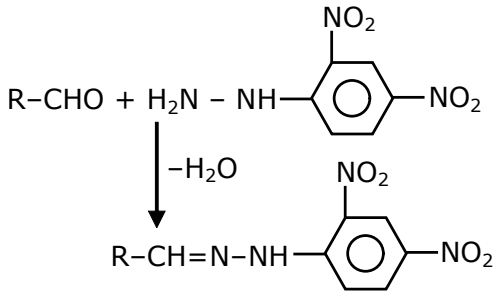
26th Feb. 2021 | Shift - 2
CHEMISTRY

Section - A

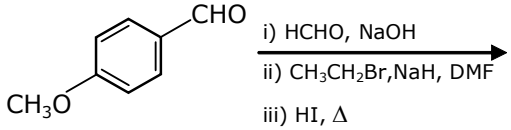
1. 2,4-DNP test can be used to identify:
(1) aldehyde
(2) halogens
(3) ether
(4) amine

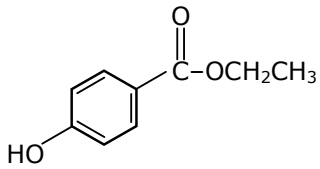
Ans. **(1)**

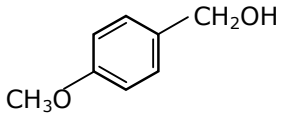
Sol.

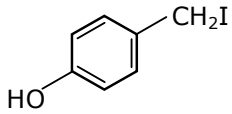


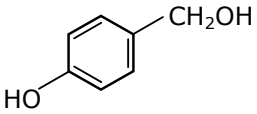
2. Identify A in the following chemical reaction.



(1) 

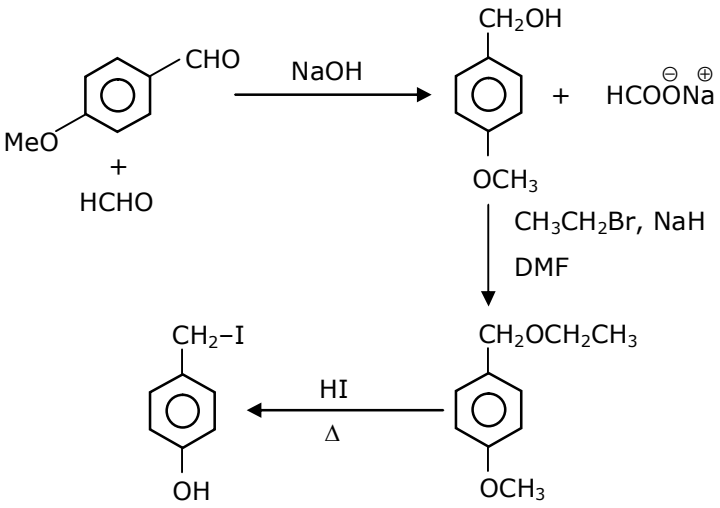
(2) 

(3) 

(4) 

Ans. (3)

Sol.



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

(1) positive

(2) neutral

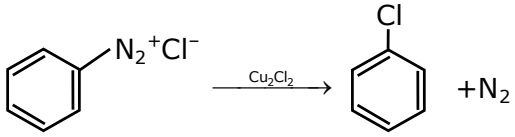
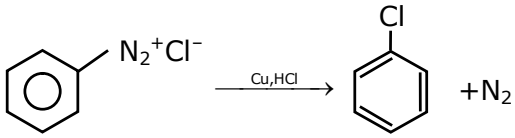
(3) sometimes positive and sometimes negative

(4) negative

Ans. (1)

Sol. 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	**List-II**
(a) 	(i) Wurtz reaction
(b) 	(ii) Sandmeyer reaction
(c) $2CH_3CH_2Cl + 2Na \xrightarrow{Ether} C_2H_5- C_2H_5 + 2NaCl$	(iii) Fitting reaction
(d) $2C_2H_5Cl + 2Na \xrightarrow{Ether} C_6H_5- C_6H_5 + 2NaCl$	(iv) Gatterman reaction

Choose the correct answer from the option given below:

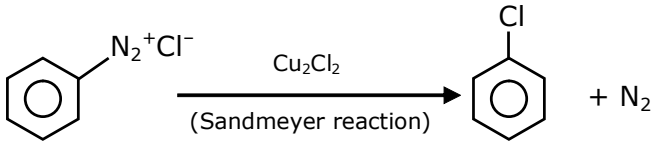
(1) (a)-(ii), (b)-(i), (c)-(iv), (d)-(iii)

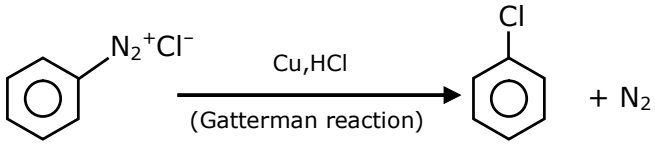
(2) (a)-(iii), (b)-(iv), (c)-(i), (d)-(ii)

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

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

Ans. (3)

Sol. (a) 

(b) 

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

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

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:

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

(2) sp^2, sp^2, sp^2, sp^3

(3) sp^2, sp^3, sp^2, sp^3

(4) sp^3, sp, sp^3, sp^3

Ans. (1)

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

6. Match List-I with List-II.

List-I	**List-II**
(a) Sucrose	(i) 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)-(iii), (b)-(i), (c)-(ii)

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

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

Ans. (4)

Sol. Sucrose $\rightarrow$ α-D- Glucose and β-D- Fructose

Lactose $\rightarrow$ β-D- Galactose and β-D- Glucose

Maltose $\rightarrow$ α-D- Glucose and α-D- Glucose

7. Which pair of oxides is acidic in nature?

(1) N_2O, BaO

(2) CaO, SiO_2

(3) B_2O_3, CaO

(4) B_2O_3, SiO_2

Ans. (4)

Sol. 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?

(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 is polymeric compound and is water soluble.

(4) It doesnot remove Ca^{2+} ion by precipitation.

Ans. **(1)**

Sol. $Na_6(PO_3)_6$ 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.

(1) alcohol, amine (2) amine, alcohol

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

Ans. **(1)**

Sol. Alcohol give positive test with ceric ammonium nitrate and primary amines gives carbyl 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 answer from the options given below:

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

(2) A is not correct but R is correct

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

(4) A is correct but R is not correct

Ans. **(3)**

Sol. $T\ell I_3$ is $T\ell^+ I_3^-$

CsI_3 is $Cs^+ I_3^-$

Thallium shows $T\ell^+$ state due to inert pair effect.

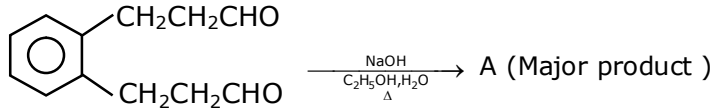
11. The correct order of electron gain enthalpy is:

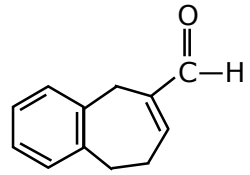
(1) S > Se > Te > O
(2) O > S > Se > Te
(3) S > O > Se > Te
(4) Te > Se > S > O

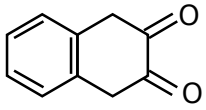
Ans. **(1)**

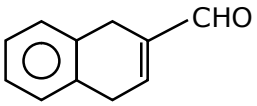
Sol. Electron gain enthalpy of O is very low due to small size.

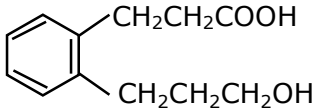
12. Identify A in the given chemical reaction.



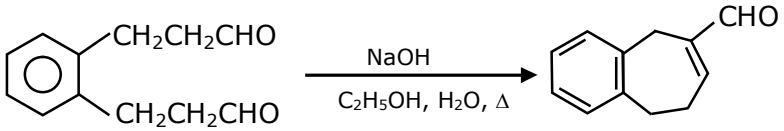
(1) 

(2) 

(3) 

(4) 

Ans. **(1)**

Sol. 

(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:

(1) (a)-(i), (b)-(ii), (c)-(v), (d)-(iii)
(2) (a)-(iii), (b)-(v), (c)-(i), (d)-(iv)
(3) (a)-(i), (b)-(ii), (c)-(iii), (d)-(iv)
(4) (a)-(iii), (b)-(i), (c)-(v), (d)-(ii)

Ans. (2)

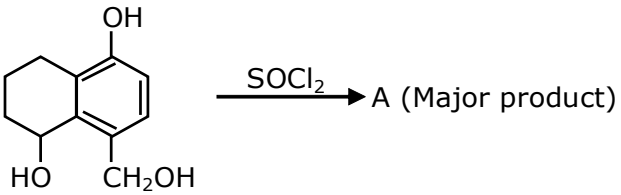
Sol. Siderite - $FeCO_3$

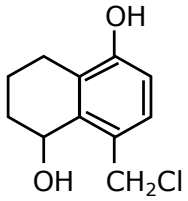
Calamine - $ZnCO_3$

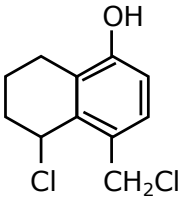
Malachite - $CuCO_3.Cu(OH)_2$

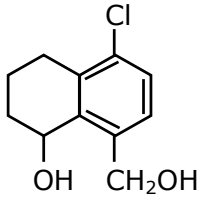
Cryolite - Na_3AlF_6

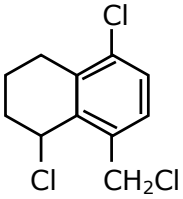
14. Identify A in the given reaction



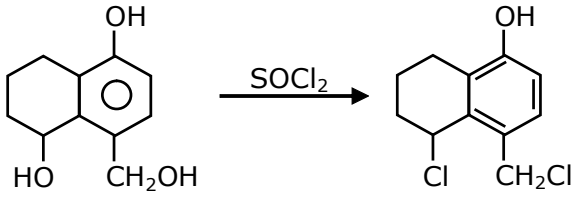
(1) 

(2) 

(3) 

(4) 

Ans. (2)

Sol. 

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:

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

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

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

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

Ans. (2)

Sol. Sodium carbonate Na_2CO_3 & $NaHCO_3$

Titanium : Van arkel method

$$T_i + I_2 \xrightarrow{T1} \underset{(g)}{T_i I_4}$$

$$\underset{(g)}{T_i I_4} \xrightarrow[T_2 > T_1]{T_2} \underset{\text{Refined titanium}}{T_i} + 2\underset{(g)}{I_2}$$

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:

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

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

Ans. (1)

Sol. Ne_2O 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 β^- particles?

(1) Proton H^+

(2) Deuterium $^{2}_{1}H$

(3) Protium $^{1}_{1}H$

(4) Tritium $^{3}_{1}H$

Ans. (4)

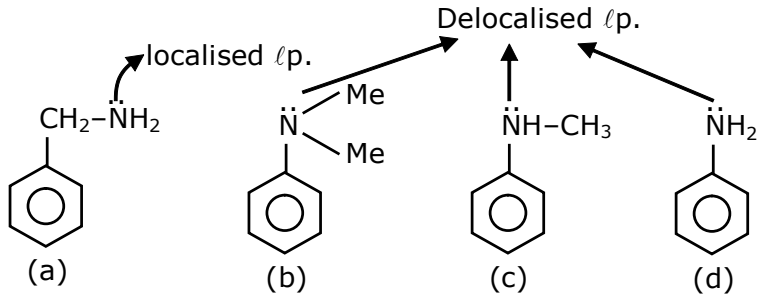
Sol. Tritium isotope of hydrogen is radioactive and emits low energy β^- particles. It is because of high n/p ratio of tritium which makes nucleus unstable.

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.

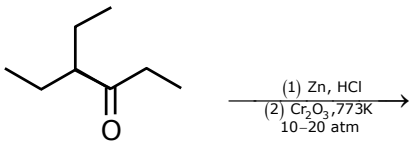
(1) D > C > B > A (2) D > B > C > A
(3) A > C > B > D (4) A > B > C > D

Ans. (4)

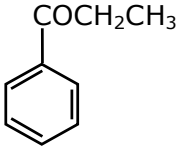
Sol.

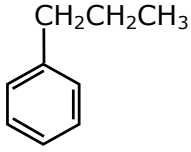


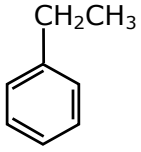
19.

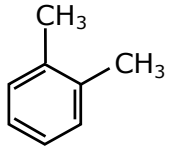


Considering the above reaction, the major product among the following is:

(1) 

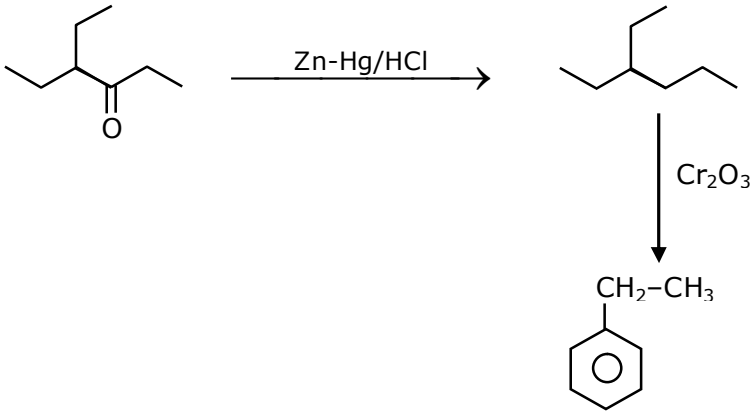
(2) 

(3) 

(4) 

Ans. **(3)**

Sol.



(Aromatisation)

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

(1) ketoses, proteins (2) proteins, ketoses

(3) aldoses, ketoses (4) ketoses, aldoses

Ans. **(1)**

Sol. Seliwanoff test and Xanthaproteic 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**

Sol. $Na^+ = 70$ mg/mL

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

$= 3500$ mg

$= 3.5$ gm

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

Moles of $NaNO_3$ = moles of Na^+

$= \frac{3.5}{23}$ mol

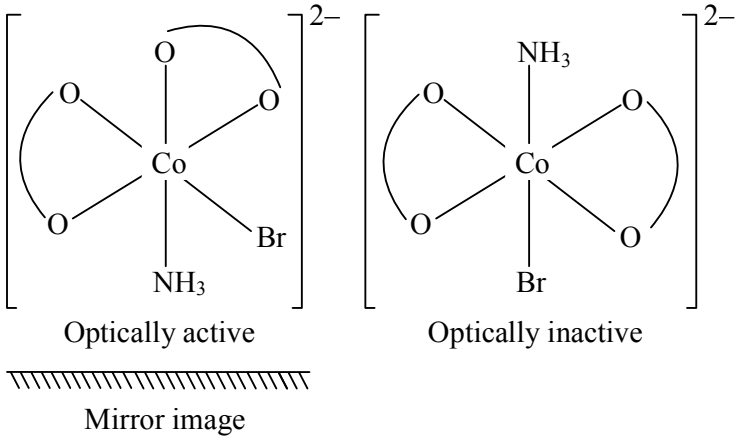
Mass of $NaNO_3 = \frac{3.5}{23} \times 85 = 12.934$

$\simeq$ 13gm Ans.

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

Ans. 3

Sol. $\left[Co\left(ox\right)_2 Br\left(NH_3\right)\right]^{2-}$



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

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

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

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

$= 275 + 480 + 1100$

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

$E_{S\text{-}F} = \frac{1855}{6} = 309.1667$

$\simeq 309$ kJ/mol Ans.

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

Ans. 147

Sol. $Zn(s)\left|Zn^{+2}(0.1M)\right|\left|Ag^{+}(0.01M)\right|Ag(s)$

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

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

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

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

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

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

$= x \times 10^{-2}$

$X = 147.15 \simeq 147$ Ans.

5. A ball weighing 10g 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. 1

Sol. $m = 10\ g = 10^{-2}$ Kg

$v = 90$ m/sec.

$$\Delta v = v \times 5\% \quad = 90 \times \frac{5}{100} = 4.5 \text{ m/sec}$$

$$m.\Delta v.\Delta x \geq \frac{h}{4\pi}$$

$$10^{-2} \times 4.5 \times \Delta x \geq \frac{6.63 \times 3 \times 10^{-34}}{4 \times \frac{22}{7}}$$

$$\Delta x \geq \frac{6.63 \times 7 \times 2 \times 10^{-34}}{9 \times 4 \times 22 \times 10^{-2}}$$

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

$$x = 1.17 \simeq 1$$

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

Ans. **6**

Sol. $S_2O_3^{2-} + MnO_4^- \xrightarrow[\text{Medium}]{\text{Alkaline}} A$

$A \rightarrow SO_4^{-2}$

$\therefore$ Oxidation no. of 'S' = +6 Ans.

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°C (K_f (H_2O) = 1.86 K kg mol^{-1}). The number (n) of benzoic acid molecules associated (assuming 100% association) is_____.

Ans. **2**

Sol. $n\ PhCOOH \rightarrow (PhCOOH)_n$

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

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

$$0.93 = \frac{1}{n} \times 1.86 \times \frac{12.2 \times 1000}{122 \times 100}$$

$n = 2$

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**

Sol. $E_a = 80.9 kJ/mol$

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

$$x = \frac{E_a}{RT} = \frac{80.9 \times 1000}{8.31 \times 700} = 13.91$$

$x \simeq 14$ Ans

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**

Sol. $(NH_4)_3PO_4 \rightleftharpoons 3NH_4^+ + PO_4^{3-}$

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

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

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

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

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

Ans. **1**

Sol. Assuming FCC

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

No. of octahedral voids = 13

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