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Chemistry Theory Assignments

Chemistry Theory Assignment 1

Q 1) Explain ill effects of hard water when used in boiler.

Ans → The ill effects of hard water when used in boiler are -

A) Corrosion -

i) Dissolved O_2

Removal of O_2 should be there to prevent corrosion.

ii) Dissolved CO_2

If water fed to boiler contains CO_2, is converted to H_2CO_3 & corrodes boiler

iii) Hydrolysis of salts.

If water contains salts like $MgCl_2$, $FeCl_2$, then hydrolysis of such salts results in formation of strong acid which converts corrodes boiler.

iv) Galvanic cells -

Galvanic cell formation and corrosion take place in boiler due to different metals or impurities.

B) Priming and foaming

- when a boiler produces steam rapidly, water droplets are carried along with steam, the process of 'wet' steam formation is called as priming.
- Foaming is the formation of continous foam or bubbles on the surface of water.

C) Sludges and scales formation

- Loose slimy mass of salts prepitated in boiler water, is the sludge.
- Scale is the hard & strongly adhered coating to the inner surface of boiler. it is a bad conductor of heat.

D) Caustic Embrittlement

- Caustic embrittlement is the phenomenon during which the boiler material becomes brittle due to accumulation of caustic substances
- It is fast type of boiler corrosion caused by highly alkaline condition of water.

Q 2) what is Hardness? How alkalinity is estimated.

Ans → ① water containing salts of Ca, Mg, Fe, Mg does not produce lather with soap, is known as hard water. And hardness is reffered to as the sum of the calcium and magnesium concentrations.

② Alkalinity can be estimated using two types

i) Phenolphthalein Alkalinity

when an alkaline water titrated with a strong acid, first all OH^- get neutralised then all CO_3^{-2} ions are half neutralised to HCO_3^-. At this stage, pH of reaction mix $\cong 8.2$ completion of this stage is indicated by change in colour of phenolphthalein.

ii) Methyl orange / Total Alkalinity.

on continued titration with acid, all HCO_3^- get neutralised & this stage is indicated by methyl orange colour (pH = 4-5)

Q 3) what is cathodic protection? How is it done? Explain anodic protection.

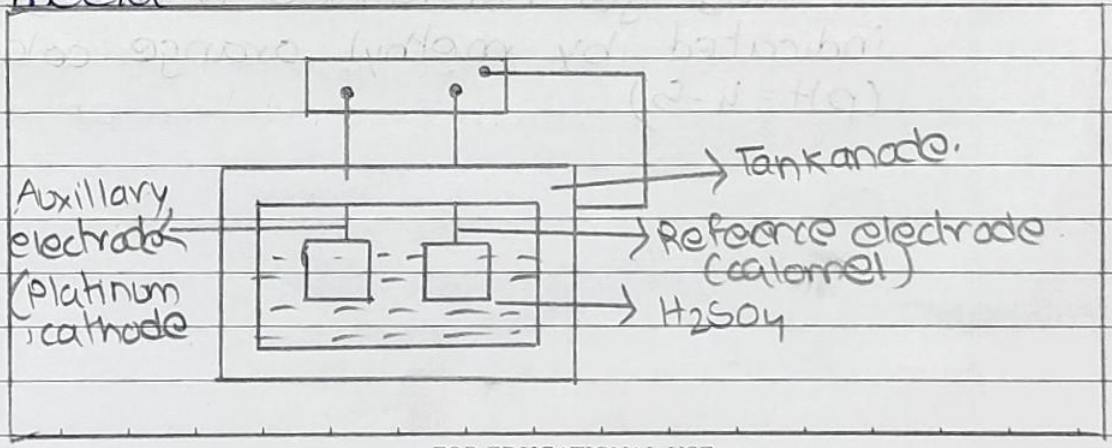
Ans → ① Cathodic protection -

It is a technique used to control the corrosion of a metal surface by making it the cathodic side of an electrochemical cell.

Principle - In electrochemical corrosion, anode is the one which undergoes corrosion. Cathode remains protected from corrosion. In cathodic protection, the metal to be protected is forced to behave like a cathode.

② Anodic protection -

A metal / alloy having wider range of passivity voltage is made anodic & voltage in passivity range, is applied over it to control its corrosion by strongly corroding media.



Explanation -

① Metal to be protected is made anode & that anode is made passive i.e by forming protective film on it using externally applied current.

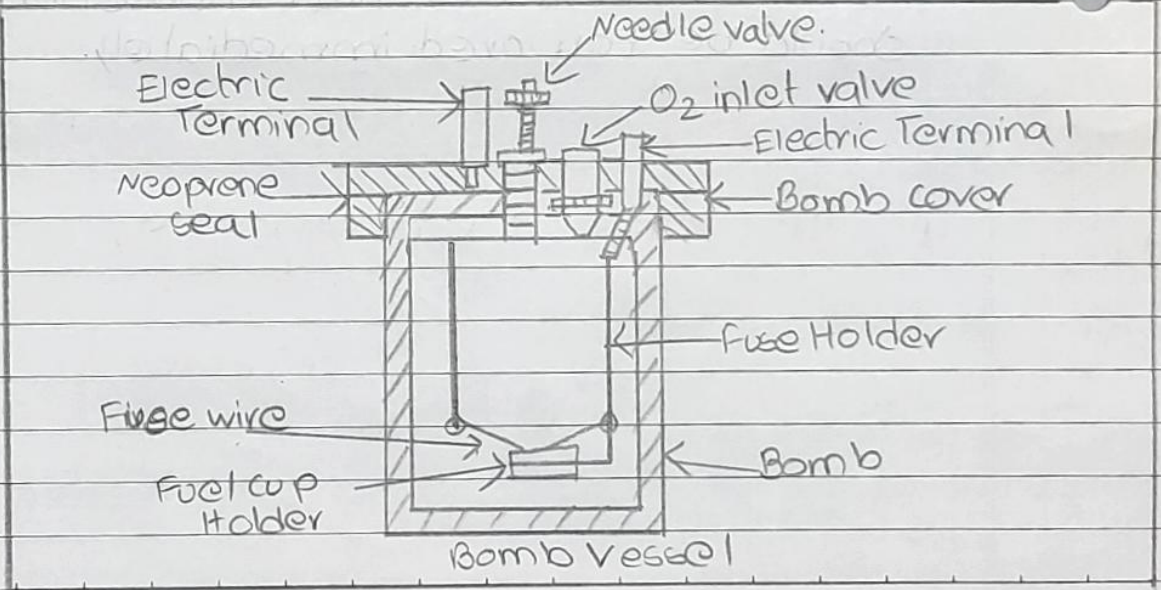
② To protect the metal making it anode, potentiostat is used. Potentiostat maintains metal at constant potential with respect to reference electrode. out of 3 terminals of potentiostat, one is connected to the metal to be protected, second to auxillary electrode and third to the reference electrode.

③ The minimum / negligible current indicates that anodic protection is taking place successfully.

④ If corrosion current is high, system goes out of control & electrical connections should be removed immediately.

Q 4) what is Bomb calorimeter experiment.

Ans → ① Bomb calorimeter work on the principle of law of conservation of energy.
② Here, a steel vessel which is coated with gold or Pt on the inside is used.
③ The vessel is usually fitted with light screw caps and contains two electrodes R_1 & R_2.
④ A small amount of substance under investigation is taken in the platinum cap.
⑤ The vessel is filled with excess O_2 at 20-25 atm pressure and sealed.
⑥ The same apparatus is dipped in an insulated both provided with a metal stirrer & thermometer.
⑦ The initial & final temperature is noted and heat combustion is calculated.



Q 5) what is proximate analysis? Explain ultimate analysis

Ans → **Proximate Analysis -**

Proximate analysis is an thermogravimetric analysis which is essential to assess suitability of coal for a particular application. Proximate analysis is determination of moisture content, volatile matter, ash content and fixed carbon content. This gives information about the practical utility of coal.

Ultimate Analysis -

The analysis of coal in which percentages of C, H, N, S and O elements are found out, is known as ultimate analysis.

Estimation of C, H, S, N -

$$C\% = \frac{\text{weight of } CO_2 \text{ formed} \times 12 \times 100}{\text{weight of coal sample} \times 44}$$

$$H\% = \frac{\text{weight of } H_2O \text{ formed} \times 2 \times 100}{\text{weight of coal sample} \times 18}$$

$$S\% = \frac{\text{weight of } BaSO_4 \text{ formed} \times 32 \times 100}{\text{weight of coal sample taken} \times 233}$$

$$N\% = \frac{\text{Volume of acid consumed} \times \text{normality of NaOH} \times 14}{\text{weight of coal sample.}}$$

Chemistry Theory Assignment 2

Q1) What is monomer? Explain types. Discuss conducting polymer with suitable example

Ans) **Monomer:-**

Monomer is the simple chemical substance of low molecular weight which can be converted into a polymer and the molecule of monomer has at least two easily reacting positions.

- Depending upon number of reacting positions there are types of monomers.

1) Bifunctional Monomers:-

Monomer molecule contains two easily reacting positions and it forms linear polymer molecule.

e.g. a) $HO-CH_2-CH_2-OH$ Ethylene glycol

b) $CH_2=CH-Cl$ Vinyl chloride

2) Trifunctional Monomers:-

Monomers having three reative positions or groups and forms highly branched polymer.

e.g. a) $HO-CH_2-CH(OH)-CH_2-OH$ Glycerol

b)  Phenol

3) Tetrafunctional Monomer:

Monomers having four reactive positions or groups. It forms 3 dimensional network or crosslinked polymers.

eg - a) $H_2C=CH-CH=CH_2$ Butadiene

b) $H_2N-CO-NH_2$ Urea

Conducting Polymer -

- If plastics are compounded with metal powder, it becomes conducting polymer
- Polymer should contain free electrons as in metals
- Free electrons are there in conjugated systems.

e.g - Polyacetylene.

$$-CH=CH-CH=CH-CH=CH-CH=CH-CH=CH-$$

Q 2) Discuss betw addition and condensation polymer with example.

Ans → ① Addition polymers:

All vinylic monomers undergo the addition reaction during polymerisation in presence of catalyst/initiator.

Reactions are fast and exothermic

$nCH_2=CH-Cl \rightarrow -(CH2-CH)_n-Cl$ PVC

$nCH_2=CH-OCH_3 \rightarrow -(CH2-CH)_n-OCH_3$ PVA

② Condensation Polymers:

Slow, stepwise progressive reaction between monomers. Byproduct is formed.

Endothermic reaction.

$nNH2-(CH_2)5-COOH \rightarrow H-\{NH_2-CH_2)5-CO\}_n-OH+nH_2O$

ω-amino caproic acid Nylon-6

Q3) Distinguish between thermosoftening and thermosetting polymers.

Thermosoftening	Thermosetting
① Formed by addition /chain polymerization	① Formed by condensation polymerization
② Linear chains	② 3 dimensional due to crosslinks
③ Bifunctional monomers used	③ Monomers ware with higher functionality are used.
④ Soften on heating & harden on coding	④ Do not soften on heating char, decom & on excessive heating char, decompose or burn.
⑤ Low mol. wt polymer	⑤ High mol. wt Polymer.
⑥ Can be remolded	⑥ Can not be remolded
⑦ Can be reclaimed from waste	⑦ Can not be reclaimed.
⑧ Soft, weak, less brittle	⑧ Hard, strong and more brittle.
⑨ Soluble in less organic solvents	⑨ Insoluble due to strong bonds & crosslinks.

Q3) Explain any 2 techniques of polymerisation.

Ans → Polymerization techniques in Addition are –

① Bulk Polymerization –

i) Mass or block polymerization: Polymerization of the undiluted monomer.
ii) Carried out by adding a soluble initiator to pure monomer (in liquid state).
iii) The mixture is constantly agitated & heated to polymerization temperature.
iv) Once the reaction starts, heating is stopped as the reaction is exothermic.
v) The heat generated is dissipated by circulating water jacket.
vi) Viscosity increases dramatically during conversion.
vii) The method is used for the polymerization of liquid state monomers.
viii) It is usually adopted to produce polystyrene, polyvinyl chloride, polymethyl methacrylate and low density polyethylene.

② Solution Polymerization -

i) Some disadvantages of bulk polymerization are eliminated in solution polymerization.
ii) Monomer along with initiator dissolved in solvent, formed polymer stays dissolved.
iii) The mixture is kept at polymerization temperature & constantly agitated.
iv) Depending on concentration of monomer the viscosity of solution does not increase.
v) After the reaction is over, the polymer is used as such in the form of polymer solution or the polymer is isolated by evaporating the solvent.
vi) Polymer so formed can be used for surface coating.
vii) It is used for the production of Polyacrylonitrile, PVC, Polyacrylic acid, Polyacrylamide, Polyvinyl alcohol, PMMA, Polybutadiene, etc.

Q 4) write principles of green chemistry. Give green pathway of preparation of adipic acid.

Ans → ① Principles of Green chemistry are -

i) Prevention of waste Efficiency.

ii) High Atom Economy

iii) Less Hazardous Synthesis

iv) Safer Chemicals

v) Design for Energy feedstock

vi) Safer Solvents

vii) Renewable

viii) Reduce Derivatization

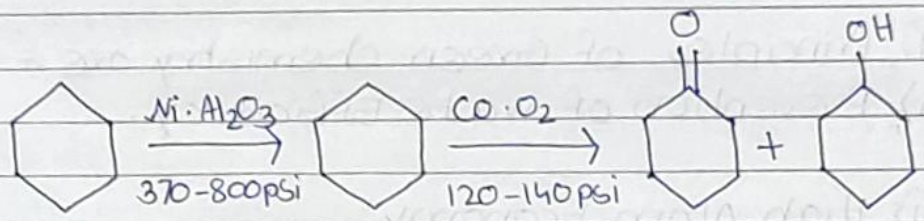
ix) Use of catalyst

x) Degradable Products.

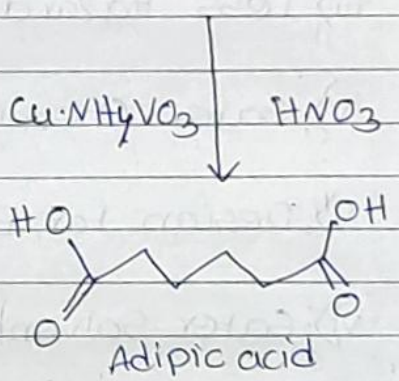
xi) Pollution Prevention.

xii) Analytical Methods.

② Green pathway for preparation of Adipic Acid.



Benzene cyclohexane cydohexanone cydohexanol



Adipic acid

$HOOC-(CH_2)_4-COOH$

Drawbacks -

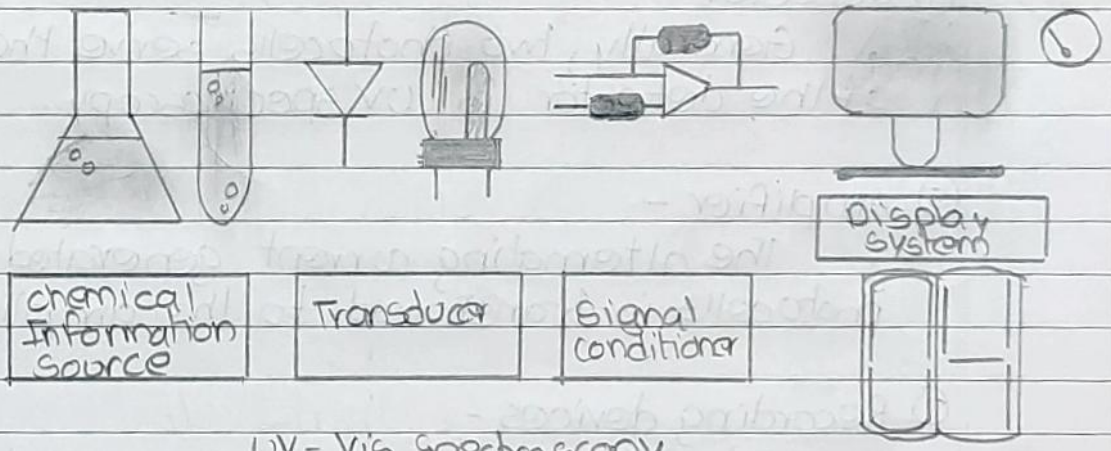
a) Benzene is carcinogenic staring Material
b) High Pressure and High Temp requirement
c) Less Atom Economy.

Qs 5) write and draw instrumentation in UV visible spectroscopy. Explain terms and transition involved in UV visible spectroscopy with examples

Ans → • UV Spectroscopy -

Spectroscopy is the measurement and interpretation of electromagnetic radiation absorbed or emitted when the molecules or atoms or ions of a sample move from one energy state to another energy state. UV spectroscopy is a type of adsorption spectroscopy in which light of the ultra violet region (200 - 400nm) is absorbed by the molecule which results in the excitation of the electrons from ground state to a higher ~~st~~ energy state.

• Diagram -



UV - Vis Spectroscopy

- Instrumentation -

① Light Source -

Tungsten filament lamps and Hydrogen - Deuterium lamps are the most widely used and suitable light sources as they cover the whole UV region.

② Monochromator -

Monochromators generally are composed of prisms and slits. The beam selected by the slit is monochromatic and further divided into two beams with the help of another prism.

③ Sample and reference cells -

One of the two divided beams is passed through the sample solution and the second beam is passed through the reference solution.

④ Detector -

Generally, two photocells serve the purpose of the detector in UV spectroscopy.

⑤ Amplifier -

The alternating current generated in the photocells is transferred to the amplifier.

⑥ Recording devices -

Most of the time amplifier is coupled to a pen recorder which is connected to the computer.