End-Term Exam.

AC-203

B.Tech.

Q1

Ans 1.a) Important tool of the organic chemistry is infrared spectroscopy, or IR. IR spectra are acquired on a special instrument, called an IR spectrometer. IR is used both to gather information about the structure of a compound and as an analytical tool to access the purity of a compound. IR spectra are quick and easy to run.

The stretching frequency of C-H can be calculated

$k = 5 \times 10^5$ dyne/cm $\quad M_2 = H = 1/6.02 \times 10^{23} = 0.167 \times 10^{-23}$ g.

$M_1 = 12/6.02 \times 10^{23} = 1.99 \times 10^{-23}$. $\quad C = 3 \times 10^{10}$ cm/s.

The observed value of C-H bond in the region 3320-2700 cm^{-1}

$$\bar{\nu} = \frac{1}{2\pi C}\sqrt{\frac{k(M_1 + M_2)}{M_1 M_2}}$$

$$\bar{\nu} = \frac{1}{2 \times 3.14 \times 3 \times 10^{10}}\sqrt{\frac{5 \times 10^5 (1.99 \times 10^{-23} + 0.167 \times 10^{-23})}{1.99 \times 10^{-23} \times 0.166 \times 10^{-23}}}$$

$\bar{\nu} = 3023\ cm^{-1}$

Force constants (K):

single Bond = 5×10^5 dyne/cm

Double Bond = 10×10^5 dyne/cm

Triple Bond = 15×10^5 dyne/cm

C C bond	triple	double	single
ν	2100	1650	1130
functional group.	alkyne	alkene	alkane

Q-1

Ans 16) Electromagnetic Spectrum is the entire distribution of electromagnetic radiation according to frequency or wavelength.

γ - Rays	X rays	UV	Visible	IR	TH_2	MW	RW

UV Rays → 100 nm – 400 nm
Visible → 380 – 750 nm
IR wave → 780 nm – 1 mm
Radio waves → 1 mm – 100 km

- Molecules containing bonding & non bonding e^- can absorb energy in the form of UV or visible light to excite these e^- to higher anti bonding molecular orbitals. (U-V visible Range)

- Infrared and radio waves are absorbed by atmospheric water vapour at ambient temperature

Q-2

Ans a) Usage of hard water lead to many problems in Boiler and many malfunctions.

Major Boiler troubles, due to the use of unsuitable water, classified as :-

→ Carry over
→ Corrosion
→ Scale formation
→ Caustic embrittlement
→ Turbine Deposits

They lead to destruction of power losses and traced explosions.

Carry Over → Steam developed has droplets (wet steam) which carry suspended matter and dissolve in boiler. Thus dissolved wet steam is 'carry over'

Corrosion → Boiler tubes, drums, economizers, super heater and condenser are most affected. It has effects to attached boiler parts because of gases O_2 & CO_2

Scale formation → Impurities fed into boiler and water extracted as steam, having impurity.
Tubes get blocked, and deposites are on metal surface as scales.

Caustic Embrittlement → Sometimes failure is there, and plate becomes brittle. & inter crystalline cracks have been formed in metal.

* Softening methods of Hard water → We need to treat boiler water for sufficiency & pure system for turbines.

treatments Listed :-

1) Preliminary treatment → This includes simple treatment like sedimentation, coagulation, filtration.

2) Pre heating → Means heating water before it enters boiler reduces portion of hardness.

3) Lime Soda process → Convert solid impurities to insoluble salt, whic precipitate $Ca(OH)_2$ is added.

4) Permutic or Zeolite process → Synthetic complex compounds consisting of Hydrated Sodium aluminium silicates approximately corresponding to $Na_2O, Al_2O_3 2SiO_2 . 6H_2O$

Other process → Ion-exchange, Membrane processes ok

Q-2

Ans b) Sample of water reacts to soap to form a white scum and not producing lather is hard water. Calcium and Magnesium salts are present mostly as bicarbonate sulphates and also as chlorides. The reason soap forms scum in hard water because insoluble soaps of Calcium & Magnesium are formed & precipitated.

$$2C_{17}H_{35}COONa + CaCl_2 \rightarrow (C_{17}H_{35}COO)_2Ca + 2NaCl$$

Sodium Stearate (Soluble) → Precipitate (insoluble)

2 types of Hardness.

1) Temporary : Also 'Carbonate Hardness' easily removed by boiling and are Ca, Mg bicarbonates and carbonates.

2) Permanent / Non Carbonate → Sulphates and Chlorides of Calcium and Magnesium not removed by boil.

Units of hardness

1) Parts per million (ppm) : $CaCO_3$ equivalent per 10^6 parts of water.

2) Milligrams per litre (mg/L) : No of $CaCO_3$ in milligrams present per liter of water.

3) Degree Clarke (Cl) → (1/70000 lb) of $CaCO_3$ per gallon water

4) Degree French (Fr) → Parts of $CaCO_3$ equivalent hardness per 10^5 parts of water.

* Given,

$CaCO_3$: 21.2 mg/L
$MgSO_4$: 20 mg/L
$Mg(HCO_3)_2$: 20.8 mg/L
$Mg(NO_3)_2$ = 28.8 mg/L
$Mg(Cl_2)$ = 21 mg/L
SiO_2 = 30 mg/L
KCl = 73.2 mg/L

Here KCl, SiO_2 do not contribute to Hardness.

→ $CaCO_3$: $21.2 \times 100/100$ = 21.2 mg/L of $CaCO_3$
→ $MgSO_4$: $20 \times 100/120$ = 16.67 mg/L of $CaCO_3$
→ $Mg(HCO_3)_2$: $20.8 \times \frac{100}{146}$ = 14.2 mg/L of $CaCO_3$
→ $Mg(Cl_2)$: $21 \times \frac{100}{95}$ = 22.1 mg/L of $CaCO_3$
→ $Mg(NO_3)_2$ = $28.8 \times \frac{100}{148}$ = 19.4 mg/L of $CaCO_3$

Total hardness : 93.5 mg/L of $CaCO_3$.
= 9.35°Fr.
= 6.545 Cl.

Q.3

Ans 3a) Characteristics of a Good lubricants.

- High Boiling point
- Low freezing point
- High Viscosity index
- Thermal Stability
- Hydraulic Stability
- Corrosion prevention.

Yes lubricants do vary with the industries on which it is going to be used.

→ Oil → Is one of the most common lubricants found in plan Thin liquid coming out in different viscosity Lower weight numbers, the trimmer oil. At times addictive can be mixed with oil to prevent oxidising and corrosion. Oil lubricants is largely used in engines and machinery.

→ Grease : Consits Soap and contain specific addictive purpose. High friction resistance, support much heavier loads at lower speed. Thickness agent so lubricants sticks firmly to metal surface.

→ Solid lubricant :- They have a lamellar structure. preventing direct contact b/w the two surfaces coming in contact even at extreme conditions.

Ex are Graphite and Molly.

Section 'B'

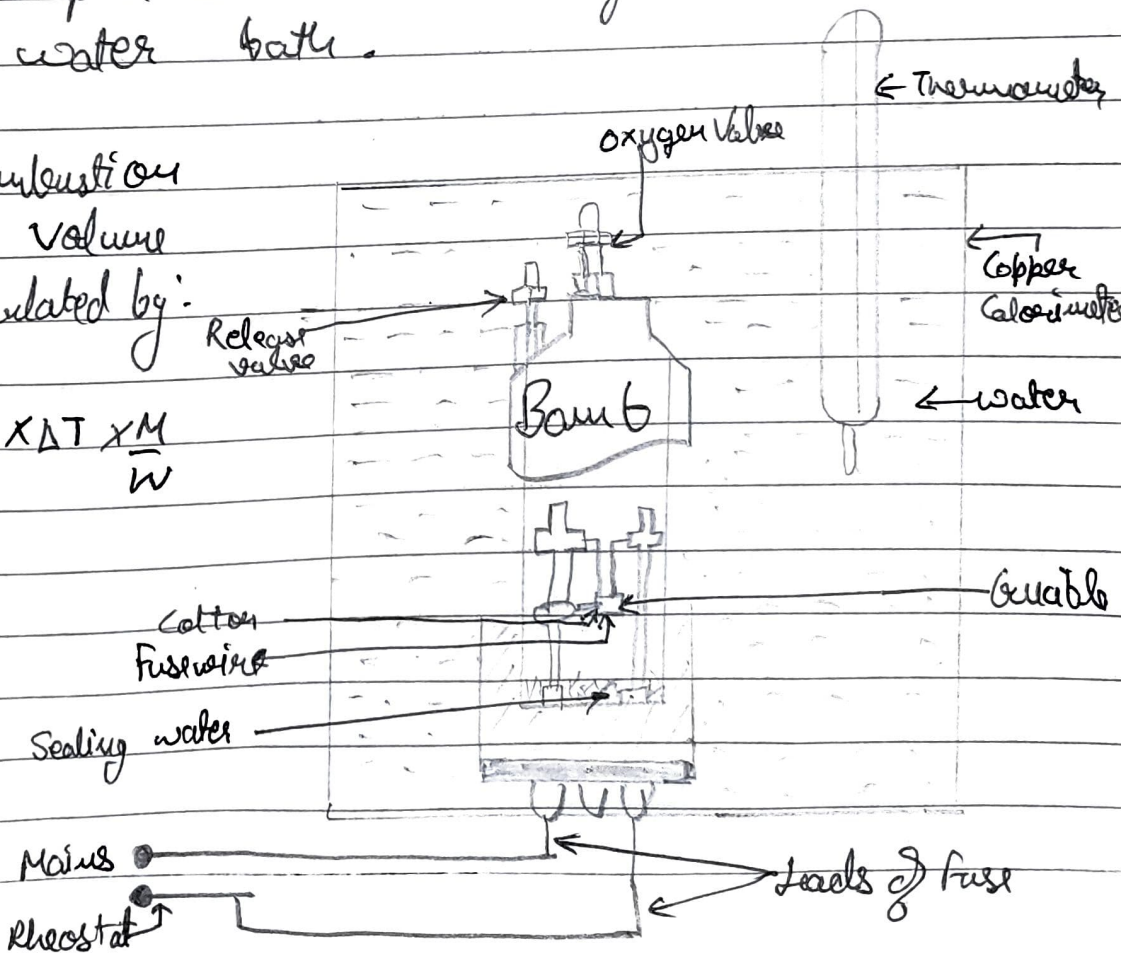
Q-4 a.

ans a) **Construction of a Bomb Calorimeter:** A bomb calorimeter is a steel vessel which is coated from inside with gold or platinum to avoid oxidation of steel during the chemical reactions. The vessel is fitted with a tight screw cap and it contains two electrodes R1 and R2

Working: The small amount of substance under investigation is taken in a platinum cap. The vessel is filled with excess of oxygen at a pressure of 20 to 25 atmospheres and then sealed. the apparatus is dipped in an insulated water bath which provides with mechanical stirrer and a thermometer. The initial temprature is recorded from the thermometer in the water bath.

The heat combustion at constant volume can be calculated by:

$$\Delta U = -Z \times \Delta T \times \frac{M}{W}$$



Application :

Bomb calorimeters are used to test the calorific value of solid and liquid fuels, which are traded based on that value. Fuels such as coal and oil must meet regulations specifying the total calorific value, quality and purity of the fuel.

Thermo dynamic studies : Bomb calorimetry is studies of scientific thermodynamic processes. It measures heat of combustion produced in a chemical reaction. and also the reaction enthalpy of same.

Metabolic study : Determine Calorie content, of process used in food and metabolic studies to examine the effects of energy content in food on humans and animals.

Q-4
Ans 4

b) i) Gross Calorific value → Heat evolved when unit of fuel by mass or volume is compelling burned and product of combustion is allowed to cool at room temperature.

Net calorific Value → Heat evolved when unit of fuel by mass or volume is completely burned and product of combustion is not allowed to cool

ii) Proximate Analysis : It includes Moisture, Ash, Volatile matter and fixed carbon content. They can determine by means gravimetric tests, both direct and indirect.

Ultimate Analysis : It is defined as the determination of carbon, hydrogen, Nitrogen and sulphur in wide type of organic and inorganic sample.

Contribution in efficiency of engine →

Calorific Value → It helps in determining the transportation charges ; and balanced calorie for increased working and energy management. engine is made efficient with such measurements.

Proximate & Ultimate Analysis: They produce comprehensive results. and SGS uses the results test to determine elemental composition of coal including moisture, ash, carbon, hydrogen, nitrogen, sulfur, and oxygen.

Q-5
Ans 5

a) Cathodic protection is a technique used to control the corrosion of a metal surface by making it Cathode of an electrochemical cell. A simple method of protection connects the metal to be protected metal. For structures such as long pipelines, where passive galvanic cathodic protection is not adequate

an external DC electrical power source is used to provide sufficient current

Sacrificial anode method :- It is type of cathodic protection where a less noble material that acts as a sacrificial anode is connected by metallic conductor to the structure to be protected and are consumed

Generally, SACP is used for protection of well coated areas where protective current requirements and soil or water resistivity are low. It is also used where the surface area of a protected structure is relatively small.

Q5
dec 16) 1) General or Uniform corrosion: Evenly distributed attack, occuring under conditions →
- No protecting layer formed
- Deterioration process
- Cathodic and anodic reaction occurs on surface.

2) Galvanic Corrosion: Noble metal or alloy is in metallic contact and with less noble, it occurs, in which corrosion rate of former is lower.

3) Thermo Galvanic Corrosion: Temperature gradient in a material exposed to a corrosive environment.

4) Deposite Corrosion: localised, concentrated, under deposites of corrosion products.

5) Pitting Corrosion → Occours in passivated metal/alloys in corrosive medium like chloride, Bromide, iodide etc.

6) Inter granular → localised at grain boundry with some attack on other parts.

7) Selective corrosion → On less noble element in contact, leaving the process material.

8) Erosion Corrosion → Relative movement between medium and metal and mechanical factor attacks

9) Cavitation → High flow velocity of fluid by dynamic condition causes it.

10) Fretting Corrosion → At interface between 2 parts which vibrate, with small amplitude.

11) Stress Corrosion → Crack formation and growth. generating stress and Corrosion.

12) Corrosion Fatigue → Simultaneous fluctuating stress.