

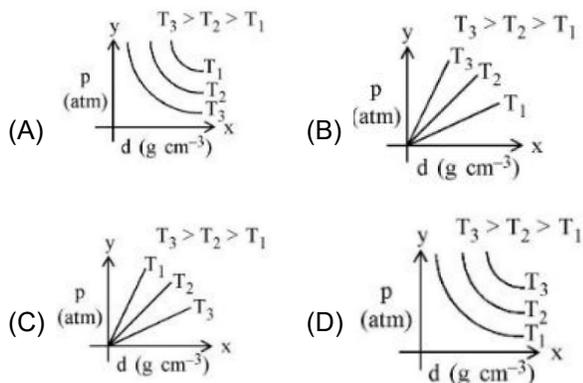
CHEMISTRY

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. Which amongst the given plots is the correct plot for pressure (p) vs density (d) for an ideal gas?

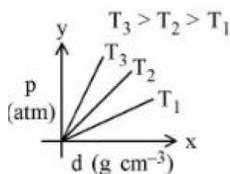


Answer (B)

$$\text{Sol. } \therefore d = \frac{pM}{RT}$$

$$\text{Hence, } dRT = pM$$

$$p \propto T$$

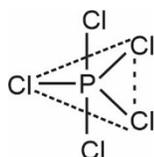


2. Identify the **incorrect** statement for PCl₅ from the following.

- In this molecule, orbitals of phosphorous are assumed to undergo sp³d hybridization.
- The geometry of PCl₅ is trigonal bipyramidal.
- PCl₅ has two axial bonds stronger than three equatorial bonds.
- The three equatorial bonds of PCl₅ lie in a plane

Answer (C)

Sol. PCl₅



- All three equatorial bonds in a plane
- sp³d hybridization
- Trigonal bipyramidal
- Axial bonds are weaker than equatorial bonds.

3. Statement-I : Leaching of gold with cyanide ion in absence of air/O₂ leads to cyano complex of Au(III).

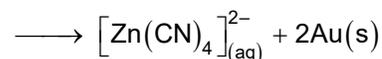
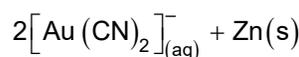
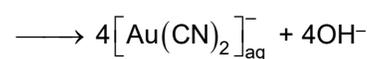
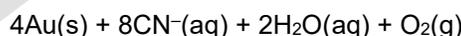
Statement-II : Zinc is oxidized during the displacement reaction carried out for gold extraction.

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

- Both statement-I and statement-II are correct
- Both statement-I and statement-II are incorrect
- Statement-I is correct but statement-II is incorrect
- Statement-I is incorrect but statement-II is correct

Answer (D)

Sol. Leaching of gold with cyanide ion is done in presence of air/O₂ leading to cyano complex [Au(CN)₂]⁻ where Au is in +1 oxidation state.



Zinc is oxidised from (0) to +2 oxidation state during displacement reaction carried out for gold extraction.

4. The correct order of increasing intermolecular hydrogen bond strength is

- HCN < H₂O < NH₃
- HCN < CH₄ < NH₃
- CH₄ < HCN < NH₃
- CH₄ < NH₃ < HCN

10. Arrange the following coordination compounds in the increasing order of magnetic moments. (Atomic numbers: Mn = 25; Fe = 26)

- (1) $[\text{FeF}_6]^{3-}$ (2) $[\text{Fe}(\text{CN})_6]^{3-}$
 (3) $[\text{MnCl}_6]^{3-}$ (high spin) (4) $[\text{Mn}(\text{CN})_6]^{3-}$

Choose the correct answer from the options given below:

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

Answer (B)

Sol.

Coordination Compound	Number of unpaired e^- (n)	Magnetic moment (μ) (B.M)
A $[\text{FeF}_6]^{3-} - d^5$	5	5.91
B $[\text{Fe}(\text{CN})_6]^{3-} - d^5$	1	1.73
C $[\text{MnCl}_6]^{3-} - d^4$	4	4.89
D $[\text{Mn}(\text{CN})_6]^{3-} - d^4$	2	2.82

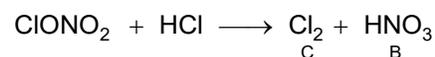
Hence, correct order of magnetic moment is $2 < 4 < 3 < 1$

11. On the surface of polar stratospheric clouds, hydrolysis of chlorine nitrate gives A and B while its reaction with HCl produces B and C. A, B and C are, respectively

- (A) HOCl, HNO_3 , Cl_2
 (B) Cl_2 , HNO_3 , HOCl
 (C) HClO_2 , HNO_2 , HOCl
 (D) HOCl, HNO_2 , Cl_2O

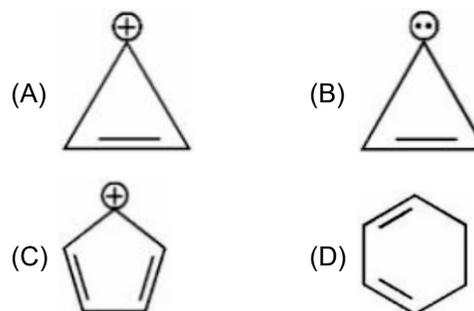
Answer (A)

Sol. On the surface of polar stratospheric clouds, hydrolysis of chlorine nitrate as



Hence A, B and C are HOCl, HNO_3 and Cl_2 respectively.

12. Which of the following is most stable?



Answer (D)

Sol.  — Aromatic compound ($2\pi e^-$)

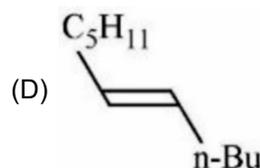
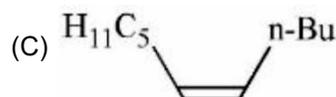
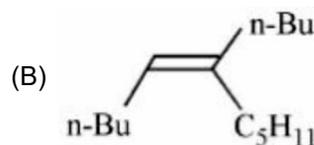
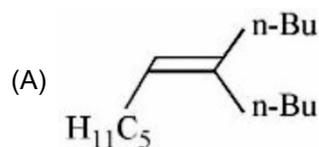
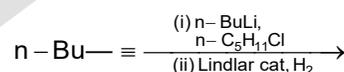
 — Carbene (electron deficient)

 — Anti Aromatic compound ($4\pi e^-$)

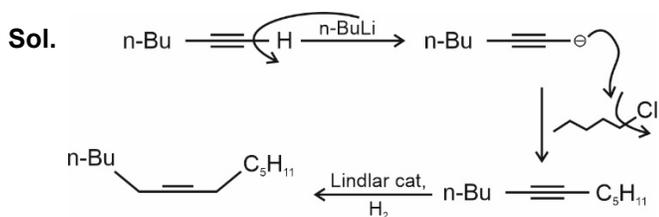
 — Non-aromatic conjugated diene

1,3-cyclohexadiene is most stable because it is a neutral molecule. All others are intermediates and hence less stable.

13. What will be the major product of following sequence of reactions?

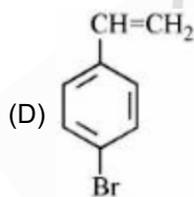
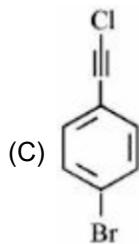
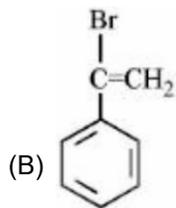
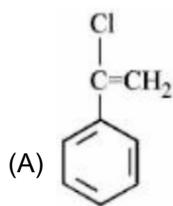
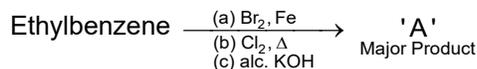


Answer (C)



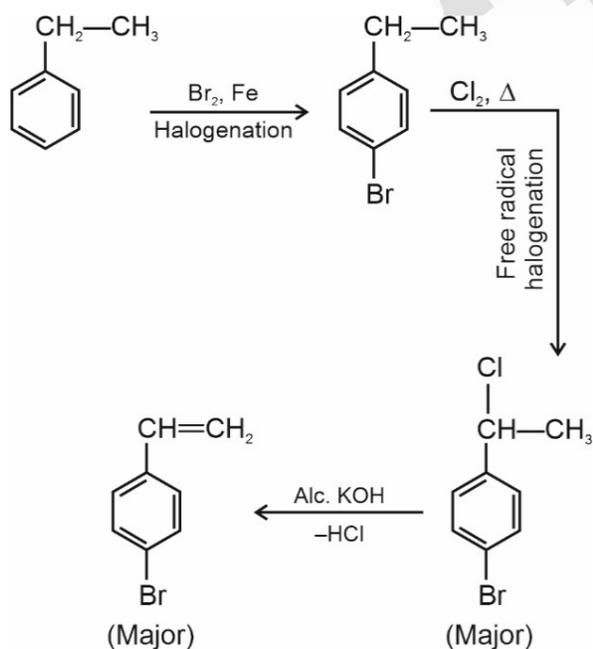
Hence correct option is (C).

14. Product 'A' of following sequence of reactions is



Answer (D)

Sol.



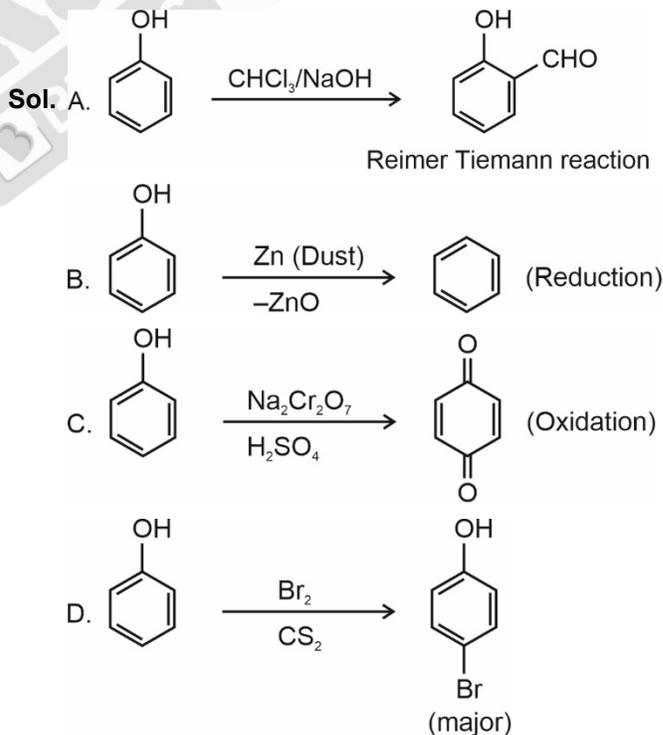
15. Match List I with List II.

List I	List II
A.	I. Br ₂ in CS ₂
B.	II. Na ₂ Cr ₂ O ₇ / H ₂ SO ₄
C.	III. Zn
D.	IV. CHCl ₃ /NaOH

Choose the correct answer from the options given below:

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

Answer (A)



∴ Correct match is

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

19. Match List I with List II.

List I		List II	
A.	Antipyretic	I.	Reduces pain
B.	Analgesic	II.	Reduces stress
C.	Tranquilizer	III.	Reduces fever
D.	Antacid	IV.	Reduces acidity (stomach)

Choose the correct answer from the options given below:

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

Answer (A)

- Sol.** Antipyretic – Reduces fever
 Analgesic – Reduces pain
 Tranquilizer – Reduces stress
 Antacid – Reduces Acidity (stomach)

20. Match List I with List II.

List I (Anion)		List II (gas evolved on reaction with dil H ₂ SO ₄)	
A.	CO ₃ ²⁻	I.	Colourless gas which turns lead acetate paper black.
B.	S ²⁻	II.	Colourless gas which turns acidified potassium dichromate solution green
C.	SO ₃ ²⁻	III.	Brown fumes which turns acidified KI solution containing starch blue.
D.	NO ₂ ⁻	IV.	Colourless gas evolved with brisk effervescence, which turns lime water milky.

Choose the correct answer from the options given below:

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

Answer (D)

Sol. CO₃²⁻ : On action of dil sulphuric acid, CO₂ gas is released which turns lime water milky.

S²⁻ : On action of dil sulphuric acid, H₂S gas is released which turns lead acetate paper black.

SO₃²⁻ : On action of dil H₂SO₄, SO₂ gas is evolved which turns acidified potassium dichromate solution green.

NO₂⁻ : On action of dil H₂SO₄, NO₂ gas is evolved which turns KI solution containing starch blue.

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. 116 g of a substance upon dissociation reaction, yields 7.5 g of hydrogen, 60 g of oxygen and 48.5 g of carbon. Given that the atomic masses of H, O and C are 1, 16 and 12, respectively. The data agrees with how many formulae of the following?

- A. CH₃COOH B. HCHO
 C. CH₃OOCH₃ D. CH₃CHO

Answer (2)
Sol.

Element	Mass%	Moles%	Relative moles
H	6.46	6.46	2
O	51.72	3.23	1
C	41.81	3.48	1

∴ Empirical formula = COH₂

The empirical formula goes with acetic acid CH₃COOH and formaldehyde HCHO.

Thus data agrees with 2 formulae.

2. Consider the following set of quantum numbers.

	n	l	m _l
A.	3	3	-3
B.	3	2	-2
C.	2	1	+1
D.	2	2	+2

The number of correct sets of quantum numbers is _____.

Answer (2)

Sol. The correct sets of Quantum numbers are, (02)

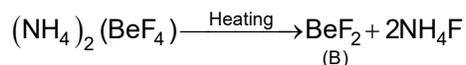
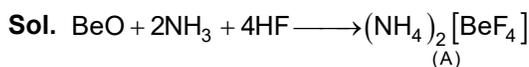
$$n = 3 \quad l = 2 \quad m_l = -2$$

$$\text{and } n = 2 \quad l = 1 \quad m_l = +1$$

l can have values from 0 to (n - 1) and m can have values from -l..... 0+l (2l + 1)

3. BeO reacts with HF in presence of ammonia to give [A] which on thermal decomposition produces [B] and ammonium fluoride. Oxidation state of Be in [A] is _____

Answer (2)



Oxidation State of Be in (A) is (+2)

4. When 5 moles of He gas expand isothermally and reversibly at 300 K from 10 litre to 20 litre, the magnitude of the maximum work obtained is _____ J. [nearest integer] (Given : R = 8.3 J K⁻¹ mol⁻¹ and log 2 = 0.3010)

Answer (8630)

$$\text{Sol. } W_{\text{rev}} = -2.303 nRT \log_{10} \left(\frac{V_2}{V_1} \right)$$

$$= -2.303 \times 5 \times 8.3 \times 300 \times \log_{10} \left(\frac{20}{10} \right)$$

$$\approx -8630 \text{ J}$$

5. A solution containing 2.5 × 10⁻³ kg of a solute dissolved in 75 × 10⁻³ kg of water boils at 373.535 K. The molar mass of the solute is _____ g mol⁻¹. [nearest integer] (Given : K_b(H₂O) = 0.52 K kg mol⁻¹ and boiling point of water = 373.15 K)

Answer (45)

$$\text{Sol. } W_{\text{solute}} = 2.5 \times 10^{-3} \text{ kg}$$

$$W_{\text{solvent}} = 75 \times 10^{-3} \text{ kg}$$

$$\Delta T_b = 373.535 - 373.15$$

$$= 0.385 \text{ K}$$

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

$$\Delta T_b = \frac{K_b \times 10^3 \times W_{\text{solute}}}{M_{\text{solute}} \times W_{\text{solvent}}}$$

$$M_{\text{solute}} = \frac{0.52 \times 10^3 \times 2.5 \times 10^{-3}}{75 \times 10^{-3} \times 0.385}$$

$$= 45.02$$

$$\approx 45$$

6. pH value of 0.001 M NaOH solution is _____.

Answer (11)

$$\text{Sol. } [\text{OH}^-] = 0.001 = 10^{-3} \text{ M}$$

$$[\text{H}^+][\text{OH}^-] = 10^{-14}$$

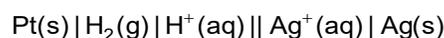
$$[\text{H}^+] = 10^{-11}$$

$$\text{pH} = -\log[\text{H}^+]$$

$$= -\log(10^{-11})$$

$$\text{pH} = 11$$

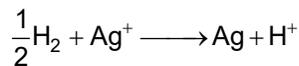
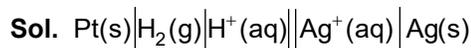
7. For the reaction taking place in the cell:



$$E^\circ_{\text{cell}} = +0.5332 \text{ V.}$$

The value of Δ_rG[⊖] is _____ kJ mol⁻¹ [in nearest integer]

Answer (51)



$$n = 1$$

$$E_{\text{cell}}^{\circ} = 0.5332$$

$$\Delta G^{\circ} = -nFE^{\circ}$$

$$= -1 \times 96500 \times 0.5332$$

$$= -51.453 \text{ kJ/mole}$$

$$\approx -51 \text{ kJ/mole}$$

8. It has been found that for a chemical reaction with rise in temperature by 9 K the rate constant gets doubled. Assuming a reaction to be occurring at 300 K, the value of activation energy is found to be _____ kJ mol⁻¹. [nearest integer]

(Given $\ln 10 = 2.3$, $R = 8.3 \text{ J K}^{-1} \text{ mol}^{-1}$, $\log 2 = 0.30$)

Answer (59)

Sol. $T_1 = 300 \text{ K}$

(Rate constant)

$$K_2 = 2K_1, \text{ on increase temperature by } 9\text{K}$$

$$T_2 = 309 \text{ K}$$

$$E_a = ?$$

$$\log \frac{K_2}{K_1} = \frac{E_a}{2.3R} \left[\frac{T_2 - T_1}{T_2 \cdot T_1} \right]$$

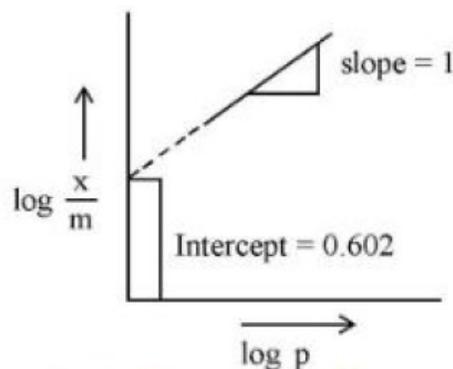
$$\log 2 = \frac{E_a}{2.3 \times 8.3} \left[\frac{9}{309 \times 300} \right]$$

$$E_a = \frac{0.3 \times 309 \times 300 \times 2.3 \times 8.3}{9}$$

$$= 58988.1 \text{ J / mole}$$

$$\approx 59 \text{ kJ/mole}$$

9.



If the initial pressure of a gas 0.03 atm, the mass of the gas absorbed per gram of the adsorbent is _____ $\times 10^{-2}$ g.

Answer (12)

Sol. Given that $\log K = \text{intercept} = 0.602 = \log 4$

$$\therefore K = 4$$

$$\text{Slope} = \frac{1}{n} = 1$$

and initial pressure = 0.03 atm

$$\frac{x}{m} = K(p)^{\frac{1}{n}} = 4 \times 0.03 = 0.12 = 12 \times 10^{-2}$$

$$\therefore \text{mass of gas absorbed per gm of adsorbent} = 12 \times 10^{-2} \text{ g}$$

10. 0.25 g of an organic compound containing chlorine gave 0.40 g of silver chloride in Carius estimation. The percentage of chlorine present in the compound is _____. [in nearest integer]

(Given : Molar mass of Ag is 108 g mol⁻¹ and that of Cl is 35.5 g mol⁻¹)

Answer (40)

Sol. Mass of organic compound = 0.25 g

Mass of AgCl = 0.40 g

$$\% \text{ Cl} = \frac{35.5 \times (\text{mass of AgCl})}{143.5 \times (\text{mass of organic compound})} \times 100$$

$$= \frac{35.5 \times 0.40 \times 100}{143.5 \times 0.25}$$

$$= 39.581$$

$$\approx 40$$

$$\% \text{ Cl} = 40 \%$$