

CHEMISTRY

SECTION - A

Multiple Choice Questions: This section contains 20 multiple choice questions. Each question has 4 choices (1), (2), (3) and (4), out of which **ONLY ONE** is correct.

Choose the correct answer :

1. Given below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R**
Assertion A: Zero orbital overlap is an out of phase overlap.

Reason R: It results due to different orientation/direction of approach of orbitals.

In the light of the above statements, choose the **correct** answer from the options given below

- (A) Both A and R are true and R is the correct explanation of A
(B) Both A and R are true but R is NOT the correct explanation of A
(C) A is true but R is false
(D) A is false but R is true

Answer (A)

Zero overlapping is something in which there is no overlapping between two orbitals. The first condition is that the two orbitals should not be symmetrical and the second condition is that both orbitals should be in different planes.

2. The correct decreasing order for metallic character is
(A) $\text{Na} > \text{Mg} > \text{Be} > \text{Si} > \text{P}$
(B) $\text{P} > \text{Si} > \text{Be} > \text{Mg} > \text{Na}$
(C) $\text{Si} > \text{P} > \text{Be} > \text{Na} > \text{Mg}$
(D) $\text{Be} > \text{Na} > \text{Mg} > \text{Si} > \text{P}$

Answer (A)

Metallic character increases top to bottom in group and decreases left to right in a period.

Mg is from second group it will be less metallic than Na. Be comes above Mg hence less metallic than Mg. Si is more metallic than phosphorous.

3. Given below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R**
Assertion A: The reduction of a metal oxide is easier if the metal formed is in liquid state than solid state.

Reason R: The value of $\Delta G^\ominus$ becomes more on negative side as entropy is higher in liquid state than solid state.

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

- (A) Both A and R are correct and R is the correct explanation of A
(B) Both A and R are correct but R is not the correct explanation of A
(C) A is correct but R is not correct
(D) A is not correct but R is correct

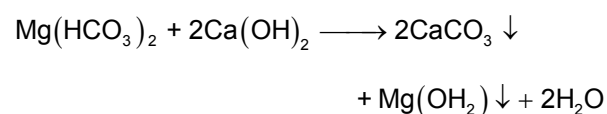
Answer (A)

Reduction of a metal oxide is easier if the metal is formed in a liquid state at the temperature of reduction because the entropy is higher if the metal is in a liquid state.

4. The products obtained during treatment of hard water using Clark's method are:
(A) CaCO_3 and MgCO_3
(B) Ca(OH)_2 and Mg(OH)_2
(C) CaCO_3 and Mg(OH)_2
(D) Ca(OH)_2 and MgCO_3

Answer (C)

Clark's method :



5. **Statement-I:** An alloy of lithium and magnesium is used to make aircraft plates.

Statement-II: The magnesium ions are important for cell-membrane integrity.

In the light of the above statements, choose the **correct** answer from the options given below:

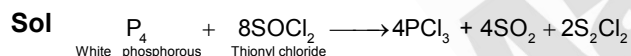
- (A) Both Statement-I and Statement-II are true
(B) Both Statement-I and Statement-II are false
(C) Statement-I is true but Statement-II is false
(D) Statement-I is false but Statement-II is true

Answer (B)

Magnesium alloys are used to make body of aircraft which is lightweight and resistant to corrosion. Calcium is responsible for cell membrane integrity.

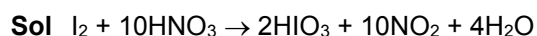
6. White phosphorus reacts with thionyl chloride to give
- (A) PCl_5 , SO_2 and S_2Cl_2
(B) PCl_3 , SO_2 and S_2Cl_2
(C) PCl_3 , SO_2 and Cl_2
(D) PCl_5 , SO_2 and Cl_2

Answer (B)



7. Concentrated HNO_3 reacts with Iodine to give
- (A) HI , NO_2 and H_2O (B) HIO_2 , N_2O and H_2O
(C) HIO_3 , NO_2 and H_2O (D) HIO_4 , N_2O and H_2O

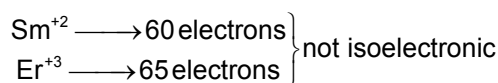
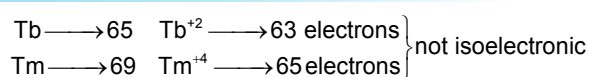
Answer (C)



8. Which of the following pair is not isoelectronic species?
- (At. no. Sm, 62; Er, 68; Yb, 70; Lu, 71; Eu, 63; Tb, 65; Tm, 69)
- (A) Sm^{2+} and Er^{3+} (B) Yb^{2+} and Lu^{3+}
(C) Eu^{2+} and Tb^{4+} (D) Tb^{2+} and Tm^{4+}

Answer (A, D)

Sol Species having same number of electrons are isoelectronic



9. Given below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A: Permanganate titrations are not performed in presence of hydrochloric acid.

Reason R: Chlorine is formed as a consequence of oxidation of hydrochloric acid.

In the light of the above statements, choose the **correct** answer from the options given below.

- (A) Both **A** and **R** are true and **R** is the correct explanation of **A**
(B) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**
(C) **A** is true but **R** is false
(D) **A** is false but **R** is true

Answer (A)

Sol HCl is not used in the process of titration because it reacts with the (KMnO_4) that is used in the process and gets oxidized.

10. Match **List-I** with **List-II**

List I (Complex)	List II (Hybridization)
A. $\text{Ni}(\text{CO})_4$	I. sp^3
B. $[\text{Ni}(\text{CN})_4]^{2-}$	II. sp^3d^2
C. $[\text{Co}(\text{CN})_6]^{3-}$	III. d^2sp^3
D. $[\text{CoF}_6]^{3-}$	IV. dsp^2

Choose the correct answer from the options given below:

- (A) A-IV, B-I, C-III, D-II
(B) A-I, B-IV, C-III, D-II
(C) A-I, B-IV, C-II, D-III
(D) A-IV, B-I, C-II, D-III

Answer (B)

Sol A. $\text{Ni}(\text{CO})_4 \rightarrow \text{sp}^3$

B. $[\text{Ni}(\text{CN})_4]^{-2} \rightarrow \text{dsp}^2$

C. $[\text{Co}(\text{CN})_6]^{-3} \rightarrow \text{d}^2\text{sp}^3$

D. $[\text{CoF}_6]^{-3} \rightarrow \text{sp}^3\text{d}^2$

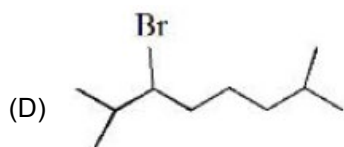
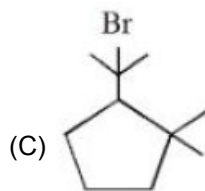
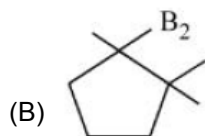
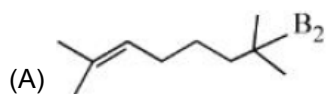
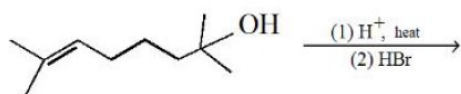
11. Dinitrogen and dioxygen, the main constituents of air do not react with each other in atmosphere to form oxides of nitrogen because

- (A) N_2 is unreactive in the condition of atmosphere
- (B) Oxides of nitrogen are unstable
- (C) Reaction between them can occur in the presence of a catalyst
- (D) The reaction is endothermic and require very high temperature

Answer (D)

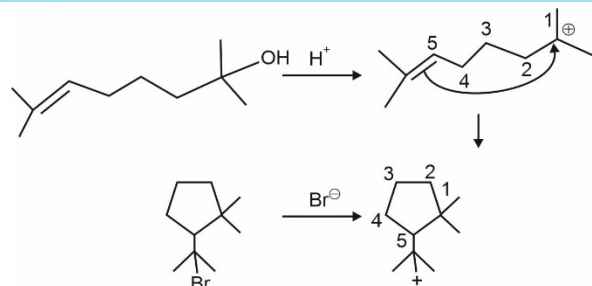
Sol. N_2 is unreactive, its reaction with oxides is endothermic and require very high temperature.

12. The major product in the given reaction is



Answer (C)

Sol.



13. Arrange the following in increasing order of reactivity towards nitration

- A. p-xylene
- B. bromobenzene
- C. mesitylene
- D. nitrobenzene
- E. benzene

(A) $\text{C} < \text{D} < \text{E} < \text{A} < \text{B}$

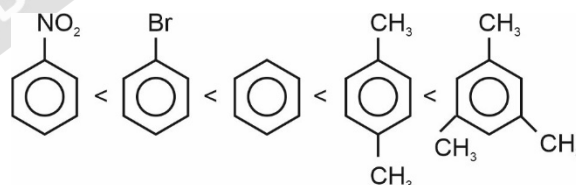
(B) $\text{D} < \text{B} < \text{E} < \text{A} < \text{C}$

(C) $\text{D} < \text{C} < \text{E} < \text{A} < \text{B}$

(D) $\text{C} < \text{D} < \text{E} < \text{B} < \text{A}$

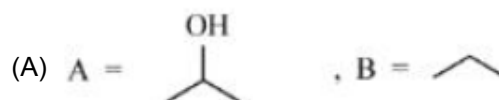
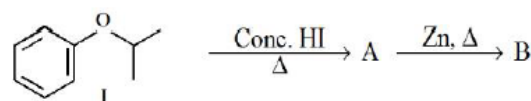
Answer (B)

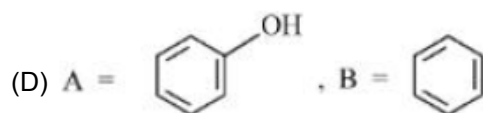
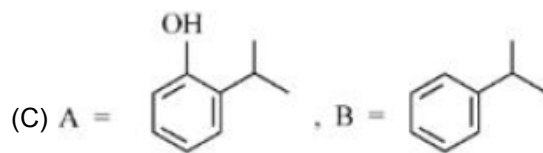
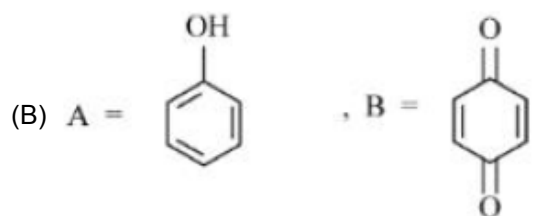
Sol. The correct order of reactivity towards nitration is



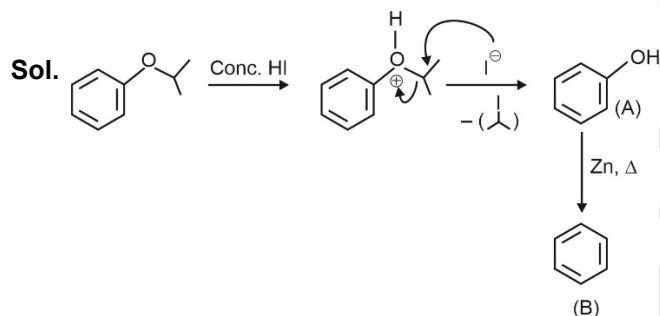
as electron releasing groups on benzene ring facilitate the nitration at benzene ring.

14. Compound I is heated with Conc. HI to give a hydroxy compound A which is further heated with Zn dust to give compound B. Identify A and B.





Answer (D)



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

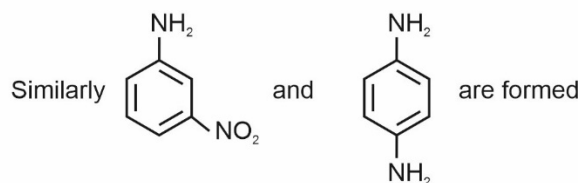
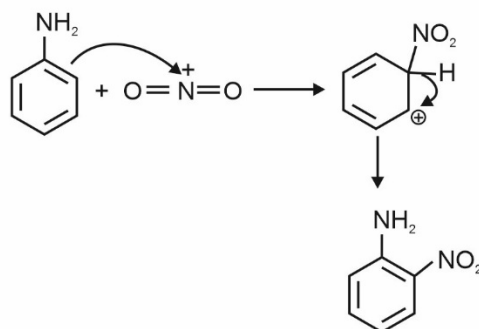
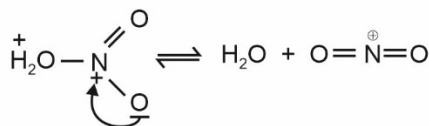
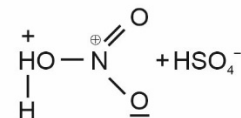
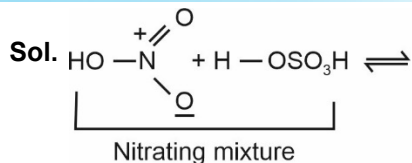
Assertion A : Aniline on nitration yields ortho, meta & para nitro derivatives of aniline.

Reason R : Nitrating mixture is a strong acidic mixture.

In the light of the above statements, choose the correct answer from the options given below.

- (A) Both **A** and **R** are true and **R** is the correct explanation of **A**
 (B) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**
 (C) **A** is true but **R** is false
 (D) **A** is false but **R** is true

Answer (A)



16. Match List I with List II

List I (Polymer)	List II (Nature)
A. $\left[\text{CH}_2 - \underset{\text{Cl}}{\text{C}} = \text{CH} - \text{CH}_2 \right]_n$	I. Thermosetting polymer
B. $\left[\text{N} \left(\text{CH}_2 \right)_6 \text{N} \left(\text{C} \left(\text{O} \right) \left(\text{CH}_2 \right)_4 \text{C} \left(\text{O} \right) \right) \right]_n$	II. Fibers
C. $\left[\text{CH}_2 - \underset{\text{Cl}}{\text{CH}} \right]_n$	III. Elastomer
D. $\left[\text{O} - \text{H} - \text{CH}_2 - \text{C}_6\text{H}_4 - \text{CH}_2 - \text{C}_6\text{H}_4 - \text{O} - \text{H} \right]_n$	IV. Thermoplastic polymer

Choose the correct answer from the options given below:

- (A) A-II, B-III, C-IV, D-I (B) A-III, B-II, C-IV, D-I
 (C) A-III, B-I, C-IV, D-II (D) A-I, B-III, C-IV, D-II

Answer (B)

- Sol.** (A) $\left[\text{CH}_2 - \underset{\text{Cl}}{\text{C}} = \text{CH} - \text{CH}_2 \right]_n$ — Elastomer
- (B) $\left[\text{N} - (\text{CH}_2)_6 - \text{N} - \overset{\text{O}}{\parallel} \text{C} - (\text{CH}_2)_4 - \overset{\text{O}}{\parallel} \text{C} \right]_n$ — Fibers
- (C) $\left[\text{CH}_2 - \underset{\text{Cl}}{\text{CH}} \right]_n$ — Thermoplastic polymer
- (D) $\left[\text{C}_6\text{H}_4(\text{OH}) - \text{CH}_2 - \text{C}_6\text{H}_4(\text{OH}) - \text{CH}_2 \right]_n$ — Thermosetting polymer

17. Two statements in respect of drug-enzyme interaction are given below

Statement I: Action of an enzyme can be blocked only when an inhibitor blocks the active site of the enzyme.

Statement II: An inhibitor can form a strong covalent bond with the enzyme.

In the light of the above statements, choose the correct answer from the options given below

- (A) Both Statement I and Statement II are true
(B) Both Statement I and Statement II are false
(C) Statement I is true but Statement II is false
(D) Statement I is false but Statement II is true

Answer (D)

Sol. Action of an enzyme can be altered by a number of factors like temperature, pH, presence of activators and coenzymes and presence of inhibitors and poisons.

Inhibitors or poisons interact with the active functional groups on the enzyme surface and often reduce or completely destroy the catalytic activity of the enzymes.

18. Given below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R**.

Assertion A: Thin layer chromatography is an adsorption chromatography.

Reason R: A thin layer of silica gel is spread over a glass plate of suitable size in thin layer chromatography which acts as an adsorbent.

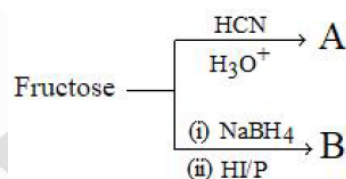
In the light of the above statements, choose the **correct** answer from the options given below

- (A) Both **A** and **R** are true and **R** is the correct explanation of **A**.
(B) Both **A** and **R** are true but **R** is NOT the correct explanation of **A**
(C) **A** is true but **R** is false
(D) **A** is false but **R** is true

Answer (A)

Sol. Thin layer chromatography is an adsorption chromatography. A thin layer of silica gel is spread over a glass plate of suitable size and act as an adsorbent.

19. The formulas of A and B for the following reaction sequence

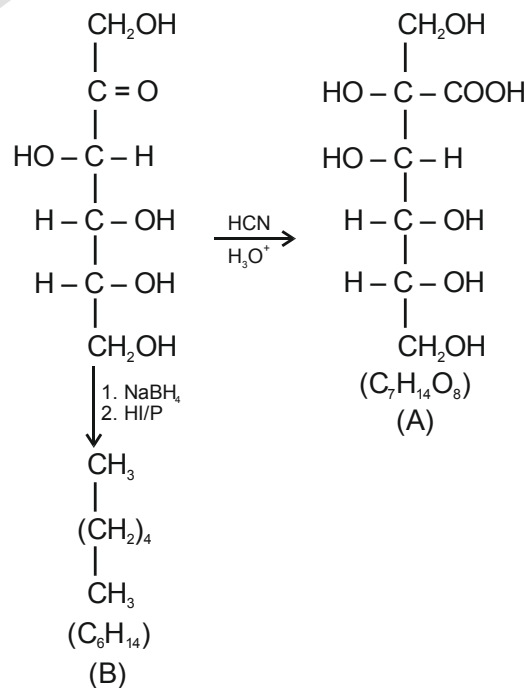


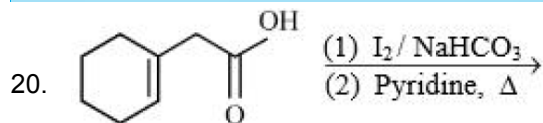
are

- (A) $\text{A} = \text{C}_7\text{H}_{14}\text{O}_8$, $\text{B} = \text{C}_6\text{H}_{14}$
(B) $\text{A} = \text{C}_7\text{H}_{13}\text{O}_7$, $\text{B} = \text{C}_7\text{H}_{14}\text{O}$
(C) $\text{A} = \text{C}_7\text{H}_{12}\text{O}_8$, $\text{B} = \text{C}_6\text{H}_{14}$
(D) $\text{A} = \text{C}_7\text{H}_{14}\text{O}_8$, $\text{B} = \text{C}_6\text{H}_{14}\text{O}_6$

Answer (A)

Sol.



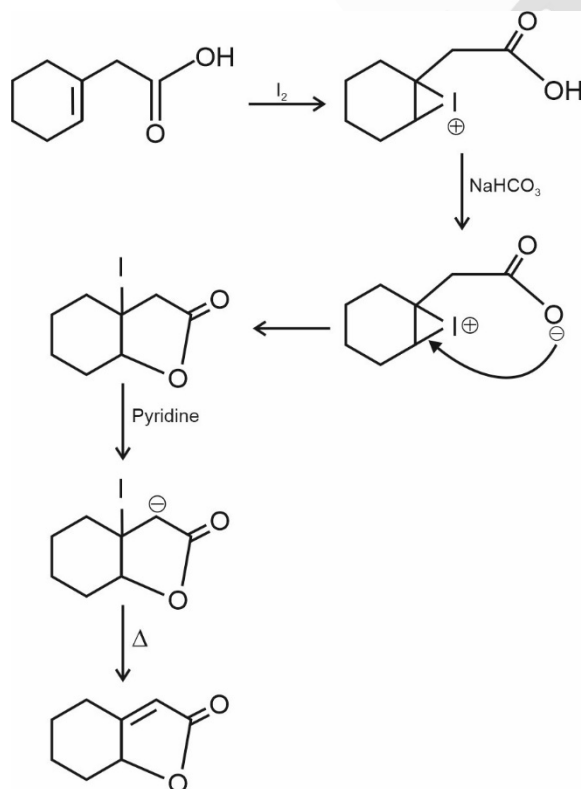


Find out the major product for the above reaction.

- (A)
- (B)
- (C)
- (D)

Answer (C)

Sol.



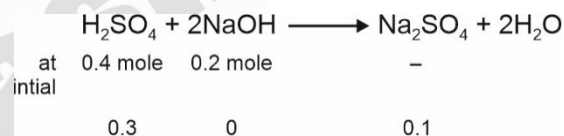
SECTION - B

Numerical Value Type Questions: This section contains 10 questions. In Section B, attempt any five questions out of 10. The answer to each question is a **NUMERICAL VALUE**. For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the second decimal place; e.g. 06.25, 07.00, -00.33, -00.30, 30.27, -27.30) using the mouse and the on-screen virtual numeric keypad in the place designated to enter the answer.

1. 2 L of 0.2 M H_2SO_4 is reacted with 2 L of 0.1 M NaOH solution, the molarity of the resulting product Na_2SO_4 in the solution is _____ millimolar. (Nearest integer)

Answer (25)

Sol.



$$\text{Molarity of Na}_2\text{SO}_4 = \frac{0.1}{4} = 0.025 \text{ M}$$

$$= 25 \text{ millimolar.}$$

2. Metal M crystallizes into a fcc lattice with the edge length of 4.0×10^{-8} cm. The atomic mass of the metal is _____ g/mol. (Nearest integer)
- (Use : $N_A = 6.02 \times 10^{23} \text{ mol}^{-1}$, density of metal, $M = 9.03 \text{ g cm}^{-3}$)

Answer (87)

$$\begin{aligned} \text{Sol. } \rho &= \frac{ZM}{N_A a^3} \Rightarrow M = \frac{9.03 \times 6.02 \times 10^{23} \times (4 \times 10^{-8})^3}{4} \\ &= \frac{9.03 \times 6.02 \times 64 \times 10^{-1}}{4} \\ &= 86.9 \text{ g mol}^{-1} \\ &\approx 87 \text{ g mol}^{-1} \end{aligned}$$

3. If the wavelength for an electron emitted from H-atom is 3.3×10^{-10} m, then energy absorbed by the electron in its ground state compared to minimum energy required for its escape from the atom, is _____ times. (Nearest integer)

[Given : $h = 6.626 \times 10^{-34}$ J s]

[Mass of electron = 9.1×10^{-31} kg]

Answer (2)

Sol. $\lambda = \frac{h}{mv}$

$$\Rightarrow mv = \frac{h}{\lambda} = \frac{6.626 \times 10^{-34} \text{ kg} \frac{\text{m}^2}{\text{sec}^2} \times \text{sec}}{3.3 \times 10^{-10} \text{ m}}$$

$$mv = \frac{6.626 \times 10^{-24}}{3.3} = 2 \times 10^{-24} \text{ kg m sec}^{-1}$$

$$\text{Kinetic energy} = \frac{1}{2}mv^2$$

$$= \frac{(mv)^2}{2m}$$

$$= \frac{(2 \times 10^{-24})^2}{2 \times 9.1 \times 10^{-31} \text{ kg}}$$

$$= 2.18 \times 10^{-18} \text{ J}$$

$$= 21.8 \times 10^{-19} \text{ J}$$

Total energy = Ionization energy + Kinetic energy absorbed

$$= (21.76 + 21.8) \times 10^{-19}$$

$$= 43.56 \times 10^{-19} \text{ J}$$

$$\approx 2 \text{ times of } 21.76 \times 10^{-19} \text{ J}$$

4. A gaseous mixture of two substances A and B, under a total pressure of 0.8 atm is in equilibrium with an ideal liquid solution. The mole fraction of substance A is 0.5 in the vapour phase and 0.2 in the liquid phase. The vapour pressure of pure liquid A is _____ atm. (Nearest integer)

Answer (2)

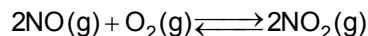
Sol. Given that $X_A = 0.2$, $Y_A = 0.5$, $P_T = 0.8$ atm

We know that $P_A = Y_A \times P_T$

$$P_A = 0.5 \times 0.8 = 0.4$$

$$\text{Now } P_A = X_A \times P_A^0 \Rightarrow P_A^0 = \frac{0.4}{0.2} = 2 \text{ atm}$$

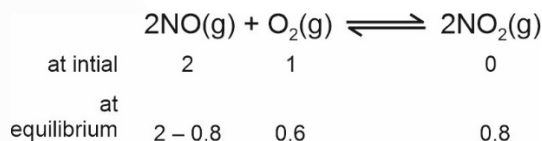
5. At 600 K, 2 mol of NO are mixed with 1 mol of O₂.



The reaction occurring as above comes to equilibrium under a total pressure of 1 atm. Analysis of the system shows that 0.6 mol of oxygen are present at equilibrium. The equilibrium constant for the reaction is _____. (Nearest integer)

Answer (2)

Sol.



$$\text{Partial pressure of NO(g)} = \frac{1.2}{2.6} \times 1$$

$$\text{Partial pressure of O}_2\text{(g)} = \frac{0.6}{2.6}$$

$$\text{Partial pressure of NO}_2\text{(g)} = \frac{0.8}{2.6}$$

$$K_p = \frac{(P_{\text{NO}_2})^2}{(P_{\text{NO}})^2 (P_{\text{O}_2})} = \frac{0.8 \times 0.8 \times 2.6}{1.2 \times 1.2 \times 0.6}$$

$$= 1.925$$

$$\approx 2$$

6. A sample of 0.125 g of an organic compound when analysed by Duma's method yields 22.78 mL of nitrogen gas collected over KOH solution at 280 K and 759 mm Hg. The percentage of nitrogen in the given organic compound is _____. (Nearest integer)

Given :

(a) The vapour pressure of water of 280 K is 14.2 mm Hg.

(b) $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$

Answer (22)

Sol. $P_{\text{actual}} = 759 - 14.2 = 744.8 \text{ mmHg}$

$$n_{\text{N}_2} = \frac{744.8 \times 22.78}{760 \times 0.0821 \times 280 \times 1000}$$

$$= 0.000971 \text{ mol}$$

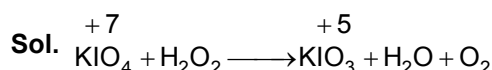
Mass of $\text{N}_2 = 0.02719 \text{ gm}$

Percentage of nitrogen

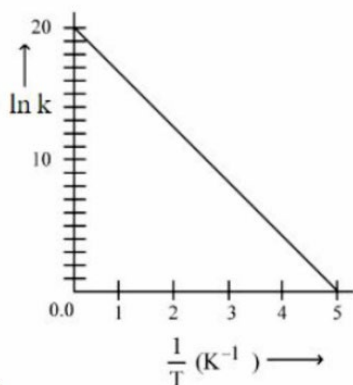
$$= \frac{0.0271}{0.125} \times 100 = 21.75 \approx 22$$

7. On reaction with stronger oxidizing agent like KIO_4 , hydrogen peroxide oxidizes with the evolution of O_2 . The oxidation number of I in KIO_4 changes to ____.

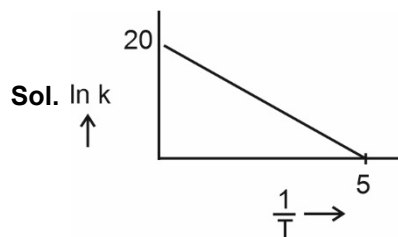
Answer (5)



8. For a reaction, given below is the graph of $\ln k$ vs $\frac{1}{T}$. The activation energy for the reaction is equal to ____ cal mol^{-1} . (Nearest integer)
(Given: $R = 2 \text{ cal K}^{-1} \text{ mol}^{-1}$)



Answer (8)

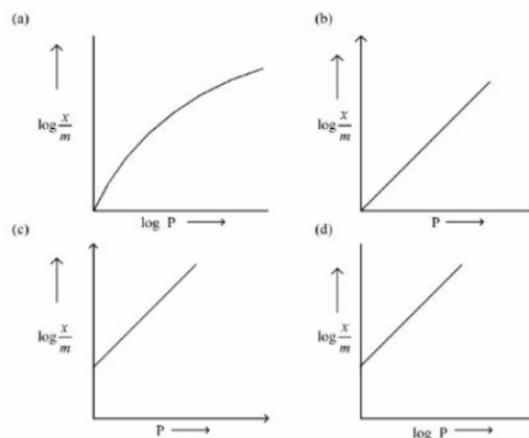


$$\text{Slope} = \frac{-20}{5}$$

$$\ln k = \ln A - \frac{E_a}{RT}$$

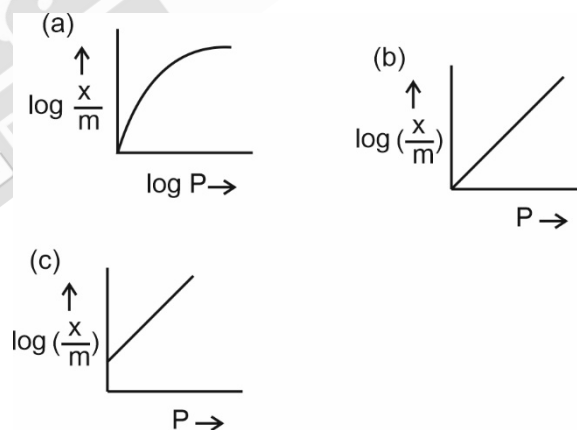
$$\therefore \frac{E_a}{R} = \frac{20}{5} \Rightarrow E = \frac{20 R}{5} = 8 \text{ cal mol}^{-1}$$

9. Among the following the number of curves not in accordance with Freundlich adsorption isotherm is ____.



Answer (3)

Sol. The following curves are not in accordance with Freundlich adsorption isotherm.



10. Among the following the number of state variables is ____.

Internal energy (U)

Volume (V)

Heat (q)

Enthalpy (H)

Answer (3)

Sol. State variables are internal energy (U), Volume (V) and Enthalpy (H).