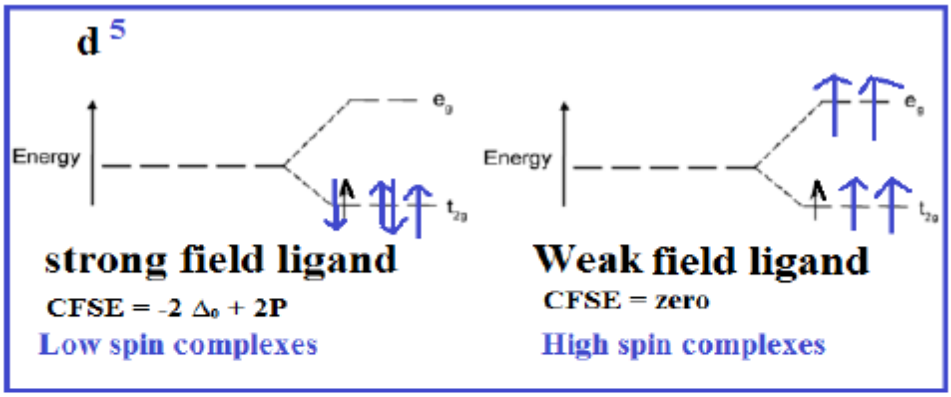
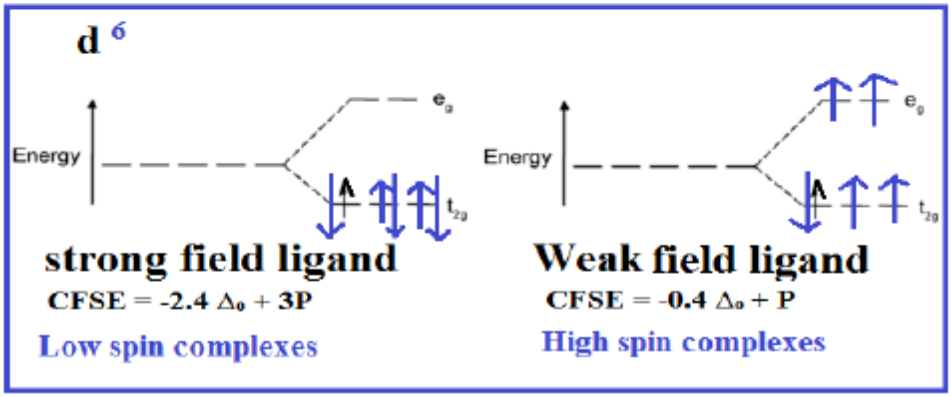
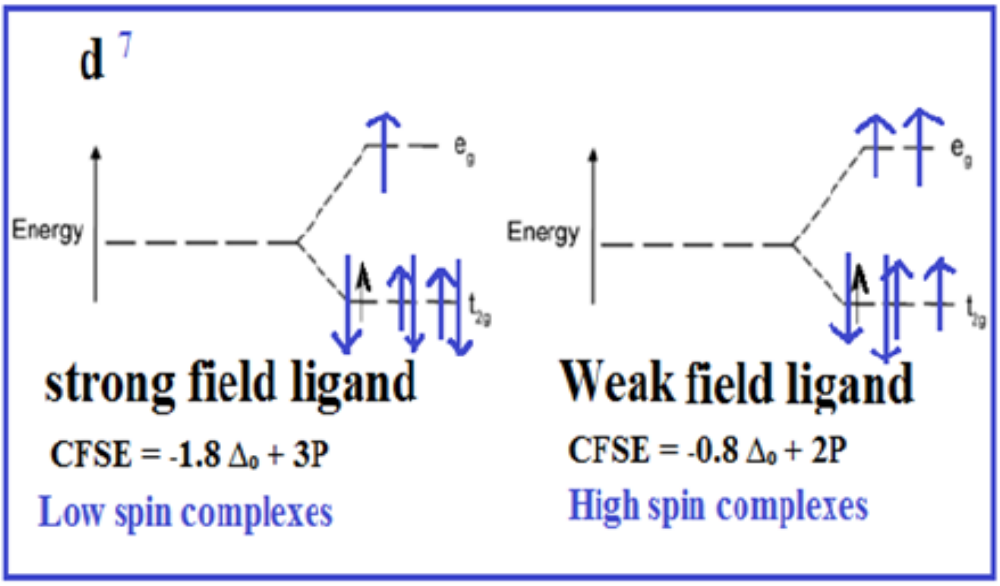
Model Answer of 323 ch

Model answer Q1: [20 Marks]

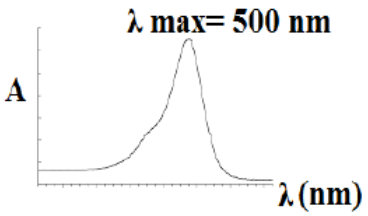
A: [10 Marks]







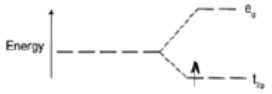
B: [10 Marks]



λ = 500 nm
nm= 10^{-9} m=10^{-7} cm
λ = 500 nm= 500 x 10^{-7} cm = 0.00005 cm
$\Delta o = 1/\lambda$ (cm) = 1/0.00005 = 20000 cm^{-1}
1 kJ/mole = 83.7 cm^{-1}
Δo = 20000/ 83.7 = 238.94 kJ/mole
CFSE =-0.4 Δ_o (nt_{2g}) + 0.6 Δ_o (n e_g)
CFSE= -0.4 Δ_0= -0.4 x 238.94 = -95.58 kJ/mole

Ti [Ar] $3d^2$ $4s^2$

Ti^{+3} [Ar] $3d^1$ $4s^0$



The violet color due to the complementary color of the previous electronic transitions adsorbed color

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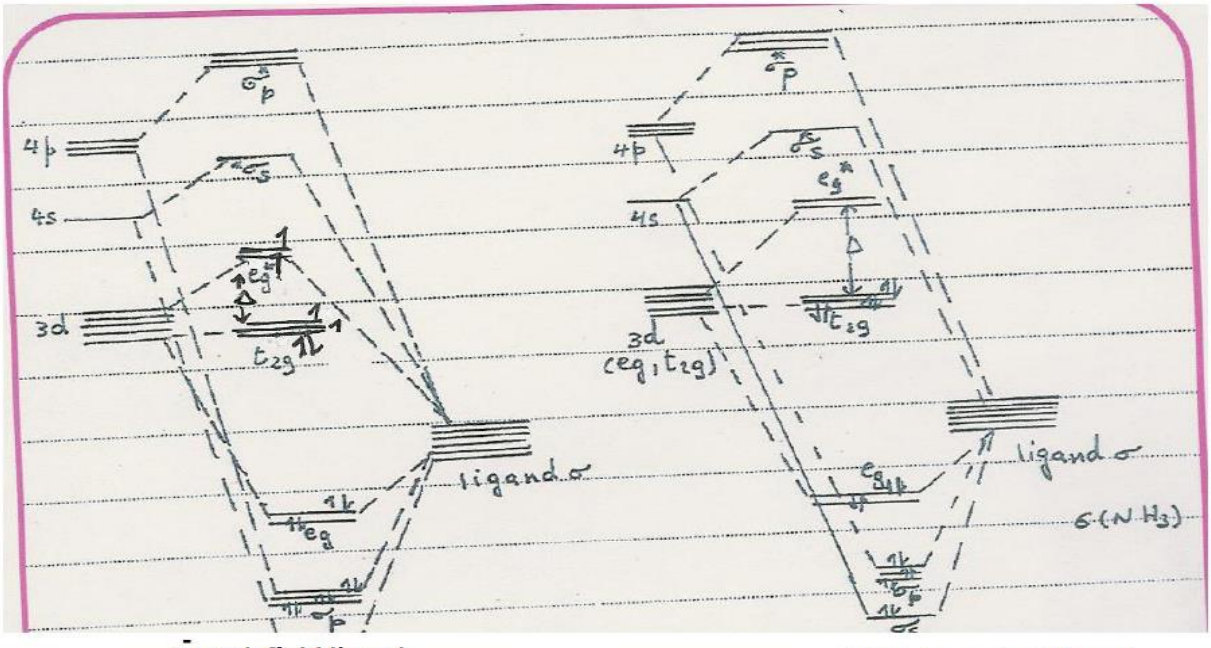
Model answer Q2: [20 Marks]

A: [10 Marks]



F weak field ligand

4 unpaied electrons
paramagnetic complex

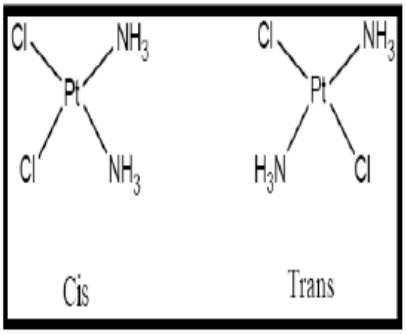
NH3 strong field ligand

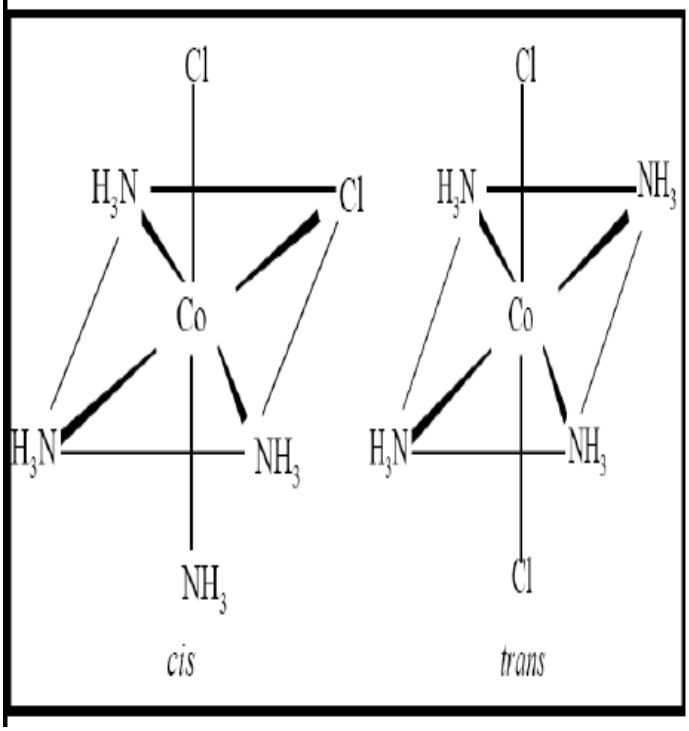
There is no unpaired electrons
Diamagnetic complex

B: [10 Marks]

Isomerism in metal complexes

1: Geometrical Isomerisation or Stereoisomerism





2: Position isomers or structural isomers

- **Ionization isomerism**

$[Co(NH_3)_5Br]SO_4$ $[Co(NH_3)_5SO_4]Br$

- **Hydrated isomerism**

$[Cr(H_2O)_6]Cl_3$ $[CrCl(H_2O)_5]Cl_2.H_2O$ $[CrCl_2(H_2O)_4]Cl.(H_2O)_2$

- **Linkage isomerism**

$[Co(NH_3)_5NO_2]Cl_2$ $[Co(NH_3)_5ONO]Cl_2$

- **Coordination isomerism**

$[Cr(NH_3)_6]\,[Co(C_2O_4)_3]$ $[Co(NH_3)_6]\,[Cr(C_2O_4)_3]$

Model answer Q3: [20 Marks]

A: [10 Marks]

$$2FeTiO_3 + 7Cl_2 + 6C \xrightarrow{900^\circ C} 2TiCl_4 + 2FeCl_3 + 6CO$$

ilmenite or rutile

$$2TiO_2 + 3C + 4Cl_2 \xrightarrow{950^\circ C} 2TiCl_4 + CO_2 + 2CO$$

$$TiCl_4 + 2Mg \xrightarrow{900^\circ C} Ti + 2MgCl_2$$

$$TiCl_4 + O_2 \xrightarrow{1000-1400^\circ} TiO_2 + 2Cl_2$$

$$TiCl_4 + 2ROH \longrightarrow TiCl_2(OR)_2 + 2HCl$$

dialkoxide

$$TiCl_4 + 4ROH + 4NH_3 \longrightarrow Ti(OR)_4 + 4NH_4Cl$$

tetraalkoxides

Ziegler–Natta Catalysts (polythene production at room temperature and atmospheric pressure)

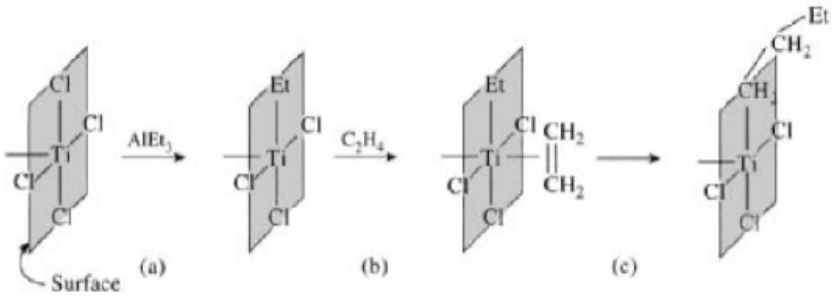


Figure A Possible mechanism of Ziegler–Natta catalyst.

(a) one of the chlorine atoms coordinated to a titanium atom is replaced by an ethyl group from $AlEt_3$,
(b) then, because the titanium atom on the surface of the solid has a vacant coordination site, a molecule of ethylene (ethene) can attach itself;
(c) migration of the ethyl group to the ethylene by a well-known process known as "*cis*-insertion" occurs.

The result of this *cis*-insertion is that a vacant site is left behind, and this can be occupied by another ethylene molecule and steps (a) and (b) repeated indefinitely.

B: [10 Marks]

i- Hexaamminechromium(III) nitrate

$$[Cr(NH_3)_6](NO_3)_3$$

ii- Bis(acetylacetonato)copper(II)

$$[Cu(CH_3COCHCOCH_3)_2]$$

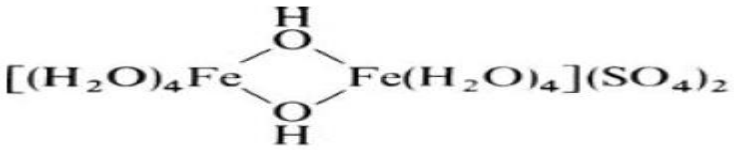
iii- Triamminechlorodinitroplatinum sulfate

$$[PtCl(NO_2)_2(NH_3)_3]_2SO_4$$

iv- Ammonium tetrabromo(ethylenediamine) chromate(III)

$$NH_4[CrBr_4(en)]$$

v- μ-dihydroxobis(tetraaquairon(III)) sulfate

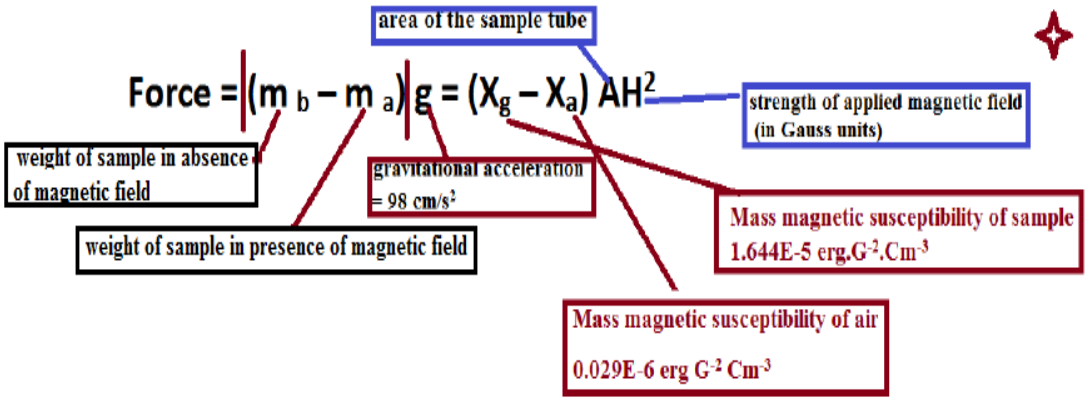


Q4: [20 Marks]

A: [10 Marks]

i-

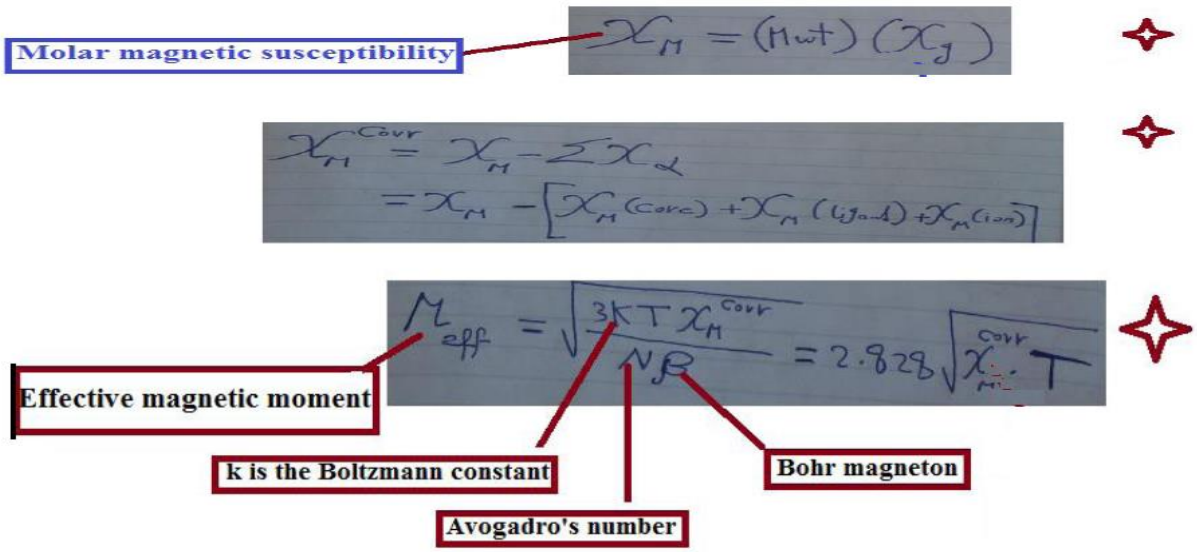
Put the calibrant mercury (II) tetrathiocyanatocobaltate Hg [Co (SCN) 4] in the tube then measure the weight in absence and presence of magnetic field



from this equation we obtain the value of AH^2

Put the sample in the tube then measure the weight in absence and presence of magnetic field

Calculate Xg using the previous equation



ii-

Paramagnetism: characterized by A: magnetic field generated in substance more than applied magnetic field B: it is easier for magnetic lines of force to travel through the substance than the vacuum C: arises as a result of unpaired electrons.

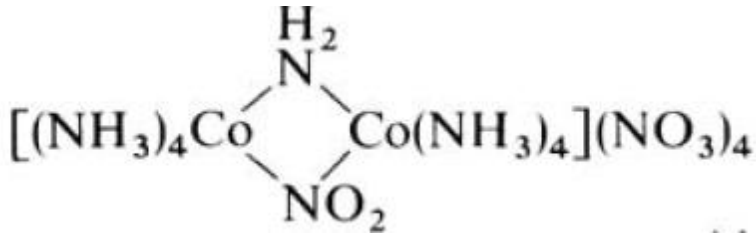
Diamagnetism: characterized by A: magnetic field generated in substance less than applied magnetic field B: it is easier for magnetic lines of force to travel through the vacuum than the substance C: all the electrons are paired.

Ferromagnetism: a special case of Paramagnetism in which the moments on individual atoms become aligned and all points in the same direction.

Antiferromagnetism: results by pairing the moments on adjacent atoms which point in opposite directions and hence this gives a magnetic moment less than would be expected for an array of independent ions.

B: [10 Marks]

i- μ-amido-μ-nitrobis(tetraamminecobalt(III) nitrate



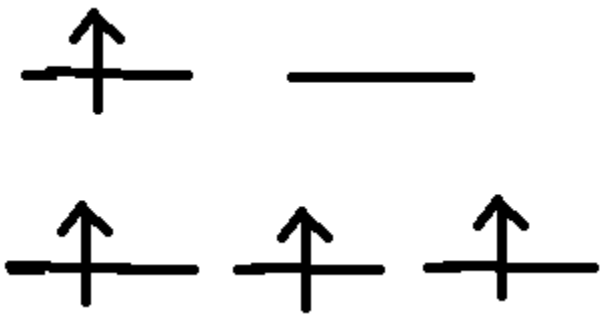
ii- Ammonium hexathiocyanato-N-chromate(III)

$(NH_4)_3[Cr(NCS)_6]$

Q5: [20 marks]

A: [10 Marks]

i)



ii) The spin on Mn ion is 2 and the complex is Paramagnetic

iii) The crystal field stabilization energy is -0.6 Δo

B:

Evans balance method

The Evans balance uses the same principle of Gouy method, but instead of measuring the force that the magnet exerts on the sample, it measures the equal and opposite force the sample exerts on a suspended permanent magnet

The Evans balance determines this force by measuring the change in current required to keep a set of suspended permanent magnets in balance when their fields interact with the sample.

The magnets are on one end of a balance beam, and when interacting with the sample change the position of the beam. This change is registered by a pair of photodiodes set on opposite sides of the balance beam's equilibrium position. The diodes send signals to an amplifier that in turn supplies current to a coil that will exactly cancel the interaction force. A digital voltmeter, connected across a precision resistor in series with the coli, measures the current directly. This current is displayed on the digital readout.

1-**A sample tube which has a narrow diameter is filled with the sample up to the mark**

2-**The sample and the tube are weighed in the usual way.**

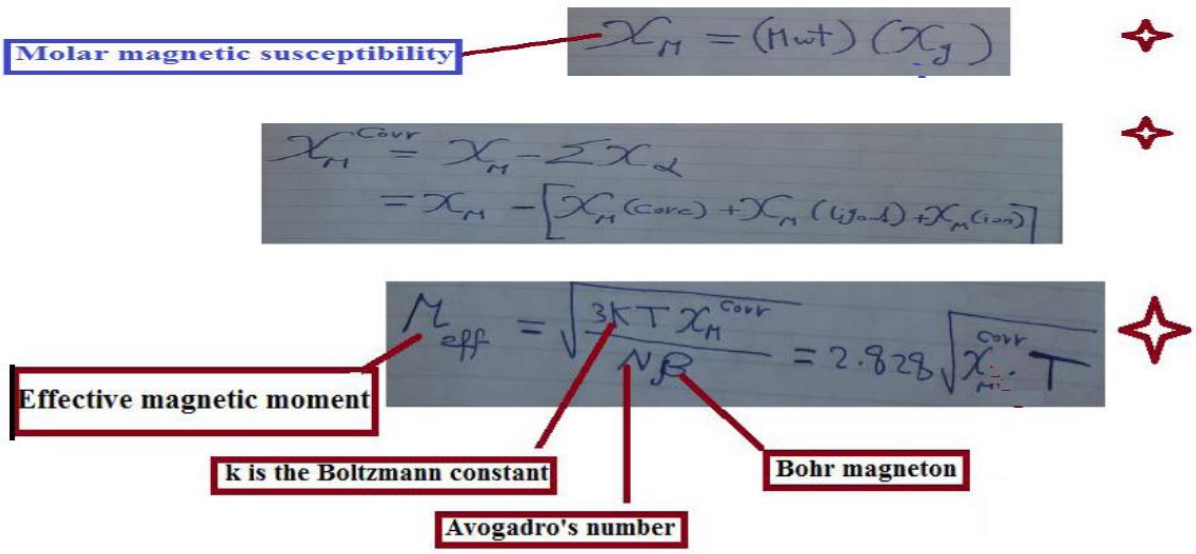
3-**The sample and empty tube were put in balance and digital readings were taken**

4- **Calculation of X_g (mass (gram) magnetic susceptibility)**

$$X_g = \frac{CL(R-R_o)}{m \cdot 10^9}$$

Where X_g is mass (gram) magnetic susceptibility, L is sample length in centimeters, m is sample mass in grams, C is balance calibration constant of the instrument, R is reading from the digital display when the sample (in the sample tube) is in place in the balance and Ro is reading from the digital display when the empty sample tube is in place in the balance. This equation gives the mass magnetic susceptibility in the cgs-units of erg.G^{-2}.Cm^{-3} (where G is Gauss).

5-**The calibration standards usually employed in magnetic susceptibility measurements are the complex mercury (II) tetrathiocyanatocobaltate, Hg [Co (SCN) $_4$] which has X_g values of 1.644E-5 erg.G^{-2}.Cm^{-3}. A preferred method to evaluate C in the previous equation is to perform the experiment with this calibration standard employing the appropriate value of X_g.**



Dr. Mostafa Y Nassar & Dr. Ehab Saleh