2-Mark MCQs

Module II

1. The wavelength of radiation is 5 μm. What is wavenumber and frequency? ($c = 2.998 \times 10^8\ ms^{-1}$).

$$\text{Frequency } \nu = \frac{c}{\lambda} = \frac{2.998 \times 10^8\ ms^{-1}}{5 \times 10^{-6}\ m} = 0.5996 \times 10^{14}\ s^{-1}$$

$$\nu = 59.96 \times 10^{12}\ s^{-1} \text{ (or) Hz}$$

Wavelength can be converted into wavenumber by simply dividing 10,000 by the wavelength expressed in micrometers.

$$\text{wavenumber}(\bar{\nu}) = \frac{10,000}{5\ \mu m} = 2,000\ cm^{-1}.$$

Ans: 2000 cm^{-1} and 59.96×10^{12} Hz

3. Calculate the CFSE values for d^3 and d^8 configurations of weak field octahedral complexes.

For octahedral complexes; the energy levels, are $t_{2g} < e_g$.

For d^3 - $t_{2g}^3\ e_g^0 \Rightarrow 3 \times -0.4 \Rightarrow -1.2\ \Delta_o$

d^8 - $t_{2g}^6\ e_g^2 \Rightarrow 6 \times -0.4 \Rightarrow -2.4$

$2 \times -0.6 \Rightarrow 1.2$

$-1.2\ \Delta_o$

Ans: $-1.2\ \Delta_o$ and $-1.2\ \Delta_o$

4. Calculate the CFSE values for d^4 and d^7 configurations of high spin tetrahedral complexes.

For tetrahedral complexes, the energy levels $e_g < t_{2g}$

High spin - Weak field ligands.

For d^4 - $e_g^2\ t_{2g}^2 \Rightarrow (2 \times -0.6) + (2 \times 0.4) \Rightarrow -1.2 + 0.8 \Rightarrow -0.4\ \Delta_t$

$\Delta_t = 4/9\ \Delta_o$ $\qquad \Rightarrow -0.4 \times \frac{4}{9} \Rightarrow -0.177\ \Delta_o$

d^7 - $e_g^4\ t_{2g}^3 \Rightarrow (4 \times -0.6) + (3 \times 0.4) \Rightarrow -2.4 + 1.2 \Rightarrow -1.2\ \Delta_t$

$\Rightarrow -1.2 \times \frac{4}{9} \Rightarrow -0.533\ \Delta_o$

Ans: $-0.18\ \Delta_o$ and $-0.54\ \Delta_o$

6. Calculate the magnetic moment of $Na_3[Fe^{3+}F_6]$.

${}_{26}Fe$ - $3d^6\ 4s^2$; Fe^{3+} - $3d^5\ 4s^0$ $\boxed{\uparrow\,|\,\uparrow\,|\,\uparrow\,|\,\uparrow\,|\,\uparrow}$

No. of Unpaired electrons: 5

$\mu = \sqrt{n(n+2)}$; $\mu = \sqrt{5(5+2)}$

Ans: $\mu = 5.92$ BM.

7. Calculate the number of fundamental vibrations for CO_2 and HCl molecules.

Vibrational frequencies for Linear : $(3N-5)$

$N \Rightarrow$ no. of atoms.

For CO_2 : $((3\times3)-5) \Rightarrow (9-5) \Rightarrow 4$ Vibrations

HCl : $((3\times2)-5) \Rightarrow (6-5) \rightarrow 1$ Vibration

Ans : 4 and 1

18. Calculate the magnetic moment of $Na_2[Co^{2+}F_4]$ Compound.

$_{27}Co - 3d^7\ 4s^2$

$Co^{2+} - 3d^7\ 4s^0$ $\boxed{\uparrow\downarrow|\uparrow\downarrow|\uparrow|\uparrow|\uparrow}$ No. of Unpaired electrons : 3

$\mu = \sqrt{n(n+2)}$; $\sqrt{3(3+2)}$

Ans: 3.87 BM

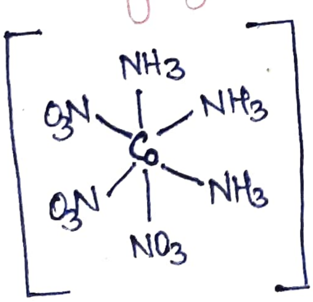
Module - III

2. The order of increasing ionic radius of the following is K^+, Li^+, Mg^{2+}, Al^{3+}.

K^+ has more number of shells than Mg^{2+} and Al^{3+} and Mg^{2+} are isoelectronic but Al^{3+} has higher nuclear charge, So $Al^{3+} < Mg^{2+}$, Mg^{2+} and Li^+ have diagonal relationship. But due to +2 charge in Mg^{2+}, the Mg^{2+} is smaller than Li^+. Hence Al^{3+} is the smallest one.

$K^+ = 1.38 A^\circ$, $Li^+ = 0.76 A^\circ$, $Mg^{2+} = 0.72 A^\circ$ and $Al^{3+} = 0.535 A^\circ$.

8. How many geometrical isomers are possible for $[Co(NH_3)_3(NO_2)_3]$ complex.



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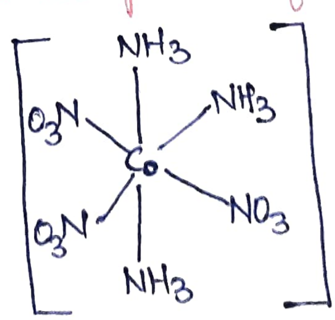

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