

FINAL JEE-MAIN EXAMINATION – APRIL, 2024

(Held On Saturday 06th April, 2024)

TIME : 9 : 00 AM to 12 : 00 NOON

CHEMISTRY

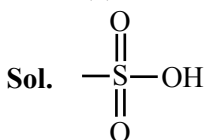
TEST PAPER WITH SOLUTION

SECTION-A

61. Functional group present in sulphonic acid is :

- (1) SO_4H (2) SO_3H
(3) $\begin{array}{c} \text{O} \\ || \\ -\text{S}-\text{OH} \end{array}$ (4) $-\text{SO}_2$

Ans. (2)



Group present in sulphonic acids

62. Match List I with List II :

| List I (Molecule / Species) | | List II (Property / Shape) | |
|--------------------------------|--------------------------|-------------------------------|--------------|
| A. | SO_2Cl_2 | I. | Paramagnetic |
| B. | NO | II. | Diamagnetic |
| C. | NO_2^- | III. | Tetrahedral |
| D. | I_3^- | IV. | Linear |

Choose the **correct** answer from the options given below :

- (1) A-IV, B-I, C-III, D-II
(2) A-III, B-I, C-II, D-IV
(3) A-II, B-III, C-I, D-IV
(4) A-III, B-IV, C-II, D-I

Ans. (2)

Sol.

| | | | |
|-----|--------------------------|-----------------------|---|
| (A) | SO_2Cl_2 | sp^3 | $\begin{array}{c} \text{O} \\ \\ \text{S} \\ / \quad \backslash \\ \text{O} \quad \text{Cl} \end{array}$ Tetrahedral |
| (B) | NO | | Paramagnetic |
| (C) | NO_2^- | | Diamagnetic |
| (D) | I_3^- | sp^3d | $\begin{array}{c} \text{I} \\ \\ \text{I} \\ \\ \text{I} \end{array}$ Linear |

63. Given below are two statements :

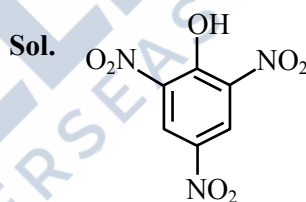
Statement I : Picric acid is 2, 4, 6-trinitrotoluene.

Statement II : Phenol-2, 4-disulphuric acid is treated with conc. HNO_3 to get picric acid.

In the light of the above statement, choose the **most appropriate** answer from the options given below :

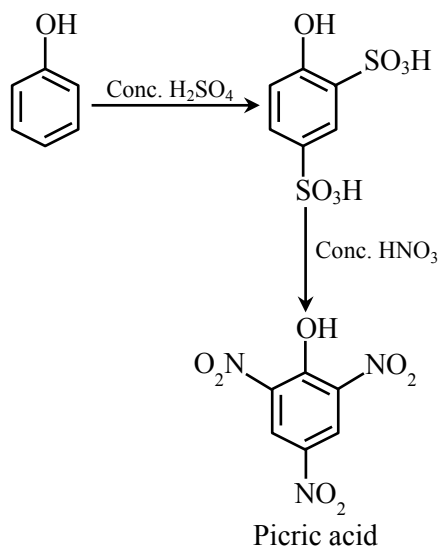
- (1) Statement I is incorrect but Statement II is correct.
(2) Both Statement I and Statement II are incorrect.
(3) Statement I is correct but Statement II is incorrect.
(4) Both Statement I and Statement II are correct.

Ans. (1)

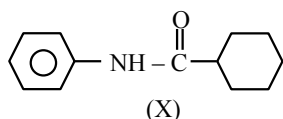


picric acid

(2, 4, 6 – trinitrophenol)



64. Which of the following is metamer of the given compound (X) ?

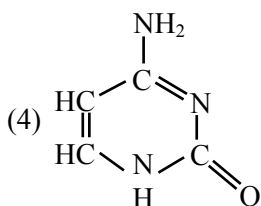
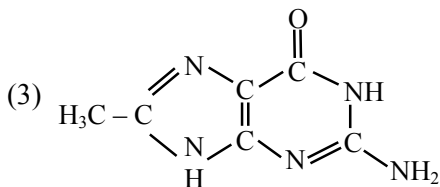
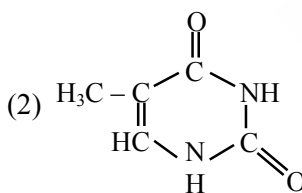
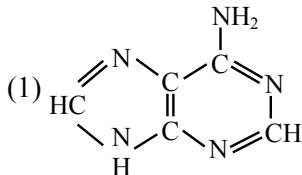


- (1)
- (2)
- (3)
- (4)

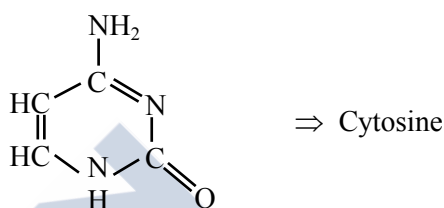
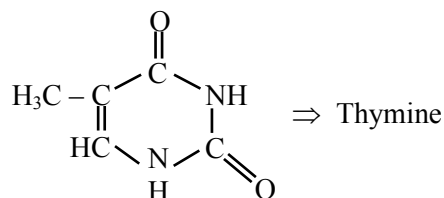
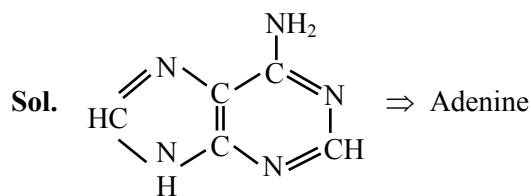
Ans. (4)

Sol. Metamer \Rightarrow Isomer having same molecular formula, same functional group but different alkyl/aryl groups on either side of functional group.

65. DNA molecule contains 4 bases whose structure are shown below. One of the structure is not correct, identify the **incorrect** base structure.



Ans. (3)



Are bases of DNA molecule. As DNA contain four bases, which are adenine, guanine, cytosine and thymine.

66. Match List I with List II :

| LIST I (Hybridization) | | LIST II (Orientation in Space) | |
|---------------------------|-----------|-----------------------------------|----------------------|
| A. | sp^3 | I. | Trigonal bipyramidal |
| B. | dsp^2 | II. | Octahedral |
| C. | sp^3d | III. | Tetrahedral |
| D. | sp^3d^2 | IV. | Square planar |

Choose the **correct** answer from the options given below :

- (1) A-III, B-I, C-IV, D-II
 (2) A-II, B-I, C-IV, D-III
 (3) A-IV, B-III, C-I, D-II
 (4) A-III, B-IV, C-I, D-II

Ans. (4)

Sol. $sp^3 \rightarrow$ Tetrahedral
 $dsp^2 \rightarrow$ Square planar
 $sp^3d \rightarrow$ Trigonal Bipyramidal
 $sp^3d^2 \rightarrow$ Octahedral



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67. Given below are two statements :

Statement I : Gallium is used in the manufacturing of thermometers.

Statement II : A thermometer containing gallium is useful for measuring the freezing point (256 K) of brine solution.

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

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

Ans. (4)

Sol. Statement - I \Rightarrow Correct

Statement - II \Rightarrow False

Ga is used to measure high temperature

68. Which of the following statements are correct ?

- A. Glycerol is purified by vacuum distillation because it decomposes at its normal boiling point.
- B. Aniline can be purified by steam distillation as aniline is miscible in water.
- C. Ethanol can be separated from ethanol water mixture by azeotropic distillation because it forms azeotrope.
- D. An organic compound is pure, if mixed M.P. is remained same.

Choose the **most appropriate** answer from the options given below :

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

Ans. (2)

Sol. Option (B) is incorrect because aniline is immiscible in water.

69. Match List I with List II :

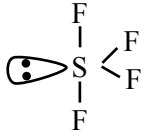
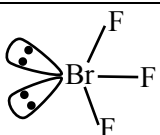
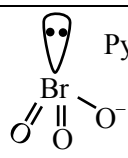
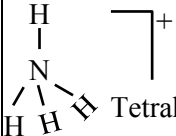
| LIST I (Compound / Species) | | LIST II (Shape / Geometry) | |
|--------------------------------|-------------------------------|-------------------------------|--------------|
| A. | SF ₄ | I. | Tetrahedral |
| B. | BrF ₃ | II. | Pyramidal |
| C. | BrO ₃ ⁻ | III. | See saw |
| D. | NH ₄ ⁺ | IV. | Bent T-shape |

Choose the **correct** answer from the options given below :

- (1) A-II, B-III, C-I, D-IV
- (2) A-III, B-IV, C-II, D-I
- (3) A-II, B-IV, C-III, D-I
- (4) A-III, B-II, C-IV, D-I

Ans. (2)

Sol.

| | | | |
|-----|-------------------------------|---------------------------------|---|
| (A) | SF ₄ | sp ³ d hybridisation |  |
| (B) | BrF ₃ | sp ³ d hybridisation |  Bent T-Shape |
| (C) | BrO ₃ ⁻ | sp ³ hybridisation |  Pyramidal |
| (D) | NH ₄ ⁺ | sp ³ hybridisation |  Tetrahedral |



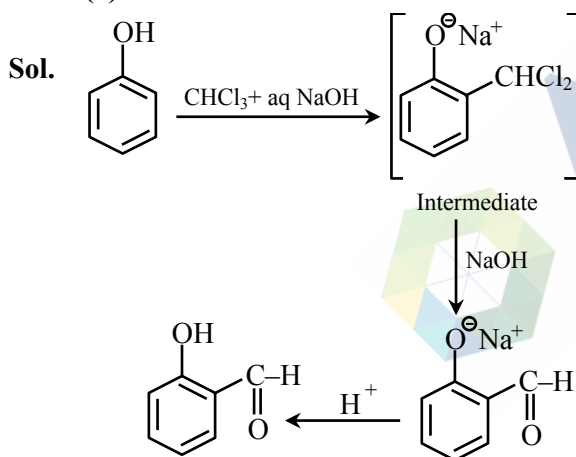
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70. In Reimer - Tiemann reaction, phenol is converted into salicylaldehyde through an intermediate. The structure of intermediate is _____.

- (1)
- (2)
- (3)
- (4)

Ans. (4)



71. Which of the following material is not a semiconductor.

- (1) Germanium
(2) Graphite
(3) Silicon
(4) Copper oxide

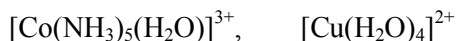
Ans. (2)

Sol. Graphite is conductor

72. Consider the following complexes.



(A) (B)



(C) (D)

The correct order of A, B, C and D in terms of wavenumber of light absorbed is :

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

Ans. (2)

Sol. As ligand field increases, light of more energy is absorbed

Energy \propto wave number

($\bar{\nu}$)

73. Match List I with List II :

| LIST I (Precipitating reagent and conditions) | | LIST II (Cation) | |
|--|--|---------------------|------------------|
| A. | $\text{NH}_4\text{Cl} + \text{NH}_4\text{OH}$ | I. | Mn^{2+} |
| B. | $\text{NH}_4\text{OH} + \text{Na}_2\text{CO}_3$ | II. | Pb^{2+} |
| C. | $\text{NH}_4\text{OH} + \text{NH}_4\text{Cl} + \text{H}_2\text{S gas}$ | III. | Al^{3+} |
| D. | dilute HCl | IV. | Sr^{2+} |

Choose the correct answer from the options given below :

- (1) A-IV, B-III, C-II, D-I
(2) A-IV, B-III, C-I, D-II
(3) A-III, B-IV, C-I, D-II
(4) A-III, B-IV, C-II, D-I

Ans. (3)

Sol. Theory based question



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74. The electron affinity value are negative for :

- A. $\text{Be} \rightarrow \text{Be}^-$
 B. $\text{N} \rightarrow \text{N}^-$
 C. $\text{O} \rightarrow \text{O}^{2-}$
 D. $\text{Na} \rightarrow \text{Na}^-$
 E. $\text{Al} \rightarrow \text{Al}^-$

Choose the most appropriate answer from the options given below :

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

Allen Ans. (4)

NTA Ans. (1)

- Sol.** (A) $\text{Be} + e^- \rightarrow \text{Be}^-$, E.A = -ive
 (B) $\text{N} + e^- \rightarrow \text{N}^-$ E.A = -ive
 (C) $\text{O} + e^- \rightarrow \text{O}^-$
 $\text{O}^- + e^- \rightarrow \text{O}^{2-}$ E.A = -ive
 (D) $\text{Na} + e^- \rightarrow \text{Na}^-$ E.A = +ive
 (E) $\text{Al} + e^- \rightarrow \text{Al}^-$ E.A = +ive

Ans. A,B and C only

75. The number of element from the following that do not belong to lanthanoids is :

Eu, Cm, Er, Tb, Yb and Lu

- (1) 3 (2) 4
 (3) 1 (4) 5

Ans. (3)

Sol. Cm is Actinide

76. The density of 'x' M solution ('x' molar) of NaOH is 1.12 g mL^{-1} . while in molality, the concentration of the solution is 3 m (3 molal). Then x is (Given : Molar mass of NaOH is 40 g/mol)

- (1) 3.5 (2) 3.0
 (3) 3.8 (4) 2.8

Ans. (2)

Sol.
$$\text{Molality} = \frac{1000 \times M}{1000 \times d - M \times (\text{Mw})_{\text{solute}}}$$

$$3 = \frac{1000 \times x}{1000 \times 1.12 - (x \times 40)}$$

$$x = 3$$

77. Which among the following aldehydes is most reactive towards nucleophilic addition reactions?

- (1) $\text{H} - \overset{\text{O}}{\parallel} \text{C} - \text{H}$ (2) $\text{C}_2\text{H}_5 - \overset{\text{O}}{\parallel} \text{C} - \text{H}$
 (3) $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{H}$ (4) $\text{C}_3\text{H}_7 - \overset{\text{O}}{\parallel} \text{C} - \text{H}$

Ans. (1)

Sol. $\text{H} - \overset{\text{O}}{\parallel} \text{C} - \text{H}$ has low steric hindrance at carbonyl carbon and high partial positive charge at carbonyl carbon.

78. At -20°C and 1 atm pressure, a cylinder is filled with equal number of H_2 , I_2 and HI molecules for the reaction

$\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$, the K_p for the process is $x \times 10^{-1}$. $x =$ _____.

[Given : $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$]

- (1) 2 (2) 1
 (3) 10 (4) 0.01

Ans. (3)

Sol. $\Delta n_g = 0$ $K_p = \frac{(n_{\text{HI}})^2}{n_{\text{H}_2} n_{\text{I}_2}} \left(\frac{P_T}{n_T} \right)^{\Delta n_g}$

$$n_{\text{HI}} = n_{\text{H}_2} = n_{\text{I}_2} \quad \text{so } K_p = 1$$

$$1 = x \times 10^{-1} \quad \text{so } x = 10$$

79. Match List I with List II :

| LIST I (Compound) | | LIST II (Uses) | |
|----------------------|----------------------|-------------------|-------------------|
| A. | Iodoform | I. | Fire extinguisher |
| B. | Carbon tetrachloride | II. | Insecticide |
| C. | CFC | III. | Antiseptic |
| D. | DDT | IV. | Refrigerants |

Choose the **correct** answer from the options given below :

- (1) A-I, B-II, C-III, D-IV
 (2) A-III, B-II, C-IV, D-I
 (3) A-III, B-I, C-IV, D-II
 (4) A-II, B-IV, C-I, D-III

Ans. (3)

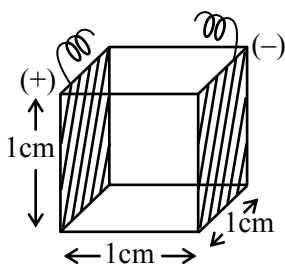


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Sol. Iodoform – Antiseptic
 CCl_4 – Fire extinguisher
 CFC – Refrigerants
 DDT – Insecticide

80. A conductivity cell with two electrodes (dark side) are half filled with infinitely dilute aqueous solution of a weak electrolyte. If volume is doubled by adding more water at constant temperature, the molar conductivity of the cell will -



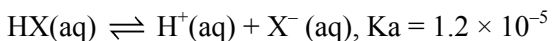
- (1) increase sharply
- (2) remain same or can not be measured accurately
- (3) decrease sharply
- (4) depend upon type of electrolyte

Ans. (2)

Sol. Solution is already infinitely dilute, hence no change in molar conductivity upon addition of water

SECTION-B

81. Consider the dissociation of the weak acid HX as given below

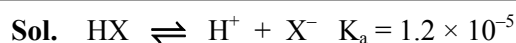


[K_a : dissociation constant]

The osmotic pressure of 0.03 M aqueous solution of HX at 300 K is $\text{_____} \times 10^{-2}$ bar (nearest integer).

[Given : $R = 0.083 \text{ L bar Mol}^{-1} \text{ K}^{-1}$]

Ans. (76)



0.03M

0.03 - x x x

$$K_a = 1.2 \times 10^{-5} = \frac{x^2}{0.03 - x}$$

0.03 - x \approx 0.03 (K_a is very small)

$$\frac{x^2}{0.03} = 1.2 \times 10^{-5}$$

$$x = 6 \times 10^{-4}$$

Final solution : 0.03 - x + x + x

$$= 0.03 + x = 0.03 + 6 \times 10^{-4}$$

$$\Pi = (0.03 + (6 \times 10^{-4})) \times 0.083 \times 300$$

$$= 76.19 \times 10^{-2} \approx 76 \times 10^{-2}$$

82. The difference in the 'spin-only' magnetic moment values of KMnO_4 and the manganese product formed during titration of KMnO_4 against oxalic acid in acidic medium is _____ BM. (nearest integer)

Ans. (6)

Sol. Spin only magnetic moment of Mn in $\text{KMnO}_4 = 0$
 Spin only value of manganese product formed during titration of KMnO_4 against oxalic acid in acidic medium is = 6

Ans. 6

83. Time required for 99.9% completion of a first order reaction is _____ time the time required for completion of 90% reaction. (nearest integer).

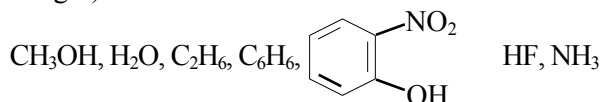
Ans. (3)

$$\text{Sol. } K = \frac{1}{t_{99.9\%}} \ln\left(\frac{100}{0.1}\right) = \frac{1}{t_{90\%}} \ln\left(\frac{100}{10}\right)$$

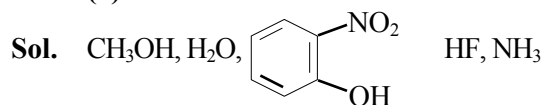
$$t_{99.9\%} = t_{90\%} \frac{\ln(10^3)}{\ln 10}$$

$$t_{99.9\%} = t_{90\%} \times 3$$

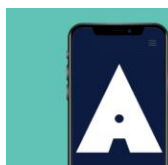
84. Number of molecules from the following which can exhibit hydrogen bonding is _____. (nearest integer)



Ans. (5)



Can show H-bonding.

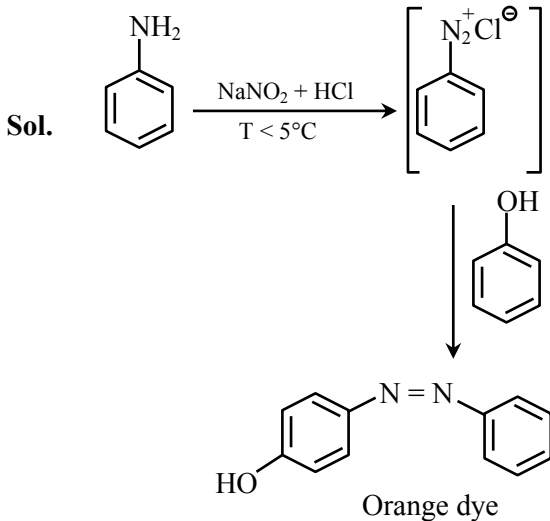


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85. 9.3 g of pure aniline upon diazotisation followed by coupling with phenol gives an orange dye. The mass of orange dye produced (assume 100% yield/ conversion) is _____ g. (nearest integer)

Ans. (20)



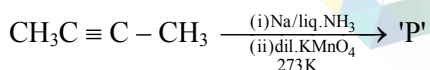
Reaction suggests that 1 mole of aniline give 1 mole of orange dye.

$$\text{so (mol)}_{\text{aniline}} = \text{(mole)}_{\text{orange dye}}$$

$$\frac{9.3\text{g}}{93\text{g mol}^{-1}} = \frac{\text{mass of orange dye}}{199\text{g mol}^{-1}}$$

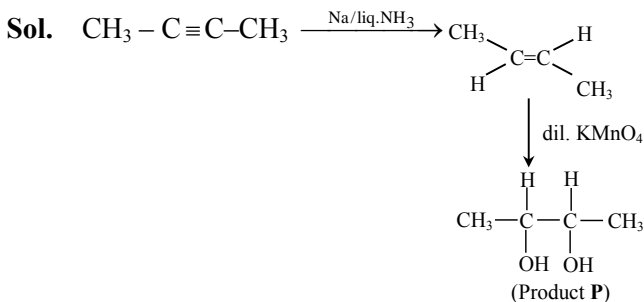
$$\text{mass of orange dye} = 19.9\text{ g} \approx 20\text{ g}$$

86. The major product of the following reaction is P.



Number of oxygen atoms present in product 'P' is _____ (nearest integer).

Ans. (2)



87. Frequency of the de-Broglie wave of election in Bohr's first orbit of hydrogen atom is _____ $\times 10^{13}$ Hz (nearest integer).

[Given : R_H (Rydberg constant) = 2.18×10^{-18} J.
 h (Plank's constant) = 6.6×10^{-34} J.s.]

Allen Ans. (661)

NTA Ans. (658)

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

$$\lambda = \frac{hv}{mv^2}$$

$$\frac{mv^2}{h} = \frac{v}{\lambda} = \nu \text{ (frequency)}$$

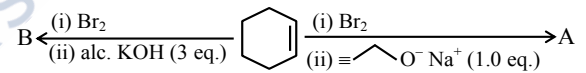
Given $\frac{1}{2} mv^2 = 2.18 \times 10^{-18}$ J

$$h = 6.6 \times 10^{-34}$$

$$\nu = \frac{4.36 \times 10^{-18}}{6.6 \times 10^{-34}} = 660.60 \times 10^{13} \text{ Hz}$$

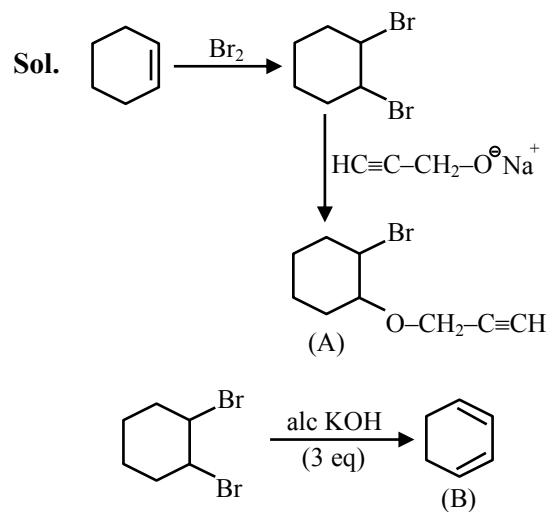
$$\approx 661 \times 10^{13} \text{ Hz}$$

88. The major products from the following reaction sequence are product A and product B.



The total sum of π electrons in product A and product B are _____ (nearest integer)

Ans. (8)



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89. Among CrO, Cr₂O₃ and CrO₃, the sum of spin-only magnetic moment values of basic and amphoteric oxides is _____ 10⁻² BM (nearest integer).

(Given atomic number of Cr is 24)

Ans. (877)

Sol. CrO Basic oxide

Cr₂O₃ Amphoteric oxide

In CrO, Cr exist as Cr⁺² and have μ only = 4.90

In Cr₂O₃, Cr exist as Cr⁺³ and have μ only = 3.87

Sum of spin only magnetic moment

$$= 4.90 + 3.87 = 8.77$$

$$\mu_{\text{only}} = 877 \times 10^{-2}$$

Ans. 877

90. An ideal gas, $\bar{C}_v = \frac{5}{2}R$, is expanded adiabatically against a constant pressure of 1 atm until it doubles in volume. If the initial temperature and pressure is 298 K and 5 atm, respectively then the final temperature is _____ K (nearest integer).

[\bar{C}_v is the molar heat capacity at constant volume]

Ans. (274)

Sol. $\Delta U = q + w$ ($q = 0$)

$$nC_v \Delta T = -P_{\text{ext}} (V_2 - V_1)$$

$$V_2 = 2V_1$$

$$\frac{nRT_2}{P_2} = \frac{2nRT_1}{P_1}$$

$$P_1 = 5, T_1 = 298$$

$$P_2 = \frac{5T_2}{2 \times 298}$$

$$n \frac{5}{2} R (T_2 - T_1) = -1 \left(\frac{nRT_2}{P_1} - \frac{nRT_1}{P_1} \right)$$

$$\text{Put } T_1 = 298$$

$$\text{and } P_2 = \frac{5T_2}{2 \times 298}$$

Solve and we get $T_2 = 274.16$ K

$$T_2 \approx 274 \text{ K}$$



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