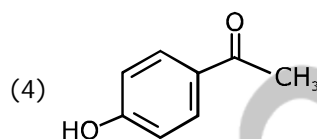
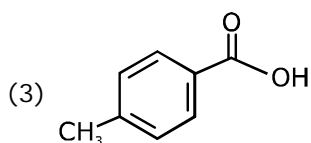
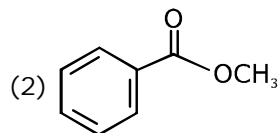
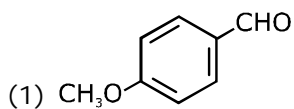
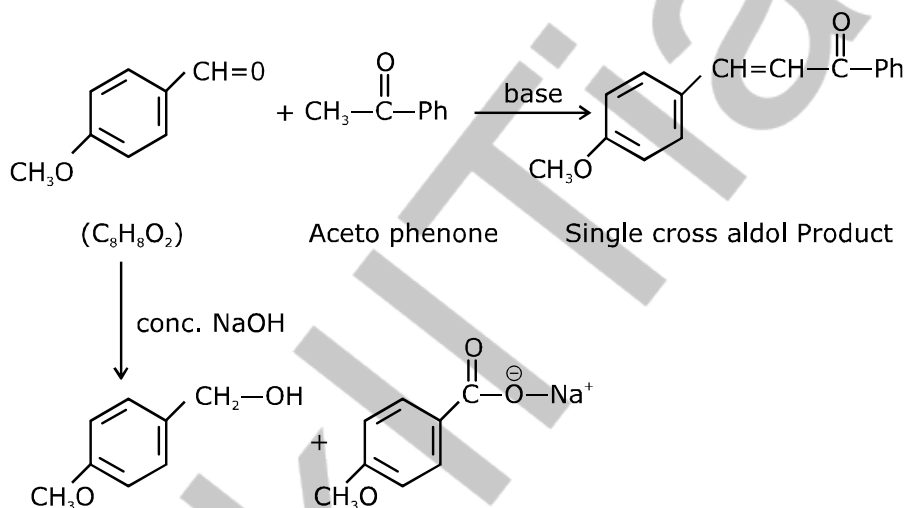


## CHEMISTRY

1. A compound of molecular formula  $C_8H_8O_2$  reacts with acetophenone to form a single cross-aldol product in the presence of base. The same compound on reaction with conc. NaOH forms benzyl alcohol as one of the products. The structure of the compound is :



Sol. 1



2. Which of the following ions does not liberate hydrogen gas on reaction with dilute acids ?  
 (1)  $V^{2+}$                       (2)  $Ti^{2+}$                       (3)  $Mn^{2+}$                       (4)  $Cr^{2+}$

Sol. 3

$Mn^{2+}$

3. The rate of a reaction quadruples when the temperature changes from 300 to 310 K. The activation energy of this reaction is :

(Assume activation energy and pre-exponential factor are independent of temperature;  $\ln 2 = 0.693$ ;  $R = 8.314 \text{ J mol}^{-1} \text{ K}^{-1}$ )

- (1)  $53.6 \text{ kJ mol}^{-1}$       (2)  $214.4 \text{ kJ mol}^{-1}$       (3)  $107.2 \text{ kJ mol}^{-1}$       (4)  $26.8 \text{ kJ mol}^{-1}$

**Sol. 3**

$$4 = \frac{E_a}{R} \left\{ \frac{1}{300} - \frac{1}{310} \right\}$$

$$\ln(4) = \frac{E_a}{R} \left\{ \frac{10}{300 \times 310} \right\}$$

$$E_a = \frac{0.693 \times 2 \times 8.314 \times 300 \times 310}{10}$$

$$= 107165.79 \text{ J} = 107.165 \text{ KJ}$$

**4.** The group having triangular planar structure is :

(1)  $\text{BF}_3, \text{NF}_3, \text{CO}_3^{2-}$  (2)  $\text{CO}_3^{2-}, \text{NO}_3^-, \text{SO}_3$  (3)  $\text{NH}_3, \text{SO}_3, \text{CO}_3^{2-}$  (4)  $\text{NCl}_3, \text{BCl}_3, \text{SO}_3$

**Sol. 2**

$\text{CO}_3^{2-}, \text{NO}_3^-, \text{SO}_3$  :  $\text{SP}^2$  Hybridised

**5.** The electronic configuration with the highest ionization enthalpy is :

(1)  $[\text{Ar}] 3d^{10} 4s^2 4p^3$  (2)  $[\text{Ne}] 3s^2 3p^1$  (3)  $[\text{Ne}] 3s^2 3p^3$  (4)  $[\text{Ne}] 3s^2 3p^2$

**Sol. 3**

$S_1 < P_1 < S_2 < P_2 < P_4 < P_3 < P_5 < P_6$  (IE order)

**6.** The electron in the hydrogen atom undergoes transition from higher orbitals to orbital of radius 211.6 pm. This transition is associated with :

(1) Lyman series (2) Balmer series (3) Brackett series (4) Paschen series

**Sol. 2**

$$R = 211.6 \text{ pm} = 2.11 \text{ \AA}$$

$$R = 0.529 \times \frac{n^2}{Z} = 2.11 \text{ \AA} \quad n^2 = 4 \Rightarrow n = 2$$

**7.** Which one of the following is an oxide ?

(1)  $\text{SiO}_2$  (2)  $\text{KO}_2$  (3)  $\text{BaO}_2$  (4)  $\text{CsO}_2$

**Sol. 1**

$\text{SiO}_2$

**8.** 50 mL of 0.2 M ammonia solution is treated with 25 mL of 0.2 M HCl. If  $\text{pK}_b$  of ammonia solution is 4.75, the pH of the mixture will be :

(1) 8.25 (2) 9.25 (3) 3.75 (4) 4.75

**Sol. 4**



$$\frac{50 \times 0.2}{1000} \quad \frac{25 \times 0.2}{1000}$$

5                      0                      5

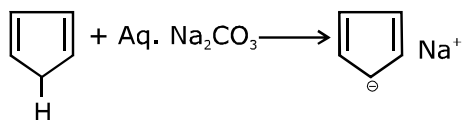
Buffer solution

$$\text{pOH} = \text{pkb NH}_3 + \text{Hg} \frac{\text{salt}}{\text{base}} = 4.75$$

9. Which of the following compounds is most reactive to an aqueous solution of sodium carbonate ?



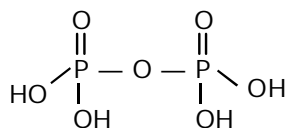
Sol. 3



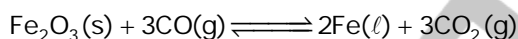
10. The number of P–OH bonds and the oxidation state of phosphorus atom in pyrophosphoric acid ( $\text{H}_4\text{P}_2\text{O}_7$ ) respectively are :

- (1) five and four      (2) four and five      (3) five and five      (4) four and four

Sol. 2



11. The following reaction occurs in the Blast Furnace where iron ore is reduced to iron metal :



Using the Le Chatelier's principle, predict which one of the following will not disturb the equilibrium ?

- (1) Addition of  $\text{CO}_2$       (2) Removal of  $\text{CO}_2$       (3) Addition of  $\text{Fe}_2\text{O}_3$       (4) Removal of CO

Sol. 3

12. A solution is prepared by mixing 8.5 g of  $\text{CH}_2\text{Cl}_2$  and 11.95 g of  $\text{CHCl}_3$ . If vapour pressure of  $\text{CH}_2\text{Cl}_2$  and  $\text{CHCl}_3$  at 298 K are 415 and 200 mm Hg respectively, the mole fraction of  $\text{CHCl}_3$  in vapour form is : (Molar mass of Cl = 35.5 g mol<sup>-1</sup>)

- (1) 0.162      (2) 0.675      (3) 0.325      (4) 0.486

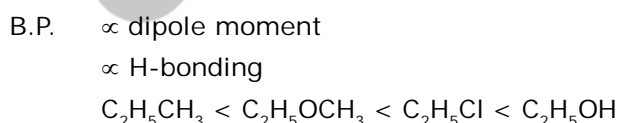
Sol. 3

13. The increasing order of the boiling points for the following compounds is :



- (1) (IV) < (III) < (I) < (II)      (2) (III) < (II) < (I) < (IV)  
 (3) (III) < (IV) < (II) < (I)      (4) (II) < (III) < (IV) < (I)

Sol. 3



14. An ideal gas undergoes isothermal expansion at constant pressure. During the process :
- (1) enthalpy remains constant but entropy increases.
  - (2) enthalpy decreases but entropy increases.
  - (3) enthalpy increases but entropy decreases.
  - (4) Both enthalpy and entropy remain constant.

Sol. 1

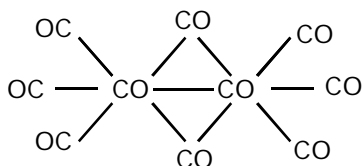
$$\Delta H = nC_p \Delta T = 0$$

$$\Delta S = nR \ln(V_f/V_i) \geq 0$$

15.  $[\text{Co}_2(\text{CO})_8]$  displays :

- (1) no Co–Co bond, six terminal CO and two bridging CO
- (2) no Co–Co bond, four terminal CO and four bridging CO
- (3) one Co–Co bond, six terminal CO and two bridging CO
- (4) one Co–Co bond, four terminal CO and four bridging CO

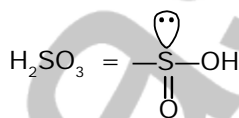
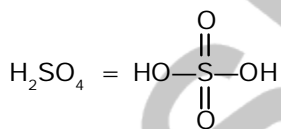
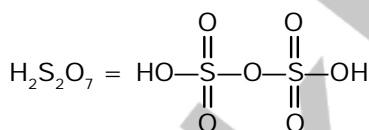
Sol. 3



16. The correct sequence of decreasing number of  $\pi$ -bonds in the structure of  $\text{H}_2\text{SO}_3$ ,  $\text{H}_2\text{SO}_4$  and  $\text{H}_2\text{S}_2\text{O}_7$  is :

- (1)  $\text{H}_2\text{S}_2\text{O}_7 > \text{H}_2\text{SO}_3 > \text{H}_2\text{SO}_4$
- (2)  $\text{H}_2\text{S}_2\text{O}_7 > \text{H}_2\text{SO}_4 > \text{H}_2\text{SO}_3$
- (3)  $\text{H}_2\text{SO}_4 > \text{H}_2\text{S}_2\text{O}_7 > \text{H}_2\text{SO}_3$
- (4)  $\text{H}_2\text{SO}_3 > \text{H}_2\text{SO}_4 > \text{H}_2\text{S}_2\text{O}_7$

Sol. 2



17. At 300 K, the density of a certain gaseous molecule at 2 bar is double to that of dinitrogen ( $\text{N}_2$ ) at 4 bar. The molar mass of gaseous molecule is :

- (1) 224 g mol<sup>-1</sup>
- (2) 112 g mol<sup>-1</sup>
- (3) 56 g mol<sup>-1</sup>
- (4) 28 g mol<sup>-1</sup>

Sol. 4



22. Adsorption of a gas on a surface follows Freundlich adsorption isotherm. Plot of  $\log \frac{x}{m}$  versus  $\log$

$p$  gives a straight line with slope equal to 0.5, then : ( $\frac{x}{m}$  is the mass of the gas adsorbed per gram of adsorbent)

- (1) Adsorption is proportional to the square root of pressure.
- (2) Adsorption is proportional to the square of pressure.
- (3) Adsorption is proportional to the pressure.
- (4) Adsorption is independent of pressure.

Sol. 1

$$\log\left(\frac{x}{m}\right) = \frac{1}{2}\log(P) + K$$

$$\frac{x}{m} = KP^{1/2}$$

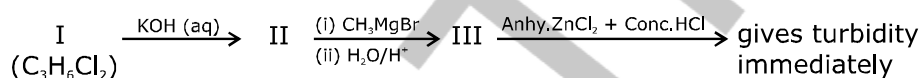
23. The incorrect statement among the following is :

- (1)  $\alpha$ -D-glucose and  $\beta$ -D-glucose are enantiomers.
- (2) The penta acetate of glucose does not react with hydroxyl amine.
- (3)  $\alpha$ -D-glucose and  $\beta$ -D-glucose are anomers.
- (4) Cellulose is a straight chain polysaccharide made up of only  $\beta$ -D-glucose units.

Sol. 1

$\alpha$ -D-Glucose and  $\beta$ -D-glucose are anomer not enantiomer.

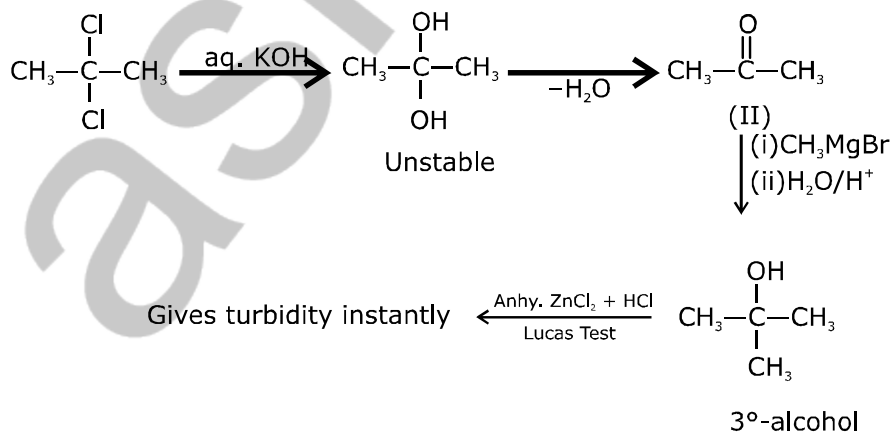
24. In the following reaction sequence :



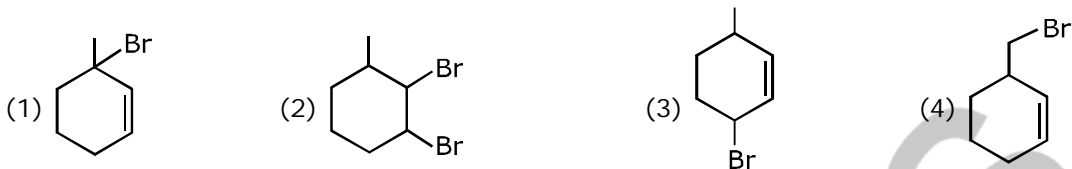
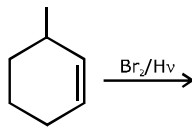
The compound I is :

- (1)  $\text{CH}_3 - \overset{\text{Cl}}{\underset{\text{Cl}}{\text{C}}} - \text{CH}_3$
- (2)  $\text{Cl} - \overset{\text{Cl}}{\text{CH}} - \text{CH}_2 - \text{CH}_3$
- (3)  $\overset{\text{CH}_2}{\text{Cl}} - \overset{\text{CH}}{\text{Cl}} - \text{CH}_3$
- (4)  $\overset{\text{CH}_2}{\text{Cl}} - \text{CH}_2 - \overset{\text{CH}_2}{\text{Cl}}$

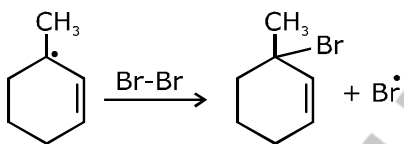
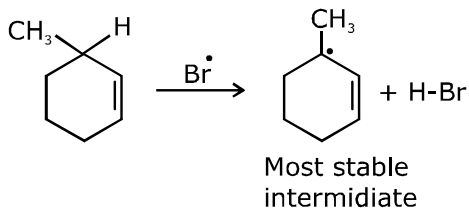
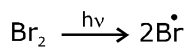
Sol. 1



25. The major product of the following reaction is :



Sol. 1



26. Among the following compounds, the increasing order of their basic strength is :



(1) (II) < (I) < (III) < (IV)

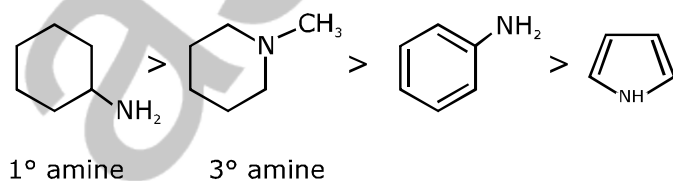
(2) (II) < (I) < (IV) < (III)

(3) (I) < (II) < (IV) < (III)

(4) (I) < (II) < (III) < (IV)

Sol. 1

Order of basicity





27. What quantity (in mL) of a 45% acid solution of a mono-protic strong acid must be mixed with a 20% solution of the same acid to produce 800 mL of a 29.875% acid solution ?

- (1) 316 (2) 320 (3) 325 (4) 330

Sol. 1

$$\frac{V \times 45}{100} + \frac{(800 - V)20}{100} = \frac{800 \times 29.875}{100}$$

$$\frac{9V}{20} + 160 - \frac{V}{5} = 239$$

$$\frac{5V}{20} = 79 \Rightarrow V = 316 \text{ Ans.}$$

28. To find the standard potential of  $M^{3+}/M$  electrode, the following cell is constituted :  $Pt/M/M^{3+}$  ( $0.001 \text{ mol L}^{-1}$ )/ $Ag^+$  ( $0.01 \text{ mol L}^{-1}$ )/ $Ag$

The emf of the cell is found to be 0.421 volt at 298 K. The standard potential of half reaction  $M^{3+} + 3e^- \rightarrow M$  at 298 K will be : (Given  $E^\ominus_{Ag^+/Ag}$  at 298 K = 0.80 volt)

(1) 0.38 volt (2) 1.28 volt (3) 0.32 volt (4) 0.66 volt

- (1) 0.38 volt (2) 1.28 volt (3) 0.32 volt (4) 0.66 volt

Sol. 3

$$0.421 = E^\ominus - \frac{0.059}{3} \log \frac{0.001}{(0.01)^3}$$

$$E^\ominus = 0.421 + \frac{0.059}{3} \log(10^3)$$

$$E^\ominus = 0.480 = 0.8 - E^\ominus_{M^{3+}/M}$$

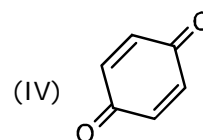
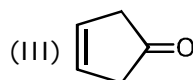
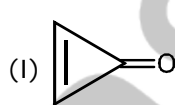
$$E^\ominus_{M^{3+}/M} = 0.32$$

29. Which of the following is a set of green house gases ?

- (1)  $O_3, NO_2, SO_2, Cl_2$  (2)  $CH_4, O_3, N_2, SO_2$  (3)  $CO_2, CH_4, N_2O, O_3$  (4)  $O_3, N_2, CO_2, NO_2$

Sol. 3

30. Which of the following compounds will show highest dipole moment ?



(1) (II)

(2) (IV)

(3) (III)

(4) (I)

Sol. 1



Exist in  
Zwitter ion