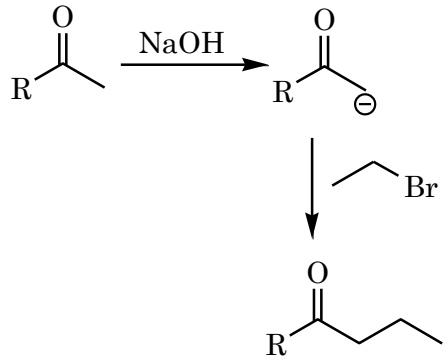
(C) 

(D) 

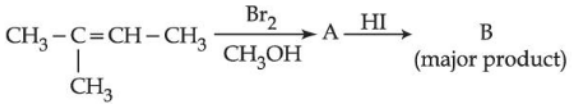
Official Ans. by NTA (C)

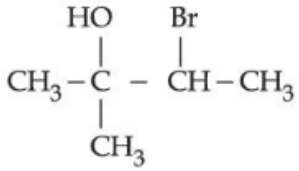
Allen Ans. (C)

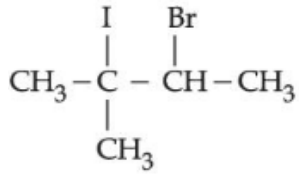
Sol.

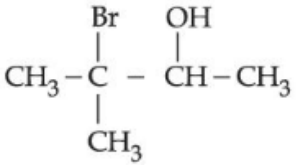


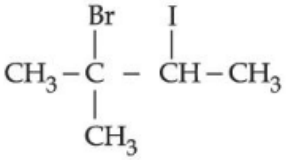
13. Major product 'B' of the following reaction sequence is:



(A) 

(B) 

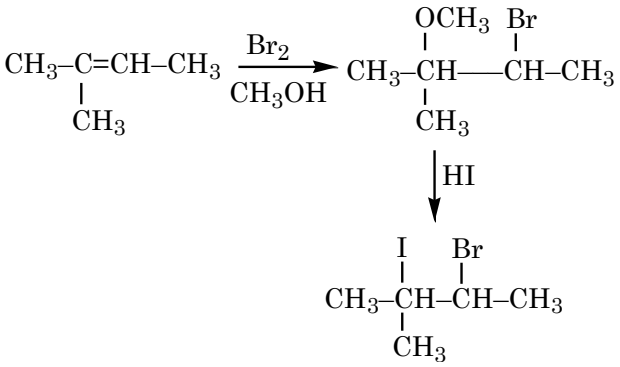
(C) 

(D) 

Official Ans. by NTA (B)

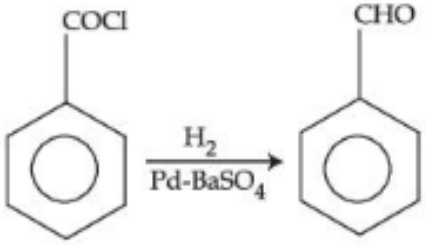
Allen Ans. (B)

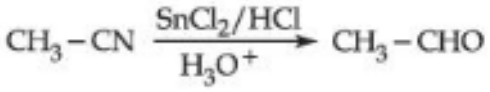
Sol

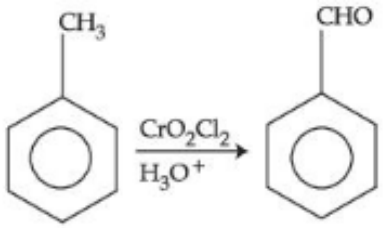


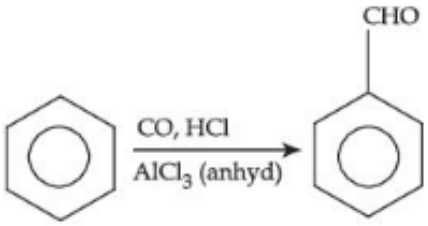
14. Match List-I with List-II.

List-I

(A) 

(B) 

(C) 

(D) 

Lits-II

(I) Gatterman Koch reaction

(II) Etard reaction

(III) Stephen reaction

(IV) Rosenmund reaction

Choose the **correct** answer from the options given below:

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

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

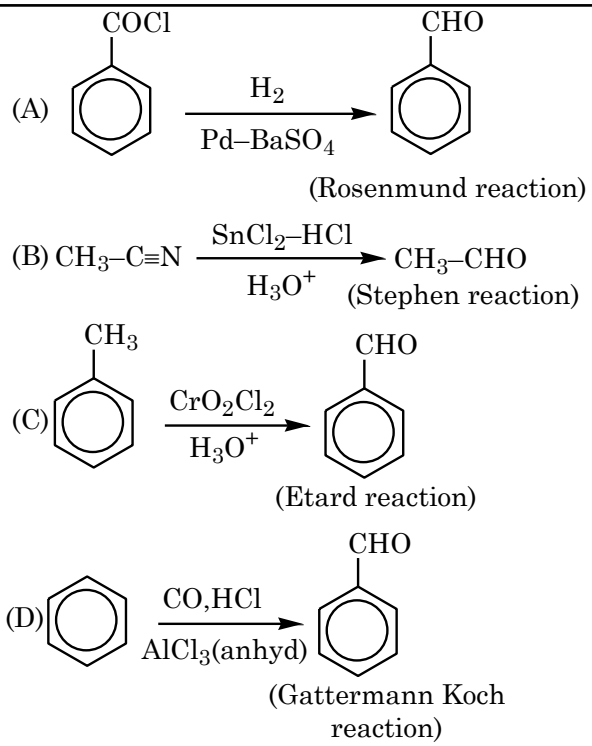
(C) (A)-(II), (B)-(III), (C)-(IV), (D)-(I)

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

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.



15. Match List-I with List-II.

List-I **(Polymer)**	**List-II** **(Monomer)**
(A) Neoprene	(I) Acrylonitrile
(B) Teflon	(II) Chloroprene
(C) Acrilan	(III) Tetrafluoroethene
(D) Natural rubber	(IV) Isoprene

Choose the correct answer from the option given below:

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

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

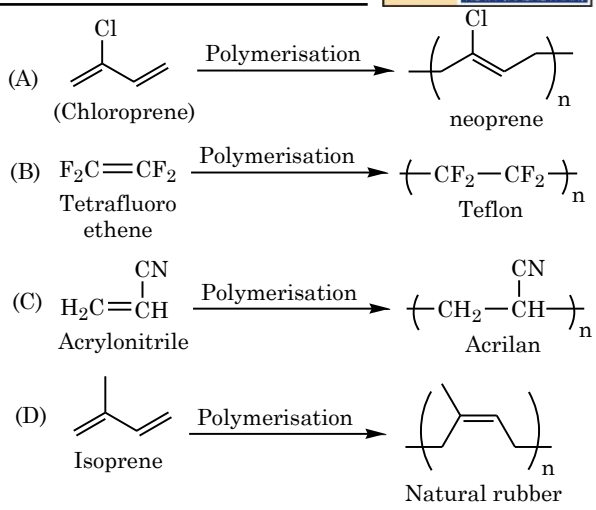
(C) (A)-(II), (B)-(I), (C)-(IV), (D-(III)

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

Official Ans. by NTA (A)

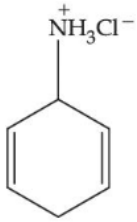
Allen Ans. (A)

Sol.

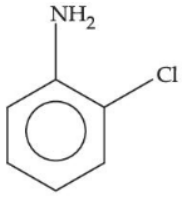


16. An organic compound 'A' contains nitrogen and chlorine. It dissolves readily in water to give a solution that turns litmus red. Titration of compound 'A' with standard base indicates that the molecular weight of 'A' is 131 ± 2. When a sample of 'A' is treated with aq. NaOH, a liquid separates which contains N but not Cl. Treatment of the obtained liquid with nitrous acid followed by phenol gives orange precipitate. The compound 'A' is :

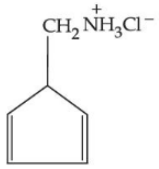
(A)



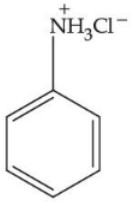
(B)



(C)



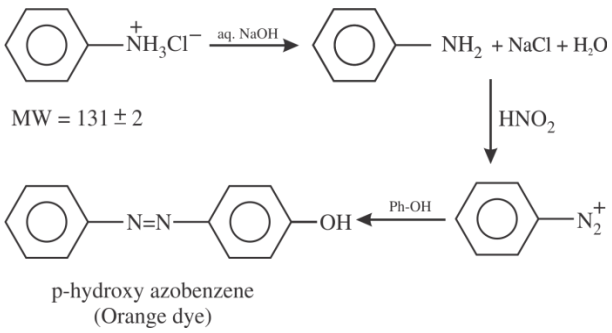
(D)



Official Ans. by NTA (D)

Allen Ans. (D)

Sol.



p-hydroxy azobenzene
(Orange dye)

17. Match List-I with List-II

List-I

(A) Glucose + HI

(B) Glucose + Br_2 water

(C) Glucose + acetic anhydride

(D) Glucose + HNO_3

List-II

(I) Gluconic acid

(II) Glucose pentacetate

(III) Saccharic acid

(IV) Hexane

Choose the correct answer from the options given below:

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

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

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

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

Official Ans. by NTA (A)

Allen Ans. (A)

Sol.

(A) $\text{Glucose} \xrightarrow{HI} \text{n-hexane}$

(B) $\text{Glucose} \xrightarrow[H_2O]{Br_2} \underset{\text{Gluconic acid}}{\overset{\overset{COOH}{|}}{(CHOH)_4}{\underset{|}{CH_2OH}}}$

(C) $\text{Glucose} \xrightarrow[\text{anhydride}]{\text{5 acetic}} \text{Glucose pentacetate}$

(D) $\text{Glucose} \xrightarrow{HNO_3} \underset{\text{Saccharic acid}}{\overset{\overset{COOH}{|}}{(CHOH)_4}{\underset{|}{COOH}}}$

18. Which of the following enhances the lathering property of soap?

(A) Sodium stearate

(B) Sodium carbonate

(C) Sodium rosinate

(D) Trisodium phosphate

Official Ans. by NTA (C)

Allen Ans. (C)

Sol. Rosin is added to soaps which forms sodium rosinate which lathers well.

19. Match List-I with List-II

List-I (Mixture)

(A) Chloroform & Aniline

(B) Benzoic acid & Napthalene

(C) Water & Aniline

(D) Napthalene & Sodium chloride

List-II (Purification Process)

(I) Steam distillation

(II) Sublimation

(III) Distillation

(IV) Crystallisation

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

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

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

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

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. (A) Chloroform + Aniline → (III) Distillation

(B) Benzoic acid + Napthalene → (IV) Crystallisation

(C) Water + Aniline → (I) Steam distillation

(D) Napthalene + Sodium chloride →(II) Sublimation

20. Fe^{3+} cation gives a prussian blue precipitate on addition of potassium ferrocyanide solution due to the formation of:

(A) $[Fe(H_2O)_6]_2\,[Fe(CN)_6]$

(B) $Fe_2[Fe(CN)_6]_2$

(C) $Fe_3[Fe(OH)_2(CN)_4]_2$

(D) $Fe_4[Fe(CN)_6]_3$

Official Ans. by NTA (D)

Allen Ans. (D)

Sol. $4Fe^{3+} + 3[Fe(CN)_6]^{-4} \longrightarrow \underset{\text{Prussian Blue}}{Fe_4[Fe(CN)_6]_3}$

SECTION-B

1. The normality of H_2SO_4 in the solution obtained on mixing 100 mL of 0.1 M H_2SO_4 with 50 mL of 0.1 M NaOH is_____$\times 10^{-1}$ N. (Nearest Integer)

Official Ans. by NTA (1)

Allen Ans. (1)

Sol. No. of equivalents of $H_2SO_4 = 100 \times 0.1 \times 2 = 20$

No. of equivalents of NaOH $= 50 \times 0.1 = 5$

No. of equivalents of H_2SO_4 left $= 20 - 5 = 15$

$\Rightarrow 150 \times x = 15$

$$x = \frac{1}{10} = 0.1\,N = 1 \times 10^{-1}\,N$$

2. for a real gas at 25°C temperature and high pressure (99 bar) the value of compressibility factor is 2, so the value of Vander Waal's constant 'b' should be_____$\times 10^{-2}$ L mol^{-1} (Nearest integer) (Given R = 0.083 L bar K^{-1} mol^{-1})

Official Ans. by NTA (25)

Allen Ans. (25)

Sol. For real gas under high pressure

$$Z = 1 + \frac{Pb}{RT} \qquad \Rightarrow b = \frac{RT}{P}$$

$$= \frac{0.083 \times 298}{99}$$

$$= 0.25 \times 10^{-2}\ L\ mol^{-1}$$

3. A gas (Molar mass = 280 g mol^{-1}) was burnt in excess O_2 in a constant volume calorimeter and during combustion the temperature of calorimeter increased from 298.0 K to 298.45 K. If the heat capacity of calorimeter is 2.5 kJ K^{-1} and enthalpy of combustion of gas is 9 kJ mol^{-1} then amount of gas burnt is_____g. (Nearest Integer)

Official Ans. by NTA (35)

Allen Ans. (35)

Sol. Let x g is burnt

$$\text{moles} = \frac{x}{280}$$

heat released by $\frac{x}{280}$ mole $= 2.5 \times 0.45$ kJ

$$\text{heat released by 1 mole} = \frac{2.5 \times 0.45 \times 280}{x}\,kJ$$

$\Delta H = \Delta U + \Delta ngRT$

$\Delta H \simeq \Delta U$

$$9 = \frac{2.5 \times 280 \times 0.45}{x}$$

$x =$ **35 g**

4. When a certain amount of solid A is dissolved in 100 g of water at 25°C to make a dilute solution, the vapour pressure of the solution is reduced to one-half of that of pure water. The vapour pressure of pure water is 23.76 mmHg. The number of moles of solute A added is_____. (Nearest Integer)

Official Ans. by NTA (3)

Allen Ans. (3 or 6)

Sol. $\because$ Diliute solution given:

$$\frac{P^0 - P_s}{P^0} \sim \frac{{}^n\text{solute}}{{}^n\text{solvent}}$$

$$\frac{P^0 - P^0/2}{P^0} = \frac{{}^n\text{solute}}{{}^n\text{solvent}}$$

$${}^n\text{solute} \sim \frac{{}^n\text{solvent}}{2} = \frac{100}{18 \times 2} = 2.78\,\text{mol}$$

More accurate approach:

$$\frac{P^0 - P_s}{P_s} = \frac{{}^n\text{solute}}{{}^n\text{solvent}}$$

$$\frac{P^0 - P^0/2}{P^0/2} = \frac{{}^n\text{solute}}{{}^n\text{solvent}}$$

$${}^n\text{solute} = {}^n\text{solvent} = \frac{100}{18} = 5.55\,\text{mol}$$

5. [A] → [B]

Reactant Product

If formation of compound [B] follows the first order of kinetics and after 70 minutes the concentration of [A] was found to be half of its initial concentration. Then the rate constant of the reaction is x × 10^{-6} s^{-1}. The value of x is_____. (Nearest Integer)

Official Ans. by NTA (165)

Allen Ans. (165)

Sol. $K = \frac{0.693}{t_{1/2}} = \frac{0.693}{70 \times 60}$

$= \frac{6930}{7 \times 6} \times 10^{-6}$

$= 165 \times 10^{-6}\ s^{-1}$

6. Among the following ores Bauxite, Siderite, Cuprite, Calamine, Haematite, Kaolinite, Malachite, Magnetite, Sphalerite, Limonite, Cryolite, the number of principal ores if (of) iron is_____.

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. Bauxite — $AlO_X(OH)_{3-2x}$(where $0 < x < 1$)

✓Siderite — $FeCO_3$

Cuprite — Cu_2O

Calamine — $ZnCO_3$

✓Haematite — Fe_2O_3

Kaolinite — $Al_2(OH)_4Si_2O_5$

Malachite — $CuCO_3 . Cu(OH)_2$

✓Magnetite — Fe_3O_4

Sphalerite — ZnS

✓Limonite — $Fe_2O_3.3H_2O$

Cryolite — Na_3AlF_6

7. The oxidation state of manganese in the product obtained in a reaction of potassium permanganate and hydrogen peroxide in basic medium is_____.

Official Ans. by NTA (4)

Allen Ans. (4)

Sol. $2KMnO_4 + 3H_2O_2 \xrightarrow{\text{basic medium}} 2\overset{+4}{Mn}O_2 + 3O_2 + 2H_2O + 2KOH$

8. The number of molecule(s) or ion(s) from the following having non-planar structure is_____.

$NO_3^-, H_2O_2, BF_3, PCl_3, XeF_4,$
$SF_4, XeO_3, PH_4^+, SO_3, [Al(OH)_4]^-$

Official Ans. by NTA (6)

Allen Ans. (6)

Sol.

SO_3	—	sp^2	Planar
BF_3	—	sp^2	Planar
NO_3^-	—	sp^2	Planar
SF_4	—	sp^3d	Non-planar
H_2O_2	—	sp^3	Non-planar
PCl_3	—	sp^3	Non-planar
$[Al(OH)_4]^-$	—	sp^3	Non-planar
XeF_4	—	sp^3d^2	Planar
XeO_3	—	sp^3	Non-planar
PH_4^+	—	sp^3	Non-planar

9. The spin only magnetic moment of the complex present in Fehling's reagent is_____ B.M. (Nearest integer).

Official Ans. by NTA (2)

Allen Ans. (2)

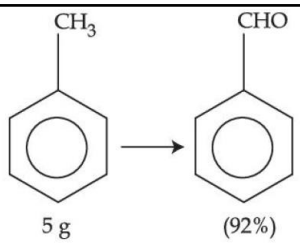
Sol. Fehling solution is a complex of Cu^{++}

$Cu^{++} = 3d^9$

No. of unpaired $e^- = 1$

$M.M = \sqrt{1(1+2)} = \sqrt{3} = 1.73$ BM

10.

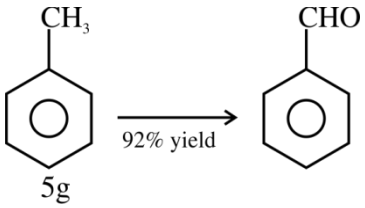


In the above reaction, 5 g of toluene is converted into benzaldehyde with 92% yield. The amount of benzaldehyde produced is_____$\times 10^{-2}$ g. (Nearest integer)

Official Ans. by NTA (530)

Allen Ans. (530)

Sol.



$$\text{moles} = \frac{5}{92}$$

$$\text{moles of } \text{C}_6\text{H}_5\text{CHO} = \frac{5}{92} \times \frac{92}{100} = 5 \times 10^{-2}$$

$$\text{mass of } \text{C}_6\text{H}_5\text{CHO} = 106 \times 5 \times 10^{-2} = 5.3 \text{ g}$$

$$= 530 \times 10^{-2} \text{ g}$$