CHEMISTRY
JEE-MAIN (February-Attempt) 25
February (Shift-2) Paper

Section -A

1. Given below are two statements :

Statement I :

The identification of Ni^{2+} is carried out by dimethyl glyoxime in the presence of NH_4OH

Statement II :

The dimethyl glyoxime is a bidentate neutral ligand.

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

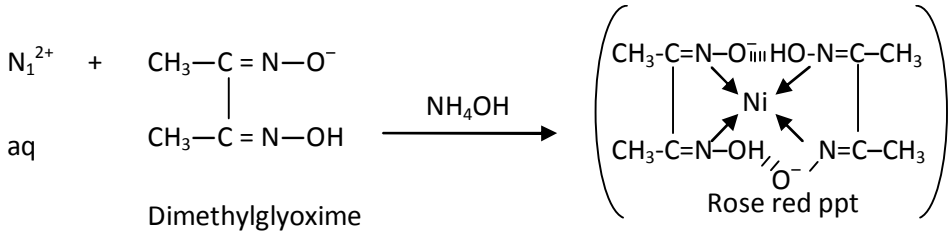
(2) Both statement I and statement II are false

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

(4) Statement I is true but statement II is false

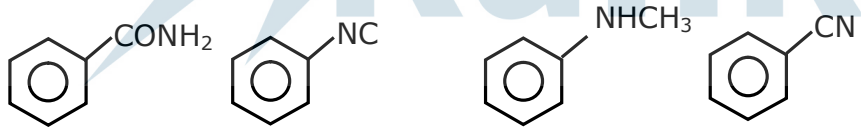
Ans. **4**

Sol.



Dimethyl glyoxime is a negative bidentate legend.

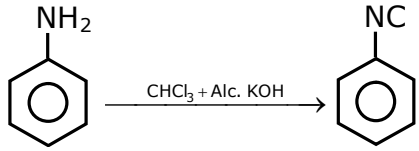
2. Carbylamine test is used to detect the presence of primary amino group in an organic compound. Which of the following compound is formed when this test is performed with aniline ?



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

Ans. **2**

Sol.



3. The correct order of bond dissociation enthalpy of halogen is :

(1) $F_2 > Cl_2 > Br_2 > I_2$

(2) $Cl_2 > F_2 > Br_2 > I_2$

(3) $Cl_2 > Br_2 > F_2 > I_2$

(4) $I_2 > Br_2 > Cl_2 > F_2$

Ans. **3**

Sol. Fact based

F_2 has F — F, F_2 involves repulsion of non-bonding electrons & more over its size is small & hence due to high repulsion its bond dissociation energy in very low.

4. Which one of the following statements is FALSE for hydrophilic sols ?
(1) These sols are reversible in nature
(2) The sols cannot be easily coagulated
(3) They do not require electrolytes for stability.
(4) Their viscosity is of the order of that of H_2O

Ans. **4**

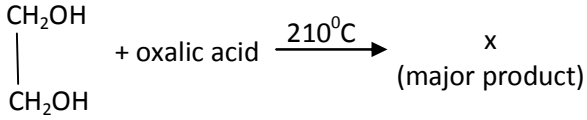
Sol. Fact base

5. Water does not produce CO on reacting with :
(1) C_3H_8
(2) C
(3) CH_4
(4) CO_2

Ans. **4**

Sol. $H_2O + CO_2 \rightarrow H_2CO_3$

6. What is 'X' in the given reaction ?



Ans. **1**

Sol. CH_2-OH | $+ oxalic\ acid \xrightarrow{210^0 C} CH_2=CH_2$ | CH_2-OH

7. If which of the following order the given complex ions are arranged correctly with respect to their decreasing spin only magnetic moment ?

(i) $[FeF_6]^{3-}$ (ii) $[Co(NH_3)_6]^{3+}$

(iii) $[NiCl_4]^{2-}$ (iv) $[Cu(NH_3)_4]^{2+}$

(1) (ii)>(i)>(iii)>(iv) (2) (iii)>(iv)>(ii)>(i)

(3) (ii)>(iii)>(i)>(iv) (4) (i)>(iii)>(iv)>(ii)

Ans. **4**

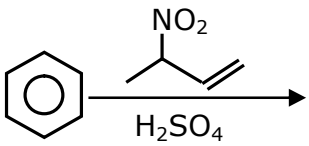
Sol. $[FeF_6]^{3-}$ Fe^{3+} $3d^5 \rightarrow$ 5-unpaired electrons as F^- is weal field legend

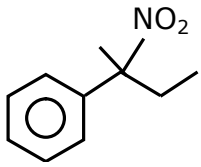
$[Co(NH_3)_6]^{3+}$ Co^{3+} $3d^6 \rightarrow$ No-unpaired electron as NH_3 is strong field light and causes pairing

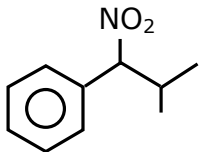
$[NiCl4]^{2-}$ Ni^{2+} $3d^8 \rightarrow$ 2-unpaired electrons

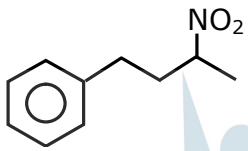
$[Cu(NH_3)_4]^{2+}$ Cu^{2+} $3d^9 \rightarrow$ 1-unpaired electrons

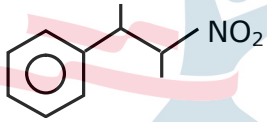
8. The major product of the following reaction is :



(1) 

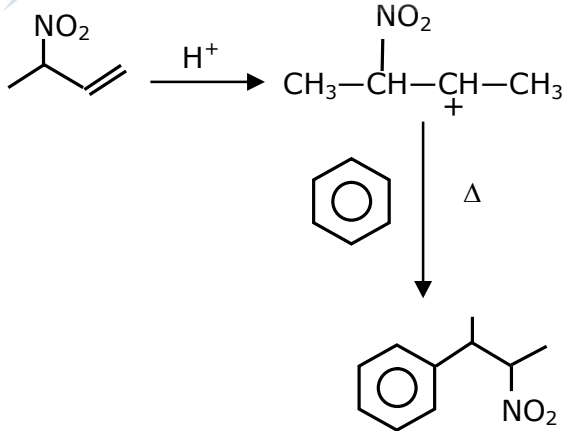
(2) 

(3) 

(4) 

Ans. **4**

Sol.



9. The correct sequence of reagents used in the preparation of 4-bromo-2-nitroethyl benzene from benezene is :

(1) $CH_3COCl/AlCl_3$, $Br_2/AlBr_3$, HNO_3/H_2SO_4, Zn/HCl

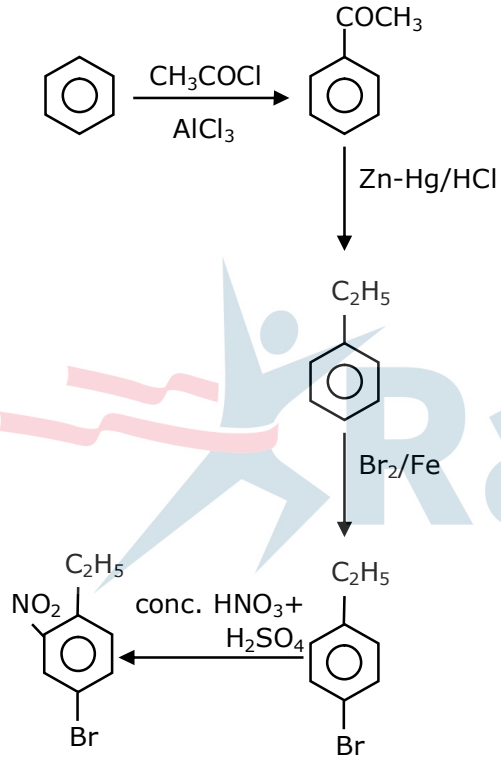
(2) $CH_3COCl/AlCl_3$, Zn-Hg/HCl, $Br_2/AlBr_3$, HNO_3/H_2SO_4

(3) $Br_2/AlBr_3$, $CH_3COCl/AlCl_3$, HNO_3/H_2SO_4, Zn/HCl

(4) HNO_3/H_2SO_4, $Br_2/AlCl_3$, $CH_3COCl/AlCl_3$, Zn-Hg/HCl

Ans. 2

Sol.



10. The major components of German Silver are :

(1) Cu, Zn and Ag (2) Ge, Cu and Ag

(3) Zn, Ni and Ag (4) Cu, Zn and Ni

Ans. 4

Sol. Fact

German silver is alloy which does not have silver.

Cu-50%; Ni-30%; Zn-20%

11. The method used for the purification of Indium is :

(1) van Arkel method (2) vapour phase refining

(3) zone refining (4) Liquation

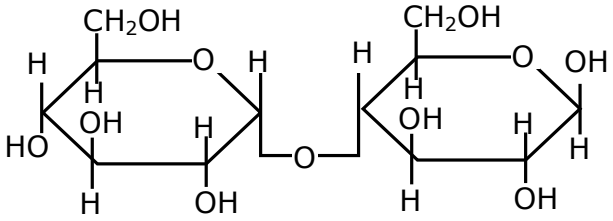
Ans. 3

Sol. Fact

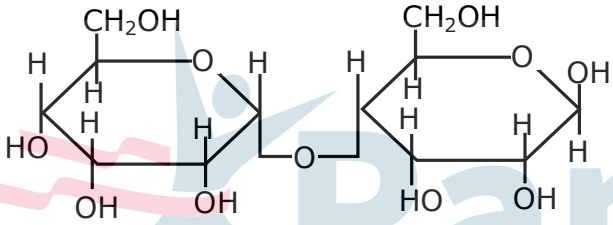
Ga, In, Si, Ge are refined by zone refining or vaccume refining.

12. Which of the following is correct structure of α-anomer of maltose :

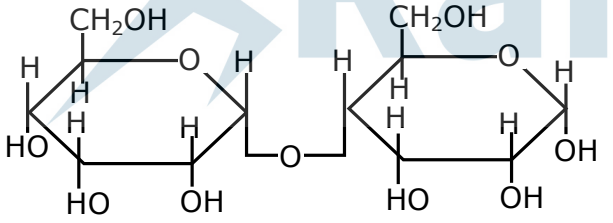
(1)



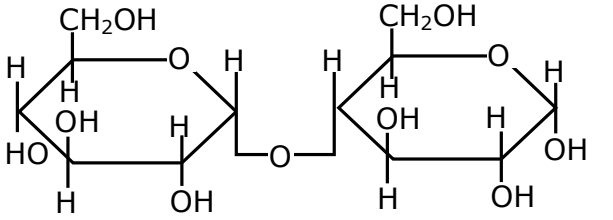
(2)



(3)

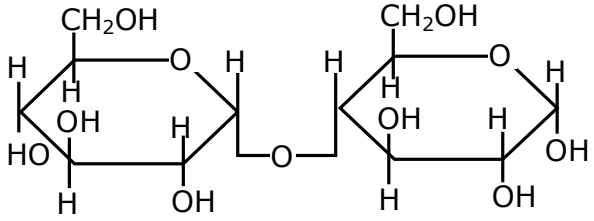


(4)



Ans. 4

Sol.



[α-Anomer of maltose]

13. The major product of the following reaction is :

$CH_3CH_2CH=CH_2 \xrightarrow[\text{Rh catalyst}]{H_2/CO}$

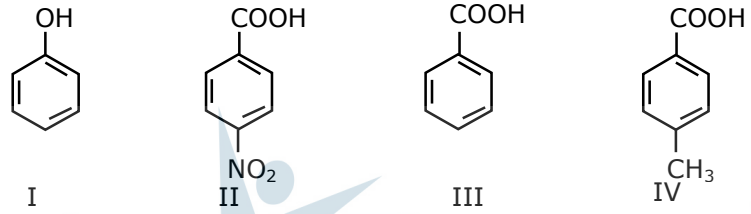
(1) $CH_3CH_2CH_2CHO$ (2) $CH_3CH_2CH=CH-CHO$

(3) $CH_3CH_2CH_2CH_2CHO$ (4) $CH_3CH_2C(=CH_2)-CHO$

Ans. **3**

Sol. $CH_3-CH_2-CH=CH_2 \xrightarrow[Rh\ catalyst]{H_2/CO} CH_3CH_2CH_2CHO$

14. The correct order of acid character of the following compounds is :



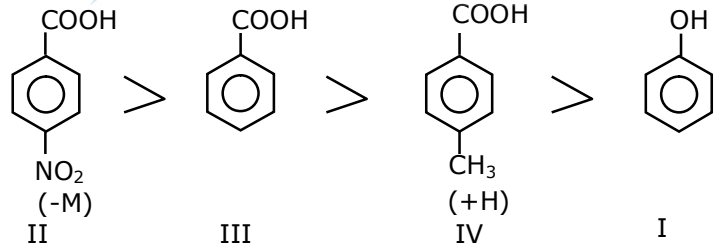
I II III IV

(1) II>III>IV>I (2) III>II>I>IV

(3) IV>III>II>I (4) I>II>III>IV

Ans. **1**

Sol. Acidity of carboxylic acid $\propto$ -R>-H>-I $\propto \frac{1}{+R>+H>+I}$



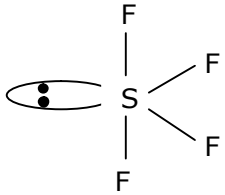
II III IV I

15. Which among the following species has unequal bond lengths ?

(1) XeF_4 (2) SiF_4 (3) BF_4^- (4) SF_4

Ans. **4**

Sol.



Sp^3d Hybridisation Sea-saw shape & axial bond length is more than equitorial bond length

16. Given below are two statements :

Statement I :

α and β forms of sulphur can change reversibly between themselves with slow heating or slow cooling.

Statement II :

At room temperature the stable crystalline form of sulphur is monoclinic sulphur.

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

(1) Both statement I and statement II are false

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

(3) Both statement I and statement II are true

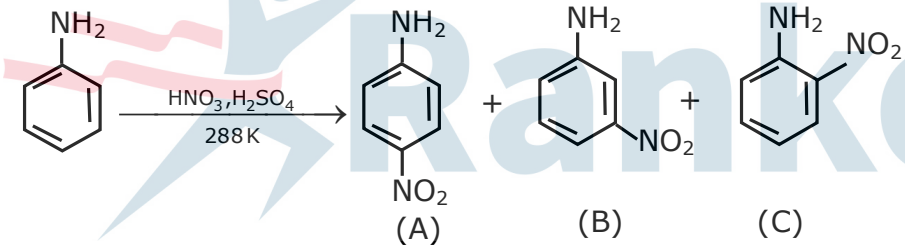
(4) Statement I is false but statement II is true

Ans. **2**

Sol. $S_{Rhambic} \underset{95.6^0 C}{\rightleftharpoons} S_{Monoclinic}$

$\alpha - sulphur \quad \beta - sulphur$

17.



Correct statement about the given chemical reaction is :

(1) Reaction is possible and compound (A) will be major product.

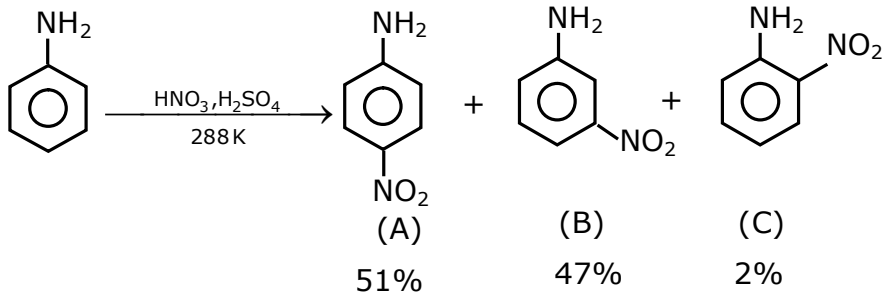
(2) The reaction will form sulphonated product instead of nitration.

(3) $-\ddot{N}H_2$ group is ortho and para directive, so product (B) is not possible.

(4) Reaction is possible and compound (B) will be the major product.

Ans. **1**

Sol.



18. Which of the following compound is added to the sodium extract before addition of silver nitrate for testing of halogens ?

(1) Nitric acid (2) Sodium hydroxide

(3) Hydrochloric acid (4) Ammonia

Ans. 1

Sol. $NaCN + HNO_3 \rightarrow NaNO_3 + HCN \uparrow$

$Na_2S + HNO_3 \rightarrow NaNO_3 + H_2S \uparrow$

Nilnic acid decomposed NaCN & Na_2S, else they precipitate in test & misquite the resolve

19. Given below are two statements :

Statement I :

The pH of rain water is normally ~5.6.

Statement II :

If the pH of rain water drops below 5.6, it is called acid rain.

In the light of the above statements, choose the correct answer from the option given below.

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

(2) Both statement I and statement II are true

(3) Both statement I and statement II are false

(4) Statement I is true but statement II is false

Ans. 2

Sol. Both statements are correct

20. The solubility of $Ca(OH)_2$ in water is :

[Given : The solubility product of $Ca(OH)_2$ in water = 5.5×10^{-6}]

(1) 1.11×10^{-6} (2) 1.77×10^{-6}

(3) 1.77×10^{-2} (4) 1.11×10^{-2}

Ans. 4

$Ca(OH)_2 \rightleftharpoons \underset{s}{Ca^{+2}} + \underset{(2s+10^{-7})}{2OH^-}$

$s(2s+10^{-7})^2 = 55\times10^{-7}$

$4s^3 = 55\times10^{-7}$

$s^3 = \frac{5500}{4}\times10^{-9}$

$s = \left(\frac{2250}{2}\right)^{1/3}\times10^{-3}$

$s = (1125)^{1/3}\times10^{-3}$

$s = 1.11\times10^{-2}$

Section -B

1. If a compound AB dissociates to the extent of 75% in an aqueous solution, the molality of the solution which shows a 2.5 K rise in the boiling point of the solution is _____molal.
(Rounded-off to the nearest integer)
[K_b=0.52 K kg mol^{-1}]

Ans. 3

$AB \rightarrow A^+ + B^-$

$1-\alpha \quad \alpha \quad \alpha$

α=3/4

N = 2

i = [1+(2-1)α]

2.5 = [1+(2-1)3/4]×0.52 ×m

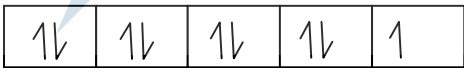
$m = \frac{2.5}{0.52\times 7/4} = \frac{10}{3.64} = 2.747$

m= 2.747 $\simeq$ 3 mol/kg

2. The spin only magnetic moment of a divalent ion in aqueous solution (atomic number 29) is _____BM.

Ans. 2

Sol. $_{29}Cu^{+2} \rightarrow [Ar]^{18} 3d^9$

$d^9 \longrightarrow$ 

No. of unpaired e^- = 1

Magnetic moment = $\mu = \sqrt{n(n+2)}$

$\mu = \sqrt{(1)(1+2)} = \sqrt{3} B.M.$

= 1.73 Ans.

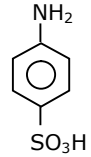
3. The number of compound/s given below which contain/s —COOH group is _____.

(1) Sulphanilic acid (2) Picric acid

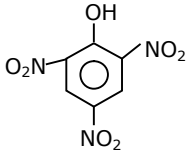
(3) Aspirin (4) Ascorbic acid

Ans. 1

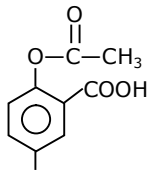
Sol.



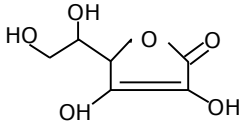
(A)



(B)



(C)



(D)

4. The unit cell of copper corresponds to a face centered cube of edge length 3.596 Å with one copper atom at each lattice point. The calculated density of copper in kg/m^3 is _____.
[Molar mass of Cu : 63.54 g; Avogadro number = 6.022×10^{23}]

Ans. **9077**

Sol. a = 3.596 Å

$$d = \frac{Z\times GMM}{N_A\times a^3}$$

$$d = \frac{4\times63.54\times10^{-3}}{6.022\times10^{23}\times(3.596\times10^{-10})^3}$$

$d = 0.9076 \times 10^4 = 9076.2$ kg/m^3

5. Consider titration of NaOH solution versus 1.25 M oxalic acid solution. At the end point following burette readings were obtained.
(i) 4.5 ml. (ii) 4.5 ml. (iii) 4.4 ml. (iv) 4.4 ml (v) 4.4 ml
If the volume of oxalic acid taken was 10.0 ml. then the molarity of the NaOH solution is _____M. (Rounded-off to the nearest integer)

Ans. **6**

Eq. of NaOH = Eq. of oxalic acid

$$[NaOH]\times1\times4.4 = \frac{5}{4}\times2\times10$$

$$[NaOH] = \frac{100}{4\times4.4} = \frac{25}{4.4} = 5.68$$

Nearest integer = 6M Ans.

6. Electromagnetic radiation of wavelength 663 nm is just sufficient to ionize the atom of metal A. The ionization energy of metal A in kJ mol^{-1} is_____. (Rounded off to the nearest integer)
[h=6.63×10^{-34}Js, c = 3.00×10^8ms^{-1}, N_A=6.02×10^{23} mol^{-1}]

Ans. **180**

Sol. Energy req. to ionize an atom of metal 'A' = $\frac{hc}{\lambda} = \frac{hc}{663nm}$

for 1 mole atoms of 'A'

Total energy required = $N_A\times\frac{hc}{\lambda}$

$$= \frac{6.023\times10^{23}\times6.63\times10^{-34}\times3\times10^8}{663\times10^{-9}}$$

$= 6.023\times3\times10^{23-34+8+7}$

$= 18.04\times10^4$ J/mol

= 180.4 KJ/mol

Nearest Integer = 180 KJ/Mol.

7. The rate constant of a reaction increases by five times on increase in temperature from 27^0 C to 52^0C. The value of activation energy in kJ mol^{-1} is _____. (Rounded off to the nearest integer) [R=8.314 J K^{-1} mol^{-1}]

Ans. **52**

$$\frac{K_{52^0C}}{K_{27^0C}} = 5$$

$$\ln\left\{\frac{k_{T_2}}{k_{T_1}}\right\} = \frac{E_a}{R}\left\{\frac{1}{T_1} - \frac{1}{T_2}\right\}$$

$$\ln(5) = \frac{E_a}{R}\left\{\frac{1}{300} - \frac{1}{325}\right\}$$

$$\frac{2.303 \times 0.7 \times 8.314 \times 300 \times 325}{25} = E_a$$

E_a = 51524.96 J/mol

E_a = 51.524 KJ/mol

52 Ans.

8. Copper reduces NO_3^- into NO and NO_2 depending upon the concentration of HNO_3 in solution. (Assuming fixed [Cu^{2+}] and $P_{NO}=P_{NO_2}$), the HNO_3 concentration at which the thermodynamic tendency for reduction of NO_3^- into NO and NO_2 by copper is same is 10^x M. The value of 2x is _____. (Rounded-off to the nearest integer)

[Given : $E^0_{Cu^{2+}/Cu} = 0.34V, E^0_{NO_3^-/NO} = 0.96V, E^0_{NO_3^-/NO_2} = 0.79V$ and at 298 K, $\frac{RT}{F}(2.303) = 0.059$]

Ans. **1**

Sol. Anode

$Cu(s) \rightarrow Cu^{+2} + 2e^-$

Cathode (1)

$$\frac{3e^- + 4H^+ + NO_3^- \rightarrow NO + 2H_2O}{8H^- + 2N0_3^- + 3Cu(s) \rightarrow 3Cu^{+2} + 2NO + 4H_2O}$$

$$Q = \frac{\left[Cu^{+2}\right]^3 \times \left(p_{NO}\right)^2}{\left[NO_3^-\right]^2\left[H^+\right]^8}$$

$$\in^0_{cell} = 1.3$$

$$\in_{cell} = 1.3 - \frac{0.059}{6}\log\frac{\left(Cu^{+2}\right)^3\left(p_{NO}\right)^2}{\left(NO_3^-\right)^2 \times \left(H^+\right)^8} \quad \text{.....(1)}$$

Anode $Cu(s) \rightarrow Cu^{+2} + 2e^-$

Cathode $\dfrac{e^- + 2n^+ + NO_3^- \rightarrow NO_2 + H_2O}{Cu(s) + 4H^+ + 2NO_3^- \rightarrow 2NO_2 + 2H_2O + Cu^{+2}}$

$\in^0_{cell} = 1.13$

$$Q = \frac{(Cu^{+2})(p_{NO_2})^2}{\left(NO_3^-\right)^2\left(H^+\right)^4}$$

$$\in_{cell} = 1.13 - \frac{0.059}{2}\log\frac{\left(Cu^{+2}\right)\left(p_{NO_2}\right)^2}{\left(NO_3^-\right)^2\left(H^+\right)^4}$$

$\in_{cell_T} = \in_{cell_2}$

$$1.3 - \frac{0.059}{6}\log\left(Q_1\right) = 1.13 - \frac{0.059}{2}\log\left(Q_2\right)$$

$$0.17 = \frac{0.059}{6}\left\{\log(Q_1) - 3\log(Q_2)\right\}$$

$$= \frac{0.059}{6}\left\{\log\frac{\left(Cu^{+2}\right)^3 \times \left(p_{NO}\right)^2 \times \left(NO_3^-\right)^6\left(H^+\right)^{12}}{\left(NO_3^-\right)^2\left(H^+\right)^8 \times \left(Cu^{+2}\right)^3 \times \left(p_{NO_2}\right)^6}\right\}$$

$$= \frac{0.059}{6}\left\{\log\frac{\left[NO_3^-\right]^4\left[H^+\right]^4}{\left(P_{NO_2}\right)^4}\right\}$$

$$0.17 = \frac{0.059}{6} \times 8\ \log\left(HNO_3\right)$$

$\log (HNO_3) = 2.16$

$[HNO_3] = 10^{2.16} = 10^x$

$x = 2.16 \Rightarrow 2x = 4.32 \approx 4$

9. Five moles of an ideal gas at 293 K is expanded isothermally from an initial pressure of 2.1 MPa to 1.3 MPa against at constant external 4.3 MPa. The heat transferred in this process is _____kJ mol^{-1}. (Rounded-off of the nearest integer)

[Use R = 8.314 J mol^{-1} K^{-1}]

Ans. **15**

Sol. Moles (n) = 5

T = 293k

Process = IsoT. $\rightarrow$ Irreversible

P_{ini} = 2.1 M Pa

P_t = 1.3 M Pa

P_{ext} = 4.3 mPa

Work = - P_{ext} Δv

$$= -4.3 \times \left(\frac{5 \times 293R}{1.3} - \frac{5 \times 293}{2.1} \right)$$

$$= -5 \times 293 \times 8.314 \times 43 \left(\frac{1}{13} - \frac{1}{21} \right)$$

$$= \frac{5 \times 293 \times 8.314 \times 43 \times 8}{21 \times 13}$$

= -15347.7049 J

= - 15.34 KJ

Isothermal process, so $\Delta U = 0$

w = - Q

Q = 15.34 KJ / mol

So answer is 15

10. Among the following, number of metal/s which can be used as electrodes in the photoelectric cell is _____(Integer answer).

(A) Li (B) Na (C) Rb (D) Cs

Ans. **1**

Sol. Cs is used in photoelectric cell due to its very low ionization potential.