JEE Main February 2021

Question Paper With Text Solution

25 Feb.| Shift-2

CHEMISTRY

MATRIX

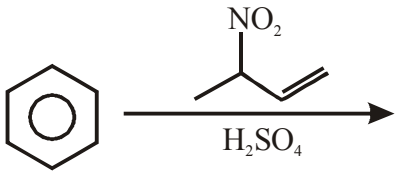
JEE Main & Advanced | XI-XII Foundation| VI-X Pre-Foundation

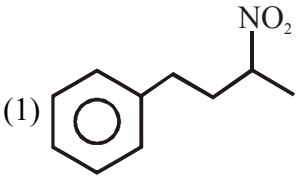
Office : Piprali Road, Sikar (Raj.) | Ph. 01572-241911
Website : www.matrixedu.in ; Email : smd@matrixacademy.co.in

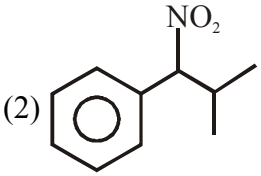
JEE MAIN FEB 2021 | 25TH FEB SHIFT-2

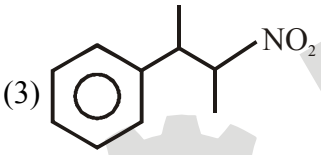
Section–A

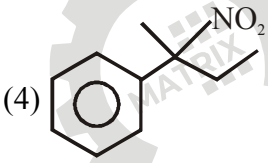
1. The major product of the following reaction is :



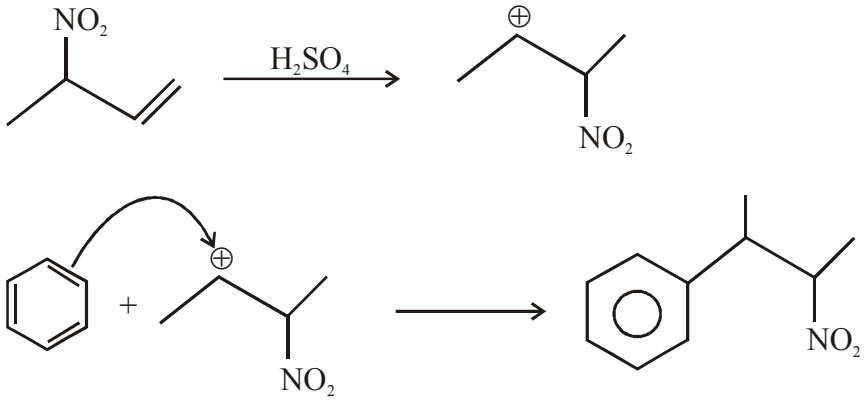
(1) 

(2) 

(3) 

(4) 

Ans. Offical Answer NTA (3)

Sol. 

2. The correct order of bond dissociation enthalpy of halogens is :

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

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

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

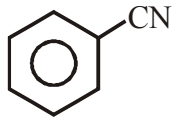
(4) $Cl_2 > Br_2 > F_2 > I_2$

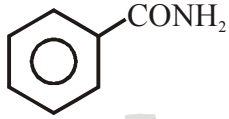
Ans. Offical Answer NTA (4)

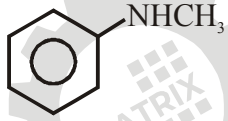
S. Order : $Cl_2 > Br_2 > F_2 > I_2$

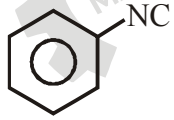
$F_2 \Rightarrow$ B.E. is less due to *l*.p. – *l*.p repulsion

3. 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) 

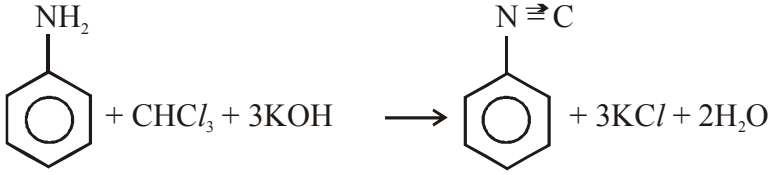
(3) 

(4) 

Ans. Offical Answer NTA (4)

Sol. Carbyl amine test is given by 1° amine

In carbyl amine test isocyanide is formed



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

(1) $CH_3COC1/A1C1_3$, Br_2/ $AlBr_3$, HNO_3/H_2SO_4, Zn/HCl

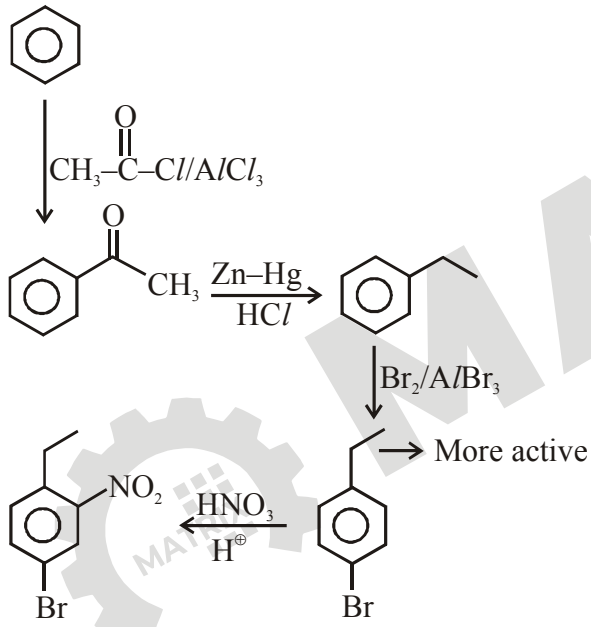
(2) $CH_3COCl/AlCl_3$, Zn-Hg/HCl, $Br_2/AlBr_3$, HNO_3/H_2SO_4

(3) HNO_3/ H_2SO_4, $Br_2/A1C1_3$, CH_3COCl/ $A1Cl_3$, Zn-Hg/HC1

(4) Br_2/ $AlBr_3$, CH_3COC1/ $AlCl_3$, HNO_3 /H_2SO_4, Zn/ HC1

Ans. Offical Answer NTA (2)

Sol.



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

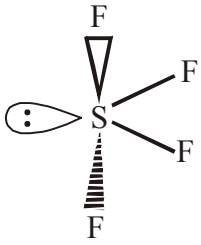
(1) SF_4

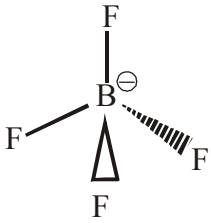
(2) BF_4^-

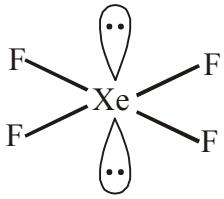
(3) XeF_4

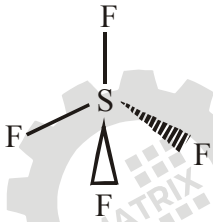
(4) SiF_4

Ans. Offical Answer NTA (1)

S. (1)  All bond lengths are not equal because in *See–Saw* axial S–F bond length is greater than S–F equitorial bond length.

(2)  Regular tetrahedral, all B. L. are same.

(3)  Square planar, all B.L. are same.

(4)  Regular tetrahedral, all B.L. are same.

6. The major components of German Silver are :

(1) Cu, Zn and Ni

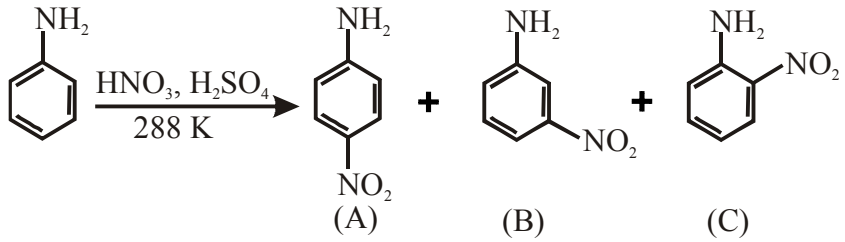
(2) Cu, Zn and Ag

(3) Zn, Ni and Ag

(4) Ge, Cu and Ag

Ans. Offical Answer NTA (1)

S. German Silver is an alloy of Cu, Ni and Zn

7. 

(A) (B) (C)

Correct statement about the given chemical reaction is :

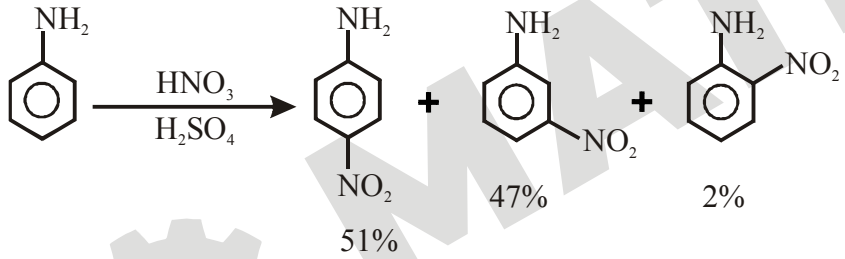
(1) The reaction will form sulphonated product instead of nitration.

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

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

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

Ans. Offical Answer NTA (2)

Sol. 

51% 47% 2%

8. 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^{-2}

(2) 1.77×10^{-2}

(3) 1.77×10^{-6}

(4) 1.11×10^{-6}

Ans. Offical Answer NTA (1)

S. $Ca(OH)_2(s) \rightleftharpoons Ca^{2+}_{(aq)} + 2OH^-$

S 2S

$4S^3 = 5.5 \times 10^{-6}$

$S^3 = \frac{5.5}{4} \times 10^{-6} \Rightarrow S = 1.11 \times 10^{-2}$

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

(1) zone refining

(2) vapour phase refining

(3) van Arkel method

(4) liquation

Ans. Offical Answer NTA (1)

S. Zone refining is used for purification of Indium.

10. Which one of the following statements is FALSE for hydrophilic sols ?

(1) Their viscosity is of the order of that of H_2O

(2) The sols cannot be easily coagulated.

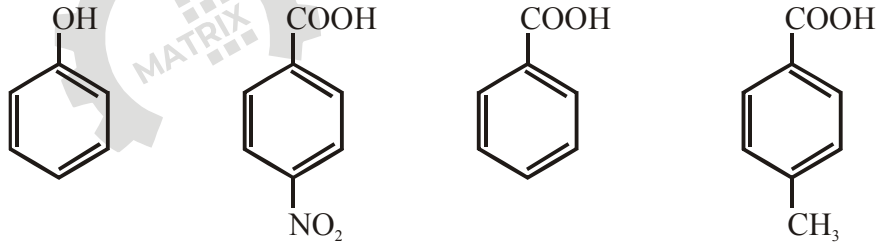
(3) These sols are reversible in nature.

(4) They do not require electrolytes for stability.

Ans. Offical Answer NTA (1)

S. Viscosity is generally higher than dispersion medium (H_2O).

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



I II III IV

(1) I > II > III > IV

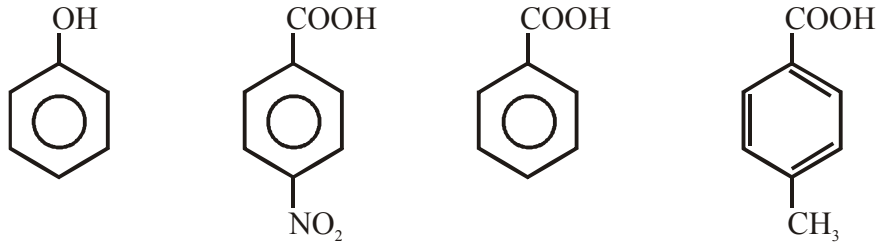
(2) IV > III > II > I

(3) II > III > IV > I

(4) III > II > I > IV

Ans. Offical Answer NTA (3)

Sol. Carboxylic acid is more acidic than phenol



–I/–M +I/+H.C

Acidic character $\Rightarrow 2 > 3 > 4 > 1$

12. Water does not produce CO on reacting with :

(1) CO_2

(2) CH_4

(3) C

(4) C_3H_8

Ans. Offical Answer NTA (1)

S. $C + H_2O \rightarrow H_2 + CO$ (Water gas)

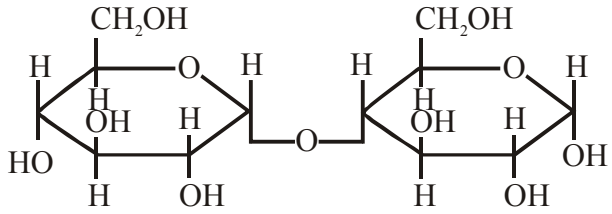
$CH_4 + H_2O \rightarrow CO + H_2$

$C_3H_8 + H_2O \rightarrow CO + H_2$

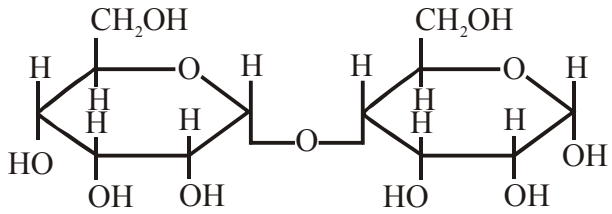
$CO_2 + H_2O \rightarrow H_2CO_3$

13. Which of the following is correct structure of α–anomer of maltose?

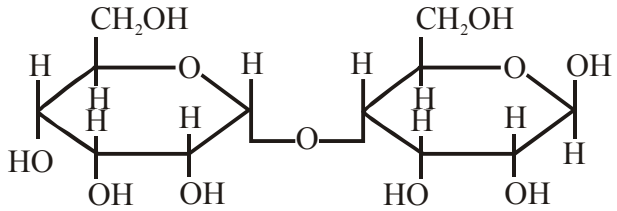
(1)



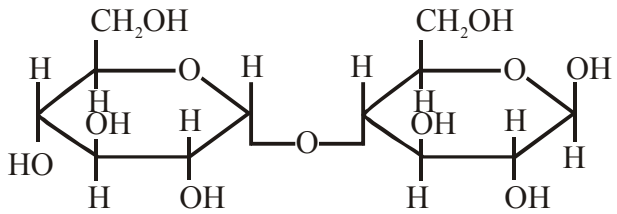
(2)



(3)

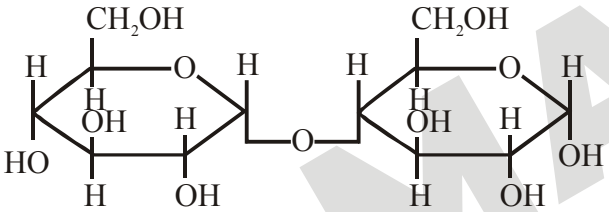


(4)

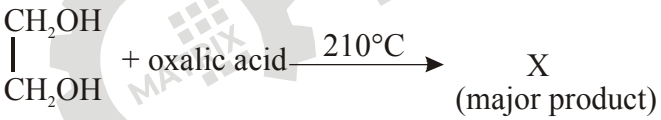


Ans. Offical Answer NTA (1)

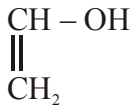
Sol. α-ANOMER OF MALTOSE : -Maltose is composed of two molecules of α-D-glucose joned by C_1–C_4 glycosidic linkage.

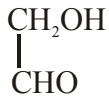


14. What is 'X' in the given reaction ?



(1) 

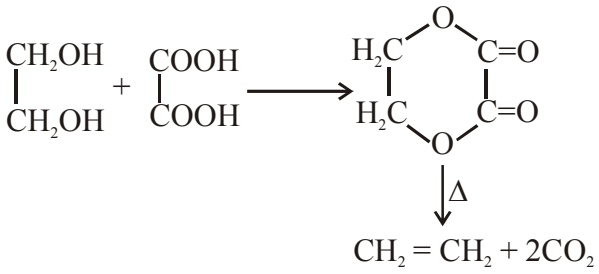
(2) 

(3) 

(4) 

Ans. Offical Answer NTA (4)

Sol.



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

(1) Ammonia

(2) Sodium hydroxide

(3) Hydrochloric acid

(4) Nitric acid

Ans. Offical Answer NTA (4)

Sol. Nitric acid is added to the sodium extract to remove CN^- or S^{-2} before the test of halides.

16. 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) Statement 1 is true but Statement II is false.

(2) Both Statement I and Statement II are false.

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

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

Ans. Offical Answer NTA (1)

Sol. (i) $dmg + NH_4OH \longrightarrow dmg^-$

(ii) $Ni^{+2} + 2dmg^- \longrightarrow [Ni(dmg)_2]$

(Rosy Red ppt)

neutral dimethyl glyoxime is not a ligand

17. The major product of the following reaction is :

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

(1) $CH_3CH_2CH_2CH_2CHO$

(2) $CH_3CH_2CH_2CHO$

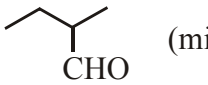
(3) $CH_3CH_2\underset{\underset{CHO}{|}}{C} = CH_2$

(4) $CH_3CH_2CH = CH - CHO$

Ans. Offical Answer NTA (1)

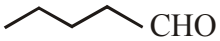
Sol. OXO PROCESS (Hydroformylation) :

$$CH_3 - CH_2 - CH = CH_2 + CO + H_2 \xrightarrow[\text{Catalyst}]{Rh}$$



(minor)

+



(major)

18. 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) Statement I is true but Statement II is false.

(2) Both Statement I and Statement II are false.

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

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

Ans. Offical Answer NTA (1)

Sol. (1) α-Sulphur $\underset{< 369\ K}{\overset{> 369\ K}{\rightleftharpoons}}$ β–Sulphur

(2) At room temperature rhombic sulphur is more stable

19. In 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) > (iii) > (i) > (iv)

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

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

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

Ans. Offical Answer NTA (2)

Sol. $[FeF_6]^{-3} \Rightarrow Fe^{+3} \Rightarrow 3d^5$ (F = W.F.L)

$3d^5 \Rightarrow$  no of unpaired $e^- = 5$

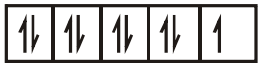
$[Co(NH_3)_6]^{+3} \rightarrow Co^{+3} \Rightarrow 3d^6$ (NH_3 = S.F.L)

$3d^6 \Rightarrow$  no of unpaired $e^- = 0$

$[NiCl_4]^{-2} \Rightarrow Ni^{+2} \Rightarrow 3d^8$ (*Cl* = W.F.L)

$3d^8 \Rightarrow$  no of unpaired $e^- = 2$

$[Cu(NH_3)_4]^{+2} \Rightarrow Cu^{+2} \Rightarrow 3d^9$ (NH_3 = S.F.L)

$3d^9 \Rightarrow$  no of unpaired $e^- = 1$

magnetic moment $\propto$ no of unpaired e^-

So (i) > (iii) > (iv) > (ii)

20. 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 options given below :

(1) Both Statement I and Statement II are true.

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

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

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

Ans. Offical Answer NTA (1)

S. p^H of rain water = 5.6. If p^H is below 5.6 then it is called acid rain.

Section–B

1. Electromagnetic radiation of wavelength 663 nm is just sufficient to ionise 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 × 10^8 ms^{-1}, N_A = 6.02 × 10^{23} mol^{-1}]

Ans. Offical Answer NTA (181)

S. $$\underset{(\text{per atom})}{\text{I.E.}} = \frac{hC}{\lambda} = \frac{6.63\times10^{-34}\times3\times10^{8}}{663\times10^{-9}}$$

$= 3 \times 10^{-21}$

I.E. (per mole) = $3 \times 10^{-19} \times 6.02 \times 10^{23}$

$= 18.06 \times 10^4$ J

$= 180.6$ kJ

2. 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 pressure 4.3 MPa. The heat transferred in this process is _____ kJ mol^{-1}. (Rounded-off to the nearest integer)

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

Ans. Offical Answer NTA (15)

Answer by Matrix is (3)

S. Ideal gas (isothermal process), n = 5

$\Delta U = 0$ (T = constant)

$q = -w$

$= -[-P_{ext}(V_f - V_i)]$

$= 4.3 \times 10^6 \left(\frac{5R \times 293}{1.3 \times 10^6} - \frac{5R \times 293}{2.1 \times 10^6}\right)$

$= 4.3(5R \times 293)\left(\frac{0.8}{2.1 \times 1.3}\right)$

q = 15.347 kJ (For 5 mole)
For per mole
q = 3.069 kJ/mole

= 3 kJ/mole (Round–off)

3. 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. Offical Answer NTA (3)

S. $AB \rightarrow A^+ + B^- \left(\alpha = \frac{3}{4}\right)$

$i = 1 + (2 - 1)\alpha = 1 + \frac{3}{4} = \frac{7}{4}$

$\Delta T_b = i.K_b.m$

$2.5 = \frac{7}{4} \times 0.52 \times m$

$m = \frac{10}{7 \times 0.52} = 2.74$

m = 3 (Round–off)

4. The number of compound/s given below which contain/s –COOH group is _____.

(Integer answer)

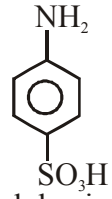
(A) Sulphanilic acid (B) Picric acid

(C) Aspirin (D) Ascorbic acid

Ans. Offical Answer NTA (1)

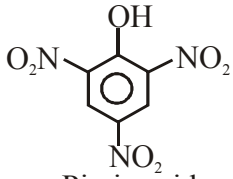
Sol.

(A)



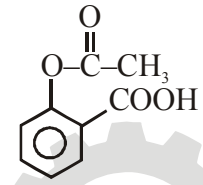
sulphanic acid

(B)



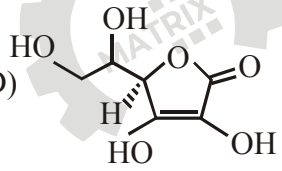
Picric acid

(C)



Asprine

(D)



Ascorbic acid

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

Ans. Offical Answer NTA (4)

S. The partial pressure of NO and NO_2 gas is taken as 1 bar.

$NO_3^- + 4H^+ + 3e^- \longrightarrow NO + 2H_2O$

$$E^\circ_{NO_3^-/NO} = 0.96V$$

$NO_3^- + 2H^+ + e^- \longrightarrow NO_2 + H_2O$

$$E^\circ_{NO_3^-/NO_2} = 0.79$$

Let $[HNO_3] = y \Rightarrow [H^+] = y$ and $[NO_3^-] = y$ for the same thermodynamic tendency

$$E_{NO_3^-/NO} = E_{NO_3^-/NO_2}$$

or, $$E^\circ_{NO_3^-/NO} - \frac{0.059}{3}\log\frac{P_{NO}}{y \times y^4}$$

$$= E^\circ_{NO_3^-/NO_2} - \frac{0.059}{1}\log\frac{P_{NO_2}}{y \times y^2}$$

or, $$0.96 - \frac{0.059}{3}\log\frac{P_{NO}}{y^5} = 0.79 - \frac{0.059}{1}\log\frac{P_{NO_2}}{y^3}$$

or, $$0.17 = -\frac{0.059}{1}\log\frac{P_{NO_2}}{y^3} + \frac{0.059}{3}\log\frac{P_{NO}}{y^5}$$

$$0.17 = -\frac{0.0591}{1}\log\frac{P_{NO_2}}{y^3} + \frac{0.0591}{3}\log\frac{P_{NO}}{y^5}$$

$$0.17 = -\frac{0.0591}{3}\log\frac{P^3_{NO_2}}{y^9} + \frac{0.0591}{3}\log\frac{P_{NO}}{y^5}$$

$$0.17 = \frac{0.0591}{3}\left[\log\frac{P_{NO}}{y^5} - \log\frac{P^3_{NO_2}}{y^9}\right]$$

$$0.17 = \frac{0.0591}{3}\left[\log\frac{P_{NO}}{y^5} \times \frac{y^9}{P^3_{NO_2}}\right]$$

Assume $P_{NO} \simeq P_{NO_2} = 1\,bar$

$$\frac{0.17 \times 3}{0.059} = \log y^4 = 8.644$$

$$\log y = \frac{8.644}{4}$$

$$\log y = 2.161$$

$y = 10^{2.16}$

$\therefore 2x = 2 \times 2.161 = 4.322$

Answer (4)

6. 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. Offical Answer NTA (9076)

Answer by Matrix is (9076)

S. $$d = \frac{4M}{N_A.a^3} = \frac{4 \times 63.54 \times 10^{-3}}{6.02 \times 10^{23} \times (3.596)^3 \times 10^{-30}}$$

$= 0.976 \times 10^4$

$= 9076.2\ Kg/m^3$

7. The spin only magnetic moment of a divalent ion in aqueous solution (atomic number 29) is _____ BM.

Ans. Offical Answer NTA (2)

S. Cu^{+2} (Z = 29)

$Cu^{+2} \Rightarrow 3d^9$ 

upaired $e^- = 1$

Magnetic moment = $\sqrt{n(n+2)} = \sqrt{3} = 1.732 = 2$

8. 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. Offical Answer NTA (6)

S. $(COOH)_2 + 2NaOH \rightarrow Na_2C_2O_4 + 2H_2O$

Mili moles of $H_2C_2O_4 = 10 \times 1.25$

Volume of NaOH consumed = 4.4 mL

Required milie moles of NaOH = 10 × 1.25 × 2

M × 4.4 = 25

M = 5.68

M = 6 (Round off)

9. 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. Offical Answer NTA (1)

S. K & Cs are used in photo electric cell.

10. The rate constant of a reaction increases by five times on increase in temperature from 27°C to 52°C. 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. Offical Answer NTA (52)

S. $K_i = K$ ($T_i = 300$ K)

$K_f = 5K$ ($T_f = 325$ K)

$$K = Ae^{-\frac{E_a}{RT}}$$

$$\ln\frac{k_f}{k_i} = \frac{E_a}{R}\left(\frac{1}{T_i} - \frac{1}{T_f}\right)$$

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

$$E_a = \frac{\ln 5 \times R \times 300 \times 325}{25}$$

= 52185.38 J

= 52.185 kJ/mole

E_a = 52 kJ