

THE UNIVERSITY OF ZAMBIA
SCHOOL OF NATURAL SCIENCES
DEPARTMENT OF CHEMISTRY

NAME : SIKASUKWE ARON

COMP # : 20182020066

ASS # : 3 (THREE)

GENDER : MALE

DUE DATE : 21-09-2020

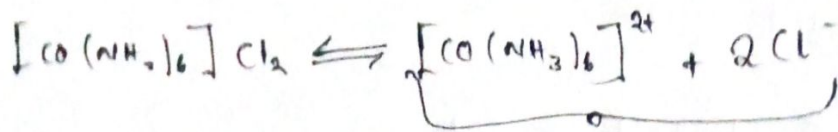
LECTURE NAME : MR. KENNETH KAMUNDA

PROGRAMME OF
STUDY : GEOLOGY

COURSE CODE : CHEM 2415

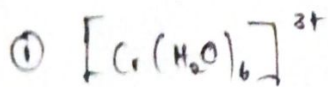
Question 1

$[\text{Co}(\text{NH}_3)_6] \text{Cl}_2$ in solution



= It has 3 ions produced.

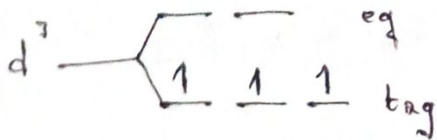
Question 2



In all the complex H_2O is neutral

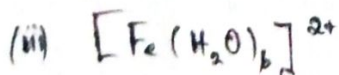
→ O.S of Cr is $+3$

→ d-count of = group number (period table) - oxidation number of metal
= d-count $6 - 3 = 3$, $3d^3$



- has 3 unpaired electrons, the ion is paramagnetic

$$\begin{aligned} \mu &= \sqrt{n(n+2)} \\ &= \sqrt{3(3+2)} \\ &= \sqrt{15} \\ &= 3.8 \\ &\approx \underline{\underline{4 \text{ BM}}} \end{aligned}$$

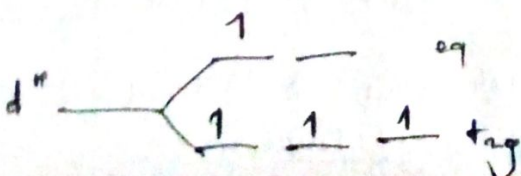


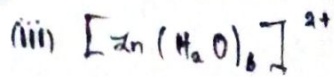
→ O.S of Fe is $+2$

→ d-count is $6 - 2 = 6$, $3d^6$

→ has 4 unpaired

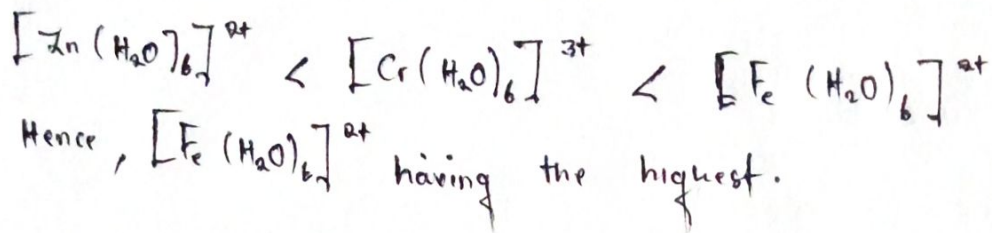
$$\begin{aligned} \mu &= \sqrt{n(n+2)} \\ &= \sqrt{4(4+2)} \\ &= \sqrt{24} \\ &= 4.90 \\ &\approx \underline{\underline{5 \text{ BM}}} \end{aligned}$$





- O.S of Zn is +2
- d-count is $12 - 2 = 10$
- Zn has no unpaired electron

Hence the ion with the highest magnetic moment value increases in the following order.



Question 3

$$\Delta_o = 171000 \frac{\text{J}}{\text{mol}} \times \frac{1 \text{ mol}}{6.022 \times 10^{23}} = 2.84 \times 10^{-19} \text{ J}$$

$$\Delta_o = 392000 \frac{1}{\text{mol}} \times \frac{1 \text{ mol}}{6.022 \times 10^{23}} = 6.51 \times 10^{-19} \text{ J}$$

High spin $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$

$$E_{\text{ph}} = nh\nu, \nu = \frac{c}{\lambda}$$

$$E_{\text{ph}} = \frac{nhc}{\lambda}$$

$$\lambda = \frac{(11)(6.626 \times 10^{-34})(2.9978 \times 10^8)}{(2.8 \times 10^{-19})}$$

$$\lambda = 7.09 \times 10^{-7} \text{ m}$$

$$\lambda \approx 709 \text{ nm}$$

(i) red colour is absorbed

(ii) $\lambda = 400 \text{ nm to } 360 \text{ nm}$ is the wavelength of colour transmitted.

(iv) green is the light transmitted.

low spin $[\text{Fe}(\text{CN})_6]^{3-}$

$$\lambda = \frac{nhc}{E_{\text{ph}}}$$

$$\lambda = \frac{(6.626 \times 10^{-34})(2.9978 \times 10^8)}{6.51 \times 10^{-19}}$$

$$\lambda = 3.05 \times 10^{-7} \text{ m}$$

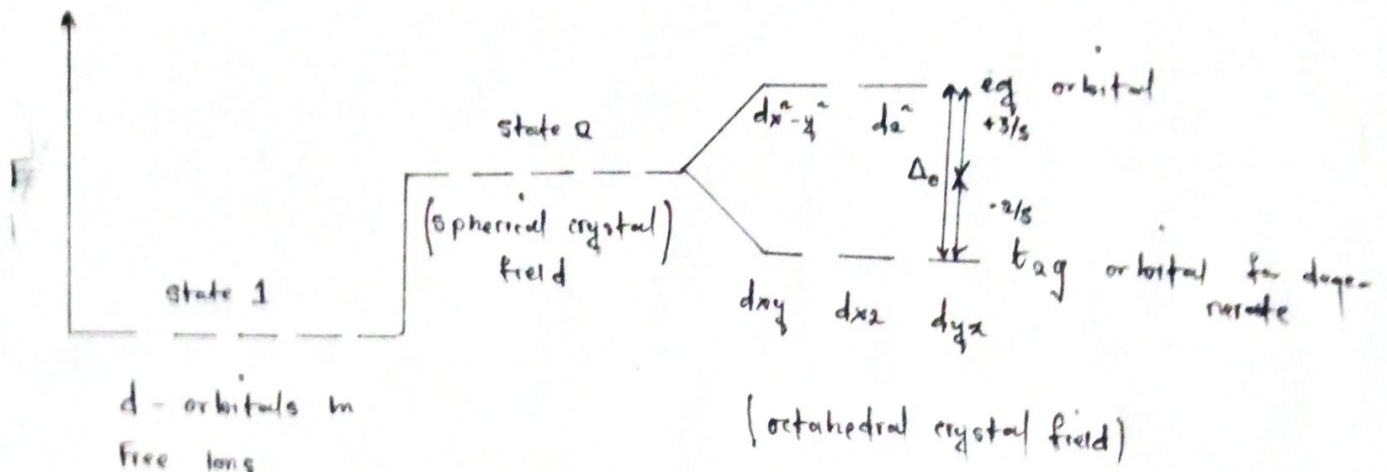
$$\lambda = 305 \text{ nm}$$

(i) absorbs violet light

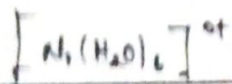
(ii) wavelength of transmitted light is 560 nm to 580 nm

(iv) colour transmitted is yellow

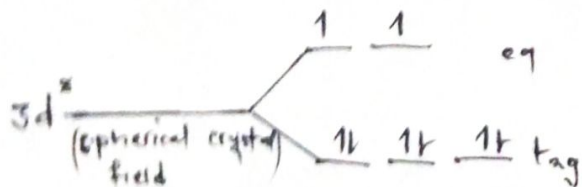
Question 4



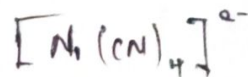
Question 5



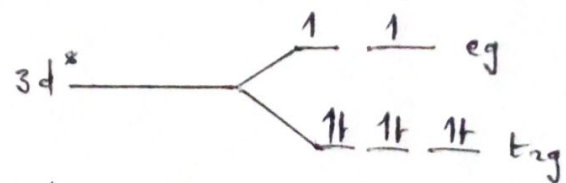
- H₂O is a weaker ligand and is neutral
- Ni has oxidation number +2
- d-count is $10 - 2 = 8$, $3d^8$



- The complex ion has 2 unpaired electrons for Ni



- $\text{Ni} + 4(-1) = -2$
- $\text{Ni} = 4 - 2$
- $\text{Ni} = 2$
- Ni has oxidation number +2
- d-count = $10 - 2 = 8$, $3d^8$



= has two unpaired electrons.

In the two complex above, Ni is in +2 oxidation state with the configuration $3d^8$, i.e. it has two unpaired electrons. In the presence of H₂O ligand, 2 unpaired electrons do not pair up with H₂O which is a weaker ligand. Hence for d-d transition, red is absorbed and complementary green light is emitted.

CN⁻ is a strong ligand, the two unpaired electrons in the 3d orbitals pair up. Thus there is no unpaired electrons present. Hence it is colourless.