Bangalore university

B.Sc, VI sem, Chemistry (Paper –VII) Inorganic chemistry

Model paper –I

Time: 3 hours Max marks: 70

Instructions: 1) The question paper has two parts. Answer both the parts.
2) Draw diagrams and write chemical equations wherever necessary.

Part – A

Answer any EIGHT of the followingquestions. Each question carries TWO marks **8x2=16**

1. Give the IUPAC names of: a) $[Co(H_2O)_6]^{+3}$ b) $[Cr(NH_3)_6]^{+3}$
2. Mention two limitations of valence bond theory.
3. State EAN rule.
4. Name the raw materials used in the manufacture of cement
5. What is glazing of ceramic wares? Write its importance.
6. Mention the four varieties of coal.
7. What are trace elements? Give two examples.
8. Write a note on Carbon Nano tubes.
9. Give any two applications of super conductors.
10. What are conducting polymers? Mention any one of its biological applications.
11. Calculate the EAN of $Mn_2(CO)_{10}$ according to 18 electron rule and write its structure.
12. Define octane number and mention its significance.

PART- B

Answer any nine of the following questionsEach question carries SIXmarks (9x6=54)

13. a) Based on the VBT explain the geometry and magnetic property of $[Fe(CN)_6]^{-4}$. 4
b) What are high spin complexes? Give an example. 2

14. a) What are ligands? How are they classified on the basis of donor atoms? Give examples for each.4
b) Explain hydrate isomerism with an example. 2

15. a) Explain the splitting of d- orbital in an octahedral complex. 4
b) What is hapticity of a ligand? Give an example.2

16. a) Explain the application of i) Cis-platin in cancer treatment ii) Wilkinson Catalyst in hydrogenation of alkenes.4
b) Give the synthesis and structure of Zeise's salt.2

17.a) Based on CFT explain spectral property of $[Ti\ (H_2O)_6]^{+3}$. 4

b)$[CoF_6]^{3-}$is paramagnetic where as $[Co(NH_3)_6]^{3+}$ is diamagnetic. Why?2

18. a) Describe the manufacture of Carborandum(Siliconcarbide). 4

b) Write a note on annealing of glass?2

19. a) What are refractories.? Give the characteristics of a good refractory.4

b) What is the role of gypsum in the setting of cement? 2

20. a) How is calorific value of a fuel is determined by bomb calorimeter?3

b) How is dynamite prepared? Give equation.3

21. a) Mention the roles of following constituents in a paint:

i. pigment
ii. medium
iii. thinners
iv. plasticizers. 4

b) What are propellants? Give an example. 2

22. a) Describe the manufacture of soda glass. 4

b) Write any two applications of high temperature super conductors. 2

23. a) Discuss the structure and biological function of hemoglobin. 4

b) Explain the role of phosphorous and nickel in biological systems.2

24.a) Discuss the salient features of BCS theory of super conductivity 4

b) How is nano materials produced by electro deposition method? 2

25. a) How is polyacetylene converted to conducting polymer by doping? 4

b) Write two commercial uses of C-60. 2

Bangalore university

B.Sc,-VI Semester , Chemistry (Paper – VII), Inorganic Chemistry,

Model Paper – I- KEY ANSWERS

Time: 3 hours Max marks: 70

Part – A

Answer any EIGHT of the following questions. Each question carries TWO marks.

1. Give the IUPAC name of: a) [$Co(H_2O)_6]^{+3}$ b) $[Cr(NH_3)_6]^{+3}$

Ans: a) hexaaquacobalt (III) b) hexaminechromium (III) .or can we give $Na_3[CrF_6]$

2. Mention two limitations of valence bond theory.

Ans: 1. Fails to explain the spectral properties of complexes 2. Fails to explain the stabilities of complexes 3. It does not explain the variation of magnetic moments of complexes with temperature. 4. Fails to distinguish between inner and outer orbital complexes.

3. State EAN rule.

Ans: In the formation of the complex, central metal or ion accepts lone pair of electrons donated by the ligands till the total number of electrons in the metal becomes equal to the atomic number of the next noble or inert gas configuration. **Or EAN=Z-X+Y**and explain the terms.z, x and y

4. Name the raw materials used in the manufacture of cement.

Ans: i) Lime CaO ii) Silica SiO_2 iii) Alumina Al_2O_3iv) Sulphur trioxide SO_3 v) Magnesia MgO& vi) Iron oxide Fe_2O_3

5. What is glazing of ceramic wares? Write its importance.

Ans: The ceramic wares have porous surface which allows the penetration of liquid or water through these pores. The process of making the surface of ceramic ware impervious to liquids and imparting glossy appearance is called glazing. It gives decorative look, increase its durability, and protect the surface from chemical effects of atmospheric gases.

6. Mention the four varieties of coal.

Ans:i) Peat ii) lignite iii) Bituminous coal iv) anthracite.

7. What are trace elements? Give two examples.

Ans: Trace elements are chemical elements present required by an organism for healthy growth and they are required in very minute amounts to maintain their structure and function. Example: Cu, Fe, Ni, V, Zn, Mo.

8. Write a note on Carbon Nano tubes.

Ans: Carbon nanotubes: A carbon nanotube is a tube-shaped material, made of carbon, having a diameter measuring on the nanometer scale. A nanometer is one-billionth of a meter, or about 10,000 times smaller than a human hair. CNT are unique because the bonding between the atoms is very strong and the tubes can have extreme aspect ratios. A carbon nano tube can be as thin as a few nanometers yet be as long as hundreds of microns.

A carbon nano tube is a sheet of carbon atoms joined in pattern hexagons and rolled into a cylinder. The conducting property of nano tube depends upon how the two ends of the sheet

meet along. For particular way of arrangement of atoms along the meeting line makes the entire tube conducting like a metal and for another type of arrangement, the tube behave like asemiconductor. When one type of nano tube is rolled inside another tube, amulti-walled nano tube is formed.Nano tubes are non-reactive and with stand high temperature.

9. Give any two applications of super conductors.

Ans: Super conductors finds applications in 1.The manufacture of superconducting magnets. 2. Magnetic levitation 3. Super conducting quantum interference device. (any two)

10. What are conducting polymers? Mention any one of its biological application.

Ans:An Organic polymer with highly delocalized pi-electron system having electrical conductance of the order of a conductor is called a conducting polymer.

Biological applications of the conducting polymers: 1. These are useful in the preparation of artificial nerves that is biocompatible conductive polymers can be used for transmitting electrical signals in the body.2.Poly aniline has been investigated for biosensors, neural probes, controlled drug delivery and tissue engineering applications.3.The conductive polymers are used as a substrate material for controllable drug delivery.4.They are used as biosensors in living systems (any two applications)

11. Calculate the EAN of $Mn_2(CO)_{10}$ according to 18 electron rule and write its structure.

Ans: Manganese has outer electronic configuration $3d^5 4^2$ i.e. 7 electrons in the valance shell.

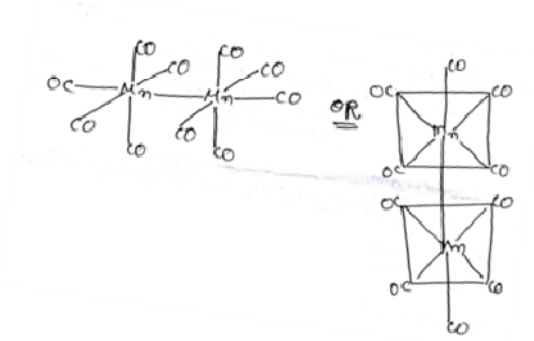
$Mn_2(CO)_{10}$ 2Mn Contributes $\rightarrow 2x7 = 14$ electrons

10 CO Contributes $\rightarrow 2 \times 10 = 20$ electrons.

Mn-Mn single bond contributes $\rightarrow$ 02 electrons

For 2 Mn, total number of electrons = 36; for one Mn $\rightarrow \frac{36}{2} = 18$ electrons

Hence 18 electron rule is satisfied by $Mn_2(CO)_{10}$ the structure of $Mn_2(CO)_{10}$ is givenbelow



It has octahedral structure.

12. Define octane number and mention its significance.

Ans: It is the measure of ignition quality of the fuel. It is the percentage of iso octane in a combustible mixture of fuel containing iso octane and n- heptane.The higher the octane number, the more compression the fuel can withstand before detonating.

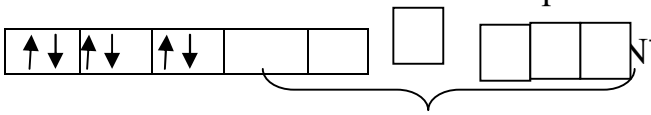
PART- B

13. a) Based on the VBT explain the geometry and magnetic property of $[Fe(CN)_6]^{-4}$. 4m

Ans: The element iron has outer electronic configuration of $3d^6 4s^2$ and Fe^{2+} ion has theouter configuration is $3d^6 4s^0$ (orbital diagram). In order to form 6 bonds with 6 cyanide ligands, six empty orbitals are made to receive the 6 pairs of electrons from $6CN^-$ ions. The two3d, 4s, 4p empty orbitals are used for hybridization to form $6d^2sp^3$hybrid orbitals.The central metal ion accepts 6x2=12 electrons forming 6 co-ordinate bonds with the ligand.

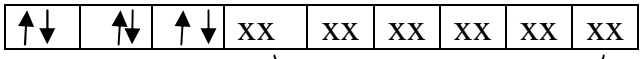
Orbitals of Fe^{2+} ion

Electronic configuration of Fe^{+2} ion



CN^- approaches Fe^{+2} ion rearrangement of electron takes d^2sp^3 hybridization

In presence of CN^- ion unpaired electrons are paired



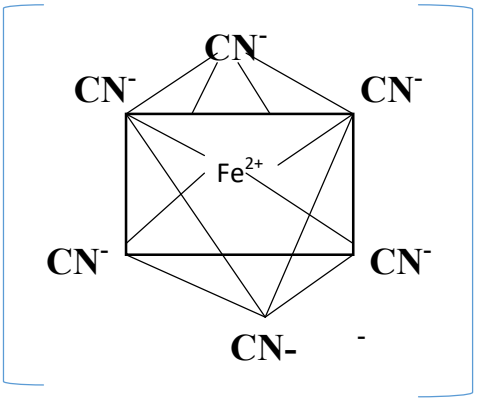
$6CN^-$ donates 6x2 =12 electrons forms 6 co-ordinate bonds with Fe^{2+} ions.

d^2sp^3hybridized orbitals of Fe^{2+}

x- Six pairs of electrons from six CN^- ligands (d^2sp^3hybridization)

The complex is an inner orbital complex having the structure of octahedral geometry.

Magnetic property:-It does not contain unpaired, it is a diamagnetic complex



Magnetic property:-It does not contain unpaired, it is a diamagnetic complex

b) What are high spin complexes? Give an example. 2m

Ans:The complexes in which the number of unpaired electrons in the free ion and in the complex is same, such complexes are known as high spin complexes. **OR**When Δ-Crystal field splitting energy (Δ) is small (weak field ligand), the electrons will fill in which all the t_{2g} and e_g orbitals are singly occupied before any pairing occurs.It is then classified as high **spin** because there is maximum number of unpaired electrons.Ex: $[CoF_6]^{3-}$.

14. a) What are ligands? How are they classified on the basis of donor atoms? Give an example for each. 4m

Ans: Ligands are the ions or neutral molecules which can donate one or more pairs electrons to the central metal atom or ion forming coordinate bond.

Classifications of Ligands: Depending on the number of donor atoms present, the ligands are classified as

i) Monodentate ligands → containing one donor atom or donate a lone pair electron. :NH_3, :CO,:CN^- ,:Cl^- ; :F^- etc.

ii) Bidentate ligands →containing two donor atoms or donate two lonepair electron

Ex:1)ethane 1,2 diamine –en→H_2N^- – $(CH_2)_2$-H_2N^- 2) Oxalato: ^-OOC-COO^-

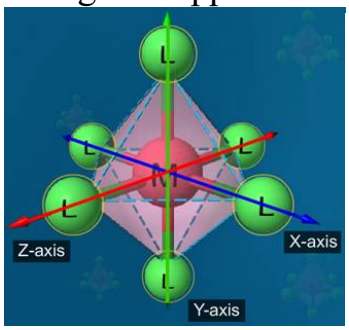
iii) Polydentate ligands → EDTA, porphyrins

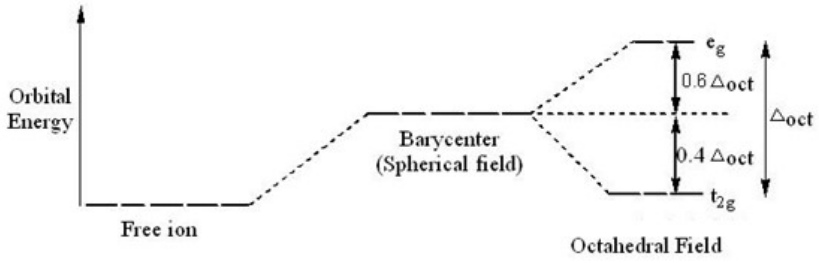
b) Explain hydrate isomerism with an example.2m

Ans: The hydrate isomerism contains same molecular formula but different number water molecules as water of hydration and as ligands. **Example:** [Cr $(H_2O)_6Cl_3$] – violet color and [Cr $(H_2O)_5Cl]Cl_2$. H_2O – green and [Cr $(H_2O)_4Cl_2]Cl$.$2H_2O$ – dark green. All these complex compounds contain same number water molecules but different number of molecules of water as water of hydration and ligands.

15. a) Explain the splitting of d- orbital in an octahedral complex. 4m

Ans: According to the crystal field theory, the ligands are considered as point charges. In an octahedral complex, the metal ion is considered to be at the center of an octahedron and the six ligands approach it along the three axes.





The ligands exert an electrostatic force of repulsion on the outer d-electrons. This repulsion raises the energy of the degenerate d orbitals to give five excited degenerate orbitals which is hypothetical. The lobes of the two orbitals d x^2-y^2 and dz^2(e_g) are more concentrated on the axes along which the ligands are approaching. Hence the electrons in these orbitals suffer a greater repulsion than the t_{2g} set of orbitals that is d_{xy}, d_{yz}, and d_{zx}which lie in between the axes. Thus in an octahedral field, the d-subshell is split into two sets of e_g has higher energy and the other set t_{2g} has lower energy as shown in the diagram.

The splitting of five degenerate d-orbitals of metal ion under the influence of approaching ligands, into two sets of orbitals having different energies is called crystal field splitting. The magnitude of difference in energy between the two sets of orbitals is designated as Δ_o. The energy of the eg orbital is 0.6Δo higher than the hypothetical degenerate d-orbitals.

b) What is hapticity of a ligand? Give an example. 2m

Ans: Hapticity of aorgano metallic ligand is defined as the number of its carbon atoms through which an organic ligand forms bonds with the central metal atom in the compound.It is indicated as η^n, where n is the number of atoms coordinated to the ligand.

Examples:i) Monohaptoligands (η^1): Only one carbon atom of the organic ligand is linked to the metal atom. Ex: $-CH_3$, $-C_6H_5$

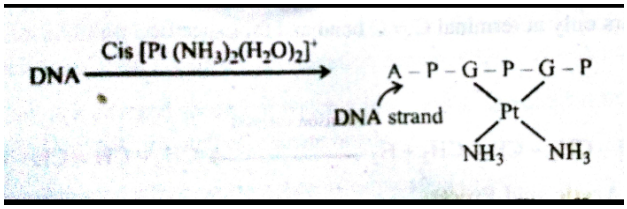
ii) Dihaptoligands (η^2): Two carbon atoms of the organic ligand is linked to the metal atom. Ex: $CH_2 = CH_2$

iii) Trihaptoligands (η^3): Three carbon atoms of the organic ligand is linked to the metal atom. Ex: Allyl radical $CH_2 = CH - CH_2^{\cdot}$

iv) Tetrahaptoligands (η^4): four carbon atoms of the organic ligand is linked to the metal atom. Ex: Conjugated dienes $CH_2 = CH - CH = CH_2$ like this penta, hexahapta ligands

16. a) Explain the application of co-ordination compounds with reference to
i) Cis-platin in cancer treatment ii) Wilkinson catalyst in hydrogenation of alkenes. 4m

Ans: i) Cis-diaminedichloroplatinum (II) complex is known as Cis-platin. This complex is used in treatment of cancer. When cis platin is injected in low concentrations platinum binds to DNA in place of chloro ligands, to the nitrogen atoms of Guanine base by coordination. Due to intra strand linking of platinum with two adjacent Guanine bases of DNA, normal reproduction of DNA is impaired and the cell division is prevented. When cis platin is injected, the chloro ligands of the complex are replaced by water molecules and then bind to the nitrogen base of DNA.



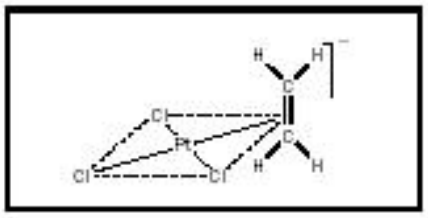
ii) Wilkinson catalyst is chlorotris(triphenylphosphine)rhodium(I). it is a square planar complex it forms five coordinate or six coordinate intermediate by acquiring 18 electrons outer orbital configuration with a ligand. Using Wilkinson catalyst, hydrogenation can be carried out at room temperature and pressure. The addition occurs only at terminal C=C bond and thus specific.

$$CH_3\text{-}CH{=}CH\text{-}CH_2\text{-}CH{=}CH_2 + H_2 \rightarrow CH_3\text{-}CH{=}CH\text{-}CH_2\text{-}CH_2\text{-}CH_2$$

b) Give the synthesis and structure of Zeise's Salt 2m Zeise's salt is synthesized by reaction between K_2PtCl_4 and ethene, with a $SnCl_2$ catalyst. It was one of the very first organometallic compounds to be prepared

$$KPtCl_4 + C_2H_4 \rightarrow KPtCl_3\text{-}C_2H_4 + KCl$$

Structure: It has square planar structure.



17. a) Based on CFT explain spectral property of $[Ti(H_2O)_6]^{+3}$. 4m

Ans: Most transition metal ion complexes are coloured this can be observed by taking electronic absorption spectrum or u.v spectrum of complexes. Ex-$[Ti(H_2O)_6]^{+3}$ which has one d electron. This occupies one of lower energy d-orbital i.e. one of the t_{2g} orbital.

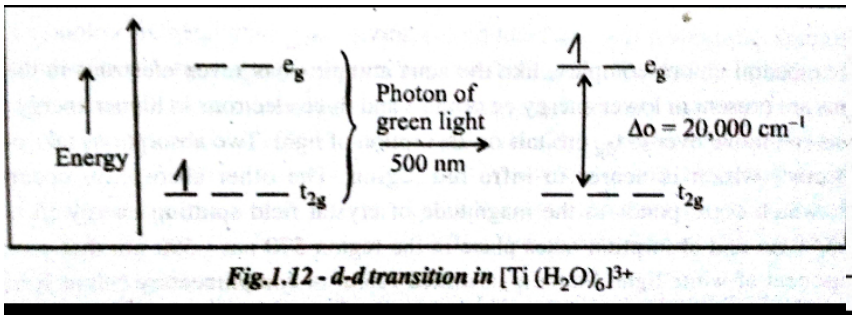


Fig.1.12 - d-d transition in $[Ti(H_2O)_6]^{3+}$

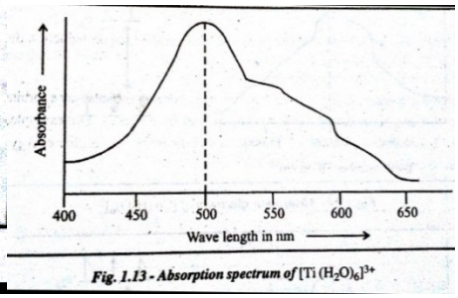


Fig. 1.13 - Absorption spectrum of $[Ti(H_2O)_6]^{3+}$

The complex absorbs energy in the visible region thus promoting the electron form t_{2g} level to the e_g level a single broad peak is observed at 20300 cm^{-1} or at 493nm corresponding to the $t_{2g}^1 \rightarrow e_g^1$. This helps in calculating the energy gap between $t_{2g}$and e_g levels in the complex. Therefore solution appears purple as yellow, green and blue are absorbed to excite the electron. The spectroscopic data provides the information about crystal field splitting. Hence on the basis of spectroscopic measurement CFSE of complex can be calculated.

b) $[CoF_6]^{3-}$ is paramagnetic where as $[Co(NH_3)_6]^{3+}$ is diamagnetic. Why?2m

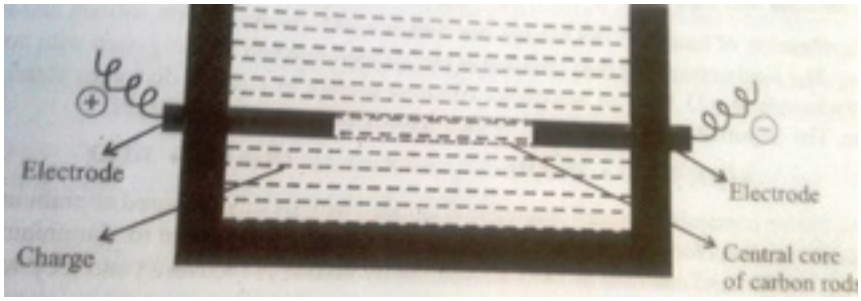
Ans: F^- ion is a weak field ligand that forms high spin complex in$[CoF_6]^{3-}$, less pairing takes place having 4 unpaired electrons forming outer complex. hence it is paramagnetic in nature. In $[Co(NH_3)_6]^{3+}$, NH_3 is a strong field ligand electron pairing takes place forming inner complex that is a low spin complex, that leads to no unpaired electrons. Hence it is diamagnetic in nature.

18. a) Describe the manufacture of Carborandum(Silicon carbide).3m

Ans: Silicon Carbide is called carborandum, it is an abrasive.The Charge consists of 56% SiO_2, 35% Coke, 7% saw dust and 2% salt. The charge is powdered and fed into the furnace where carbon electrodes are kept horizontally at the center leaving a gap in between as shown in the diagram.

$$SiO_2 + 3\,C \xrightarrow[+\,618.5\ kJ]{} SiC + 2\,\overrightarrow{CO}$$

Diagram



An electric arc is struck between the electrodes which produces a heat of 3000K for 36hrs.SiC formed at the gap of two electrodes. The saw dust keeps the mass porous and facilitates easy escape of gaseous products. Salt acts as a flux and makes the mass easily fusible. The black strip is cooled for 24 hours. Washed repeatedly with sulphuric acid and sodium hydroxide to remove the impurities and then dried and graded.

b) Write a note on annealing of glass? 3m

Ans: Glass becomes annealed if it is heated above a transition point then allowed to cool slowly, without being quenched. Glass is treated with heat in order to change its properties by the annealing process. Annealed glass is the most common glass used in windows. Annealed glass is also known as a standard sheet of **float glass**.

Annealing is actually a process of slowly cooling glass to relieve internal stresses after it is formed. The glass, formerly annealed on shelves in a melting furnace, is now usually carried on rollers through temperature-controlled kiln known as a **Lehr (**annealing ovens). The shaped glass is annealed to relieve stresses caused by manipulation, then is slowly cooled. Glass which has not been annealed is liable to crack or shatter when subjected to a relatively small temperature change or mechanical shock. Annealing glass is critical to its durability. If glass is not annealed, it will retain many of the thermal stresses caused by quenching and significantly decrease the overall strength of the glass.

19.a) What are refractories.? Give the characteristics of a good refractory.4m

Ans: The refractories are the substances which retains its strength at high temperatures. Refractory materials are used in linings for furnaces, kilns, incinerators, and reactors.

The characteristics of a good refractory are

1) Should be able to with stand very high temperature of the order of 2000^0C.
2) Have resistance to with stand temperature fluctuations.
3) Have low porosity
4) Should be able to with stand sudden changes in pressure, palling, cracking.
5) Low electrical conductivity.
6) Should possess low or high thermal conductivity.

b) What is the role of gypsum in the setting of cement? 2m

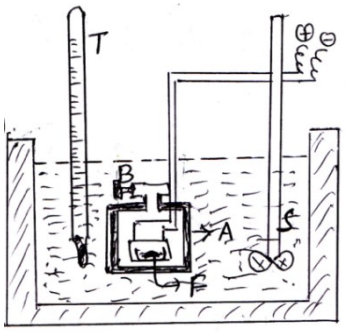
Ans: The addition of 3-5% gypsum during the grinding of clinker cement helps retarding the process of setting of cement. It is found that slower the setting process greater is the strength

of hardened cement. Gypsum retards the setting process by removing fast setting tricalcium aluminate content of the cement by forming calcium sulfoaluminate.

20. a) How is calorific value of a fuel is determined by bomb calorimeter?4mAns: The calorific value of a solid or liquid fuel is determined using a bomb copper calorimeter. The bomb is made of a strong cylindrical steel container 'A' in which the known amount of Fuel is burnt. It is provided within air tight lid 'B' and an inlet value for passing oxygen. The Bomb is placed inside a copper calorimeter filled with a definite mass of water this provided with a precision thermometer T and a stirrer S.

A known mass of the fuel is taken in a silica crucible F and kept inside the bomb. A thinMagnesium wire is projecting from the crucible which is connected to the terminal rods. Oxygen is filled into the bomb. The initial temperature of water in the meter is down. The fuel in the bomb is ignited by connecting the terminal rods to a source of electric current. The water is kept stirred and the maximum temperature attained by water is noted.

Observations and Calculation of calorific value:



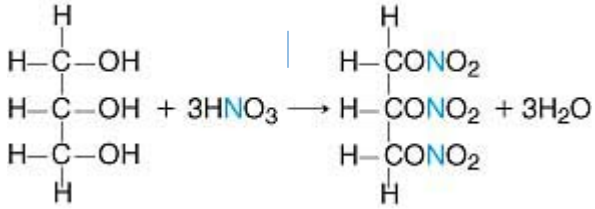
1. Mass of the fuel =m g
2. Water equivalent of calorimeter =w g
3. Volume of water in calorimeter= x cm^3
4. Mass of water in calorimeter= x cm^3 x density of water=y g
5. Initial temperature of calorimeter and water= $t_1{}^0C$
6. Maximum temperature of calorimeter and water after combustion= $t_2{}^0C$.
7. Rise in temperature = $\Delta T = (T_2 - T_1)K$

Heat liberated on combustion of fuel= heat absorbed by water and calorimeter

Calorific value of the fuel is calculated by the equation: $Q = Ws\Delta T/m$. Where W= water equivalent of the calorimeter is determined by carrying out the experiment using a fuel of known calorific value. s=specific heat of water.

b) How is dynamite prepared? Give equation.2m

Ans: Dynamite is prepared by the reaction of glycerol with40% conc. nitric acid in presence of 59.5% conc.sulphuric acid10^0C.the reaction completes in 90 minutes and separates as yellow liquid. It purified by washing with aqueous solution of sodium carbonate and water



21. a) Explain the roles of following constituents of paint: i) Pigment ii)Medium iii)Thinners iv) Plasticizers. 4m

Ans: Emulsion paints are oil based water paints. The raw materials used in the manufacture of emulsion paints are:

Sl.No.	Raw materials	Role of the raw materials in the man. of emulsion paints
1.	Pigments	Solid colored substances bounds to a surface that imparts specific color to the surface: Ex: TiO_2
2.	Medium	The medium or the film forming material plays a duel role. It acts as a medium for suspension of pigment and also forms protective film. Unsaturated vegetable oil i.e. linseed, tung, cotton seed, castor oil etc.are used they form a protective film by process of oxidization and polymerization.
3.	Thinners	These acts as diluents and reduce the viscosity of the paint so that application of paint becomes easy. Benzene , toluene , acetone , alcohols are being used.
4.	Plasticizers	They impart plasticity to the film and prevent it from cracking, low volatile liquids like dehydrated Castor oil or solids of low melting point are used.

b) What are propellants? Give an example. 2m

Propellants are the materials containing fuel and an oxidizer, which on combustion produces large volume of gases and high temperature of about 3273K

Ex: i) ethanol + liquid oxygen ii) Liquid oxygen + liquid hydrogen

22.a) Describe the manufacture of soda glass. 4m

Ans: a) The raw materials required for the manufacture of soda glass are i) Silica the form of sand or quartz ii)Soda ash Na_2CO_3 iii) Cullet-broken glass

Process: Above raw materials are ground separately and mixed in proper proportion. The cullet reduces the melting point of the charge. The intimate mixture is called "BATCH". The glass batch is then melted in the hearth of open hearth furnace or in a pot furnace made up of fine clay. Heating is done by burning producer gas. The cullet melts first and helps in the fusion of remaining raw materials. The high temperature between 1500^0C to 1800^0C is maintained to reduce the viscosity of glass melt and to obtain homogeneous liquid. During heating following reactions occurs.

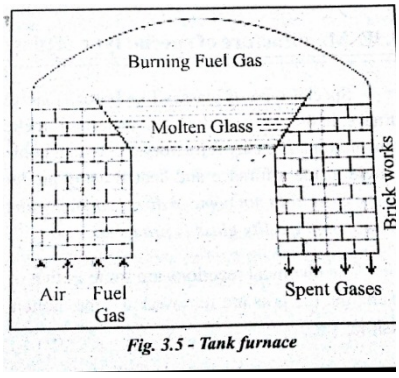


Fig. 3.5 - Tank furnace

$$Na_2CO_3 + SiO_2 \rightarrow Na_2SiO_3 + CO_2,\ CaCO_3 \rightarrow CaO + CO_2$$

$$CaO + SiO_2 \rightarrow CaSiO_3$$

$$Na_2CO3 + CaCO_3 + 6SiO_2 \rightarrow Na_2OCaO\ 6SiO_2 + 2CO_2$$

Heating is continued till the glass melt is free from gas bubbles. Unreacted and other impurities form a scum called glass gall which is skimmed off. The clear liquid is allowed to cool after adding de-coloring agent or coloring agent. The mixer temperature is reduced to 700 -1200^0C to get correct viscosity and then subject tomoulding for shaping of glass. After shaping, glass articles are cooled slowly or subjected to annealing. After annealing glass articles are subjected to finishing such as cleaning, grinding, polishing, and cutting and then packed.

b) Write any two applications of high temperature super conductors. 2m

Ans: 1.Applications of high temperature superconductors include; magnetic shielding devices, medical imaging systems.

2. Superconducting quantum interference devices (SQUIDS), infrared sensors, analog signal processing devices, and microwave devices use high temperature superconductors.

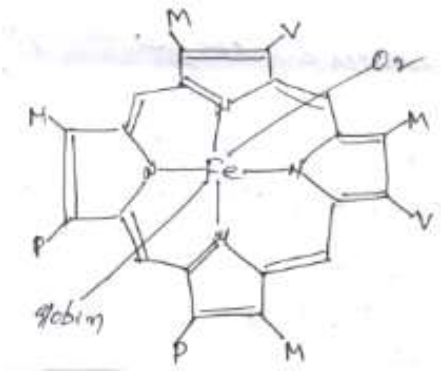
3. Finds applications in power transmission, superconducting magnets in generators, energy storage devices, particle accelerators, levitated vehicle transportation, rotating machinery.

4. Finds applications in magnetic separators will become more practical.

5. The field of electronics

23.a) Discuss the structure and biological function of hemoglobin. 4m

Ans: Hemoglobin is obtained when iron combines with porphyrin cycle and attached to the protein globin. Hemoglobin is a conjugated protein which constitutes the red colouring matter of the blood. Hemoglobin is unique in its ability to bind with molecular oxygen in easy reversible combination and serve as oxygen transporters to the cells. During respiration, hemoglobin combines with oxygen to form oxy hemoglobin in the lungs. When the oxygenated blood reaches the tissues where Oxygen availability is low, oxyhemoglobin is dissociated and oxygen is freely available to the cells. In hemoglobin, the iron in heme is conjugated to the nitrogen atoms of the tetra pyrrole rings. This conjugation is helpful for iron to combine with molecular oxygen in the lungs and transported to tissues.



Note, M = CH_3 P = CH_2-CH_2–COOH, V = - CH =CH_2

b) Explain the role of Phosphorous and nickel in biological system. 2m

Ans: 1) Nickel: i) It is a tracer element, stabilizes coiled ribosome and activates hydrogenase reaction.2) Phosphorous: i) Essential constituent of bones and teeth and alsoADP, ATP, RNA and DNA.

24. a) Discuss the salient features of BCS theory of super conductivity 4m

Ans: In 1957,Bardeen, Cooper, and Schrieffer gave a theory to explain the phenomenon of super conductivity which is known as BCS theory.It is based upon the formation "Cooper pairs" and it is positively "Quantum mechanical concept". **1)**When a current flows in a superconductor, the electron approaches the +ve ion core of the lattice, it experiences an

attractive force due to the opposite charges between the electron and the +ve ion as a result +ve ion will be displace from its position called "lattice distortion".

2)Now a second electron which approaches the distorted +ve ion core experiences a columbic attractive force. This process can be looked upon as interaction on apparent forces of attraction develops between the electrons and then tend to move in pairs.

3)The lattice vibrations are Quantized in terms of what are called "phonons" thus the process is called "electron-lattice-electron "interaction ,via the phonon field the attractive force established may exceed the columbic repulsive force between the two electrons at Temperature below critical temperature (T_c) leading to the formation of "COOPER PAIRS".

4)"Cooper pairs is abound pair of electrons formed by the interaction between the electrons formed by interaction between the electrons with opposite spin and moment in a phonon field". **5)**When the electrons flow in the form of cooper pairs in materials, they do not encounter any scattering by the lattice ions & do not get slow down, finally the resistance factor vanishes i.e. the material has "zero resistivity"which is named as Superconductivity. This is called essence of BCS theory.

b) How is nano materials produced by electro deposition method? 2m

Ans: Electrodeposition method of production of nanomaterials: The synthesis of various nanoscale materials, such as nanoparticles, nanowires of Au, Pt, Ni Co, Fe, Ag etc., by electrodeposition techniques. Both potentiostatic and Galvanostatic methods were employed to carry out the electrodeposition process under different potential ranges, time durations, and current densities. The electrochemical behavior of the deposited nanoparticles on various substrates was investigated by cyclic voltammetric and chrono-amperometric techniques.

Ex: The synthesis of mono-dispersed gold (Au) nanoparticles on indium tin oxide (ITO) coated glass, preparation of Au nano rods on nano porous anodic alumina oxide (AAO), formation of Au nanoclusters on polypyrrole-modified glassy carbon electrode and one-step electrodeposition of nickel nanoparticle chains embedded in TiO_2 .

25. a) How is polyacetylene converted to conducting polymer by doping? 4m

Ans: Intrinsically conducting polymers(ICPs) have low conductivity, their conductivity can be improved by creating either positive or negative charges on polymer back bone by oxidation or reduction which can be facilitated by their property of low ionization energy and electron affinity that favours easy oxidation or reduction. This technique of adding small quantities of oxidant or reductant to increase the conductance of polymer is called doping.

i) p-doping: Intrinsically conducting polymer -poly-acetylene is treated with a lewis acid like Iodine or bromine oxidation takes place, positive charges on the polyer backbone is created.

ii) n-doping: ICP is treated with a lewis base like Na or Li or Ca, that creates negative charges on the polymer backbone and makes it conducting polymer.

b) Write two commercial uses of C-60. 2m

Ans:i) Anti-viral activity: the fullerenes of C-60 and its derivatives have potential anti-viral activity which has strong implication on the treatment of HIV infection.**ii)** Photosensitization **iii)** Antioxidants **iv)** Drug and gene delivery

Bangalore university
B.Sc, VI sem, Chemistry (Paper –VII inorganic chemistry)
Model paper –II

Time: 3 hours Max marks: 70

Part – A

Answer any EIGHT of the following questions. Each question carries TWO marks. **8x2=16**

1. Give the IUPAC name of :a) [Co $(NH_3)_3(H_2O)_3]Cl_3$ b) $Li[AlH_4]$
2. Explain ambidentate ligands with an example.
3. Give any two limitations of crystal field theory
4. Explain the role of Cobalamine in living systems.
5. Give the significance of PCE value of a refractory?
6. What are organometallic compounds? Give two examples.
7. What are abressives? Give an example.
8. Mention any two advantages of gaseous fuels.
9. Write a note on bi-propellants
10. What are Nano materials? Give two applications of Nano materials.
11. Explain fullerenes with an example.
12. How is $Y_1Ba_2Cu_3O$ produced?

PART- B

Answer any nine of the following questionsEach question carries SIX marks **(9x6=54)**

13. a) Explain the crystal field splitting pattern and Crystal Field Stabilization Energy of tetrahedral complexes. 4
b) What are low spin complexes? Give an example. 2

14. a) Give the postulates of Werner's theory of coordination compounds. 4
b) How is ferrocene synthesized? Give equation. 2

15 a) Based on VBT explain the geometry and magnetic property of $[CoF_6]^{3-}$. 4
b) What is Spectrochemical series? 2

16. a) Explain the application of coordination compounds in :
i) Monsanto acetic acid process ii) Na_2Ca EDTA in treatment of heavy metal poisoning. 4
b) Write the name and the structure of the co-ordination compound used in cancer therapy. 2

17. a) Explain optical isomerism in octahedral complexes with an example. 4
b) Calculate the EAN of Cr $(CO)_6$ according to 18 electron rule and write its structure.2

18. a) Describe the manufacture of Portland cement by wet process. 4
    b) Write a note on tempered Safety glass. 2

19. a) Mention the raw materials and their roles in the production of Ceramic wares. 4
    b) What is spalling? How does it occur? 2

20. a) What are explosives? How are they classified? Give an example each. 4
    b) Give any two characteristics of propellants? 2

21. a) Explain the production of coal gas. 4
    b) Write the constituents of Varnishes. 2

22. a) Mention the composition and one application each of :
i) Borosilicate glass ii) Optical glass. 4
b) Write a note on electrical conductivity of conducting polymers. 2

23. a) Discuss the structure and biological functions of Myoglobin. 4
    b) Classify the following into essential and trace elements: K, Ca, Na, Fe, P, Cu, V, Ni. 2

24. a) Explain in brief type I and type II superconductors. 4
    b) How is Nano materials produced by Plasma synthesis method? 2

25. a) Give any four engineering applications of conducting polymers. 4
    b) How is C-60 isolated? 2

Bangalore university
B.Sc, VI sem, Chemistry (Paper –VII inorganic chemistry)
Model paper –II: answer keys

Part-A

Answer any Eight of the following questions each. Each carries 2 marks. 8x2=16

1. Give the IUPAC name of i) $[Co(NH_3)_3(H_2O)_3]Cl_3$, ii) $Li[AlH_4]$
Ans: i) triamminetriaquacobalt(III)chloride.
ii) lithiumtetrahydridoaluminate(III).

2. Explain ambidentate ligands with an example.
Ans: Ligands containing more than one donor atom, but only one atom donates at a time are called ambidentate ligands. Examples: NO_2 ,SCN^{-1} etc.

3. Give any two limitations of crystal field theory.
Ans: 1.It assumes the interaction between metal and the ligand is purely electrostatic. 2. It takes only d-orbital of central metal atom .the s and p orbitals are not considered. 3. Fails to explain the behavior of certain metals which causes large splitting while other shows small splitting.4. Rules out the possibility of π- bond. 5. Gives no significance to the orbital of ligand.

4. Explain the role of cobalamin in living system.
Ans: Cyno cobalamin is also known as vitamin B_{12},it consists of porphyrin ring containing Co(III).the deficiency of vitamin B_{12}cause pernicious anemia which is acompaniedwith neurological problems. This is indicated by inability of the body to convert the methyl malonic acid to succinic acid. In living systems it undergoes one or two electron redox reaction forming Co (II) and Co (I) complexes. These complexes play important roles in reaction such as bio methylation, reduction of CHOH group to CH_2 as in case of reduction of RNA to DNA.

5. Give the significance of PCE value of a refractory?
Ans: The thermal softening behaviour of a refractory material technically known as 'Refractoriness', is determined by Pyrometric Cone Equivalent (PCE) test. In other words, by Pyrometric Cone Equivalent (PCE) of a refractory material we come to know about its ability to withstand exposure to elevated temperature without undergoing appreciable deformation.

6. What are organometallic compounds? Give two examples.
Ans: The compounds containing metal and carbon bond are known as organometallic compounds.Ex: $Fe(C_5H_5)_2$, $(CH_3)_2Zn$,$(CH_3)_4Si$, etc.

7. What are abrassives? Give two examples.
Ans: The hard substances which rub down or grind away the surface of the other substances are known as abrasives. Ex: fused alumina, boron carbide, tungsten carbide etc.

8. Mention any two advantages of gaseous fuels.

Ans: 1.Rate of burning can be controlled easily. 2. Have a high calorific value. 3. Easily transported through pipes.4. Complete combustion occurs with little of air 5. High thermal efficiency 6. Smoke and ash are not produced during burning avoiding air pollution.

9. Write a note on bi-propellants.

Ans: The propellants containing liquid fuel and liquid oxidizer and are storied in separate compartments are known as bi propellants. Liquid fuels are kerosene, liquid hydrogen, hydrazine ethanol etc. Liquid oxidizers are liquid oxygen, fuming nitric acid, hydrogen peroxide etc.

10. What are Nano materials? Give two applications.

Ans: Nano materials the substances which have nano structured components with less than 100nm. Applications: i) Electronics or semiconducting devices ii) Manufacture of solar cells and rechargeable batteries. iii) Used in the manufacture of auto-mobile body parts and manufacture of paints. iv) Nano materials are used as catalysts to convert the harmful pollutants from automobiles to less harmful gases. v) Used in space and defense as aero gels since they have large pores with nanosize.This reduces density and are poor conductors of heat.

11. Explain fullerenes with an example.

Ans: Fullerene is a pure carbon molecule containing at least 60 carbon atoms in the form of hollow sphere, ellipsoid, tube and many other shapes. Fullerenes are similar in structure to graphite, which is composed of stacked graphene sheets of linked hexagonal rings; they may also contain pentagonal (or sometimes heptagonal) rings. Ex: C-60, C-70, C-76 C-82

12. How is $YBa_2Cu_3O_x$ synthesized? Give equation.

Ans: Relatively pure YBCuO is synthesized by heating a mixture of the metal carbonates at temperatures between 1000 and 1300 K

$$4\ BaCO_3 + Y_2(CO_3)_3 + 6\ CuCO_3 + (1/2-x)\ O_2 \rightarrow 2\ YBa_2Cu_3O_{7-x} + 13\ CO_2$$

Part-B

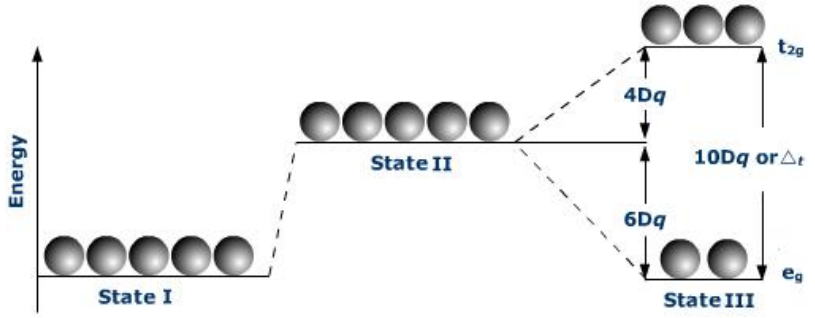
Answer any Nine of the following questions. Each carries six marks 9x6=54

13.a) Explain the crystal field splitting pattern and Crystal Field Stabilization Energy of tetrahedral complexes. 4m

Ans: A regular tetrahedral arrangement is related to a cube with an atom at the centre and four ligand are occupied at the 4 alternative corners of a cube. The directions X, Y and Z point towards the centre of the faces of the cube where d_{x2-y2} and d_{z2} orbit of metal is directed. dxy, dyz and dzx orbital of metal are directed in between X, Y and Z axes.

The direction of approach of the ligands are between the axes such that dxy, dyz and dzx have greater interaction with the ligands another such orbitals will be raised in energy and the

dx^2- y^2 and dz^2 will be lowered in energy by a corresponding amount as shown in the fig. hence 2 sets of orbitals, a triply degenerate t_{2g} of and doubly degenerate e_g will result.



Crystal field splitting energy of tetrahedral complex is represented by Δt or 10DQ which is less than octahedral splitting since only 4 ligands interact with the metal instead of six in octahedral complex and the orbitals one not exactly in the direction of ligands.

b) What are low spin complexes. Give an example. 2m

Ans: The complexes in which the number of unpaired electrons in the free ion and in the complex is not same, such complexes are known as low spin complexes. **OR**When Δ-Crystal field splitting energy (Δ) is large (strong field ligand), the electrons will first fill in the **lower** energy d orbitals before any electrons are placed on the higher energy d orbitals. It is then classified as **low spin** because there is a minimal amount of unpaired electrons.
Ex: $[Co(NH_3)_6]^{+3}$, $[Fe(CN)_6]^{-4}$.

14. a)Give the postulates of Werner's theory of coordination compounds. 4m

Ans: Postulates of Werner's theory:

i) Every central metal atom in a complex has two types of valancy

- primary valency
- secondary valency

ii) Primary valency is ionisable and the secondary valency is non ionisablevalency. The primary valency is satisfied by negative ions,where as Secondary valency of a metal is satisfied by negative ions or neutral molecules known as ligands.

iii) The secondary valency has directional characteristics and directed towards fixed positions in three dimensional space producing a definite geometry to the complex.

iv) The primary valancy is variable valancy and the secondary valancy of the metal is fixed.

b) How is ferrocene synthesized? Give equation. 2m

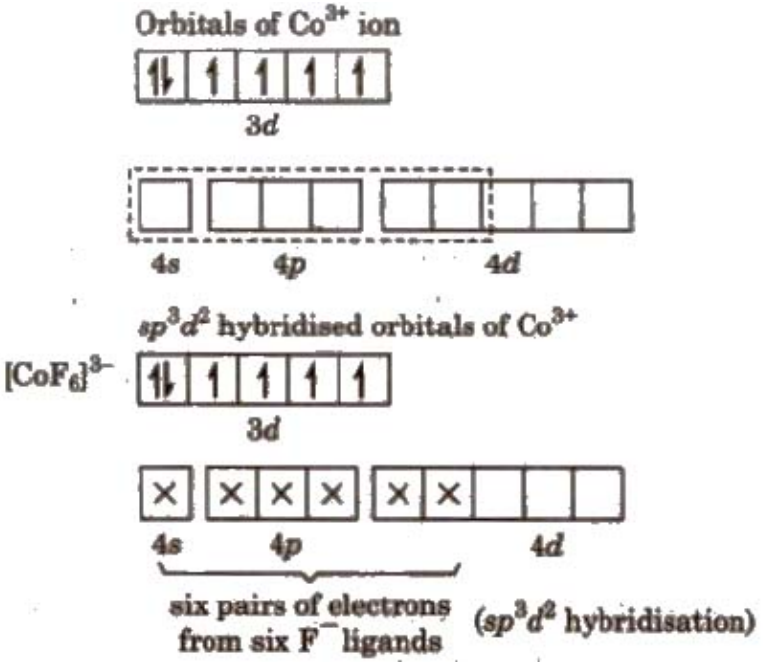
Ans: Metallic iron is directly treated with gas-phase cyclopentadiene at elevated temperature. Ferrocene is obtained. An approach using iron pentacarbonyl was also reported

$$Fe(CO)_5 + 2\ C_5H_6(g) \rightarrow Fe(C_5H_5)_2 + 5\ CO(g) + H_2(g$$

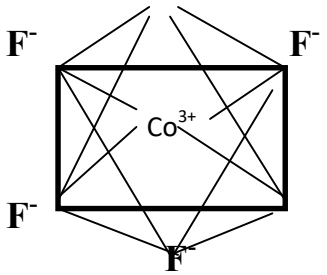
15. a) Based on VBT explain the geometry and magnetic property of $[CoF_6]^{3-}$. 4m

The element cobalt has outer electronic configuration of $3d^74s^2$ and Co^{3+} ion has the outer configuration is $3d^64s^0$(orbital diagram). In order to form 6 bonds with 6fluorido

ligands, six empty orbitals are made to receive the 6 pairs of electrons from $6F^-$ ions.
The 4s,4p and two 4d empty orbitals can be used for hybridization to form six sp^3d^2 hybrid orbitals.The central metal ion accepts 6x2=12 electrons forming 6 co-ordinate bonds with the ligand.The complex is an outer orbital complex having the structure of octahedral geometry.



Structure:F^-



Since the complex contains four un paired electrons, it is paramagnetic.

b) What is spectrochemical series? 2m

Ans: The arrangement of common ligands in the increasing order their field strengths to split the d-orbitals is called spectrochemicalseries.Ex: $OH^- < C_2O_4^{2-} < H_2O < NH_3$……

16. a) Explain the application of coordination compounds in

i) Monsanto acetic acid process ii) $Na_2CaEDTA$ in the treatment of heavy metal poisoning. 4m

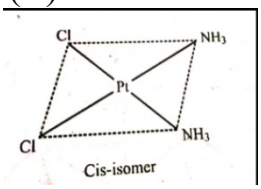
Ans: i) The Process involves the production of acetic acid from Methyl alcohol with carbon monoxide in presence of the rhodium salt and iodine at atmospheric pressure and temperature. The catalyst $[RhI_2(CO)_2]^-$ is formed which converts methyl alcohol to acetic acid.

$CH_3OH + CO \longrightarrow CH_3COOH.$

ii) EDTA-is a very good chelating agent and a ligand form octahedral stable complex and water soluble. This principle is used to remove heavy metal ions. Hence EDTA solution used as antidote to lead poisoning because EDTA great affinity for pb^{+2} ions. EDTA has lowtoxicity to cells end administered as the sodium salt of the calcium chelate ie,Na_2[Ca (EDTA)] by injection.

b) Write the name and the structure of the coordination compound used in the cancer therapy. 2m

Ans: cis-diamminedichloroplatinum (II)



Cis-isomer

17. a) Explain optical isomerism in octahedral complexes with an example. 4m

Ans: Two compounds with same chemical formula such that their mirror images are notsuper imposable on each other are known as optical isomers or enantiomers. Depending on the direction they rotate the plane of polarised light in Polarimeter, the two forms of the compound are known as d-dextro (rotates to right) or l-laevo (rotates to left).Almost all octahedral complexes with 2 or more bidentate ligands show optical activity.

Ex: $[Co\ (en)_3]^{+3}$ where en-ethylenediammine: NH_2-CH_2-CH_2-NH_2

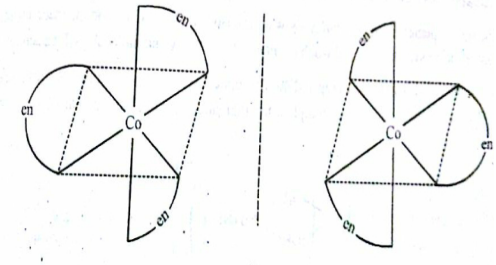


Fig. 1.1 - Enantiomers of $[Co(en)_3]^{3+}$

b) Calculate EAN of $[Cr\ (CO)_6)]$according to 18 electron rule and write its structure. 2m

Ans: Contribution of e^-s from Cr→ 6 electrons, 6 CO Contributes → 2 x6 = 12 electrons.

Total of = 18 electrons, Hence 18 electron rule is satisfied .It has anoctahedral structure.

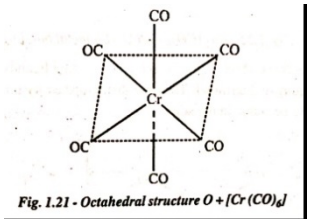


Fig. 1.21 - Octahedral structure O + $[Cr\ (CO)_6]$

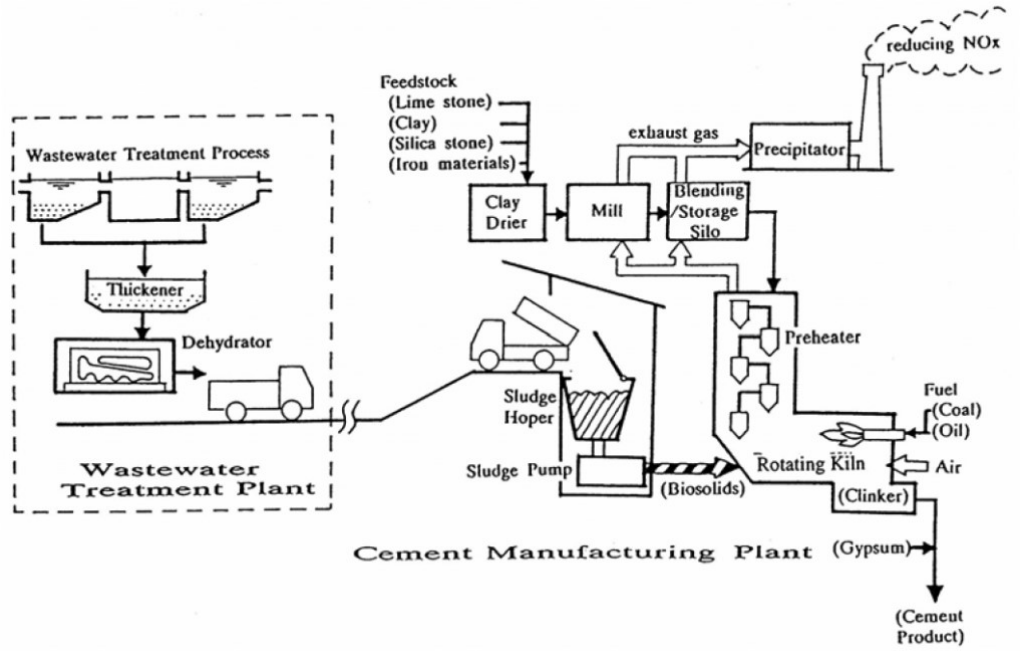
18. a) Describe the manufacture of Portland cement by wet process. 4m

Ans: The **raw materials** used in the manufacture of Portland cement are LimeCaO, Silica (SiO_2), Alumina (Al_2O_3), Ironoxide (Fe_2O_3), Magnesia (MgO), Sulphur tri-oxide (SO_3) and Clay. There are two methods for the manufacture of cement:

i) Wet process: Raw materials are mixed to form homogeneous slurry with 40% water.

Burning or Calcination: The raw materials obtained by wet process are fed into a rotary kiln. The charge moves down slowly. A blast of burning coal dust and air is sent in from the

other end so that the temperature attains to 1750^0C. During the process carbonation takes place, at the other end of the kiln lime and clay undergo chemical fusion forming calcium aluminates and silicates.



Reactions: $CaCO_3 \rightarrow 1000^oC \dashrightarrow CaO + CO_2$; $2CaO + SiO_2 \rightarrow Ca_2SiO_4$ or $2CaO.SiO_2$

$3CaO + SiO_2 \rightarrow Ca_3SiO_5$ or $3CaO.SiO_2$; $3CaO + Al_2O_3 \rightarrow 3CaO.Al_2O_3$

$4Cao\ Fe_2O_3 + Al_2O_3 \rightarrow 4Cao\ Al_2O_3Fe_2O_3$

The product is in the form of small hard, grayish stones called cement clinkers, which are allowed to cool. **Grinding and packing**: The clinkers are ground to fine powder in ball mills, at this stage 3% gypsum is added to reduce the setting time of cement and packed in air tight bags.

b) Write a note on tempered safety glass. **2m**

Ans:Tempered safety glassare made by heat treatment of the glass. The ordinary glass plate is heated just below its softening temperature (695 K) and then quenched in oil or molten salt bath. The surface becomes hard, the interior on the outside surface imparting strength to the glass. On breakage under the impact, shatter into small pieces without any sharp edges, do not fly and cause no deep injuries therefore these are used in making doors and windows of automobiles, aircrafts etc.

19. a) Mention the raw materials and their role in the production of ceramic ware. 4m

Ans: The raw materials and the roles in the production of ceramic wares are: **i) Clay**: clay is a hydrated aluminium silicate. It is formed due to weathering of Ignitius rocks, shales, and limestone. Feldspars present in these materials are converted to clay by the action of water and carbon dioxide,

$$K_2O\ Al_2O_3 6SiO_2 + 2\ H_2O + CO_2 \rightarrow K_2CO_3 + 4SiO_2 + Al_2O_3 2SiO_2\ 2\ H_2O$$

When the clay is wetted, it gains plasticity and can be easily moulded, on heating it becomes hard stone like and becomes glassy. If a clay is heated to above 873K it becomes amorphous due to elimination of water of hydration.

$$Al_2O_3 2SiO_2\ 2\ H_2O \rightarrow Al_2O_3 + 2SiO_2 + 2\ H_2O$$

When clay is heated about 1200 K, it is converted to a stable crystalline compound known as mullite goes shrinkage on heating.

$$3Al_2O_3\ 2SiO_2\ 2\ H_2O \rightarrow 3Al_2O_3\ 2SiO_2 + 6\ H_2O$$

iii) Feldspar: these are allumino silicate of sodium or potassium or calcium. These act as ceramic fluxes. They have lower fusion temperature and greater fluxing power. These also act as binders in the body of ceramic articles and also make the surface glassy.

b) What is spalling? How does it occur? 2m

Ans : Cracking or flaking of a refractory due to uneven expansion or contraction as result of sudden variation of temperature is called spalling. It may also occur due to mechanical causes like careless handling procedures such as charging, removal of products and slag. Spalling results in deterioration of the furnace. It can be minimized using the bricks that are properly baked or fired.

20. a) What are explosives? How they are classified? Give an example. 4m

Ans: A material, which under the influence of thermal or mechanical shock decomposes rapidly and spontaneously with evolution of large volume of gases liberating lot of heat, is called explosives. They are classified into detonating or high explosives and deflagrating or low explosives.

High explosives: i) primary explosives: these are highly sensitive explosives which explode by slight shock or fire. i.e. lead azide, mercury fulminate, DDNP etc.

ii) Secondary explosives: these are quite insensitive to fire and mechanical shock, but they have high energy content. They are exploded by detonation using primary explosives. Ex: dynamite, RDX, TNT etc.

Low explosives: these simply burn but do not explode suddenly. Ex: trinitrotoluene, gun powder etc.

b) Give any two characteristics of a good propellant. 2m

Ans: The characteristics of propellants are:**1)** It should have a high heat of combustion.**2)** It must have a low ignition temperature.3) It should yield low molecular weight combustion products.**4)** Should be easy to handle.**5)** It should not leave corrosive, toxic, solid products after combustion.

21. a) Explain the production of coal gas. 4m

Ans: Coal gas is produced by the carbonization of bituminous coal at high temperatures.

In Vertical retort process as shown in the above diagram, the bituminous coal is fed intoclosed silica retorts. It is heated by burning a mixture of producer gas and air in heating jackets surrounding the retorts. An outlet is provided at the top of the retort through which coal gas is collected.The resulting outcoming gas contains HCN, CO_2, H_2S and CS_2.these impurities are removed by passing through a scrubber containing water when water vapour, coal tar and little ammonia condenses. After removing the final traces of ammonia, the mixture is passed through moist ferric oxide followed by an alkaline solution of ferrous-

sulphate to remove hydrogen sulphide and HCN finally dehydrated by passing through anhydrous calcium chloride, finally the purified gas is stored in cylinders.

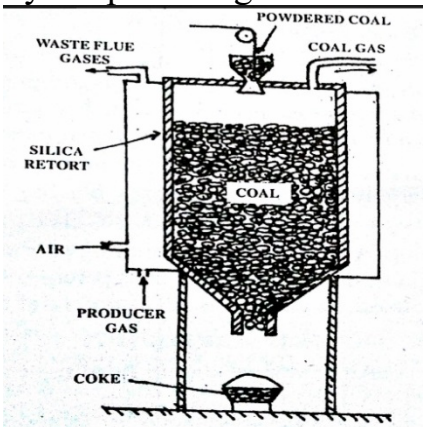


Fig. 3.9 Production of coal gas

b) Write four constituents of varnishes. 2m

Ans: The constituents of varnishes are: i) Resin ii) Drying oils iii) Solvents iv) Driers v) Plasticizers.

22. a) Write the composition and one application each of i) Borosilicate glass ii) Optical glass. 4m

Ans: Composition of borosilicate glass i) Silica SiO_2, 81% ii) Boron trioxide B_2O_3, 12% iii) Aluminum trioxide Al_2O_3 ,2% iv) Potassium oxide K_2O, 3% v) traces of oxides of sodium and calcium.Applications: i) Borosilicate glass is used in making quality glass apparatus ii) Baking utensils iii) Thermometers iv) Television tubes v) Electrical insulators.

ii) Composition of Optical glass: i) Silica SiO_2, 73% ii) Lead oxide PbO 7-15% iii) Potassium oxide K_2O, 5-7% Applications: i) Optical glass is used in making lenses, prisms etc. For i) Telescopes ii) Microscopes iii) Spectrophotometers etc.

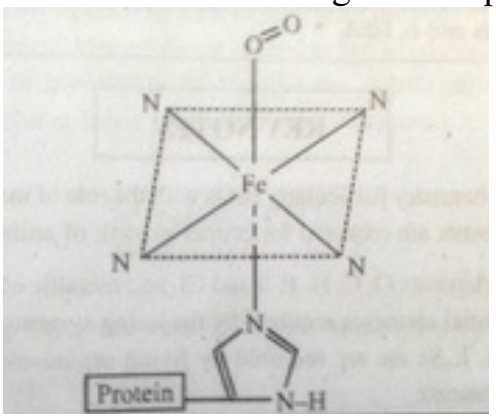
b) Write a note on electrical conductivity of conducting polymers. 2m

Ans: As a result of inherent rigidity of the conjugated macromolecular chains resulted from the delocalized π-electron system along the polymer backbone, it has been a huge challenge to make conducting polymer hydrogels elastic. The resulting hydrogels show some novel properties, e.g., shape memory elasticity, fast fictionalization with various guest objects, and fast removal of organic infectants from aqueous solutions, all of which cannot be observed from traditional non-elastic conducting polymer counterparts. What's more, light weight, elastic, and conductive organic sponges with excellent stress-sensing behavior have been successfully achieved via using the resulting polypyrrole hydrogels as precursors.

23. a) Discuss the structure and biological functions of myoglobin. 4m

Ans: One of the most important proteins in the human body is Myoglobin. Generally Myoglobin is found in muscle tissue, where it binds oxygen, helping to provide extra oxygen to release energy to power muscular contractions. It is a relatively small, oxygen-binding heme protein found in muscle cells. It consists of eight ά-helix connected through the turns

with an oxygen binding site. It has a globular structure.Myoglobin contains a heme (prosthetic) group which is responsible for its main function of carrying molecules to muscle tissues and globin protein. Heme group consists of proto-porphyrin organic component and an iron atom located in its center. It consists of a single polypeptide chain of 153 amino acids.In resting, oxygen remains fixed to myoglobin. During contraction when muscle demands oxygen, oxygen dissociates from muscles and is available for oxidation. In human beings, myoglobin is present in cardiac muscles in significant quantity.



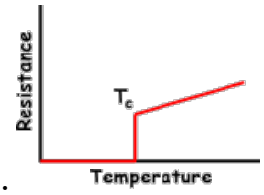
b) Classify the following in to essential and trace elements: Na,P,K,Ca, Fe, Cu, V & Ni **2m**

Ans: Essential elements: K, Ca, Na, And P; Trace elements: Cu, V, Ni, Fe

24. a) Explain in brief type-I and type- II super conductors. **4m**

Ans: 1) **<u>Type I –Superconductors</u>**: Type I superconductors are those superconductors which loose their superconductivity very easily or abruptly when placed in the external magnetic field. As you can see from the graph of intensity of magnetization (M) versus applied magnetic field (H), when the Type I superconductor is placed in the magnetic field, it suddenly or easily looses its superconductivity at critical magnetic field (Hc) (point A).

Ex: 1 Sulfur which, requires a pressure of 9.3 million atmospheres (9.4 x 1011 N/m^2) and a temperature of 17 °K to reach superconductivity. 2) Aluminum (Hc = 0.0105 Tesla), 3) Zn, Hg, Pb.It is clear that magnetization vanishes suddenly in the case of type- I super conductor The highest known Hc for these materials 01Tesla.



2) Type II Superconductors

Type II superconductors are those superconductors which lose their superconductivity gradually but not easily or abruptly when placed in the external magnetic field. When the Type II superconductor is placed in the magnetic field, it gradually loses its superconductivity. Type II superconductors start to lose their superconductivity at lower critical magnetic field (Hc1) and completely lose their superconductivity at upper critical magnetic field (Hc2).Ex: 1. NbN (Hc = 8 x 106 Tesla), 2. $Babi_3$ (Hc = 59 x 103Tesla),

Note: Type I superconductors perfectly obey Meissner effect. Where as Type II super conductors obey Meissner effect but not completely.

b) How is Nano materials produced by plasma synthesis? 2m

Ans: Plasma method of synthesis: A thermal plasma can deliver the energy to vaporize small micrometer-size particles. The thermal plasma temperatures are in the order of 10,000 K, so that solid powder easily evaporates. Nanoparticles are formed upon cooling while exiting the plasma region. The main types of the thermal plasma torches used to produce nanoparticles are dc plasma jet, dc arc plasma, and radio frequency (RF) induction plasmas. In the arc plasma reactors, the energy necessary for evaporation and reaction is provided by an electric arc formed between the anode and the cathode. For example, silica sand can be vaporized with an arc plasma at atmospheric pressure, or thin aluminum wires can be vaporized by exploding wire method. The resulting mixture of plasma gas and silica vapour can be rapidly cooled by quenching with oxygen, thus ensuring the quality of the fumed silica produced.

25. a) Write four engineering applications of conducting polymers. 4m

Ans: Engineering applications of conducting polymers

1. Conducting polymers are useful in discharging large quantities of static electricity in computer industries and in chemical industries. This can be accomplished by coating the conducting polymer over an insulating surface. Hence conducting polymers are used as antistatic.2. Conducting polymers can absorb harmful electromagnetic radiation. So these can be used to coat on the cases of computer monitors and cell phones.

3. Printed circuit boards are used in electrical and electronic instruments. They contain copper coated epoxy resins which are expensive and have less adhesive nature. But polymer sheets coated with conducting polymers are inexpensive and have better adhesive properties.

4. Artificial intelligent materials: These are also called as smart materials. The interesting aspects of these materials is that they can remember configuration and can confirm when exactly same stimulus is given. This property can be utilized in generating pass words where high security is required.

b) How is C-60 isolated? 2m

Ans: During the production, mixture of C-60, C-70 and higher homologues are formed. The fullerenes enriched in C-60, C-70, starts with extraction in toluene followed by filtration with filter paper. The solvent is evaporated and the residue is re dissolved in toluene and subjected to chromatography.C-60elute first with purple colour and C-70 is next with radish colour.