JEE MAIN 26th Feb. shift-2 2021 (Chemistry)

Section-A

1. 2,4-DNP test can be used to identify

   a. aldehyde

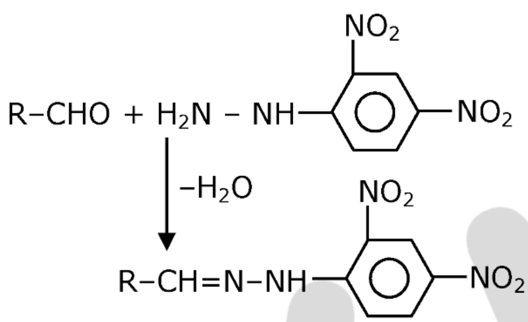
   b. halogens

   c. ether

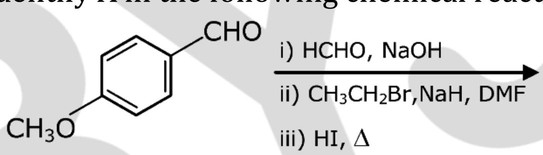
   d. amine

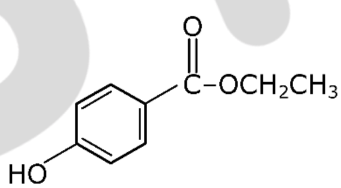
Ans: (a)

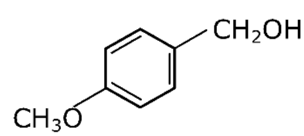
Solution:

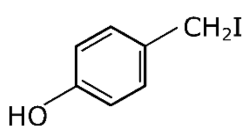


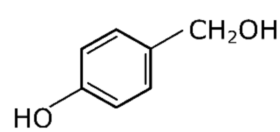
2. Identify A in the following chemical reaction.



a. 

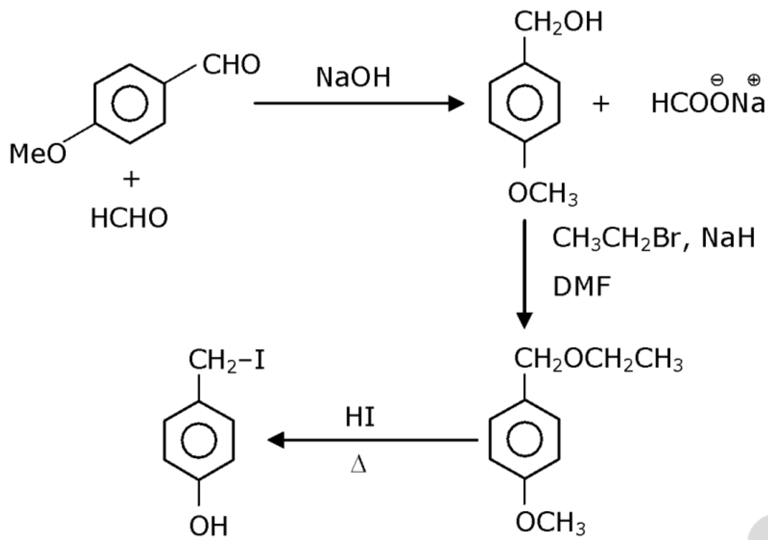
b. 

c. 

d. 

Ans: (c)

Solution:



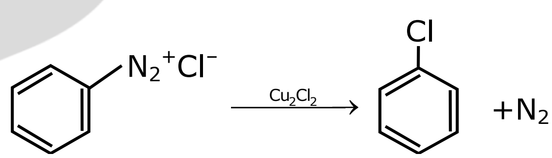
3. The nature of charge on resulting colloidal particles when $FeCl_3$ is added to excess of hot water is:
   a. positive
   b. neutral
   c. sometimes positive and sometimes negative
   d. negative

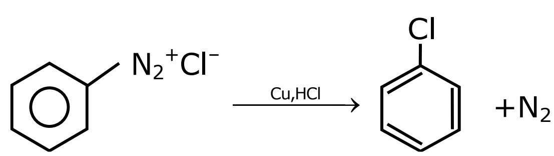
   Ans: (a)

   Solution:
   If $FeCl_3$ is added to excess of hot water, a positively charged sol of hydrated ferric oxide is formed due to adsorption of Fe^{3+} ions.

4. Match List-I with List-II

List-I

a. 

b. 

c. $2CH_3CH_2Cl + 2Na \xrightarrow{\text{Ether}} C_2H_5 - C_2H_5 + 2NaCl$

d. $2C_2H_5Cl + 2Na \xrightarrow{\text{Ether}} C_6H_5 - C_6H_5 + 2NaCl$

List-II

i. Wurtz reaction

ii. Sandmeyer reaction

iii. Fitting reaction

iv. Gatterman reaction

Choose the correct answer from the option given below:

a. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

b. (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

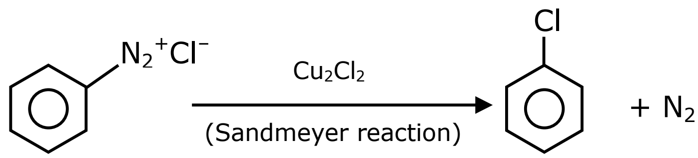
c. (a)-(ii), (b)-(iv), (c)-(i), (d)-(iii)

d. (a)-(iii), (b)-(i), (c)-(iv), (d)-(ii)

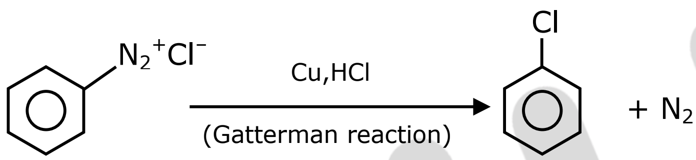
Ans: (c)

Solution:

(a)



(b)



(c)

$$2CH_3{-}CH_2Cl + 2Na \xrightarrow[\text{(Wurtz reaction)}]{\text{Ether}} C_2H_5{-}C_2H_5 + 2NaCl$$

(d)

$$2C_6H_5Cl + 2Na \xrightarrow[\text{(Fitting reaction)}]{\text{Ether}} C_6H_5{-}C_6H_5 + 2NaCl$$

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

a. sp^2, sp, sp^2, sp^3

c. sp^2, sp^3, sp^2, sp^3

b. sp^2, sp^2, sp^2, sp^3

d. sp^3, sp, sp^3, sp^3

Ans: (a)

Solution:

$$\underset{sp^2}{CH_2} = \underset{sp}{C} = \underset{sp^2}{CH} - \underset{sp^3}{CH_3}$$

6. Match List-I with List-II.

List-I	List-II
a. Sucrose	i. b-D-Galactose and b-D-Glucose
b. Lactose	ii. a-D-Glucose and b-D-Fructose
c. Maltose	iii. a-D- Glucose and a-D-Glucose

Choose the correct answer from the options given below:

a. (a)-(iii), (b)-(ii), (c)-(i)
b. (a)-(iii), (b)-(i), (c)-(ii)
c. (a)-(i), (b)-(iii), (c)-(ii)
d. (a)-(ii), (b)-(i), (c)-(iii)

Ans: (d)

Solution:

Sucrose → a-D- Glucose and b-D- Fructose

Lactose → b-D- Galactose and b-D- Glucose

Maltose → a-D- Glucose and a-D- Glucose

7. Which pair of oxides is acidic in nature?
 a. N_2O, BaO
 b. CaO, SiO_2
 c. B_2O_3, CaO
 d. B_2O_3, SiO_2

Ans: (d)

Solution:

B_2O_3 and SiO_2 both are oxides of non-metal and hence are acidic in nature.

8. Calgon is used for water treatment. Which of the following statement is NOT true about calgon?
 a. Calgon contains the 2nd most abundant element by weight in the earth's crust
 b. It is also known as Graham's salt.
 c. It is polymeric compound and is water soluble.
 d. It does not remove Ca^{2+} ion by precipitation.

Ans: (a)

Solution:

$Na_6(PO_3)_6$ or $Na_6P_6O_{18}$

Order of abundance of element in earth crust is

O > Si > Al > Fe > Ca > Na > Mg > K

So, second most abundant element in earth crust is Si not Ca.

9. Ceric ammonium nitrate and $CHCl_3$/alc. KOH are used for the identification of functional groups present in ________and_______ respectively.
 a. alcohol, amine
 b. amine, alcohol
 c. alcohol, phenol
 d. amine, phenol

Ans: (a)

Solution:

Alcohol give positive test with ceric ammonium nitrate and primary amines gives carbonyl amine test with $CHCl_3$, KOH

10. 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 metals has fourteen *f* electrons in its electronic configuration.

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

a. Both A and R are correct and R is the correct explanation of A
b. A is not correct but R is correct
c. Both A and R are correct R is NOT the correct explanation of A
d. A is correct but R is not correct

Ans: (c)

Solution:

TlI_3 is $Tl^+ I_3^-$

CsI_3 is $Cs^+ I_3^-$

Thallium shows Tl^+ state due to inert pair effect.

11. The correct order of electron gain enthalpy is:

a. $S > Se > Te > O$ b. $O > S > Se > Te$

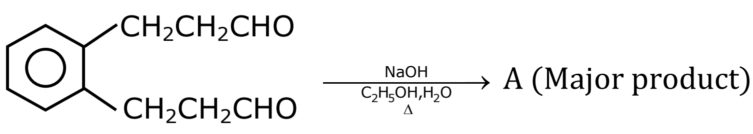
c. $S > O > Se > Te$ d. $Te > Se > S > O$

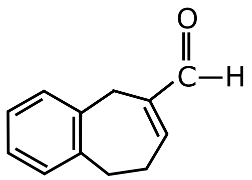
Ans: (a)

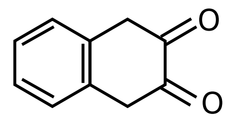
Solution:

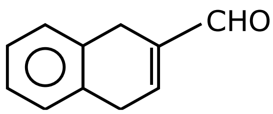
Electron gain enthalpy of O is very low due to small size.

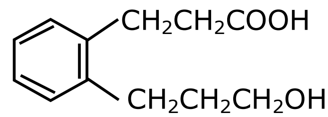
12. Identify A in the given chemical reaction.



a. 

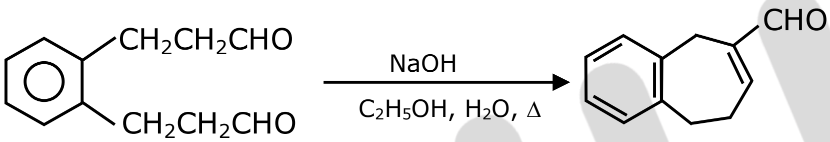
b. 

c. 

d. 

Ans: (a)

Solution:



e. (Internal aldol condensation)

13. 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:

a. (a)-(i), (b)-(ii), (c)-(v), (d)-(iii)

b. (a)-(iii), (b)-(v), (c)-(i), (d)-(iv)

c. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)

d. (a)-(iii), (b)-(i), (c)-(v), (d)

Ans: (b)

Solution:

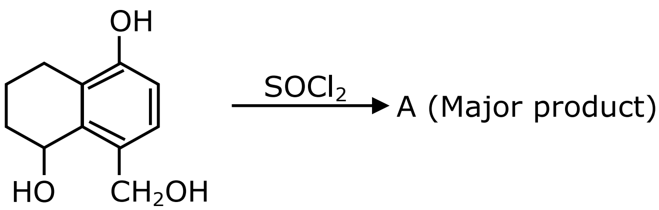
Siderite - $FeCO_3$

Calamine - $ZnCO_3$

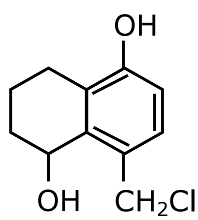
Malachite - $CuCO_3.Cu(OH)_2$

Cryolite - Na_3AlF_6

14. Identify A in the given reaction.



a.



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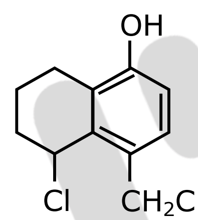
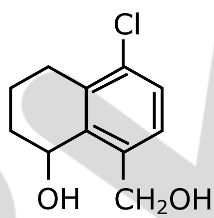
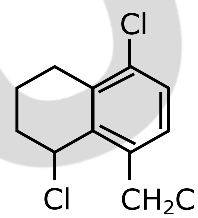


c.

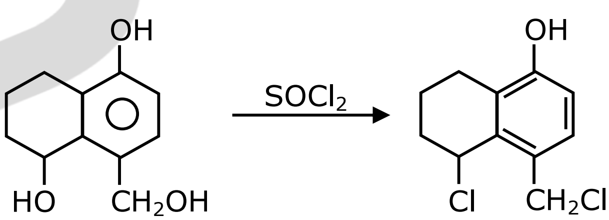


d.



Ans: (b)

Solution:



15. Match List-I with List-II

List-I	**List-II**
a. Sodium Carbonate	i. Deacon
b. Titanium	ii. Caster-Kellner
c. Chlorine	iii. Van-Arkel
d. Sodium hydroxide	iv. Solvay

Choose the correct answer from the option given below:

a. (a)-(iii), (b)-(ii), (c)-(i), (d)-(iv)
b. (a)-(iv), (b)-(iii), (c)-(i), (d)-(ii)
c. (a)-(iv), (b)-(i), (c)-(ii), (d)-(iii)
d. (a)-(i), (b)-(iii), (c)-(iv), (d)-(ii)

Ans: (b)

Solution:

Sodium carbonate Na_2CO_3 & $NaHCO_3$

Titanium : Van arkel method

$$Ti + I_2 \xrightarrow{T_1} \underset{(g)}{Ti\,I_4}$$

$$\underset{(g)}{Ti\,I_4} \xrightarrow{T_2 T_2 > T_1} \underset{\substack{Refined\\titanium}}{Ti} + 2\underset{(g)}{I_2}$$

Chlorine : Decon's process

$$HCl + O_2 \xrightarrow{CuCl_2} H_2O + Cl_2$$

Sodium hydroxide :- Caster-Kellner cell

16. 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:

a. (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)
b. (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
c. (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)
d. (a)-(iv), (b)-(iii), (c)-(ii), (d)-(i)

Ans: (a)

Solution:

Ne_2	BO = 0
N_2	BO = 3
F_2	BO = 1
O_2	BO = 2

As per molecular orbital theory

17. Which of the following forms of hydrogen emits low energy b- particles?

a. Proton H^+

b. Deuterium ^2_1H

c. Protium ^1_1H

d. Tritium ^3_1H

Ans: (d)

Solution:

Tritium isotope of hydrogen is radioactive and emits low energy b⁻ particles. It is because of high n/p ratio of tritium which makes nucleus unstable

18. A. Phenyl methanamine

B. N, N-Dimethylaniline

C. N-Methyl aniline

D. Benzenamine

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

a. D > C > B > A

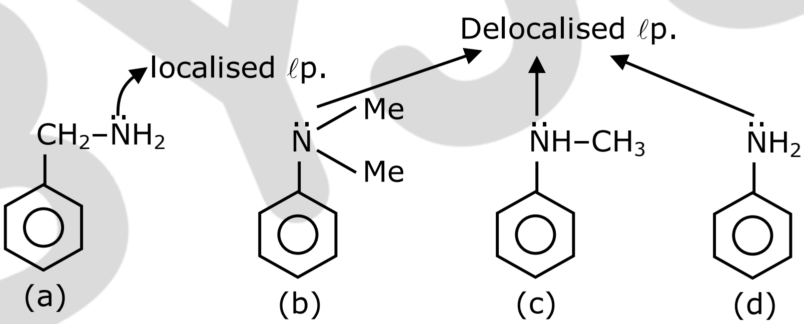
c. A > C > B > D

b. D > B > C > A

d. A > B > C > D

Ans: (d)

Solution:



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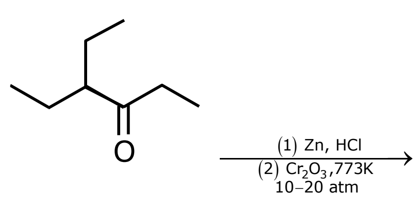
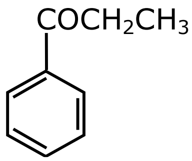
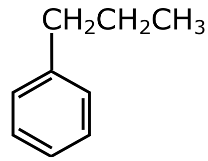
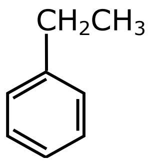
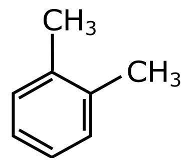


Considering the above reaction, the major product among the following is:

a. 

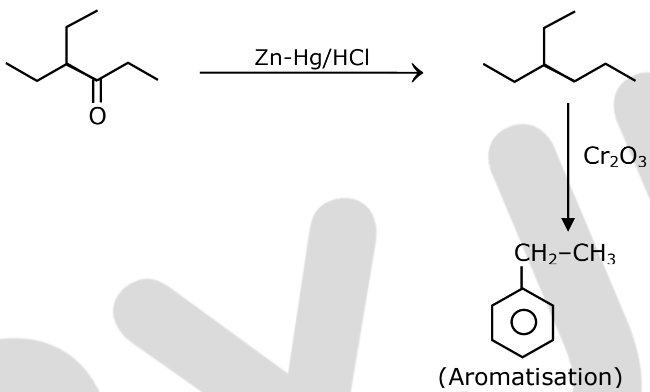
b. 

c. 

d. 

Ans:(c)

Solution:



20. Seliwanoff test and Xanthoproteic test are used for the identification of _________ and __________ respectively

a. ketoses, proteins
b. proteins, ketoses
c. aldoses, ketoses
d. ketoses, aldoses

Ans:(a)

Solution:

Seliwanoff test and Xanthoproteic test are used for identification of 'Ketoses' and proteins respectively.

Section B

1. 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: (13)

Solution:

$Na^+ = 70$ mg/mL

W_{Na^+} in 50 mL solution $= 70 \times 50$ mg $= 3500$ mg $= 3.5$ g

Moles of Na^+ in 50 ml solution $= \frac{3.5}{23}$

Moles of $NaNO_3$ = moles of $Na^+ = \frac{3.5}{23}$ mol

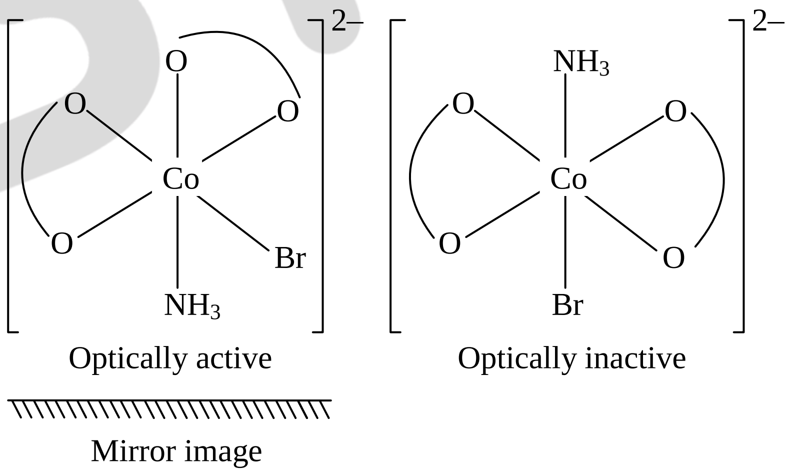
Mass of $NaNO_3 = \frac{3.5}{23} \times 85 = 12.934 \simeq 13$ g Ans.

2. The number of stereoisomers possible for $[Co(ox)_2(Br)(NH_3)]^{2-}$ is ___________
   [ox = oxalate]

Ans:3

Solution:

$[Co(Ox)_2Br(NH_3)]^{2-}$



Total stereoisomer = 2 (OI) + 1 POE (pair of enantiomers) = 3

3. The average S–F bond energy in kJ mol^{-1} of SF_6 is ________. (Rounded off to 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: (309)
Solution:

$$SF_6(g) \longrightarrow S(g) + 6F(g)$$

$$\Delta H^o_{reaction} = 6 \times E_{S-F} = \Delta H^o_f[S(g)] + 6 \times \Delta H^o_f[F(g)] - \Delta H^o_f[SF_6(g)]$$

$6 \times E_{S\text{-}F} = 275 + 6\times80 - (-1100) = 275 + 480 + 1100$

$6 \times E_{S\text{-}F} = 1855$

$E_{S\text{-}F} = \frac{1855}{6} = 309.1667 = 309$ kJ/mol

4. E.m.f 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: $E^0_{Zn^{2+}/Zn} = -0.76V; E^0_{Ag^+/Ag} = +0.80V; \frac{2.303RT}{F} = 0.059$]

Ans: (147)

Solution:

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

$Zn(s) + 2\,Ag^+ \rightleftarrows 2Ag(s) + Zn^{+2}$

$E^0 = 0.80 + 0.76 = 1.56; Q = \left\{\frac{Zn^{2+}}{(Ag^+)^2}\right\}$

$E = E^0 - \frac{0.059}{n}\log(Q)$

$E = 1.56 - \frac{0.059}{2} log\left[\frac{0.1}{(0.01)^2}\right]$

$E = 1.56 - \frac{0.059}{2} log[(10)^3]$

$E = 1.4715 = 147.15 \times 10^{-2} volt = x \times 10^{-2}$

X = 147.15 ≃ 147

5. A ball weighing 10g is moving with a velocity of 90ms^{-1}. If the uncertainty in its velocity is 5%, then the uncertainty in its position is _______×10^{-33}m. (Rounded off to the nearest integer)
   [Given: h = 6.63×10^{-34} J s]

Ans: 1

Solution:

m = 10 g = 10^{-2} kg

v = 90 m/s

$\Delta v = v \times 5\% = 90 \times \frac{5}{100} = 4.5\frac{m}{s}$

m. Δv. Δx $\geq \frac{h}{4\pi}$

$10^{-2} \times 4.5 \times \Delta x \geq \frac{6.63\times3\times10^{-34}}{4\times\frac{22}{7}}$

$\Delta x \geq \frac{6.63\times7\times2\times10^{-34}}{9\times4\times22\times10^{-2}}$

$\Delta x \geq 1.17 \times 10^{-33} = x \times 10^{-33}$

$x = 1.17 \simeq 1$

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

Ans: (+6)

Solution:

$S_2O_3^{2-} + MnO_4^- \xrightarrow{AlkalineMedium} A$

$A \rightarrow SO_4^{2-}$

Oxidation no. of 'S' = +6

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

Ans: (2)

Solution:

n PhCOOH → $(PhCOOH)_n$

$N = \frac{1}{x} = i\{As, \alpha = 1\}$

$\Delta T_f = i \times k_f \times m$

$0.93 = \frac{1}{n} \times 1.86 \times \frac{12.2\times1000}{122\times100}$; n = 2

8. If the activation energy of a reaction is 80.9 kJ mol^{-1}, the fraction of molecules at 700K, 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 JK^{-1} mol^{-1}]

Ans: (14)

Solution:

$E_a = 80.9\frac{kJ}{mol}$

Fraction of molecules able to cross energy barrier $= e^{-\frac{E_a}{RT}} = e^{-x}$

$x = \frac{E_a}{RT} = \frac{80.9\times1000}{8.31\times700} = 13.91$

$x \simeq 14$

9. 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: 7

Solution:

$(NH_4)_3PO_4 \rightleftarrows 3NH_4^+ + PO_4^{3-}$

$[H^+] = K_a \times \sqrt{\frac{kw}{k_a\times k_b}}$

$pH = pk_a + \frac{1}{2}\{pk_w - pk_a - pk_b\}$

$pH = 5.23+\frac{1}{2}\{14-5.23-4.75\}$

$pH = 5.23 + \frac{1}{2}\ (4.02) = 7.24 = 7$(Nearest integer)

10. The number of octahedral voids per lattice site in a lattice is _________.

(Rounded off to the nearest integer)

Ans: 1

Solution:

Assuming FCC

No of lattice sites = 6 face centre + 8 corner = 14

No. of octahedral voids = 13

Ratio = $\frac{13}{14}$ = 0.92857 = 1 (nearest integer)