JEE Main February 2021

Question Paper With Text Solution

26 Feb.| Shift-2

CHEMISTRY

MATRIX

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

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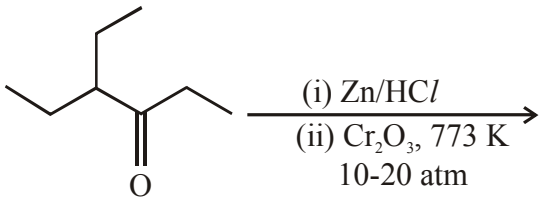
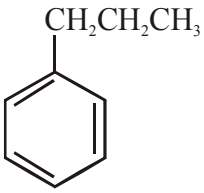
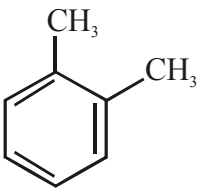
JEE MAIN FEB 2021 | 26TH FEB SHIFT-2

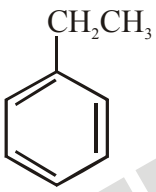
Section–A

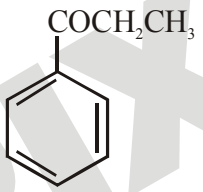
1. 

Considering the above reaction, the major product among the following is :

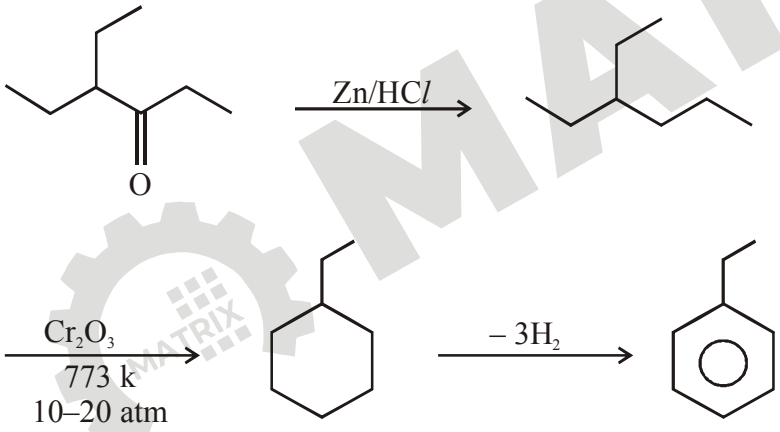
(1) 

(2) 

(3) 

(4) 

Ans. Official Answer NTA : (3)

Sol. 

2. A. Phenyl methanamine

B. N,N-Dimethylaniline

C. N-Methyl aniline

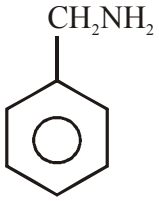
D. Benzenamine

Choose the correct order of basic nature of the above amines.

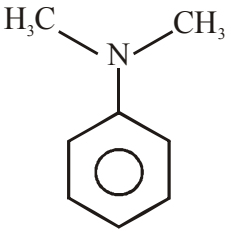
(1) D > C > B > A (2) A > B > C > D (3) A > C > B > D (4) D > B > C > A

Ans. Official Answer NTA : (2)

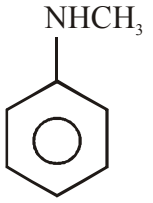
Sol.



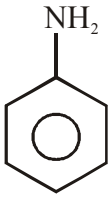
(Phenyl methamine)



(N,N–Dimethyl aniline)



(N–methyl aniline)



(B-enzenamine/Aniline)

Phenyl methanamine > N, N–Dimethyl aniline > N–methyl aniline > Benzenamine
(as lonepair is localised) (3° amine) (2° Amine) (1° Amine)

3. Seliwanoff test and Xanthoproteic test are used for the identification of .....and ..... respectively.

(1) Proteins, ketoses (2) Ketoses, aldoses (3) Ketoses, proterins (4) aldoses, ketoses

Ans. Official Answer NTA : (3)

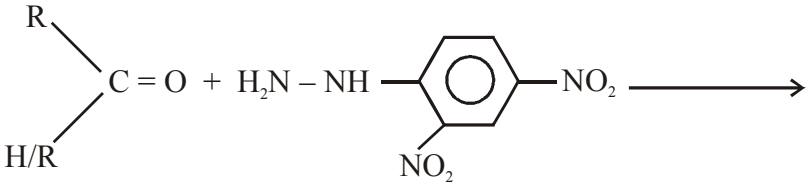
Sol. The Xanthoproteic test is used to detect the presence of protein soluble in a solution, using Conc. HNO_3 acid. Seliwaanoff's test distinguishes between aldose and ketose sugars and ketoses give +ve Seliwaanoff's test.

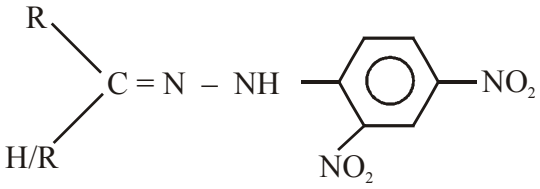
4. 2, 4-DNP test can be used to identify :

(1) ether (2) halogens (3) aldehyde (4) amine

Ans. Official Answer NTA : (3)

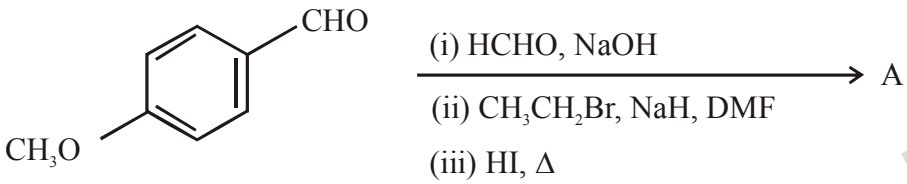
Sol. The aqueous solution of 2,4–dinitro phenyl hydrazine (or 2, 4– DNP) reacts with Carbonyl Compounds (aldehydes and ketones). It is also known as Brady's reagent.

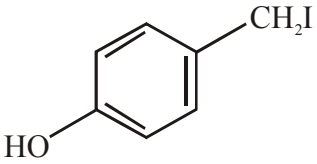


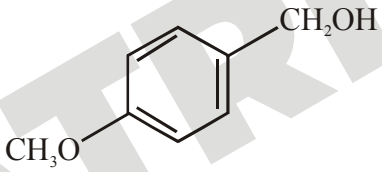


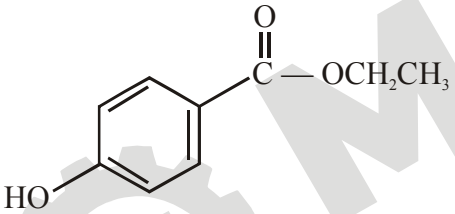
yellow

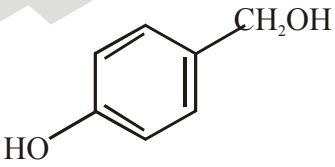
5. Identify A in the following chemical reaction.



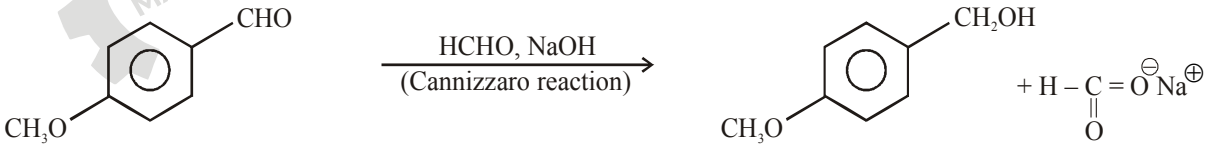
(1) 

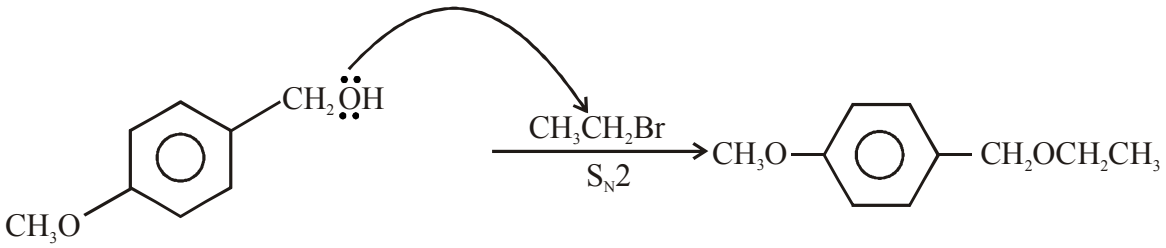
(2) 

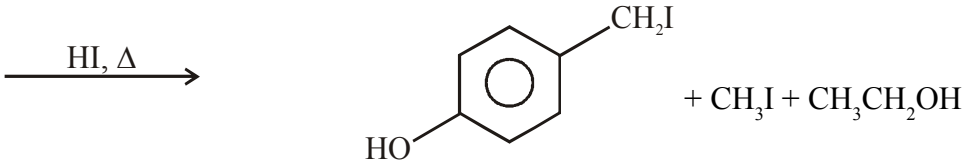
(3) 

(4) 

Ans. Official Answer NTA : (1)

Sol. 





6. The correct order of electron gain enthalpy is :

(1) Te > Se > S > O (2) S > O > Se > Te (3) O > S > Se > Te (4) S > Se > Te > O

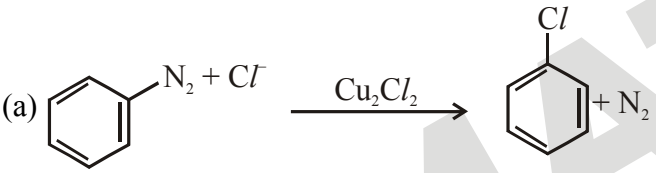
Ans. Official Answer NTA : (4)

S. Due to small size or high electron density, electron affinity of O is low.

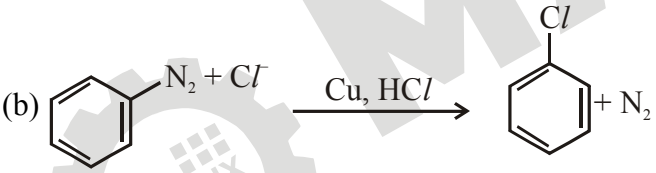
S > Se > Te > O (Order of magnitude of electron gain enthalpy)

7. Match List-I with List-II.

List -I List-II



(i) Wurtz reaction



(ii) Sandmeyer reaction

(c) $2CH_3CH_2Cl + 2Na \xrightarrow{\text{Ether}} C_2H_5 - C_2H_5 + 2NaCl$ (iii) Fittig reaction

(d) $2C_6H_5Cl + 2Na \xrightarrow{\text{Ether}} C_6H_5 - C_6H_5 + 2NaCl$ (iv) Gatterman reaction

Choose the correct answer from the options given below :

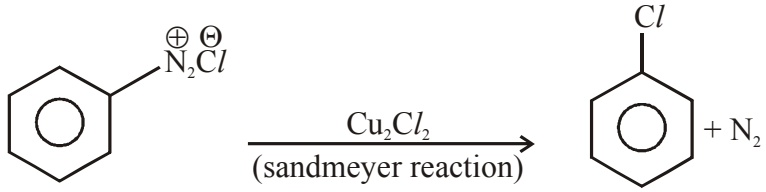
(1) (a) → (iii), (b) → (i), (c) → (iv), (d) → (ii)

(2) (a) → (ii), (b) → (i), (c) → (iv), (d) → (iii)

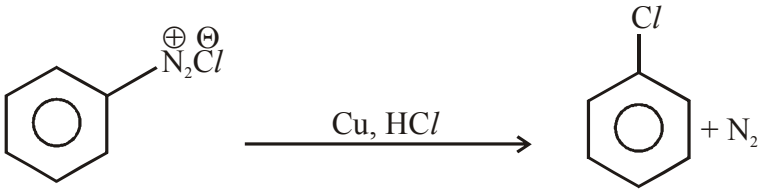
(3) (a) → (ii), (b) → (iv), (c) → (i), (d) → (iii)

(4) (a) → (iii), (b) → (iv), (c) → (i), (d) → (ii)

Ans. Official Answer NTA : (3)

Sol. (i) 

(ii) Gatterman reaction



(iii) Wurtz reaction

$2CH_3CH_2Cl + 2Na \xrightarrow{\text{ether}} C_2H_5 - C_2H_5 + 2NaCl$

(iv) Fittig reaction

$2C_6H_5Cl + 2Na \xrightarrow{\text{ether}} C_6H_5 - C_6H_5 + 2NaCl$

8. Which of the following forms of hydrogen emits low energy β^- particles ?

(1) Deuterium ${}^2_1H$ (2) Proton H^+ (3) Protium ${}^1_1H$ (4) Tritium ${}^3_1H$

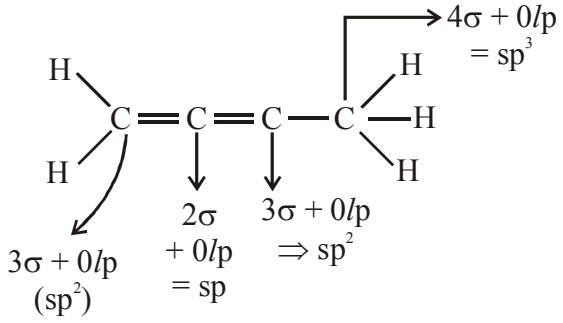
Ans. Official Answer NTA : (4)

Sol. Tritium emits β– particle because of high n/p ratio.

9. In $\overset{1}{CH_2} = \overset{2}{C} = \overset{3}{CH} - \overset{4}{CH_3}$ molecule, the hydribization of carbon 1, 2, 3 and 4 respectively, are :

(1) sp^2, sp^2, sp^2, sp^3 (2) sp^3, sp, sp^3, sp^3 (3) sp^2, sp, sp^2, sp^3 (4) sp^2, sp^3, sp^2, sp^3

Ans. Official Answer NTA : (3)

Sol. 

10. Match List-I with List-II.

List-I	List-II
(a) Sodium Carbonate	(i) Deacon
(b) Titanium	(ii) Castner-Kellner
(c) Chlorine	(iii) Van-Arkel
(d) Sodium hydroxide	(iv) Solvay

Choose the correct answer from the options given below :

(1) (a) → (i), (b) → (iii), (c) → (iv), (d) → (ii)

(2) (a) → (iii), (b) → (ii), (c) → (i), (d) → (iv)

(3) (a) → (iv), (b) → (iii), (c) → (i), (d) → (ii)

(4) (a) → (iv), (b) → (i), (c) → (ii), (d) → (iii)

Ans. Official Answer NTA : (3)

S. Sodium carbonate is prepared by Solvay process.

Refining of Ti is done by Van–arkel method.

Chlorine is prepared by Deacon process.

NaOH is prepared in Castner–Kellner cell.

11. Ceric ammonium nitrate and $CHCl_3$/alc. KOH are used for the identification of functional groups present in.....and .....respectively.

(1) amine, phenol (2) amine, alcohol (3) alcohol, phenol (4) alcohol, amine

Ans. Official Answer NTA : (4)

Sol. Ceric ammonium nitrate test → For alcohol.

$CHCl_3$/alc. KOH → used for the identification of amine functional group.

12. Match List-I with List-II.

List-I (Molecule)	List-II (Bond order)
(a) Ne_2	(i) 1
(b) N_2	(ii) 2
(c) F_2	(iii) 0
(d) O_2	(iv) 3

Choose the correct answer from the options given below :

(1) (a) → (ii), (b) → (i), (c) → (iv), (d) → (iii)

(2) (a) → (iv), (b) → (iii), (c) → (ii), (d) → (i)

(3) (a) → (iii), (b) → (iv), (c) → (i), (d) → (ii)

(4) (a) → (i), (b) → (ii), (c) → (iii), (d) → (iv)

Ans. Official Answer NTA : (3)

Sol. $B-O = \frac{N_b - N_a}{2}$

$Ne_2 = \frac{10-10}{2} = 0$

$N_2 = \frac{10-4}{2} = 3$

$F_2 = \frac{10-8}{2} = 1$

$O_2 = \frac{10-6}{2} = 2$

13. Match List-I with List-II.

List-I	List-II
(a) Sucrose	(i) β-D-Galactose and β-D-Glucose
(b) Lactose	(ii) α-D-Glucose and β-D-Fructose
(c) Maltose	(iii) α-D-Glucose and α-D-Glucose

Choose the correct answer from the options given below :

(1) (a) → (iii), (b) → (ii), (c) → (i)

(2) (a) → (i), (b) → (iii), (c) → (ii)

(3) (a) → (iii), (b) → (i), (c) → (ii)

(4) (a) → (ii), (b) → (i), (c) → (iii)

Ans. Official Answer NTA : (4)

S. (a) Sucrose → α-D-Glucose and β-D-Fructose

(b) Lactose → β-D-Galactose and β-D-Glucose

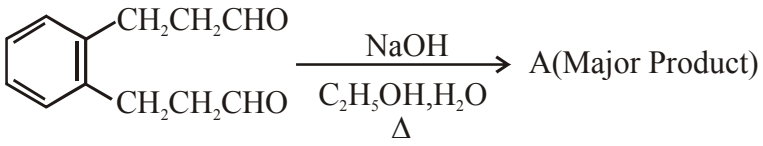
(c) Maltose → α-D-Glucose and α-D-Glucose

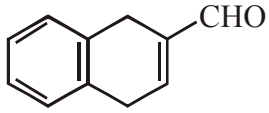
(a) → II

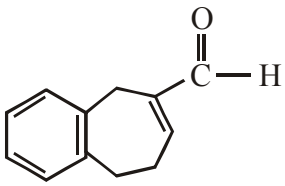
(b) → I

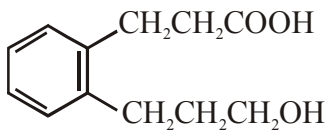
(c) → III

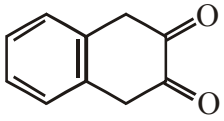
14. Identify A in the given chemical reaction.



(1) 

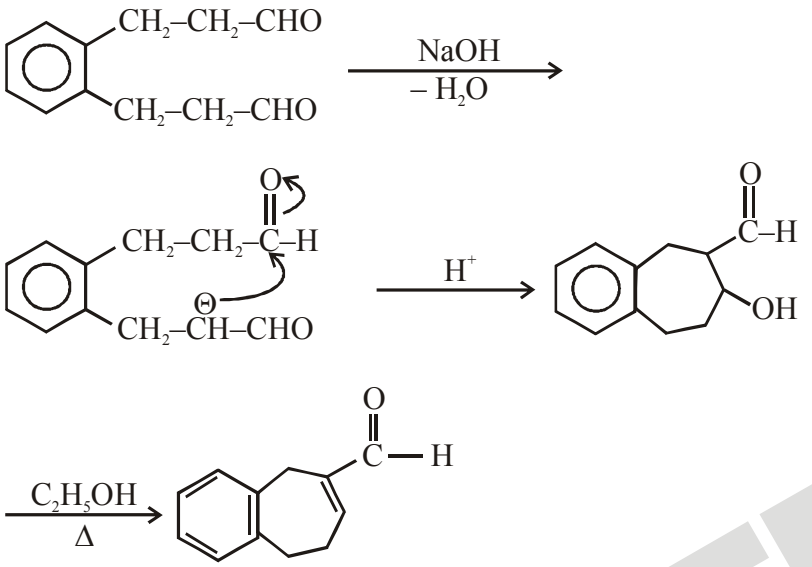
(2) 

(3) 

(4) 

Ans. Official Answer NTA : (2)

Sol.



15. Given below are two statements : one is labelled as Assertion A and the other is labelled as Reason R.

Assertion A : In TlI_3, isomorphous to CsI_3, the metal is present in +1 oxidation state.

Reason R : Tl metal has fourteen *f* electrons in its electronic configuration.

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

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

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

(3) A is correct but R is not correct

(4) A is not correct but R is correct

Ans. Official Answer NTA : (2)

S. As TlI_3 is isomorphous to CsI_3,

TlI_3 is $\equiv Tl^{+}I_3^{-}$.

$Tl^{+} = [Xe]\ 4f^{14}5d^{10}6s^{2}$

16. Calgon is used for water treatment. Which of the following statement is NOT true about Calgon ?

(1) Calgon contains the 2nd most abundant element by weight in the Earth's crust.

(2) It is also known as Graham's salt.

(3) It does not remove Ca^{2+} ion by precipitation.

(4) It is polymeric compound and is water soluble.

Ans. Official Answer NTA : (1)

S. Calgon = $Na_6P_6O_{18}$.

2nd most abundant element is Si and it is not present in calgon.

It is also known as Graham's salt.

It is polymeric compound $\equiv (NaPO_3)_6$.

17. The nature of charge on resulting colloidal particles when $FeCl_3$ is added to excess of hot water is :

(1) Sometimes positive and sometimes negative

(2) Neutral

(3) Negative

(4) Positive

Ans. Official Answer NTA : (4)

S. Positive colloidal solution of hydrated ferric oxide is obtained due to adsorption of Fe^{3+} ions.

18. Match List-I with List-II.

List-I	List-II
(a) Siderite	(i) Cu
(b) Calamine	(ii) Ca
(c) Malachite	(iii) Fe
(d) Cryolite	(iv) Al
	(v) Zn

Choose the correct answer from the options given below :

(1) (a) → (iii), (b) → (i), (c) → (v), (d) → (ii)

(2) (a) → (i), (b) → (ii), (c) → (iii), (d) → (iv)

(3) (a) → (i), (b) → (ii), (c) → (v), (d) → (iii)

(4) (a) → (iii), (b) → (v), (c) → (i), (d) → (iv)

Ans. Official Answer NTA : (4)

S. (a) Siderite → $FeCO_3$

(b) Calamine → $ZnCO_3$

(c) Malachite → $CuCO_3.Cu(OH)_2$

(d) Cryolite → Na_3AlF_6

19. Which pair of oxides is acidic in nature ?

(1) B_2O_3, SiO_2 (2) N_2O, BaO (3) CaO, SiO_2 (4) B_2O_3, CaO

Ans. Official Answer NTA : (1)

Sol. B_2O_3 → Acidic

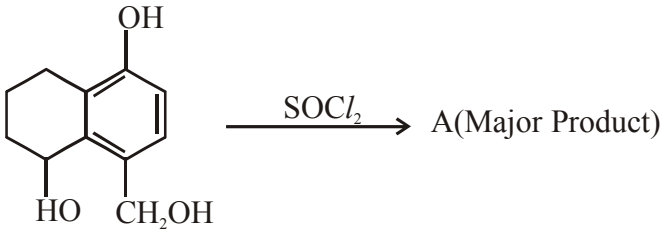
SiO_2 → Acidic

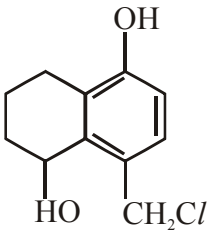
N_2O → Neutral

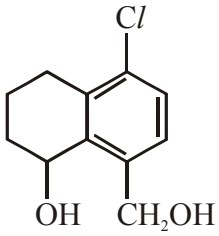
BaO → Basic

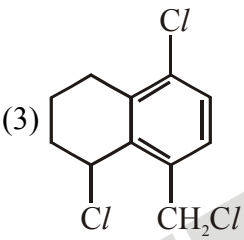
CaO → Basic

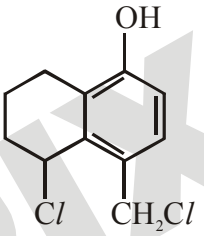
20. Identify A in the given reaction.



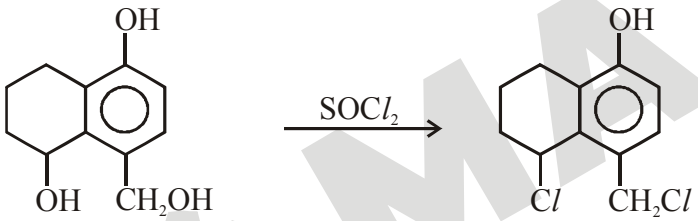
(1) 

(2) 

(3) 

(4) 

Ans. Official Answer NTA : (4)

Sol. 

Section–B

1. The pH of ammonium phosphate solution, if pk_a of phosphoric acid and pk_b of ammonium hydroxide are 5.23 and 4.75 respectively, is.....

Ans. Official Answer NTA : (7)

Ans. (7.24)

Sol. Ammonium phosphate is a salt of weak acid & weak base :

$$pH = 7 + \frac{1}{2}[pK_a - pK_b]$$

$$pH = 7 + \frac{1}{2}[5.23 - 4.75]$$

$$pH = 7.24$$

2. The average S–F bond energy in kJ mol^{-1} of SF_6 is.....(Rounded off ot the nearest integer)

[Given : The values of standard enthalpy of formation of $SF_6(g)$, S(g) and F(g) are – 1100, 275 and 80 kJ mol^{-1} respectively.]

Ans. Official Answer NTA : (309)

Sol. $SF_{6(g)} \longrightarrow S_{(g)} + 6F_{(g)}$; $\Delta H_f = -1100$ kJ/mol

$\Delta H = 6 \in_{S-F}$

$6 \in_{S-F} = \Delta H_f(s,g) + 6\Delta H_f(F,g) - \Delta H_f(SF_6,g)$

$6 \in_{S-F} = 275 + 6 \times 80 - (-1100) = 309.16$ kJ/mole

3. If the activation energy of a reaction is 80.9 kJ mol^{-1}, the fraction of molecules at 700 K, having enough energy to react to form products is e^{-x}. The value of x is.....

(Rounded off to the nearest integer)

[Use R = 8.31 J K^{-1} mol^{-1}]

Ans. Official Answer NTA : (14)

Sol. $K = Ae^{-\frac{E_A}{RT}}$

Fraction of active molecules $= \frac{K}{A} = e^{-\frac{E_A}{RT}}$

$e^{-E_A/RT} = e^{-\frac{80.9\times10^3}{8.314\times700}}$

$e^{-13.9} = e^{-x}$

$x = 13.9$

$x = 14$

4. Emf of the following cell at 298 K in V is $x \times 10^{-2}$.

$Zn/Zn^{2+}(0.1\ M)||Ag^{+}(0.01\ M)|Ag$

The value of x is.....(rounded off to the nearest integer)

[Given : $E^{\theta}_{Zn^{2+}/Zn} = -0.76V; E^{\theta}_{Ag^{+}/Ag} = +0.80V; \frac{2.303RT}{F} = 0.059$]

Ans. Official Answer NTA : (147)

Ans. (147)

Sol. **Anode**

$Zn(s) \longrightarrow Zn^{2+}(aq.) + 2e^-$

Cathode

$Ag^+_{(aq.)} + e^- \longrightarrow Ag(s)$

Cell reaction

$Zn(s) + 2Ag^+(aq.) \longrightarrow Zn^{2+}(aq.) + 2Ag(s)$
(0.01M) (0.1M)

$E_{cell} = E^0_{cell} - \frac{0.0591}{n}\log\frac{[Zn^{2+}]}{[Ag^+]^2}$

$E_{cell} = 0.8 - (0.76) - \frac{0.0591}{n}\log\frac{[Zn^{2+}]}{[Ag^+]^2}$

$= 1.56 - \frac{0.0591}{2}\log\frac{0.1}{(0.01)^2}$

$= 1.56 - \frac{0.0591}{2}(+3)$

$= 1.56 - 0.0886$

$E_{cell} = 147.18 \times 10^{-2} = x \times 10^{-2}$

$x = 147$

5. The number of octahedral voids per lattice site in a lattice is .....(Rounded off to the nearest integer)

Ans. Official Answer NTA : (1)

Sol. Number of O.V. = Number of lattice points/sites.

O.V. per lattice sites = 1

6. The $NaNO_3$ weighed out to make 50 mL of an aqueous solution containing 70.0 mg Na^+ per mL is.....g.

(Rounded off to the nearest integer)

[Given : Atomic weight in g mol^{-1} – Na : 23 ; N : 14 ; O : 16]

Ans. Official Answer NTA : (13)

Sol. $NaNO_3 \longrightarrow Na^+ + NO_3^-$

$w_{Na^+} = 70$ mg/ml

in 50 ml $w_{Na^+} = 3500$ mg = 3.5 g

$n_{Na^+} = \frac{3.5}{23}$, $n_{NaNO_3} = n_{Na^+} = \frac{3.5}{23}$

$w_{NaNO_3} = \frac{3.5}{23} \times 85 = 12.93$

7. In mildly alkaline medium, thiosulphate ion is oxidized by MnO_4^- to "A". The oxidation state of sulphur in "A" is .....

Ans. Official Answer NTA : (6)

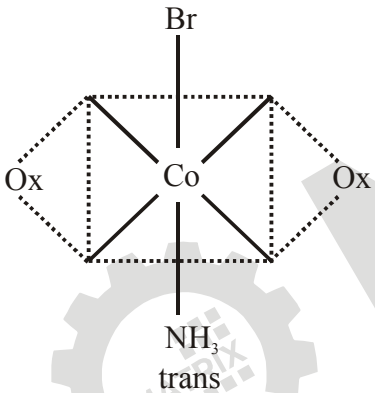
Sol. $S_2O_3^{2-} + MnO_4^- \longrightarrow MnO_2 + SO_4^{2-}$

Oxidation number of sulphur in SO_4^{2-} is 6.

8. The number of stereoisomers possible for $[Co(ox)_2(Br)(NH_3)]^2$ is .....

Ans. Official Answer NTA : (3)

S.



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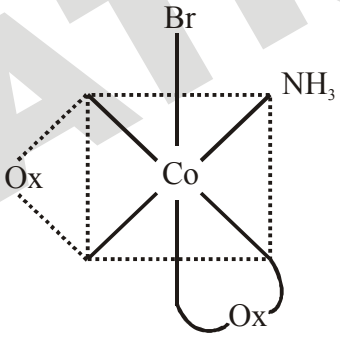

Cis [d + ℓ]

9. When 12.2 g of benzoic acid is dissolved in 100 g of water, the freezing point of solution was found to be – 0.93°C ($K_f(H_2O) = 1.86$ K kg mol^{-1}). The number (n) of benzoic acid molecules associated (assuming 100% association) is .....

Ans. Official Answer NTA : (2)

Sol. $\Delta T_f = ik_f m$

$\Delta T_f = 0.93$

$n_{\text{benzoic acid}} = \frac{12.2}{127} = 0.1$

$n_{H_2O} = \frac{100g}{18} = 5.55$

$\Delta T_f = ik_f m$

$0.93 = i \times 1.86 \times \frac{0.1}{100} \times 1000$

$i = \frac{0.93}{1.86 \times 1}$

$i = \frac{1}{2} = 0.5$

$i = \frac{1}{n} = 0.5$

$n = 2$

10. A ball weighing 10 g is moving with a velocity of 90 ms^{-1}. If the uncertainty in its velocity is 5%, then the uncertainty in its position is.....$\times 10^{-33}$ m. (Rounded off to the nearest integer)

[Given : $h = 6.63 \times 10^{-34}$ Js]

Ans. Official Answer NTA : (1)

Sol. $V = 90\ ms^{-1}$

$\Delta V = 90 \times \frac{5}{100} = 4.5\ ms^{-1}$

$(m\Delta V)(\Delta x) = \frac{h}{4\pi}$

$(10 \times 10^{-3})(4.5) \times \Delta x = \frac{h}{4\pi}$

$\Delta x = \frac{6.63 \times 10^{-34}}{4\pi \times 4.5 \times 10^{-2}}$

$= 1.17 \times 10^{-33}$ m