# FINAL JEE–MAIN EXAMINATION – JULY, 2022

**(Held On Tuesday 26th July, 2022)** **TIME : 9 : 00 AM to 12 : 00 NOON**

## CHEMISTRY

## TEST PAPER WITH SOLUTION

### SECTION-A

**1.** Match **List - I** with **List - II**.

| **List - I (Compound)** | **List – II (Shape)** |
|---|---|
| (A) $BrF_5$ | (I) bent |
| (B) $[CrF_6]^{3-}$ | (II) square pyramidal |
| (C) $O_3$ | (III) trigonal bipyramidal |
| (D) $PCl_5$ | (IV) octahedral |

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

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

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

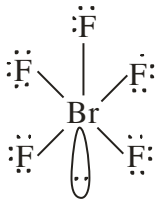
(C) (A) - (II), (B) - (IV), (C) - (I), (D) - (III)

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

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

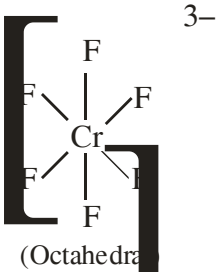
**Allen Ans. (C)**

**Sol.**



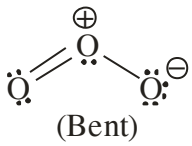
(Square pyramidal)

$[CrF_6]^{3-}$ :



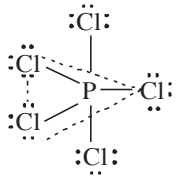
(Octahedral)

$O_3$ :



(Bent)

$PCl_5$ :



(Trigonal bipyramidal)

**2.** Match **List - I** with **List - II.**

| **List –I (Processes/Reactions)** | **List – II (Catalyst)** |
|---|---|
| (A) $2SO_2(g)+O_2(g)\rightarrow 2SO_3(g)$ | (I) Fe(s) |
| (B) $4NH_3(g)+5O_2(g)\rightarrow 4NO(g)+6H_2O(g)$ | (II) Pt(s)-Rh(s) |
| (C) $N_2(g)+3H_2(g)\rightarrow 2NH_3(g)$ | (III) $V_2O_5$ |
| (D) Vegetable oil($l$)+$H_2\rightarrow$Vegetable ghee(s) | (IV) Ni(s) |

Choose the correct answer from the options given below :

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

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

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

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

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

**Allen Ans. (B)**

**Sol.** $2SO_2(g)+O_2(g)\xrightarrow{V_2O_5}2SO_3(g)$:

contact process

$4NH_3(g)+5O_2(g)\xrightarrow{Pt(s)-Rh(s)}4NO(g)+6H_2O(g)$:

Ostwald's process

$N_2(g)+3H_2(g)\xrightarrow{Fe(s)}2NH_3(g)$; Haber's process

Vegetable oil $(l)+H_2(g)\xrightarrow{Ni(s)}$ vegetable ghee

: Hydrogenation

**3.** Given two statements below :

**Statement I :** In $Cl_2$ molecule the covalent radius is double of the atomic radius of chlorine.

**Statement II :** Radius of anionic species is always greater than their parent atomic radius.

Choose the **most appropriate** answer from 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 (D)**

**Allen Ans. (D)**

**Sol.** In $Cl_2$ molecule, the covalent radius is half of the internuclear distance, so statement(I) is false.

For the same element, anion has lower effective nuclear charge than atom $\Rightarrow$ so anion is larger than atom. $\Rightarrow$ statement (II) is correct.

**4.** Refining using liquation method is the most suitable for metals with :

(A) Low melting point

(B) High boiling point

(C) High electrical conductivity

(D) Less tendency to be soluble in melts than impurities

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

**Allen Ans. (A)**

**Sol.** Liquation is used to purify metals having lower melting point than impurities present in them.

**5.** Which of the following can be used to prevent the decomposition of $H_2O_2$?

(A) Urea

(B) Formaldehyde

(C) Formic acid

(D) Ethanol

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

**Allen Ans. (A)**

**Sol.** Urea acts as stabiliser for $H_2O_2$.

**6.** Reaction of $BeCl_2$ with $LiAlH_4$ gives :

(A) $AlCl_3$

(B) $BeH_2$

(C) LiH

(D) LiCl

(E) $BeAlH_4$

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

(A) (A), (D) and (E)

(B) (A) , (B) and (D)

(C) (D) and (E)

(D) (B) , (C) and (D)

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

**Allen Ans. (B)**

**Sol.** $2BeCl_2 + LiAlH_4 \rightarrow 2BeH_2 + LiCl + AlCl_3$

**7.** Borazine, also known as inorganic benzene, can be prepared by the reaction of 3-equivalents of "X" with 6-equivalents of "Y". "X" and "Y", respectively are :

(A) $B(OH)_3$ and $NH_3$ (B) $B_2H_6$ and $NH_3$

(C) $B_2H_6$ and $HN_3$ (D) $NH_3$ and $B_2O_3$

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

**Allen Ans. (B)**

**Sol.** $3B_2H_6 + 6NH_3 \xrightarrow{\Delta} 2B_3N_3H_6 + 12\ H_2$

**8.** Which of the given reactions is not an example of disproportionation reaction ?

(A) $2H_2O_2 \rightarrow 2H_2O + O_2$

(B) $2NO_2 + H_2O \rightarrow HNO_3 + HNO_2$

(C) $MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$

(D) $3MnO_4^{2-} + 4H^+ \rightarrow 2MnO_4^- + MnO_2 + 2H_2O$

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

**Allen Ans. (C)**

**Sol.** $\overset{-1}{2H_2O_2} \longrightarrow \overset{2-}{2H_2O} + \overset{0}{O_2}$ : Disproportionation

$\overset{+4}{2NO_2} + H_2O \rightarrow \overset{+5}{HNO_3} + \overset{+3}{HNO_2}$ : Disproportionation

$MnO_4^- + 4H^+ + 3e^- \rightarrow MnO_2 + 2H_2O$ : reduction

$\overset{+6}{3MnO_4^{2-}} + 4H^+ \rightarrow 2\overset{+7}{MnO_4^-} + \overset{+4}{MnO_2} + 2H_2O$ : Disproportionation

**9.** The dark purple colour of $KMnO_4$ disappears in the titration with oxalic acid in acidic medium.

The overall change in the oxidation number of manganese in the reaction is :

(A) 5 (B) 1

(C) 7 (D) 2

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

**Allen Ans. (A)**

**Sol.** In acidic medium,

$\overset{+7}{MnO_4^-} \rightarrow Mn^{+2}$

change in ox. no. = 5

**10.** $\dot{Cl} + CH_4 \rightarrow A + B$

A and B in the above atmospheric reaction step are

(A) $C_2H_6$ and $Cl_2$ (B) $\dot{C}HCl_2$ and $H_2$

(C) $\dot{C}H_3$ and HCl (D) $C_2H_6$ and HCl

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

**Allen Ans. (C)**

**Sol.** $\dot{Cl} + CH_4 \longrightarrow \dot{C}H_3 + HCl$

**11.** Which technique among the following, is most appropriate in separation of a mixture of 100 mg of p-nitrophenol and picric acid ?

(A) Steam distillation

(B) 2-5 ft long column of silica gel

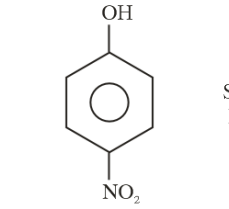
(C) Sublimation

(D) Preparative TLC (Thin Layer Chromatography)

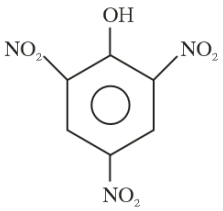
**Official Ans. by NTA (D)**

**Allen Ans. (D)**

**Sol.**




Shows inter molecular H-bonding




Shows intra molecular H-bonding

Solvent polarity has been related to $R_f$ value of nitrocompounds.

100 mg p-nitrophenol and picric acid have different $R_f$ value on silica gel plate

$\therefore$ Preparative TLC is best to separate 100 mg of para nitrophenol and picric acid

**12.** The difference in the reaction of phenol with bromine in chloroform and bromine in water medium is due to :

(A) Hyperconjugation in substrate

(B) Polarity of solvent

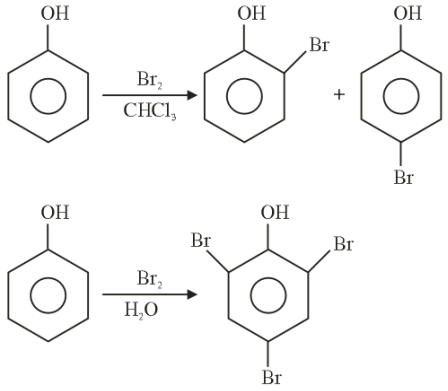
(C) Free radical formation

(D) Electromeric effect of the substrate

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

**Allen Ans. (B)**

**Sol.**

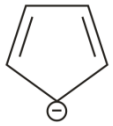



Difference in reactions is observed due to solvent polarity, which

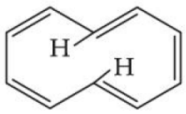
(i) Ionizes phenol to make more reactive phenoxide ion

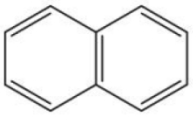
(ii) Increases electrophilicity of bromine.

**13.** Which of the following compounds is **not** aromatic?

(A) 

(B) 

(C) 

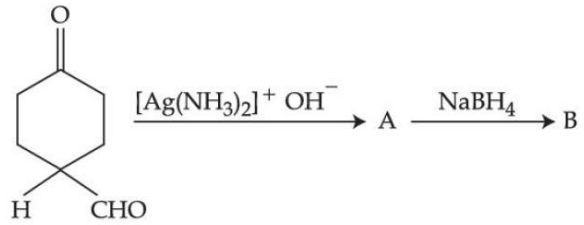

(D) 

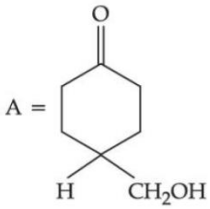
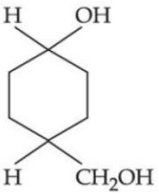
**Official Ans. by NTA (C)**

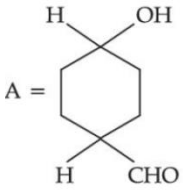
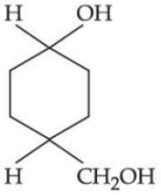
**Allen Ans. (C)**

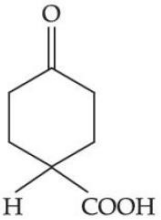
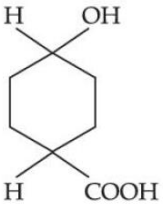
**Sol.** [10] Annulene, although follow $(4n + 2)\pi$ electron rule, but it is non-aromatic due to its non planar nature. It is nonplanar due to repulsion of C – H bonds present inside the ring.

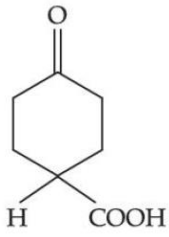
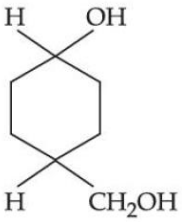
**14.** The products formed in the following reaction, A and B are




(A) A =  , B = 

(B) A =  , B = 

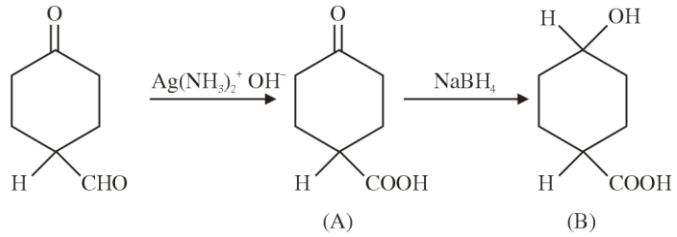
(C) A =  , B = 

(D) A =  , B = 

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

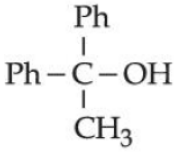
**Allen Ans. (C)**

**Sol.**



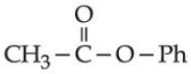

$NaBH_4$ does not reduce carboxylic acid.

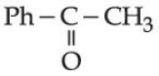
**15.** Which reactant will give the following alcohol on reaction with one mole of phenyl magnesium bromide (PhMgBr) followed by acidic hydrolysis ?




(A) $CH_3 - C \equiv N$

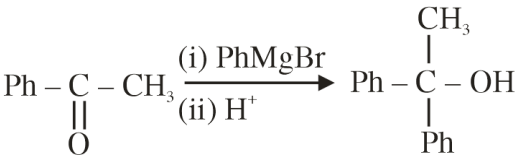
(B) $Ph - C \equiv N$

(C) 

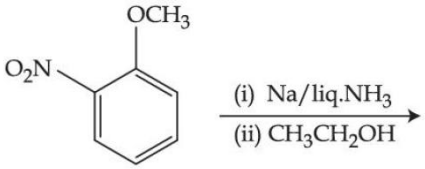
(D) 

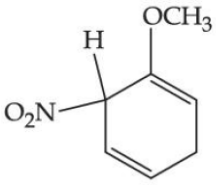
**Official Ans. by NTA (D)**

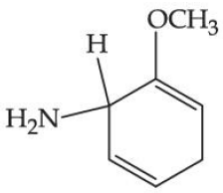
**Allen Ans. (D)**

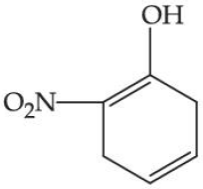
**Sol.** 

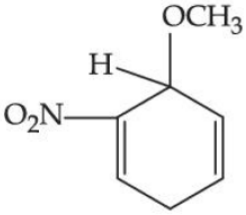

**16.** The major product of the following reaction is




(A) 

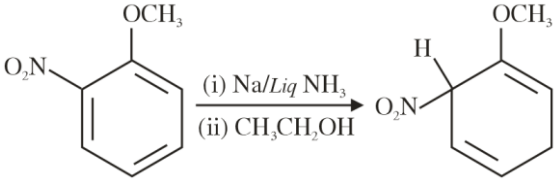
(B) 

(C) 

(D) 

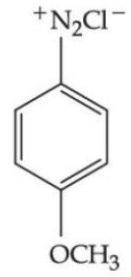
**Official Ans. by NTA (A)**

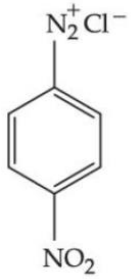
**Allen Ans. (A)**

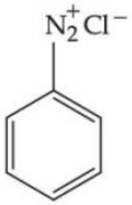
**Sol.** 

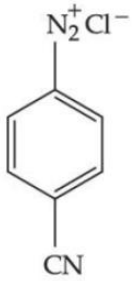

Given reaction is an example of birch reduction.

**17.** The correct stability order of the following diazonium salt is

(A) 

(B) 

(C) 

(D) 

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

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

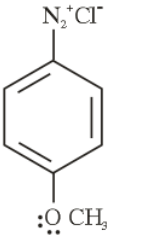
(C) (C) > (A) > (D) > (B)

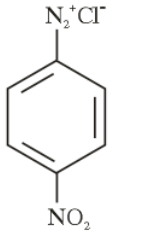
(D) (C) > (D) > (B) > (A)

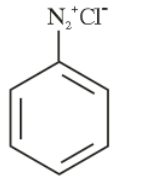
**Official Ans. by NTA (B)**

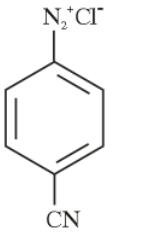
**Allen Ans. (B)**

**Sol.**

(A) 
(+ M group)

(B) 
(– M & – I group)

(C) 

(D) 
(– M & – I group)

Since diazonium ion is a cation hence it is stabilized by electron donating groups and destabilized by electron withdrawing group.

Hence Stability order should be A > C > D > B.

**18.** Stearic acid and polyethylene glycol react to form which one of the following soap/s detergents ?

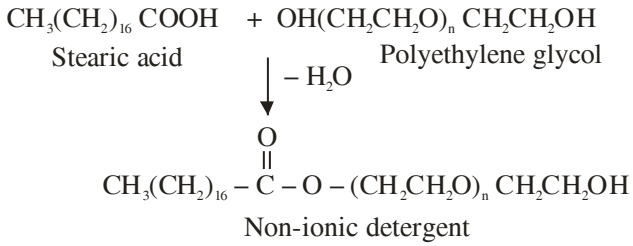
(A) Cationic detergent (B) Soap

(C) Anionic detergent (D) Non-ionic detergent

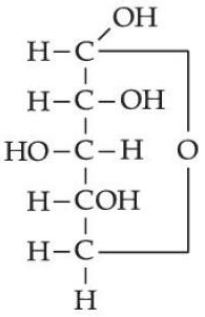
**Official Ans. by NTA (D)**

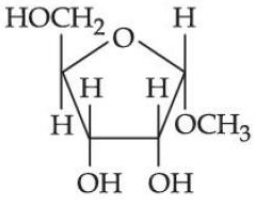
**Allen Ans. (D)**

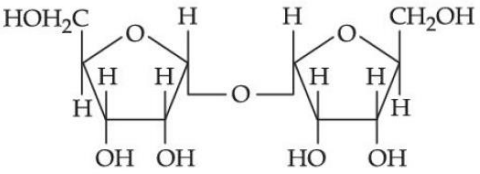
**Sol.**

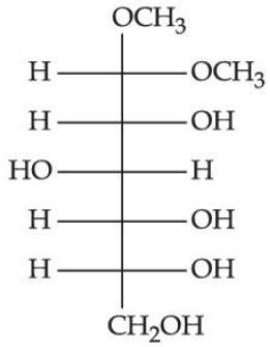



**19.** Which of the following is reducing sugar?

(A) 

(B) 

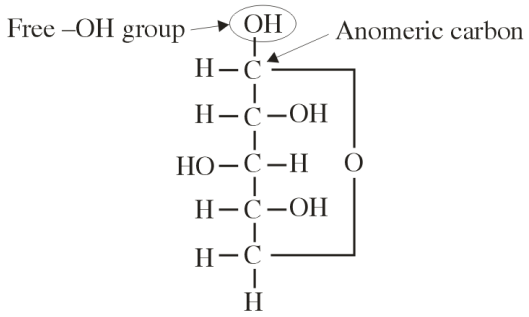
(C) 

(D) 

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

**Allen Ans. (A)**

**Sol.** If any sugar is having free –OH group at anomeric carbon then it will be a reducing sugar




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

**Assertion (A) :** Experimental reaction of $CH_3Cl$ with aniline and anhydrous $AlCl_3$ does **not** give o and p-methylaniline.

**Reason (R) :** The — $NH_2$ group of aniline becomes deactivating because of salt formation with anhydrous $AlCl_3$ and hence yields *m*-methyl aniline as the product.

In the light of the above statements, choose the most appropriate 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).

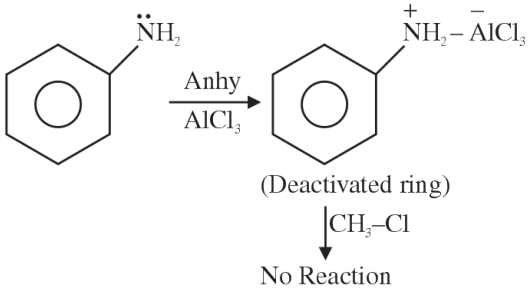
(C) (A) is true, but (R) is false.

(D) (A) is false, but (R) is true.

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

**Allen Ans. (C)**

**Sol.**




Friedel Craft Alkylation does not occur on this deactivated ring.

## SECTION-B

**1.** Chlorophyll extracted from the crushed green leaves was dissolved in water to make 2 L solution of Mg of concentration 48 ppm. The number of atoms of Mg in this solution is $x \times 10^{20}$ atoms. The value of x is_____. (Nearest Integer)

(Given : Atomic mass of Mg is 24 g $mol^{-1}$, $N_A = 6.02 \times 10^{23}$ $mol^{-1}$)

**Official Ans. by NTA (24)**

**Allen Ans. (24)**

**Sol.** $ppm = \frac{W_{Mg}}{V_{soln}} \times 10^6 = 48$

$\Rightarrow W_{Mg} = \frac{48 \times 2 \times 1000}{10^6}$

$= 48 \times 2 \times 10^{-3}$ g

$n_{Mg} = \frac{W_{Mg}}{24} = \frac{48 \times 2 \times 10^{-3}}{24}$

$= 4 \times 10^{-3}$

Number of Mg atoms $= 4 \times 10^{-3} \times 6.02 \times 10^{23}$

$= 4 \times 6.02 \times 10^{20}$

$= 24.08 \times 10^{20}$

$\therefore \quad x = 24.08$

**2.** A mixture of hydrogen and oxygen contains 40% hydrogen by mass when the pressure is 2.2 bar. The partial pressure of hydrogen is bar.

(Nearest Integer)

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

**Allen Ans. (2)**

**Sol.** Let $W_{H_2} = 40$ g $\Rightarrow n_{H_2} = \frac{40}{2} = 20$

$W_{O_2} = 60$g $\Rightarrow n_{O_2} = \frac{60}{32} = \frac{15}{8}$

$P_{H_2} = \left(\frac{20}{20 + \frac{15}{8}}\right) \times 2.2$

$= \frac{20}{20 + 1.875} \times 2.2$

$= \frac{20}{21.875} \times 2.2$

$= 2.0114$

$\simeq 2.01$ bar

**3.** The wavelength of an electron and a neutron will become equal when the velocity of the electron is x times the velocity of neutron. The value of x is_____. (Nearest Integer)

(Mass of electron is $9.1 \times 10^{-31}$ kg and mass of neutron is $1.6 \times 10^{-27}$ kg)

**Official Ans. by NTA ( 1758)**

**Allen Ans. (1758)**

**Sol.** $\nu_e = x\nu_N$

$\lambda_e = \lambda_N$

$$\Rightarrow \frac{h}{m_e\nu_e} = \frac{h}{m_N\nu_N}$$

$$\nu_e = \frac{m_N}{m_e}.\nu_N$$

$$= \frac{1.6\times10^{-27}}{9.1\times10^{-31}}\nu_N$$

$\nu_e = 1758.24 \times \nu_N$

$\therefore \quad x = 1758.24$

**4.** 2.4 g coal is burnt in a bomb calorimeter in excess of oxygen at 298 K and 1 atm pressure.

The temperature of the calorimeter rises from 298 K to 300 K. The enthalpy change during the combustion of coal is – x kJ $mol^{-1}$. The value of x is_____. (Nearest Integer)

(Given : Heat capacity of bomb calorimeter 20.0 kJ $K^{-1}$ . Assume coal to be pure carbon)

**Official Ans. by NTA (200)**

**Allen Ans. (200)**

**Sol.** $C(s) + O_2(g) \rightarrow CO_2(g)$ ; $\Delta H$ = -x kJ/mole

$Q = C\Delta T = 20$ kJ × 2

40 kJ heat is released for 2.4 g of C

For 1 mole 'C' : $$Q = \frac{40}{2.4}\times12$$

$$= \frac{400}{24}\times12 = 200 \text{ kJ/mole}$$

$Q = \Delta E = \Delta H = 200$ kJ ($\because \Delta n_g = 0$)

$x = 200$

**5.** When 800 mL of 0.5 M nitric acid is heated in a beaker, its volume is reduced to half and 11.5 g of nitric acid is evaporated. The molarity of the remaining nitric acid solution is x × $10^{-2}$ M. (Nearest Integer)

(Molar mass of nitric acid is 63 g $mol^{-1}$)

**Official Ans. by NTA ( 54)**

**Allen Ans. (54)**

**Sol.** $n_{HNO_3} = 0.5\times0.8$

$= 0.4$ mole

$$(n_{HNO_3})_{remains} = 0.4 - \frac{11.5}{63}$$

$= 0.4 - 0.1825$

$= 0.2175$

$$\text{Molarity} = \frac{0.2175}{400}\times1000$$

$$= \frac{0.2175}{0.4}$$

$= 0.5437$ mole/lit.

$\simeq 0.54$ mole/lit.

$= 54 \times 10^{-2}$ mol/lit.

**6.** At 298 K, the equilibrium constant is $2 \times 10^{15}$ for the reaction :

$Cu(s) + 2Ag^+(aq) \rightleftharpoons Cu^{2+}(aq) + 2Ag(s)$

The equilibrium constant for the reaction

$$\frac{1}{2}Cu^{2+}(aq) + Ag(s) \rightleftharpoons \frac{1}{2}Cu(s) + Ag^+(aq)$$

is x × $10^{-8}$. The value of x is_____.

(Nearest Integer)

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

**Allen Ans. (2)**

**Sol.** $$K'_{eq} = \frac{1}{\sqrt{K_{eq}}} = \frac{1}{\sqrt{2\times10^{15}}} = x\times10^{-8}$$

$$\Rightarrow \frac{1}{\sqrt{20}}\times\frac{1}{10^7} = x\times10^{-8}$$

$$\Rightarrow \frac{1}{\sqrt{20}}\times10^{-7} = x\times10^{-8}$$

$$\frac{10}{\sqrt{20}} = x$$

$$\Rightarrow x = \frac{\sqrt{10}}{\sqrt{2}} = \sqrt{5} = 2.236$$

$\simeq 2.24$

**7.** The amount of charge in F (Faraday) required to obtain one mole of iron from $Fe_3O_4$ is _____. (Nearest Integer)

**Official Ans. by NTA (3)**

**Allen Ans. (3)**

**Sol.** $Fe_3O_4 \xrightarrow{+8e^-} 3Fe$

Charge for 1 mole Fe = 8/3 F

= 2.67 F

**8.** For a reaction A → 2B + C the half lives are 100 s and 50 s when the concentration of reactant A is 0.5 and 1.0 mol $L^{-1}$ respectively. The order of the reaction is___ _____. (Nearest Integer)

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

**Allen Ans. (2)**

**Sol.** $t_{\frac{1}{2}} \propto \frac{1}{[A_0]^{n-1}}$

$[100] \propto \frac{1}{(0.5)^{n-1}}$

$(50) \propto \frac{1}{(1)^{n-1}}$

$[2]^1 = \left[\frac{1}{0.5}\right]^{n-1}$

$[2]^1 = [2]^{n-1}$

$n - 1 = 1$

$n = 2$

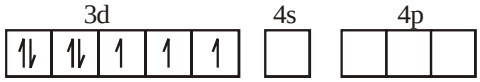
order = 2

**9.** The difference between spin only magnetic moment values of $[Co(H_2O)_6]Cl_2$ and $[Cr(H_2O)_6]Cl_3$ is_____.

**Official Ans. by NTA (0)**

**Allen Ans. (0)**

**Sol.** $[Co(H_2O)_6]^{2+}$

$Co^{+2}$ : 


number of unpaired $e^-$ = 3

$\mu = \sqrt{15}BM$

$[Cr(H_2O)_6]^{3+}$

$Cr^{+3}$ : 


number of unpaired $e^-$ = 3

$\mu = \sqrt{15}BM$

Difference in spin only magnetic moment = 0

**10.** In the presence of sunlight, benzene reacts with $Cl_2$ to give product, X. The number of hydrogens in X is_____.

**Official Ans. by NTA (6)**

**Allen Ans. (6)**

**Sol.**