

**Learning Temple**

**IIT/NEET ACADEMY**

**25<sup>th</sup> Feb. 2021 | Shift - 1**  
**CHEMISTRY**

### SECTION - A

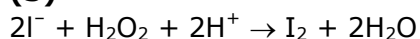
1. Ellingham diagram is a graphical representation of:  
 (1)  $\Delta G$  vs T                      (2)  $(\Delta G - T\Delta S)$  vs T    (3)  $\Delta H$  vs T                      (4)  $\Delta G$  vs P

**Sol. (1)**

Ellingham diagram tells us about the spontaneity of a reaction with temperature.

2. Which of the following equation depicts the oxidizing nature of  $H_2O_2$ ?  
 (1)  $Cl_2 + H_2O_2 \rightarrow 2HCl + O_2$                       (2)  $KIO_4 + H_2O_2 \rightarrow KIO_3 + H_2O + O_2$   
 (3)  $2I^- + H_2O_2 + 2H^+ \rightarrow I_2 + 2H_2O$                       (4)  $I_2 + H_2O_2 + 2OH^- \rightarrow 2I^- + 2H_2O + O_2$

**Sol. (3)**



Oxygen reduces from -1 to -2

So, its reduction will take place. Hence it will behave as oxidising agent or it shows oxidising nature.

While in other option it change from (-1) to 0.

3. In Freundlich adsorption isotherm at moderate pressure, the extent of adsorption  $\left(\frac{x}{m}\right)$  is directly proportional to  $P^x$ . The value of x is:

- (1)  $\infty$                       (2) 1                      (3) zero                      (4)  $\frac{1}{n}$

**Sol. (4)**

$$\frac{x}{m} = p^x$$

the formula is  $\frac{x}{m} = p^{\frac{1}{n}}$

Hence  $x = \frac{1}{n}$

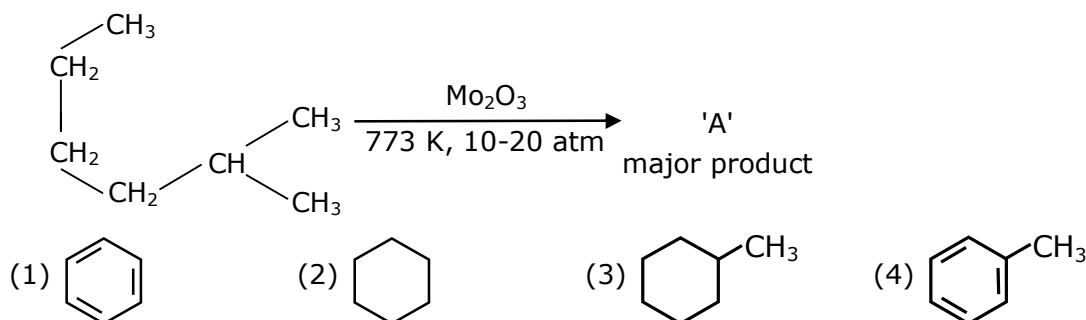
The value of 'n' is any natural number.

4. According to molecular orbital theory, the species among the following that does not exist is:  
 (1)  $He_2^-$                       (2)  $He_2^+$                       (3)  $O_2^{2-}$                       (4)  $Be_2$

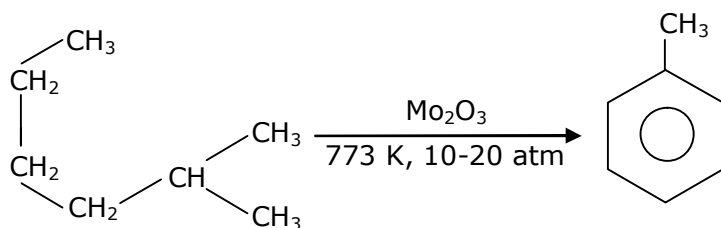
**Sol. (4)**

B.O. of  $Be_2$  is zero, So it does not exist.

5. Identify A in the given chemical reaction.



**Sol. (4)**



Aromatization reaction or hydroforming reaction.

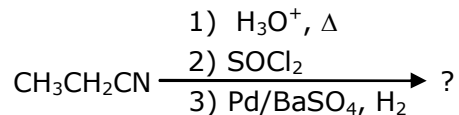
**6.** Given below are two statements:  
 Statement-I :  $\text{CeO}_2$  can be used for oxidation of aldehydes and ketones.  
 Statement-II : Aqueous solution of  $\text{EuSO}_4$  is a strong reducing agent.

- (1) Statement I is true, statement II is false  
 (2) Statement I is false, statement II is true  
 (3) Both Statement I and Statement II are false  
 (4) Both Statement I and Statement II are true

**Sol. (4)**

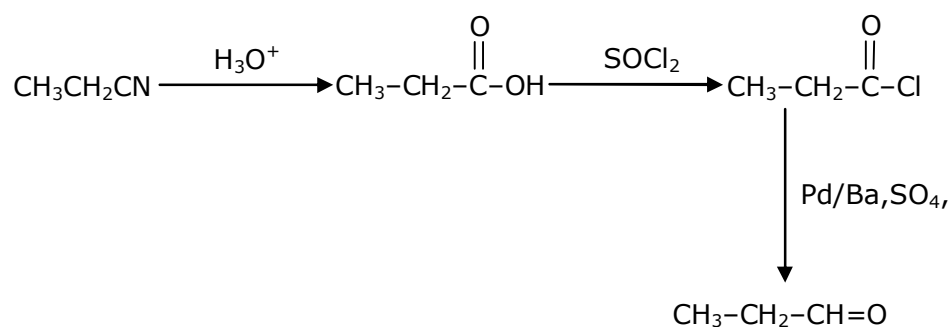
$\text{CeO}_2$  can be used as oxidising agent like  $\text{SeO}_2$ .  
 Similarly  $\text{EuSO}_4$  used as a reducing agent.

**7.** The major product of the following chemical reaction is:



- (1)  $(\text{CH}_3\text{CH}_2\text{CO})_2\text{O}$     (2)  $\text{CH}_3\text{CH}_2\text{CHO}$     (3)  $\text{CH}_3\text{CH}_2\text{CH}_3$     (4)  $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$

**Sol. (2)**



**8.** Complete combustion of 1.80 g of an oxygen containing compound ( $\text{C}_x\text{H}_y\text{O}_z$ ) gave 2.64 g of  $\text{CO}_2$  and 1.08 g of  $\text{H}_2\text{O}$ . The percentage of oxygen in the organic compound is:  
 (1) 63.53    (2) 53.33    (3) 51.63    (4) 50.33

**Sol. (2)**

$$n_{\text{CO}_2} = \frac{2.64}{44} = 0.06$$

$$n_c = 0.06$$

$$\text{weight of carbon} = 0.06 \times 12 = 0.72 \text{ gm}$$

$$n_{\text{H}_2\text{O}} = \frac{1.08}{18} = 0.06$$

$$n_H = 0.06 \times 2 = 0.12$$

$$\text{weight of H} = 0.12 \text{ gm}$$

$$\therefore \text{Weight of oxygen in } C_xH_yO_z$$

$$= 1.8 - (0.72 + 0.12)$$

$$= 0.96 \text{ gram}$$

$$\% \text{ weight of oxygen} = \frac{0.96}{1.8} \times 100$$

$$= 53.3\%$$

**9.** The correct statement about  $B_2H_6$  is:

(1) All B-H-B angles are of  $120^\circ$ .

(2) Its fragment,  $BH_3$ , behaves as a Lewis base.

(3) Terminal B-H bonds have less p-character when compared to bridging bonds.

(4) The two B-H-B bonds are not of same length.

**Sol. (3)**

Terminal bond angle is greater than that of bridge bond angle

Bond angle  $\propto$  s-character

$$\propto \frac{1}{p - \text{character}}$$

**10.** In which of the following pairs, the outer most electronic configuration will be the same?

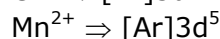
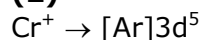
(1)  $Fe^{2+}$  and  $Co^+$

(2)  $Cr^+$  and  $Mn^{2+}$

(3)  $Ni^{2+}$  and  $Cu^+$

(4)  $V^{2+}$  and  $Cr^+$

**Sol. (2)**



**11.** Which statement is correct?

(1) Buna-S is a synthetic and linear thermosetting polymer

(2) Neoprene is addition copolymer used in plastic bucket manufacturing

(3) Synthesis of Buna-S needs nascent oxygen

(4) Buna-N is a natural polymer

**Sol. (3)**

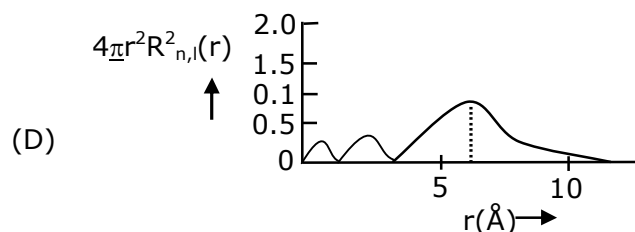
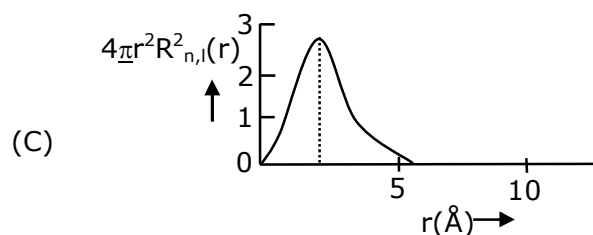
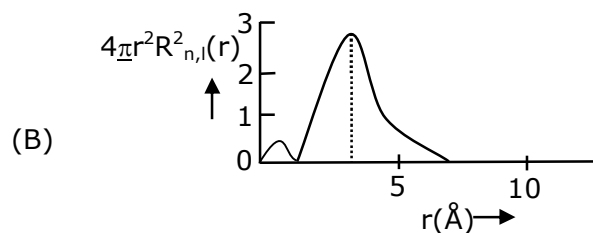
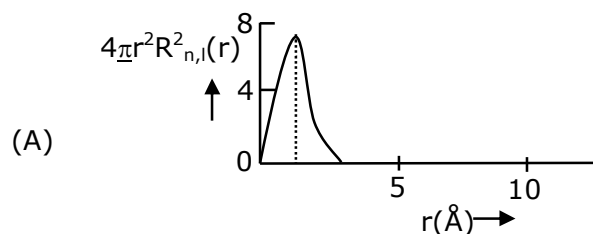
Synthesis of Buna-S needs nascent oxygen.

- 12.** Given below are two statements:  
 Statement-I : An allotrope of oxygen is an important intermediate in the formation of reducing smog.  
 Statement-II : Gases such as oxides of nitrogen and sulphur present in troposphere contribute to the formation of photochemical smog.  
 In the light of the above statements, choose the correct answer from the options given below:  
 (1) Statement I and Statement II are true  
 (2) Statement I is true about Statement II is false  
 (3) Both Statement I and Statement II are false  
 (4) Statement I is false but Statement II is true

**Sol. (3)**

Reducing smog as is acts as reducing agent, the reducing character is due to presence of sulphur dioxide and carbon particles.

- 13.** The plots of radial distribution functions for various orbitals of hydrogen atom against 'r' are given below:



The correct plot for 3s orbital is:

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

**Sol. (1)**

3s orbital

Number of radial nodes =  $n - \ell - 1$

For 3s orbital  $n = 3$   $\ell = 0$

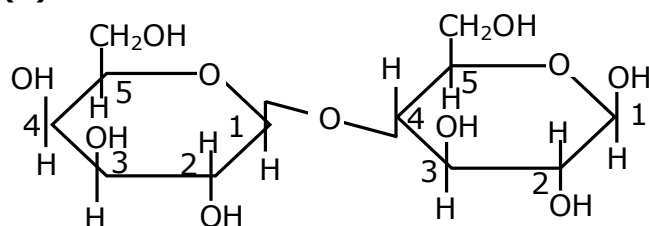
Number of radial nodes =  $3 - 0 - 1 = 2$

It is correctly represented in graph of option D

**14.** Which of the glycosidic linkage galactose and glucose is present in lactose?

- (1) C-1 of glucose and C-6 of galactose    (2) C-1 of galactose and C-4 of glucose  
 (3) C-1 of glucose and C-4 of galactose    (4) C-1 of galactose and C-6 of glucose

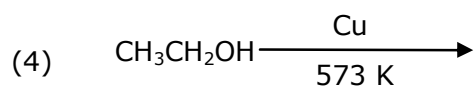
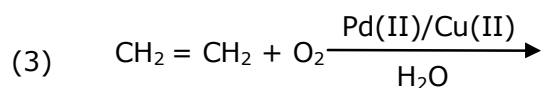
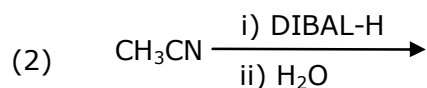
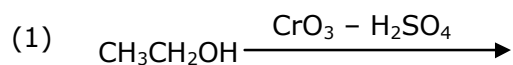
**Sol. (2)**



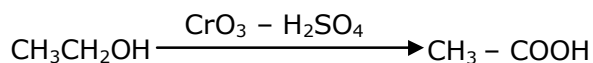
$\beta$ -D-Galactose

$\beta$ -D-Glucose

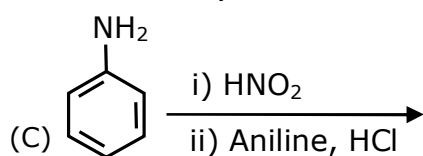
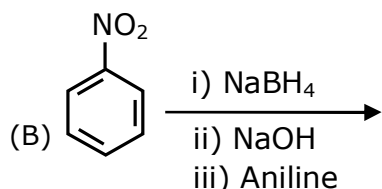
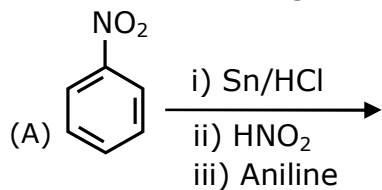
**15.** Which one of the following reactions will not form acetaldehyde?



**Sol. (1)**



16. Which of the following reaction/s will not give p-aminoazobenzene?



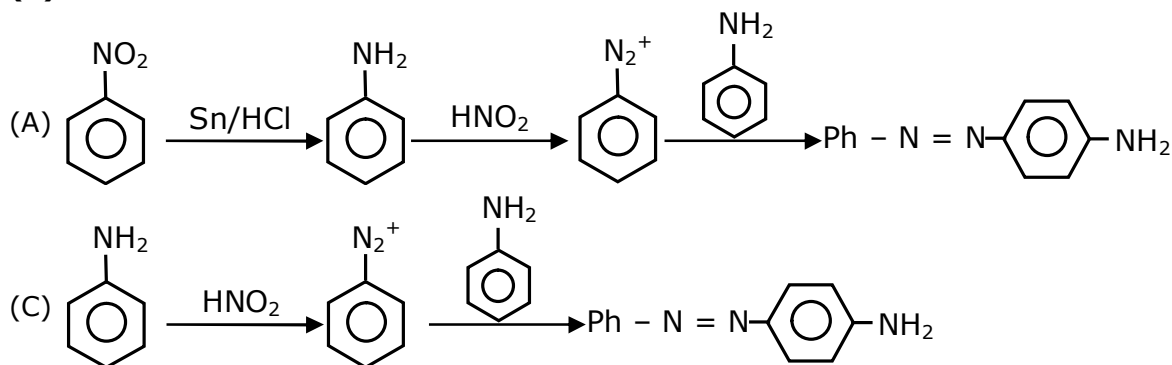
(1) B only

(2) A and B

(3) C only

(4) A only

Sol. (1)



17. The hybridization and magnetic nature of [Mn(CN)<sub>6</sub>]<sup>4-</sup> and [Fe(CN)<sub>6</sub>]<sup>3-</sup>, respectively are:

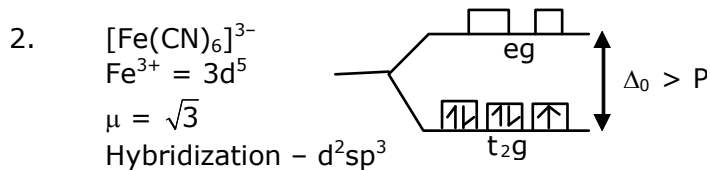
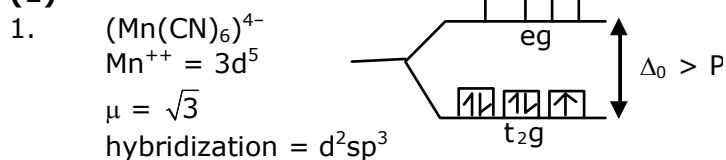
(1) d<sup>2</sup>sp<sup>3</sup> and paramagnetic

(2) sp<sup>3</sup>d<sup>2</sup> and paramagnetic

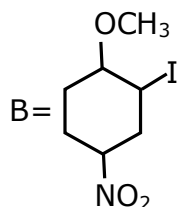
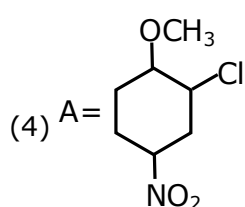
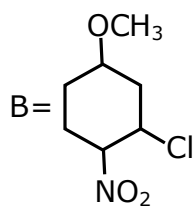
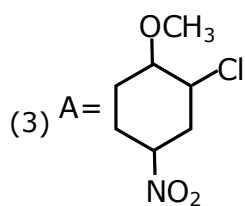
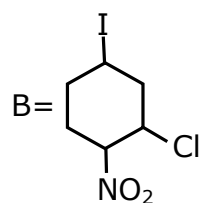
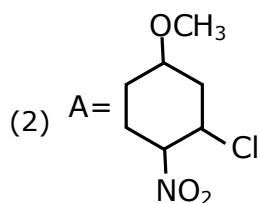
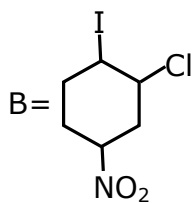
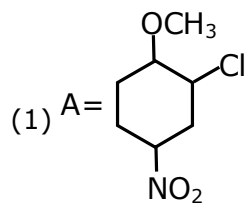
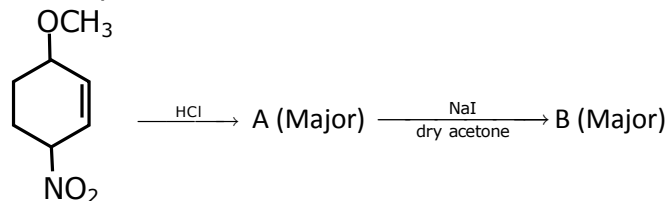
(3) d<sup>2</sup>sp<sup>3</sup> and diamagnetic

(4) sp<sup>3</sup>d<sup>2</sup> and diamagnetic

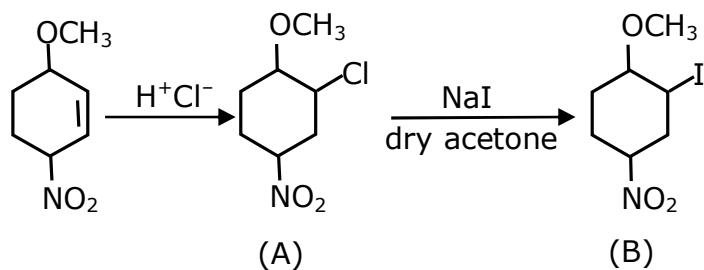
Sol. (1)



18. Identify A and B in the chemical reaction.

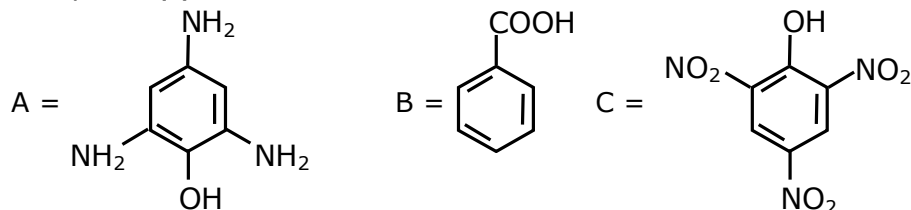


Sol. (4)





19. Compound(s) which will liberate carbon dioxide with sodium bicarbonate solution is/are:



- (1) B and C only      (2) B only      (3) A and B only      (4) C only

**Sol. (1)**

Compounds which are more acidic than  $\text{H}_2\text{CO}_3$ , gives  $\text{CO}_2$  gas on reaction with  $\text{NaHCO}_3$ . Compound B i.e. Benzoic acid and compound C i.e. picric acid both are more acidic than  $\text{H}_2\text{CO}_3$ .

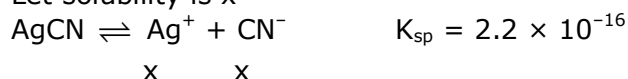
20. The solubility of  $\text{AgCN}$  in a buffer solution of  $\text{pH} = 3$  is  $x$ . The value of  $x$  is:

[Assume: No cyano complex is formed;  $K_{\text{sp}}(\text{AgCN}) = 2.2 \times 10^{-16}$  and  $K_a(\text{HCN}) = 6.2 \times 10^{-10}$ ]

(1)  $0.625 \times 10^{-6}$       (2)  $1.6 \times 10^{-6}$       (3)  $2.2 \times 10^{-16}$       (4)  $1.9 \times 10^{-5}$

**Sol. (4)**

Let solubility is  $x$



$$K_{\text{sp}} \times \frac{1}{K_a} = [\text{Ag}^+][\text{CN}^-] \times \frac{[\text{HCN}]}{[\text{H}^+][\text{CN}^-]}$$

$$2.2 \times 10^{-16} \times \frac{1}{6.2 \times 10^{-10}} = \frac{[\text{S}][\text{S}]}{10^{-3}}$$

$$S^2 = \frac{2.2}{6.2} \times 10^{-9}$$

$$S^2 = 3.55 \times 10^{-10}$$

$$S = \sqrt{3.55 \times 10^{-10}}$$

$$S = 1.88 \times 10^{-5} \Rightarrow 1.9 \times 10^{-5}$$

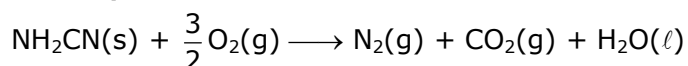
### SECTION - B

1. The reaction of cyanamide,  $\text{NH}_2\text{CN}_{(s)}$  with oxygen was run in a bomb calorimeter and  $\Delta U$  was found to be  $-742.24 \text{ kJ mol}^{-1}$ . The magnitude of  $\Delta H_{298}$  for the reaction



[Assume ideal gases and  $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ ]

**Sol. 741 kJ/mol**

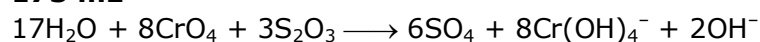


$$\Delta n_g = (1 + 1) - \frac{3}{2} = \frac{1}{2}$$

$$\begin{aligned}\Delta H &= \Delta U + \Delta ng RT \\ &= -742.24 + \frac{1}{2} \times \frac{8.314 \times 298}{1000} \\ &= -742.24 + 1.24 \\ &= 741 \text{ kJ/mol}\end{aligned}$$

2. In basic medium  $\text{CrO}_4^{2-}$  oxidizes  $\text{S}_2\text{O}_3^{2-}$  to form  $\text{SO}_4^{2-}$  and itself changes into  $\text{Cr}(\text{OH})_4^-$ . The volume of 0.154 M  $\text{CrO}_4^{2-}$  required to react with 40 mL of 0.25 M  $\text{S}_2\text{O}_3^{2-}$  is \_\_\_\_\_ mL. (Rounded-off to the nearest integer)

**Sol. 173 mL**

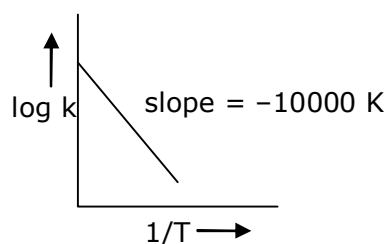


Applying mole-mole analysis

$$\frac{0.154 \times v}{8} = \frac{40 \times 0.25}{3}$$

$$V = 173 \text{ mL}$$

3. For the reaction,  $a\text{A} + b\text{B} \rightarrow c\text{C} + d\text{D}$ , the plot of  $\log k$  vs  $\frac{1}{T}$  is given below:



The temperature at which the rate constant of the reaction is  $10^{-4}\text{s}^{-1}$  is \_\_\_\_\_ K. [Rounded off to the nearest integer]

[Given: The rate constant of the reaction is  $10^{-5}\text{s}^{-1}$  at 500 K]

**Sol. 526 K**

$$\log_{10}K = \log_{10}A - \frac{E_a}{2.303RT}$$

$$\text{Slope} = \frac{E_a}{2.303R} = -10000$$

$$\log_{10} \frac{K_2}{K_1} = \frac{E_a}{2.303R} \times \left[ \frac{1}{T_1} - \frac{1}{T_2} \right]$$

$$\log_{10} \frac{10^{-4}}{10^{-5}} = 10000 \times \left[ \frac{1}{500} - \frac{1}{T} \right]$$

$$1 = 10000 \times \left[ \frac{1}{500} - \frac{1}{T} \right]$$

$$\frac{1}{10000} = \frac{1}{500} - \frac{1}{T}$$

$$\frac{1}{T} = \frac{1}{500} - \frac{1}{10000}$$

$$\frac{1}{T} = \frac{20 - 1}{10000} = \frac{19}{10000}$$

$$T = \frac{10,000}{19} \Rightarrow 526 \text{ K}$$

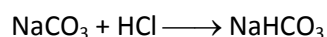
4. 0.4g mixture of NaOH, Na<sub>2</sub>CO<sub>3</sub> and some inert impurities was first titrated with  $\frac{N}{10}$  HCl using phenolphthalein as an indicator, 17.5 mL of HCl was required at the end point. After this methyl orange was added and titrated. 1.5 mL of same HCl was required for the next end point. The weight percentage of Na<sub>2</sub>CO<sub>3</sub> in the mixture is \_\_\_\_\_. (Rounded-off to the nearest integer)

**Sol. 3%**

**1<sup>st</sup> end point reaction**



$$nf = 1$$

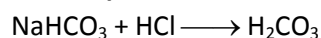


$$nf = 1$$

$$\text{Eq of HCl used} = n_{\text{NaOH}} \times 1 + n_{\text{Na}_2\text{CO}_3} \times 1$$

$$17.5 \times \frac{1}{10} \times 10^{-3} = n_{\text{NaOH}} + n_{\text{Na}_2\text{CO}_3}$$

**2<sup>nd</sup> end point**



$$1.5 \times \frac{1}{10} \times 10^{-3} = n_{\text{NaHCO}_3} \times 1 = n_{\text{NaHCO}_3}$$

$$0.15 \text{ mmol} = n_{\text{Na}_2\text{CO}_3}$$

$$0.15 = n_{\text{Na}_2\text{CO}_3}$$

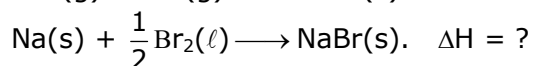
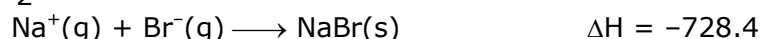
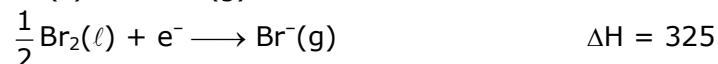
$$W_{\text{Na}_2\text{CO}_3} = \frac{0.15 \times 106 \times 10^{-3}}{0.5} \times 100 \times 10$$

$$= 3 \times 106 \times 10^{-2}$$

$$= 3 \times 1.06 = 3.18\%$$

5. The ionization enthalpy of Na<sup>+</sup> formation from Na<sub>(g)</sub> is 495.8 kJ mol<sup>-1</sup>, while the electron gain enthalpy of Br is -325.0 kJ mol<sup>-1</sup>. Given the lattice enthalpy of NaBr is -728.4 kJ mol<sup>-1</sup>. The energy for the formation of NaBr ionic solid is (-)\_\_\_\_\_ × 10<sup>-1</sup> kJ mol<sup>-1</sup>.

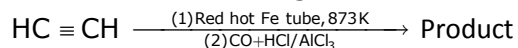
**Sol. 5576 kJ**



$$\Delta H = 495.8 - 325 - 728.4$$

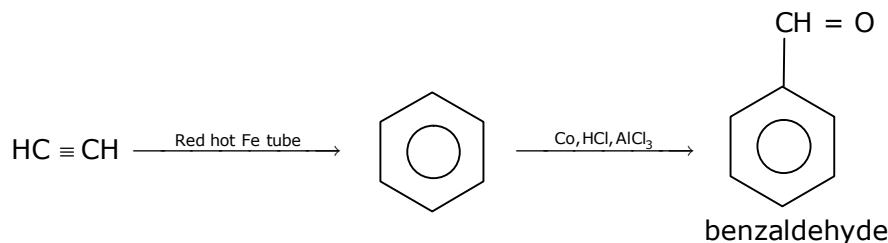
$$-557.6 \text{ kJ} = -5576 \times 10^{-1} \text{ kJ}$$

6. Consider the following chemical reaction.



The number of  $sp^2$  hybridized carbon atom(s) present in the product is \_\_\_\_\_.

**Sol. 7**



All carbon atoms in benzaldehyde are  $sp^2$  hybridised

7. A car tyre is filled with nitrogen gas at 35 psi at 27°C. It will burst if pressure exceeds 40 psi. The temperature in °C at which the car tyre will burst is \_\_\_\_\_. (Rounded-off to the nearest integer)

**Sol. 69.85°C ≈ 70°C**

$$\frac{P_1}{T_1} = \frac{P_2}{T_2}$$

$$\frac{35}{300} = \frac{40}{T_2}$$

$$T_2 = \frac{40 \times 300}{35}$$

$$= 342.86 \text{ K}$$

$$= 69.85^\circ\text{C} \approx 70^\circ\text{C}$$

8. Among the following, the number of halide(s) which is/are inert to hydrolysis is \_\_\_\_\_.

(A)  $\text{BF}_3$                       (B)  $\text{SiCl}_4$                       (C)  $\text{PCl}_5$                       (D)  $\text{SF}_6$

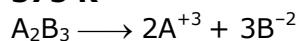
**Sol. 1**

Due to crowding  $\text{SF}_6$  is not hydrolysed.

9. 1 molal aqueous solution of an electrolyte  $\text{A}_2\text{B}_3$  is 60% ionised. The boiling point of the solution at 1 atm is \_\_\_\_\_ K. (Rounded-off to the nearest integer)

[Given  $K_b$  for  $(\text{H}_2\text{O}) = 0.52 \text{ K kg mol}^{-1}$ ]

**Sol. 375 K**



$$\text{No. of ions} = 2 + 3 = 5$$

$$i = 1 + (n - 1) \alpha$$

$$= 1 + (5 - 1) \times 0.6$$

$$= 1 + 4 \times 0.6 = 1 + 2.4 = 3.4$$

$$\Delta T_b = K_b \times m \times i$$

$$= 0.52 \times 1 \times 3.4 = 1.768^\circ\text{C}$$

$$\Delta T_b = (T_b)_{\text{solution}} - [(T_b)_{\text{H}_2\text{O}}]_{\text{solution}}$$

$$1.768 = (T_b)_{\text{solution}} - 100$$

$$(T_b)_{\text{solution}} = 101.768 \text{ }^\circ\text{C}$$

$$= 375 \text{ K}$$

10. Using the provided information in the following paper chromatogram:

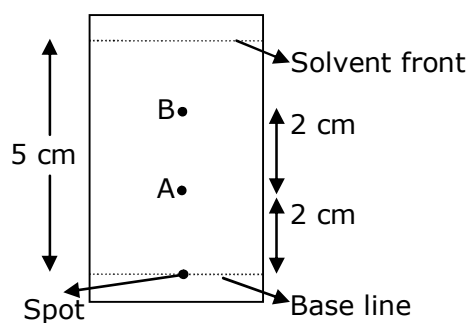


Fig: Paper chromatography for compounds A and B  
the calculated  $R_f$  value of A \_\_\_\_\_  $\times 10^{-1}$ .

**Sol. 4**

$$R_f = \frac{\text{Distance travelled by compound}}{\text{Distance travelled by solvent}}$$

On chromatogram distance travelled by compound is  $\rightarrow 2 \text{ cm}$

Distance travelled by solvent = 5 cm

$$\text{So } R_f = \frac{2}{5} = 4 \times 10^{-1} = 0.4$$