PART-A

Answer any **EIGHT** of the following questions: (8 x 2 = 16)

1) State the condensed Phase rule and indicate the terms.

Ans.: Statement of Condensed Phase Rule: **F = C – P + 1**;

Where, F = number of degrees of freedom , C = number of components, P = number of phases at equilibrium

2) Mention the number of phases in the following systems:

(i) $CaCO_3(s) \longrightarrow CaO(s) + CO_2(g)$; number of phases 3 (2 Solid + 1 gas)

(ii) $2KClO_3(s) \longrightarrow 2KCl(s) + 3O_2(g)$ number of phases 3 (2 Solid + 1 gas)

3) State law of constancy of interfacial angles.

The interfacial angle between any two corresponding faces of the crystals remains constant irrespective of the different shape, size and mode of the crystal growth.

4) Name any two chemical and biological impurities present in water.

Chemical impurities-Inorganic and organic chemicals- Cations- Ca^{2+},Mg^{2+}, Na^{+} Anions- Cl^{-} SO_4^{2-}, NO^{3-} , Dyes, paints, petroleum products, pesticides, detergents, drugs, textile materials etc.,

Biological impurities- Pathogens, bacteria, algae, fungi, viruses, parasite worms etc.,

5) Complete the following nuclear reactions

(i) $_4Be^9 + {}_1H^2 \longrightarrow {}_5B^{10} +$ $\boxed{{}_0n^1}$ **(ii)** $_{12}Mg^{24} + {}_1H^2 \longrightarrow$ $\boxed{{}_{11}Na^{22}}$ $+ {}_2He^4$

6) Define mass defect.

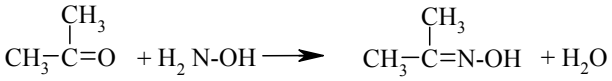
Ans.: Mass defect is the difference between the sum of masses of the nucleons present in the nucleus and the actual mass of the nucleus

7) What is tempering of steel. Mention its effect on the property of steel.

Ans.: A process where hardened steel is reheated between 200^0C to 700^0C to remove the internal stresses is called tempering. From this process, resulting steel becomes less hardened and more ductile.

8) Give the reaction of acetone react with hydroxylamine?

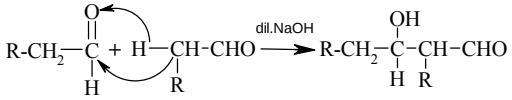
acetone react with hydroxyl amine to form **acetone oxime**



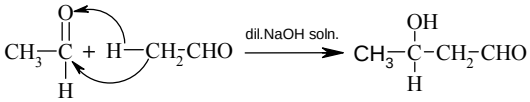
Acetoneoxime

9) Explain Aldol condensation with example.

Aldehydes that contain α-hydrogen atoms, undergo self-condensation in presence of dil NaOH solution to give **Aldol**

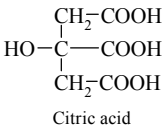


Acetaldehyde undergoes self-condensation in presence of dil. NaOH soln to give acetaldol (3-hydroxybutanal) or (β-hydroxybutanal)



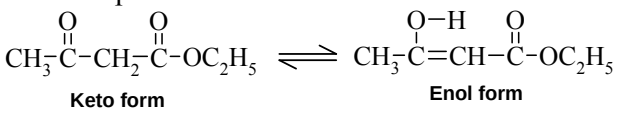
10) Write the structural formula of citric acid and give its basicity.

Ans.: (It contains 3 carboxylic groups, its **basicity** is **3**) hence it is **tribasic** acid.


Citric acid

11) Explain Keto-enol tautomerism with an example.

A carbonyl compound containing α-H atom rapidly equilibriates with its enolic formThis phenomenon of rapid interconversion between keto and enol form of a carbonyl compound is known as keto-enol tautomerism. Example: Acetoacetic ester


Keto form Enol form

12) What is photochemical smog?

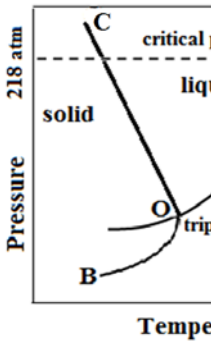
Ans.: Photochemical smog(smoke + fog) is a complex and highly noxious pollutant mixture formed by the interaction of sunlight with an urban atmosphere of hydrocarbons and oxides of nitrogen from automobile exhaust gases.

The major pollutants of photochemical smog are oxides of nitrogen, ozone , carbon monoxide, carbon di oxide, lead, smoke

PART-B

Answer any NINE of the following questions: (9 x 6 = 54)

13 (a) Explain the phase diagram of water system.



Ans.: Salient features of the diagram

Three areas AOB, AOC and COB correspond to single phases of vapour, liquid and solid respectively.

a) The line **OA** is the **vapour pressure curve** of water. Above this line only liquid phase and below this line only vapour phase exists. A is the critical point.
b) Line **OB** is the **sublimation curve** of ice. It represents the solid-vapour equilibrium at different temperatures.
c) The line **OC** is the **freezing point curve** of water or melting point curve of ice. It gives the variation of melting point with temperature.
d) O is the **triple point** where the three phases co-exist.

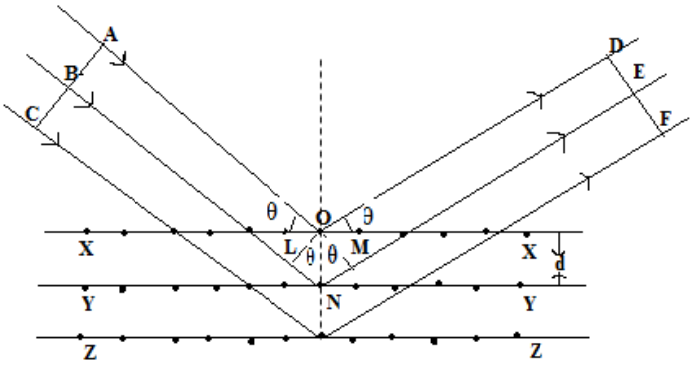
13 (b) What are eutectic mixtures? Give an example.

It is defined as a mixture of two or more components, having a definite composition and possessing lowest melting or fi than any of the components.

Examples

1. In water-KI system, a eutectic mixture of 58% of KI + 48% H_2O exists at the eutectic temperature of -22^oC
2. In Pb-Ag system, a eutectic mixture of 97.6% Pb + 2.4% Ag exists at the eutectic temperature of 303^oC

14 (a) Derive Bragg's equation; $n\lambda = 2d \sin\theta$



Consider a set of identical lattice planes XX, YY and ZZ, separated from one another by a distance d, in a crystal. Let a parallel beam of X-rays fall on these planes at a glancing angle θ. AO and OD are incident and reflected rays. Similarly BN and NE are the incident and reflected rays. Let OL and OM be the **perpendiculars** drawn to the incident and reflected rays. The second ray BN has to travel an extra distance of LN + NM compared to the first ray, known as the **path difference** between the two rays.

For constructive interference, the two rays have to be in phase with each other and this is possible only if the path difference between them is equal to integral multiple of the wavelength.

$$\text{i.e.} \quad LN + MN = n\lambda$$

since the triangles OLN and OMN are congruent, $LN = MN$

$$2LN = n\lambda$$

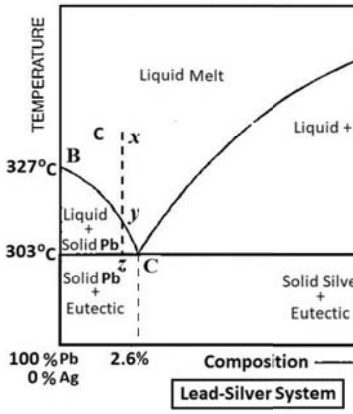
$$\mathbf{2d \sin\theta = n\lambda}$$

14 (b) Write a note on smectic liquid crystals.

Ans.: Smectic means soapy. These have layered structure with well- defined interlayer spacing. The layers slide ov Smectic phase has a complex structure and a fan like appearance. They are not affected by a magnetic field.

e.g.: *Ethyl-p-azoxybenzoate, Ethyl-p-azoxy-cinnamate*

15 (a) Draw a labeled phase diagram of lead-silver system. Identify the eutectic point. Give the composition at th



Eutectic point is C. --

Composition at this point is

97.6% Pb and 2.4% Ag --

15 (b) What are high temperature super conductors? Give an example.

Ans.: Super conducting materials having higher values of critical temperatures (Tc) are called high temperature sup

These are mostly alloys and possess better superconducting abilities

Examples: i) $Ba_2Ca_2Cu_3O_{2.33}$ (T_c = 138 K), (ii)YBa_2CuO_7 (T_c = 92 K)

16 (a) Describe the production of tungsten powder from wolframite.

Concentration: The powdered ore [(Fe, Mn) WO_4] is concentrated by gravity method followed by electromagnetic sepa

Roasting: The concentrated ore is fused with sodium carbonate in a reverb oratory furnace at 1000^0C to get sod Na_2WO_4

Treatment with HCl and Ammonia: Sodium tungstate is extracted with water. The insoluble oxides of Fe and Mn are f then treated with hot HCl when yellow tungstic acid, H_2WO_4 precipitates out. Tungstic acid is treated with amm solution of ammonium paratungstate $(NH_4)_2WO_4$. The solution is then evaporated to dryness to get anhydrous oxide W

Reduction: WO_3 is reduced to tungsten powder at a temperature above 1000^0C. It is compacted and converted in to de heat treatment and sintering

16 (b) Write a note on hardness of water.

Ans.: Water which does not produce lather with water is known as **hard water**. It is due to some of the salts dissolved i When we treat the water with soap, it gets precipitated in the form of insoluble salts of Ca and Mg.

Types of Hardness:

1. **Temporary Hardness:** It is due to the presence of bicarbonates of Ca and Mg. It can be easily removed by **boiling**
2. **Permanent Hardness:** This type of hardness can not be removed by boiling. This is due to the presence of chlorid sulphates of Ca and Mg. The hardness can be removed by the addition of some agents and ion exchange method.

Most common unit of measurement of water hardness is in parts per million (*ppm*) of calcium carbonate.

17 (a) Distinguish between nuclear fission and nuclear fusion.

Ans.:

	Nuclear Fission	**Nuclear Fusion**
a	Involves the splitting up of heavy nucleus Into lighter nuclei	Involves combination of lighter nuclei to form a heavy nucleus
b	Chain reaction	Not a chain reaction
c	Fission reactions are carried out by bombarding heavy nuclei with neutrons.	Fusion reactions are carried out by heating the lighter nuclei to extremely high temperatures.
d	Produces a large amount of energy.	Energy produced is much morethan that produced during fission
e	Nuclear fission reactions can be controlled to produce energy	Nuclear fusion reactions have not been controlled so far
f	Large amount of nuclear waste is left	No nuclear waste is left
g	Temperature required for the reaction is not very high	Temperature required for the reaction is very high

17 (b) Write a note on radioactive carbon dating.

Ans: This method is used to determine the age of animal, fossils, wood, prehistoric objects and antiques. Radio produced in the atmosphere by the action of cosmic ray neutrons on Nitrogen. ^{14}C undergoes β-ray decay with Half 5760 years

$$_7N^{14} + {}_0n^1 \longrightarrow {}_6C^{14} + {}_1H^1$$

$$_6C^{14} \xrightarrow{t_{1/2} = 5760 \text{ years}} {}_7N^{14} + {}_{-1}\beta^0$$

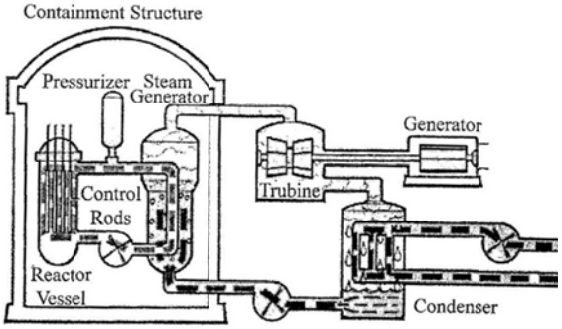
Atmospheric air contains $^{12}CO_2$ and $^{14}CO_2$ in a fixed ratio (^{12}C:^{14}C). This is assimilated by plants, and in tu

During their life time, they maintain this same ratio in their bodies. However after their death, there is no intake o while the amount of ^{12}C remains constant, ^{14}C starts decaying, thus upsetting the original ratio. If we measure ^{14}C co radioactivity of a dead object, we can calculate the death time of the specimen under investigation. using the equation:

sample = $\mathbf{t} = \frac{2.303}{\lambda} \log \frac{N_0}{N_t}$; Where N_o is the number of β-particles emitted by the freshly cut sample of wood, N_t is th particles emitted by the specimen at the time of measurement of the age (which is measured using a GM counter).

18 (a) Write a neat diagram of a nuclear reactor and mention the role of control rods and moderators.

Nuclear reactor is a device which converts nuclear energy into electrical energy.



Control rods: Boron and cadmium rods are used as control rods to absorb neutrons and slow down the chain reaction.They are placed between the fuel rods to regulate the chain reaction as well as safety rods to shut down the process in case of emergency.

Moderators: It is a substance used to slow down fast moving neutrons.Water, heavy water, graphite and beryllium are used as effective moderators.

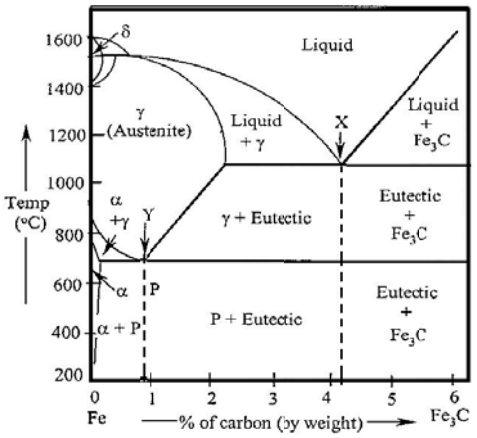
18 (b) State Group displacement law.

Statement: "The emission of an alpha particle results in the formation of an element which lies two places to the left of element and the emission of a beta particle results in the formation of an element which lies one place to the right of the element in the periodic table"

19 (a) Explain Iron Carbon Phase diagram

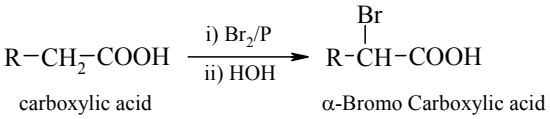
The iron-carbon phase equilibria play a vital role in the technical metallurgy of iron (Fig). The carbon content are mainly associated with the formation and distribution of the hard carbide Fe containing about 1% carbon is cooled slowly from 720°C, a soft malleable product is obtained interleaved with ***cementite***. If the same mixture is cooled rapidly, the layers cannot get separat

Austenite is a solid solution of carbon in γ- iron. Steel containing 0.87% C, consists of ***pearlite*** (**P**) alone. Less than 0.87% C gives *hypoeutectoid* steels containing a mixture of α-iron and *pearlite*. *Hypereutectoid* steels containing carbon between 0.87% and 1.80% consist mainly of *cementite* and *pearlite*. Steels with 1.8 to 4.3 % carbon are *hypoeutectic* alloys which ultimately consist of a mixture of *pearlite* and *cementite*.



19 (b) Write a note on HVZ (Hell Volhard Zelinsky) **reaction?**

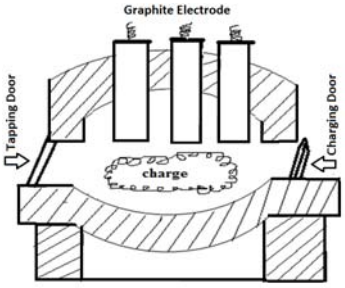
Carboxylic acids having at least one α-hydrogen react with X_2 (Cl_2 or Br_2) in presence of phosphorus (or phosphorus halide) to give α-halo acids. **This reaction is known** as HVZ reaction



20 (a) Describe the manufacture ferrosilicon.

Ans.: <u>Manufacture of ferrosilicon</u>: The raw materials required are: (1) Iron oxide (FeO) or haematite (Fe_2O_3) (2) Silica (SiO_2) (3) Coke. The electric furnace consists of a steel vessel lined with refractory bricks. Three movable water jacketed graphite electrodes are suspended from the top. The charge is introduced into the furnace. An electric arc is struck between the electrodes. Ferrosilicon is formed at high temperature. The impurities form a slag which is tapped out. The molten alloy is also tapped out of the furnace.

$$FeO + SiO_2 + 3C \longrightarrow (Fe+Si) + 3CO$$

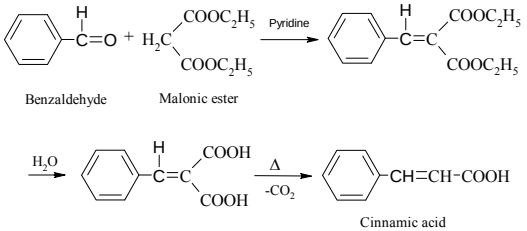


20 (b) How is nitriding of steel carried out?

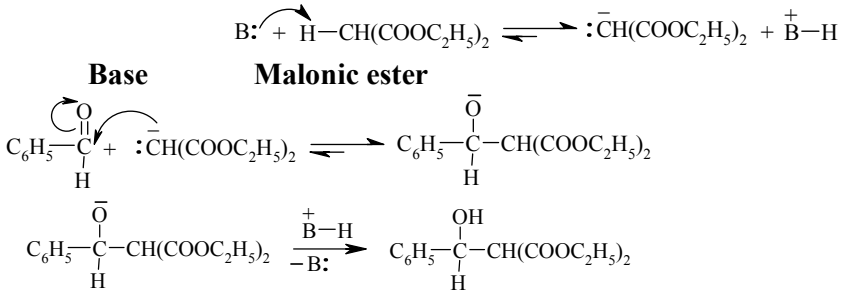
It is process which is employed for producing super hard surfaces and generally employed effectively in the case of alloy steels. The process consists in heating the metal alloy in presence of ammonia at 340°-350°C. At this temperature, ammonia dissociates and nitrogen produced reacts with the constituents of the surface of the alloy and forms extremely hard nitrides.

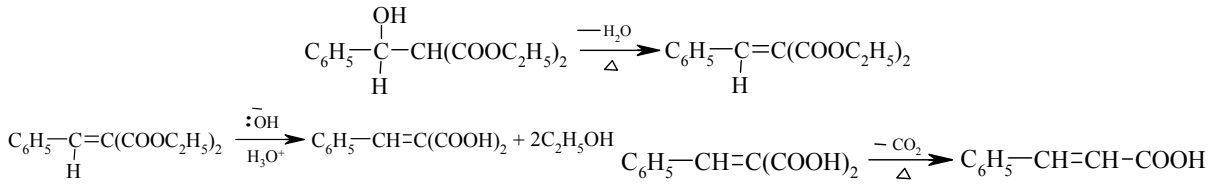
21 (a) Explain the following Reaction with **mechanism Knoevengel condensation**

Knoevenagelcondensation: Benzaldehyde condenses with active methylene compounds (Diethyl malonate) in the presence of organic bases (*pyridine*, *piperidine*) to give an α,β–unsaturated esters which on hydrolysis followed by heating gives the respective α,β–unsaturated acid.



<u>Mechanism</u> of Knoevenagel condensation

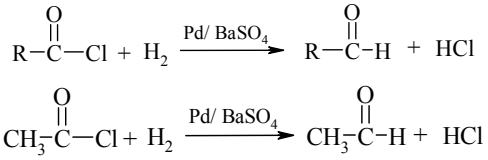




Cinnamic acid

21 (b) Explain Rosenmund's reduction reaction with an example.

Ans.: Acyl chloride or acid chloride on hydrogenation in presence of Palladium catalyst on Barium Sulfate ($BaSO_4$) gives corresponding aldehydes.

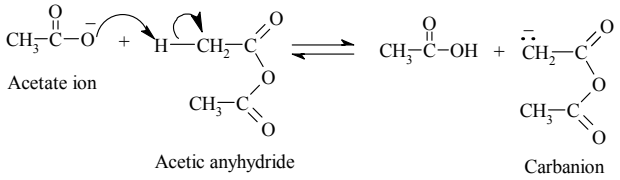


Acetyle chloride **Acetaldehyde**

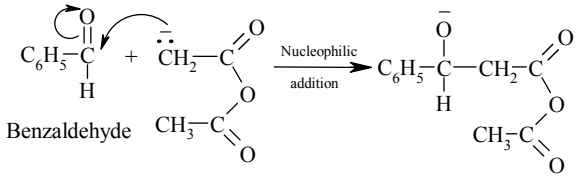
22 (a) Explain the mechanism of Perkin reaction.

Ans.: <u>Mechanism</u> of Perkin Reaction:

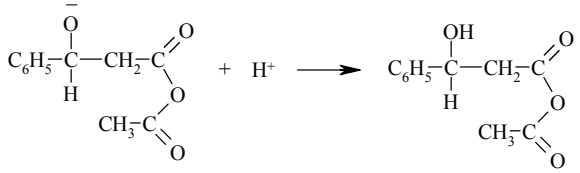
<u>Step-1</u>



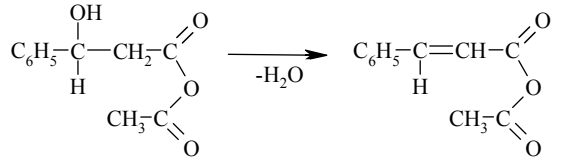
<u>Step-2</u>



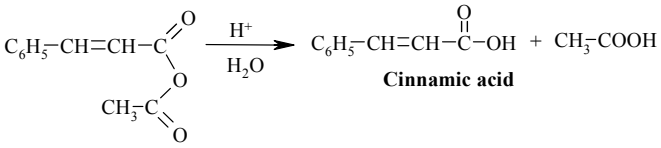
<u>Step-3</u>



<u>Step-4</u>



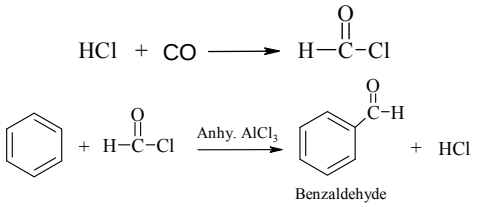
<u>Step-5</u>



22 (b) Write Gattermann Koch aldehyde synthesis.

Ans.: When benzene reacts with an equimolar mixture of carbon monoxide and HCl in presence of

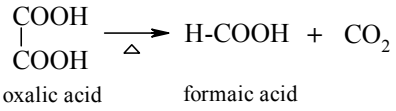
anhyd. $AlCl_3$ benzaldehyde is produced



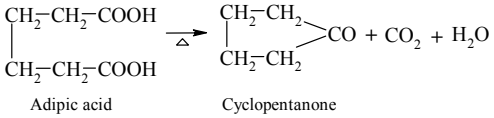
CO and HCl behave as **formyl chloride**, which enters into Friedel-Craft's reaction with benzene

23 (a) Describe the action of heat on the following: (i) Oxalic acid, (ii) Adipic acid.

i) Oxalic acid on heating decarboxylates with the formation of ***formic*** acid



ii) Adipic acid on heating gives ***cyclopentanone*** by the elimination of ($CO_2 + H_2O$) carbonic acid.



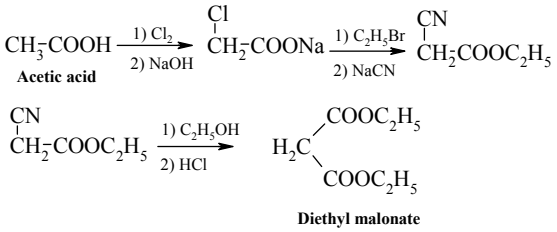
23 (b) Arrange the following in the increasing order of acid strength

CH_3COOH, $Cl_2CHCOOH$, $ClCH_2COOH$, Cl_3CCOOH.

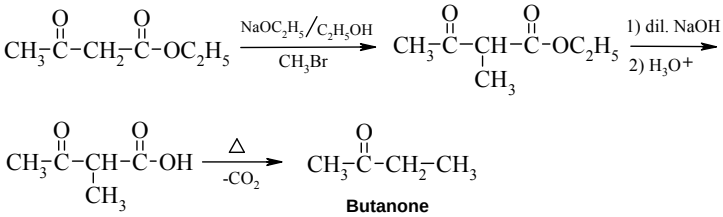
Order of acid strength**:** $Cl_3CCOOH > Cl_2CHCOOH > ClCH_2COOH > CH_3COOH$

Most acidic **Least acidic**

24 (a) How is diethyl malonate prepared from acetic acid?



24 (b) How is butanone prepared from ethyl acetoacetate ?



25 (a) What are the causes of depletion of ozone layer, give the remedial measures.

Natural causes: Sun spots, Stratospheric winds, Volcanic eruptions

Man made causes: Chlorofluorocarbons (CFC's), Halons (Bromine containing hydrocarbons), Methyl chloroform(CH_3CCl_3), Carbon tetrachloride, hydrofluorocarbons(HCFCs), hydrobromofluoro carbons, methyl bromide, Nitrous oxide, Nitric Oxide.

Remedial measures taken up:

- Phase out ozone depleting chemicals
- Regulation of supersonic transport to control the amount of NO_x in stratosphere.
- Use of halons should be phased out
- Use of CH_3CCl_3 and CCl_4 used as solvents should be restricted
- Use of methyl bromide as a fumigant to be controlled
- Total ban of CFCs

25 (b) What is stone leprosy?

When acid rain which has a pH of less than 5.6 falls on marble buildings, it damages the marble ($CaCO_3$) due to which buildings acquires a pitted, corroded appearance. This is known as ston

--- 2 M