APPLIED CHEMISTRY 1

(CBCGS , DEC-2017)

Q1] (a) Distinguish between BOD and COD. (3)

Ans:-

BOD	COD
1.It means the oxygen demand of bio-degradable pollutants only.	**1.**It measures the oxygen demand for bio-degradable pollutants along with non-biodegradable pollutants.
2.Less stable measurement method as it uses micro-organism which are susceptible to pH , temperature and other variable in the water.	**2.**More stable measurement method as it uses potassium dichromate which oxidises regardless of water condition.
3.Slow process. It takes 5 days.	**3.**Fast process. It takes 2-3 hours.
4.BOD values are generally less than COD values.	**4.**COD values are generally greater than BOD values.
5. $\text{BOD} = (DO_b - DO_i) \times \frac{\text{Volume of undiluted sample}}{\text{Volume of diluted sample.}}$	**5.** $\text{COD} = \frac{(V_1 - V_2) \times N \times 8000}{Y}$

Q1] (b) Give the preparation ,properties, and uses of Kevlar. (3)

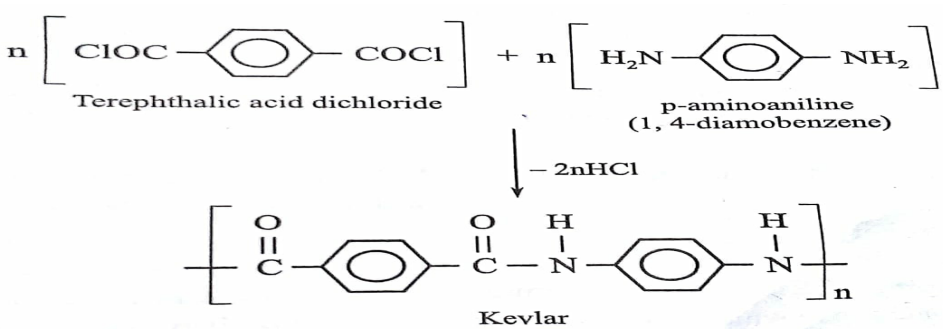
Ans:-It is an aromatic polyamide with benzene rings linked to the amide group, -CONH- group.

1.<u>PREPARATION.</u>

It is prepared by polycondensation between aromatic dichloride like terephthalic acid dichloride (terephthaloyl chloride) and aromatic diamines like 1,4-phenylene diamine (1,4-diamine benzene).

<u>2.PROPERTIES.</u>

- It is exceptionally strong, 5 times stronger than steel and 10 times stronger than aluminium.
- It has high heat stability and flexibility.
- It has resistance against almost all the solvents except some powerful acids.
- It does not lose its strength at -196°C .



3.USES.

- *It is used in aerospace and aircraft industries.*
- *It is used for the preparation pf car parts such as tyres, brakes, clutch, lining etc.*
- *Used for the preparation of ropes ,cables, helmets etc.*

Q1] (c)Calculate total hardness , in ppm, in given water sample. (3)

i)50ml standard hard water , containing 1mg pure $CaCO_3$ per ml , consumed 20ml EDTA solution.

ii)50ml water sample consumed 30ml EDTA solution using EBT indicator.

Ans:-

	1 ml SHW	≡	*1 mg of* $CaCO_3$ *eq.*
∴	*50 ml SHW*	≡	*50 mg of* $CaCO_3$ *eq.*
	50 ml of SHW	≡	*20 ml of EDTA solution.*
	20 ml of EDTA	≡	*50 mg of* $CaCO_3$ *eq.*
∴	*1 ml of EDTA*	≡	$\frac{50}{20}$ *mg of* $CaCO_3$ *eq.*
		=	*2.5 mg of* $CaCO_3$ *eq.*
	50 ml of water sample	≡	*30 ml of EDTA solution.*
∴	*1000 ml of water sample*	≡	$\frac{1000 \times 30}{50}$
		=	*600 ml of EDTA solution*
	1 ml of EDTA	≡	*2.5 mg of* $CaCO_3$ *eq.*
∴	*600 ml of EDTA*	≡	*2.5 × 600*
		=	*1500 mg of* $CaCO_3$ *eq*
∴	*Total hardness of*	=	*1500 mg/L*
	water sample	=	*1500 ppm.*

Q1] (d)Define flash point and fire point? Give its significance. (3)

Ans:- :-Flash point:- Flash point is defined as the lowest temperature at which the lubricant gives off enough vapours to cause a momentary flash when a standard test flame is brought near it.

Fire point:- Fire point is the lowest temperature at which the oil vapours catch fires for at least 5 seconds , on being lighted by a test flame.

Fire point is usually 5-40°C above the flash point. A good lubricant should have flash point at least above the working temperature . This ensures safety against the risk hazards. Thus flash point acts as a guide for the safe storage, transportation and use in machine. **Good lubricant oil should have high flash and fire point.**

Q1] (e) State the number of phases , component, for the following equilibrium

i) $H_2O_{(s)} \leftrightarrow H_2O_{(l)} \leftrightarrow H_2O_{(g)}$

ii)Mixture of Rhombic and monoclinic sulphur. (3)

Ans:- i) No. of. Phases = 3 (solid, liquid and gas)

No. of . components = 1 (H_2O).

ii) No. of. Phases = 2 (rhombic and monoclinic)

No. of . components = 1 (sulphur).

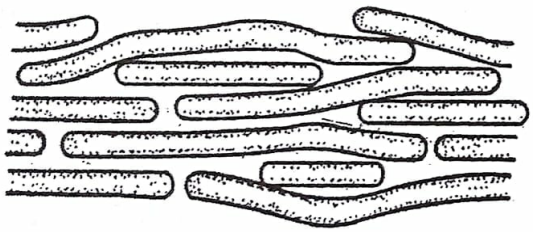
Q1] (f) What are plasticizers ? Give its uses and examples. (3)

Ans:-Plasticizers are added to increase the plasticity and flexibility of the polymers.

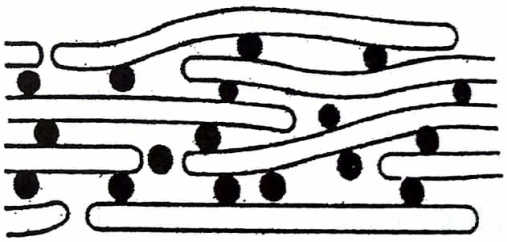
The Plasticizer molecule occupies between the polymeric chains and neutralizes the intermolecular forces of attraction and thus allows freedom of movement. The functions of plasticizers are as follows:-

- Increases the plasticity of the plastics.
- Lowers the softening temperature and hence moulding and remoulding can be done at low temperature.
- Imparts flames proofness.
- Reduces resistance towards chemical , solvents etc.
- Examples:- esters of fatty acids, vegetables oils etc.

The presence of small molecules of plasticizers reduces the attraction of the large polymer molecules for one another and thus permit more flexibility and easier slip.



(a) No plasticizer



(b) Plasticizer present

Q1] (g)Write a brief note on CNT's. ***(3)***

Ans:- :-*Carbon nanotubes represents one of the best examples of the novel nanostructures derived by bottom-up chemical synthesis approaches. Nanotubes have the simplest chemical composition and atomic bonding configuration but exhibit perhaps the most extreme diversity and richness among nanomaterial in structure and structure-property relations. The different types of carbon nanotubes are as follows;*

1. *SINGLE WALLED NANOTUBES.*

SWNTs are an important variety of carbon nanotube. In SWNTs have different chiralities of carbon nanotubes that include Armchair, Zigzag, Chiral. These can be easily twisted. SWNT synthesis requires catalyst.

2. *MULTIWALLED NANOTUBES.*

Multi-walled nanotubes (MWNTs) consist of multiple rolled layers (concentric tubes) of graphene. This types of CNT's cannot be easily twisted. Purity of MWNT is high also can be easily produced without catalyst.

Q2] (a)Calculate the quantity of lime and soda required for softening of 1,00,000 litres of water containing the following impurities in ppm. The purity of lime is 70% and soda is 85% $Ca(HCO_3)$ ***= 30.2 ,*** $Mg(HCO_3)$ ***= 20.8 ,*** $CaCl_2$ ***= 28.1 ,*** $MgCl_2$ ***= 8.78 ,*** $CaSO_4$ ***= 35 ,*** $MgSO_4$ ***= 6.7.*** ***(6)***

Ans:-

Impurities(mg/lit)	*Multiplication factor*	$CaCO_3$ *equivalent (mg/lit)*	*Requirement*
$Ca(HCO_3)$*=30.2*	$\frac{100}{162}$	$30.2\times\frac{100}{162} = 18.64$	*L*
$Mg(HCO_3)_2$*=20.8*	$\frac{100}{146}$	$20.8\times\frac{100}{146} = 14.24$	*2L*
$CaCl_2$ *= 28.1*	$\frac{100}{111}$	$28.1\times\frac{100}{111} = 25.32$	*S*

$CaSO_4$ = 35	$\frac{100}{136}$	$35\times\frac{100}{136} = 25.74$	S
$MgSO_4$ = 6.7	$\frac{100}{120}$	$6.7\times\frac{100}{120} = 5.58$	L+S
$MgCl_2$ = 8.7	$\frac{100}{95}$	$8.7\times\frac{100}{95} = 9.16$	L+S

LIME = $\frac{74}{100}\left[CaCO_3 \text{ equivalent of } Ca(HCO_3)+2\times Mg(HCO_3)_2+MgCl_2+MgSO_4\right]\times \frac{\text{Volume of water}}{1000}\times\frac{100}{\%\text{ purity}}$

$= \frac{74}{100}\times[18.64 + 2\times14.25 + 9.16 + 5.58]\times\frac{100000}{1000}\times\frac{100}{70}$

= *6541.6 gms.*

SODA = $\frac{106}{100}\left[CaCO_3 \text{ equivalent of } CaCl_2+MgCl_2+MgSO_4+CaSO_4\right]\times\frac{\text{Volume of water}}{1000}\times\frac{100}{\%\text{purity}}.$

$= \frac{106}{100}[25.31+9.16+25.73+5.58]\times\frac{100000}{1000}\times\frac{100}{85}.$

= *8203.15 gms.*

The lime requirement is 6541.6 gms and soda requirement is 8203.15 gms.

Q2] (b) i) Distinguish between thermoplastic and thermosetting resins. (3)

Ans:- Ans:-

THERMOPLASTIC	*THERMOSETTING*
1.Formed by addition polymerization.	*1. Formed by condensation polymerization.*
2.Can be moulded and remoulded.	*2.Remoulding is not possible.*
3.They softens on heating because the linear chains can slip over each other very easily.	*3.They do not become soft on heating, because cross links retain the strength on heating. But prolonged heating causes charring.*
4.Soft , weak and less brittle.	*4. Hard , strong and brittle.*
5.Soluble in some organic solvents.	*5.Insoluble in almost all organic solvents.*
6.Relatively low molecular weight.	*6.Relatively high molecular weight.*
7.Example: PVC, PE, Teflon.	*7.Example: UF, PF, Nylon 6-6, etc.*

Q2] (b) ii)What are the functions of lubricants. (2)

Ans:- *1. It reduces surface deformation , wear and tear because direct contact between the rubbing surface is avoided.*

2. *It reduces the frictional heat, or it acts as a coolant . This reduces the expansion of metal.*
3. *It increases the maintenance cost and running costs of machine.*
4. *It makes the relative motion of sliding parts smooth and noise free.*
5. *It increases the efficiency of machine by minimizing the loss of mechanical , electrical or chemical energy.*

Q2](c)What is Decay of concrete? Discuss its prevention. (4)

Ans:- *The cement concrete although mechanically strong , but due to the presence of free lime it become susceptible to the attack of acidic water. Alkaline water do not have marked effect on concrete strength. Also lime is more soluble in soft water than hard water and hence deterioration of concrete in contact with soft water is more. Presence of sulphates cause maximum damage because it reacts with tricalcium aluminate to form sulpho aluminates which occupies more volume and hence undergo expansion making the cement structure weak.*

PROTECTION OF CONCRETE

- *By giving a coating of bituminous material. This prevents direct contact between concrete and water. This is a very inexpensive method.*
- *By coating the surface with silicon fluoride in a soluble form together with oxides of Zn, Mg or Al. the precipitate of calcium fluoride so-formed in the capillaries prevents dissolution of lime.*

Q3] (a)Define Fabrication. List the methods used. Discuss extrusion moulding in detail. (6)

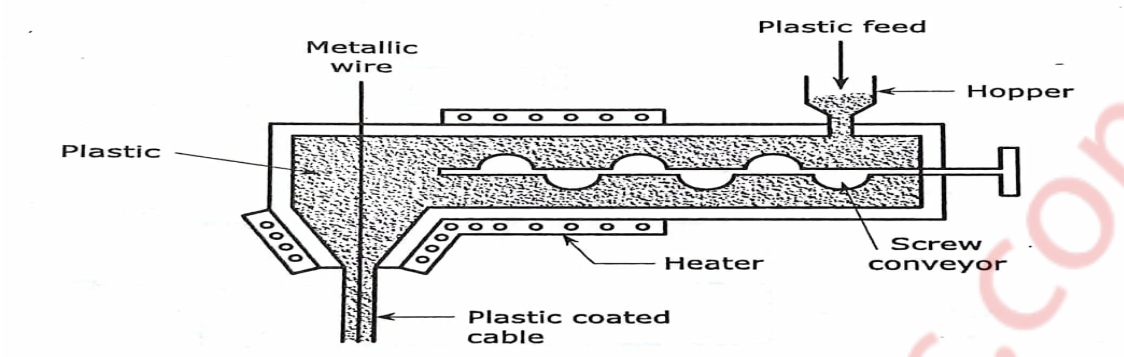
Ans:- *Fabrication of plastic is the technique of giving any desired shape to the plastics by the use of mould. Because of the properties of polymers it is possible to mould them and change their shape using a number of different repetitions manufacturing processes. A proper method is to be selected depending upon the shape and type of resin being used. Before moulding ,it is essential to dry the resin in order to achieve optimum performance of finished products.*

The methods used are:

1. *compression moulding.*
2. *transfer moulding.*
3. *extrusion moulding.*
4. *injection moulding.*

EXTRUSION MOULDING.

The thermoplastic materials are moulded by this method. They undergo continuous moulding to from articles of uniform cross-section. These articles include tubes, rods, strips, insulated electrical cables , etc. In this method , thermoplastic materials are heated to plastic condition and then pushed by means of a screw conveyor into a die having the required shape of the article to be manufactured. Here the plastic mass gets cooled due to the atmosphere exposure. A long conveyor carriers away the cooled product continuously .



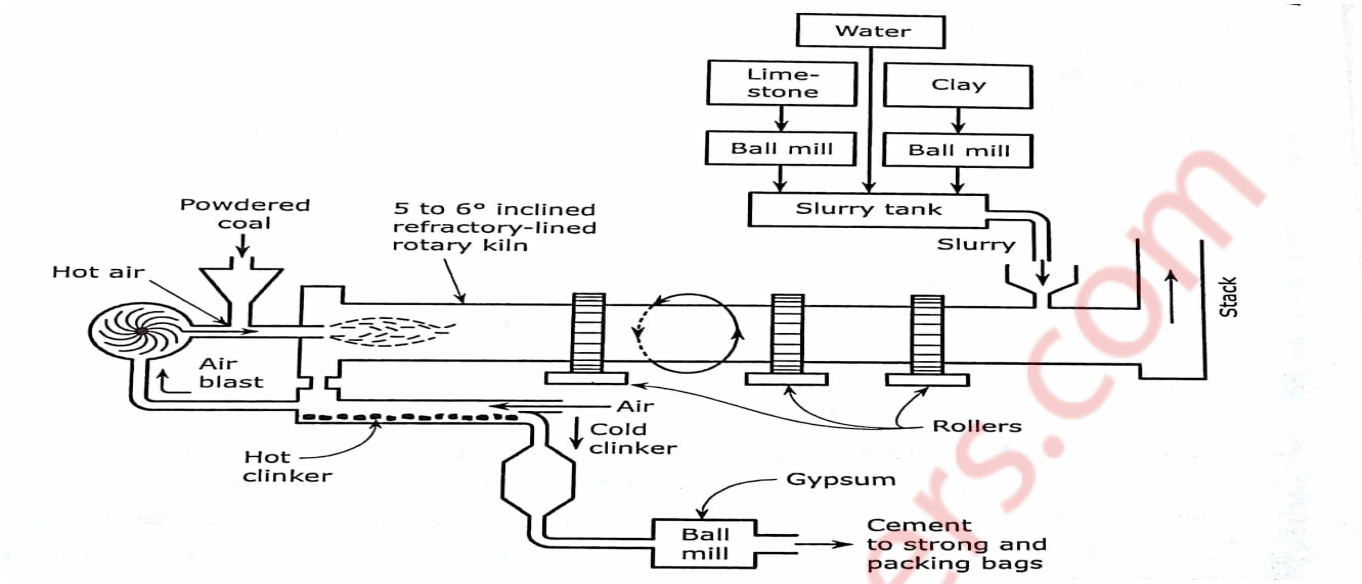
Q3] (b)i) What are the limitations of Phase rule? *(3)*

Ans:- :-*The limitations of phase rule are as follows:*

1. *It can be applied to system in equilibrium. It is not of much help when system attain equilibrium very slowly.*
2. *It applies only to single equilibrium state. It does not indicate other possible equilibrium in the system.*
3. *Phase rule consider only the number of phase ,but not their quantities .Even a minute quantity of phases when present accounts towards number of phases.*
4. *All phases must be present under the same condition of the temperature , pressure and gravitational forces.*
5. *Solid and liquid phases must not be in finely-divided state, otherwise deviations occur.*

Q3](b) ii)Draw a neat , labelled diagram of the rotatory kiln. (2)

Ans:-



Q3](c)15000 litres of hard water was passed through a zeolite softener. The exhausted zeolite required 120 litres of NaCl having stream of 30g/l of NaCl. Calculate the hardness of water.
(4)

Ans:- *1 litre of NaCl solution = 30 gm of NaCl.*

∴ 120 litre of NaCl = 120 ×30×10^3 mg of NaCl.

∴ 3600 ×10^3 mg of NaCl. = 3600 ×10^3×$\frac{50}{58.5}$

= 30.7692 ×10^5mg of $CaCO_3$ equivalent.

15000 litres of water = 30.7692 ×10^5mg of $CaCO_3$ equivalent.

∴ 1 litres of water = $\frac{30.7692\times10^5}{15000}$ = 205.1 ppm

∴ Hardness of water sample = 205.1 ppm

Q4](a) What is activated sludge? How is the process carried out for treatment of waste water? Explain with a flow sheet diagram. (6)

Ans:- *Sewage is the liquid which includes human and household waste water, industrial waste , ground waste and street and storm water. Hence due to the toxicity the sewage have to be treated because of the reasons like:*

1. *To prevent pollution of water into which the sewage is left off.*
2. *To prevent offensive odour in the water, and the destruction of fish and other aquatic life.*

SEWAGE TREATMENT BY ACTIVATED SLUDGE PROCESS.

1. *Preliminary Treatment.*

The principal objective of preliminary treatment is the removal of gross solids i.e., large floating and suspended solid matter , grit, oil, and greases if present in considerable quantities . For removing inorganic matter , sewage is allowed to pass through bar screen and mesh screen.

2.Primary Treatment.

For removing suspended matter efficiently and economically , sedimentation process is carried out .Sewage is treated with certain chemicals (e.g., alum, hydrated lime etc.) which form a floc that absorbs and entraps the suspended and colloidal particles present.

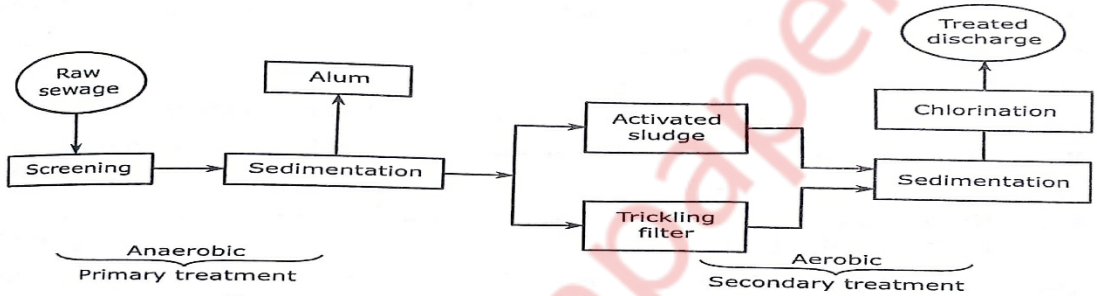


Fig. 1.15 : Flow diagram for sewage treatment.

3.Secondary or Biological Treatment .

It is an essential an aerobic chemical oxidation which includes filtration and activated sludge process. Sewage water is filtered through specially designed sprinkling filters to maintain aerobic conditions. Carbon of the organic matter is converted into CO_2; and nitrogen into NH_3 and finally into nitrates and nitrites. Trickling filters are used for biological oxidation of sewage. Trickled sewage starts percolating downwards an the aerobic bacteria bring about the biological oxidation of organic matter of sewage.

Hence the sludge formed is known as Activated Sludge. The further process includes mixing of sedimental sewage with proper quantity of activated sludge and mixture is then agitated for 4-5 hrs by blowing air. Suspended and dissolved organic matter is oxidised by aerobic bacteria . after all these process a part of sludge deposited is used for next oxidation batch and the remainder is either spread on land as fertile matter or used for biogas or dumped in sea.

Q4](b) i) 20ml of lubricating oil was dissolved in alcohol. The solution was titrated against 0.1N KOH solution. At the end point the burette reading was found to be 2.5ml. calculate the acid value of the oil.(density of oil = 0.86 g/ml) (3)

Ans:- *Given data :- Normality of KOH = 0.1N*

Volume of KOH = 2.5 ml

Density of oil = 0.86 g/ml

Volume of oil = 20ml.

To find :- *Acid value of oil*

Formula :- $\text{Acid value} = \frac{\text{Vol. of KOH} \times \text{Normality of KOH} \times 56}{\text{Weight of oil}}$

Solution :- *weight of oil = Density × Volume*

$= 0.86 \times 20$

= 17.2 gms.

$\text{Acid value} = \frac{\text{Vol of KOH} \times \text{Normality} \times 56}{\text{Weight of oil}}$

$= \frac{2.5 \times 0.1 \times 56}{17.2}$

= 0.814 mg

∴ *Acid value = 0.814 mg/ gm of the oil.*

Q4](b) ii) Distinguish between the dry and wet process for manufacturing of Portland cement. (2)

Ans:-

DRY PROCESS	*WET PROCESS*
1. *This is used when the raw material are hard.*	***1.*** *This is used for any type of raw material.*
2.*Fuel consumed is less.*	***2.****Fuel consumed is more.*
3.*Process is slow.*	***3.****Process is faster.*
4.*Cement produced is of inferior quality.*	***4.****Cement produced is of superior quality.*
5.*Costly process.*	***5.****Cheaper process.*

Q4](c) List the uses of polymer in medicine and surgery. (4)

Ans:- *Materials which are not causing adverse effect on blood and other tissues can be used in diagnostic, surgical and can be implanted in the body. They can be developed from metals, ceramics and polymers. Uses of polymers in the field of medicine and surgery are increasing day by day. Characteristics of biomedical polymers are:*

1.should be bio-compatible, can be fabricated into desire shape or form without being

degraded.

2.can be easily sterilized with no alteration in properties, should have optimum physical and chemical properties.

3.They should not destroy cellular elements of blood, enzymes or produced toxic or allergic reactions.

4.They should have purity and reproducibility.

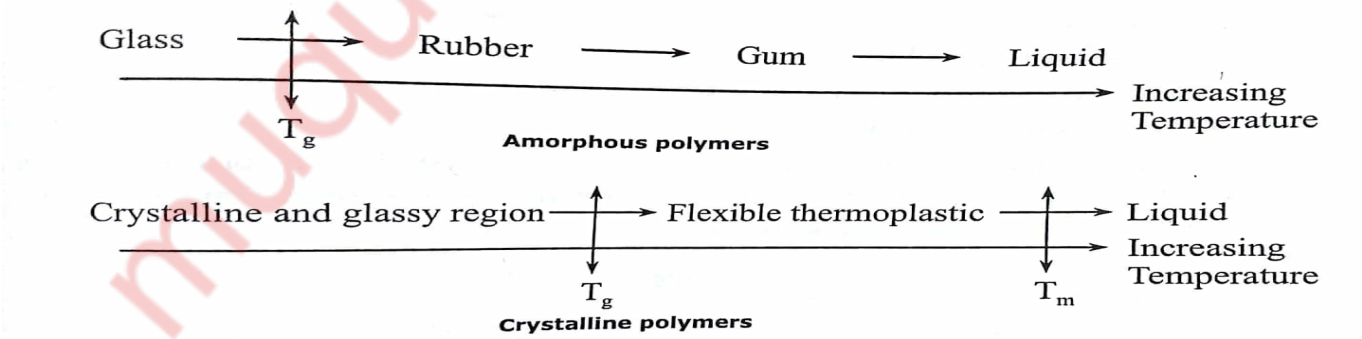
Examples are as follows:

POLYMER	***APPLICATION***
1. PMMA.	*Contact lenses.*
2. silicon rubber, polyurethane.	*Heart walls, drain tubes.*
3. Polyvinyl chloride.	*Disposable syringes.*
4. polyalkyl sulphone.	*Membrane oxygenator.*
5.Acrylic hydrogels	*Grafting*

Q5] (a) Write notes on (any two) *(6)*

i)Glass transition temperature *(3)*

Ans:- *The temperature at which polymer experience the transition from rubbery to rigid state is termed as the 'Glass transition temperature'(T_g).The behaviour of a polymer is temperature sensitive. Glass transition temperature is also defined as the lowest temperature below which the polymer becomes hard and brittle and above which it becomes soft and flexible. The polymer becomes too soft, that it behaves like a fluid called as the visco fluid state. The temperature at which the soft, flexible polymer goes to the visco fluid state is called the melting temperature T_m.*



Factors Influencing T_g.

1.Cross linking increases the T_g value.

2.Presence of bulky groups increases the T_g value.

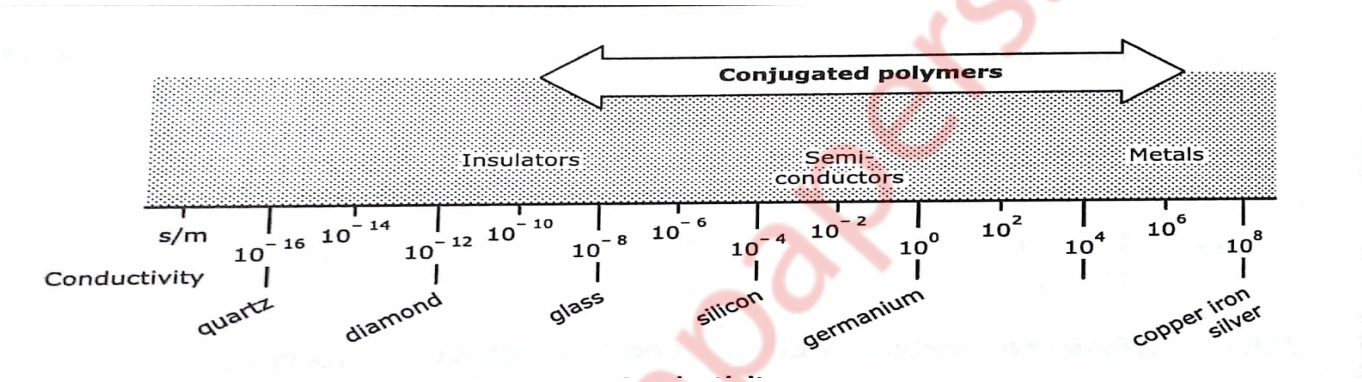
3.Addition of plasticizer decreases the T_g value.

4.Polymers having strong intermolecular forces of attraction increases T_g value.

5.Polar side atoms or groups of atoms increases the T_g value.

Q5](a) ii)Conducting polymers *(3)*

Ans:-*Polymers are insulated because of the absence of free electrons. In becoming electrically conductive , a polymer has to imitate metal that is the electron needs to be free to move. Such type of polymer are called Conducting polymer. Polymers with conjugate π-electron backbones display unusual electronic properties such as low energy optical transition , low ionization potentials and high electron affinities. The result is a class of polymers that can be oxidised or reduced more easily and more reversibly than conventional polymers. The effect of this oxidation or reduction on polymer is called doping i.e., convert an insulating polymer to conducting one.*



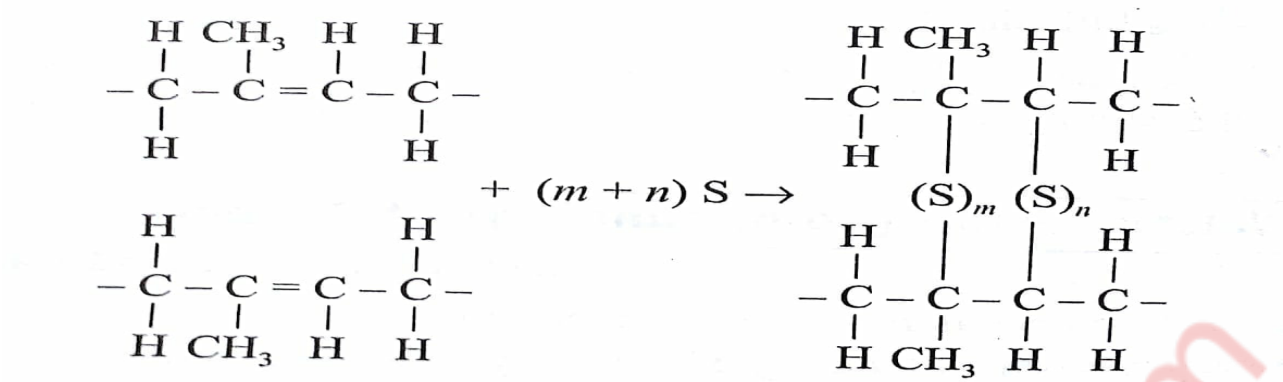
<u>Two conditions for a polymer to become conducting are:-</u>

1. *Polymer possess conjugate double bonds.*
2. *Polymer has to be distributed either by removing or adding electron to the material. This process is called doping.*

Q5](a) iii)Vulcanization. *(3)*

Ans:-*When rubber is heated with sulphur, its tensile strength , elasticity and resistance to swelling are increased tremendously. This process is named as <u>Vulcanization.</u> Vulcanization brings about a stiffness of the rubber by anchoring and restricting the intermolecular movement of the rubber springs. The vulcanization can be carried out in several ways:-*

1. *The article to be vulcanised is heated with a steam under pressure.*
2. *The article is immersed in hot water under pressure.*
3. *By heating the article in air or in carbon dioxide.*
4. *By vulcanizing the article in the mould in which it is shaped.*



PROPERTIES OF VULCANIZED RUBBER.

- *High tensile strength.*
- *Elastic to lesser extent.*
- *Water absorption is small.*
- *Do not swell much in organic solvents.*
- *Better abrasion resistance.*

Q5](b) i)Discuss the treatment of water using bleaching powder (3)

Ans:- *In small water-works, about 1 kg of bleaching powder per 1,000 kilolitres of water is mixed and water is allowed to stand undisturbed for several hours the chemical action produces hypochlorous acid*

$$CaOCl_2 + H_2O \rightarrow Ca(OH)_2 + Cl_2$$

$$Cl_2 + H_2O \rightarrow HCl + HOCl$$

$$\text{germs} + HOCl \rightarrow \text{germs are killed}$$

The disinfecting action of bleaching powder is due to the chlorine made available by it.

Drawbacks:

1. *Bleaching powder introduces calcium in water , thereby making it more hard.*
2. *Bleaching powder deteriorates, due to its continuous decomposition during storage. So whenever it is added , it has to be analysed for its effective chlorine content.*
3. *Only a calculated quantity of bleaching powder should be used , since an excess of it gives a bad taste and smell to treated-water.*

Q5](b) ii)Explain the mechanism of Extreme pressure lubrication. (2)

Ans:-*Under heavy load and high speed operating conditions, large amount of frictional heat is generated. Under these conditions a liquid lubricant fails to stick and may decompose. To withstand such extreme conditions, special additives are added to the lubricating oil. Additives*

are generally organic compounds having active radicals or group such as chlorine, sulphur , phosphorous etc. They react with the metal surfaces at high temperature and form durable films of metallic chlorides, sulphides and phosphides. These compounds posses high melting point and good thermal stability and hence , serve as good lubricant. However , they are not effective on chemically inert metal surfaces of Ag, Ti , and Cu. This type of lubrication is used for cutting tools, in wire drawing, rocket crushing machines etc.

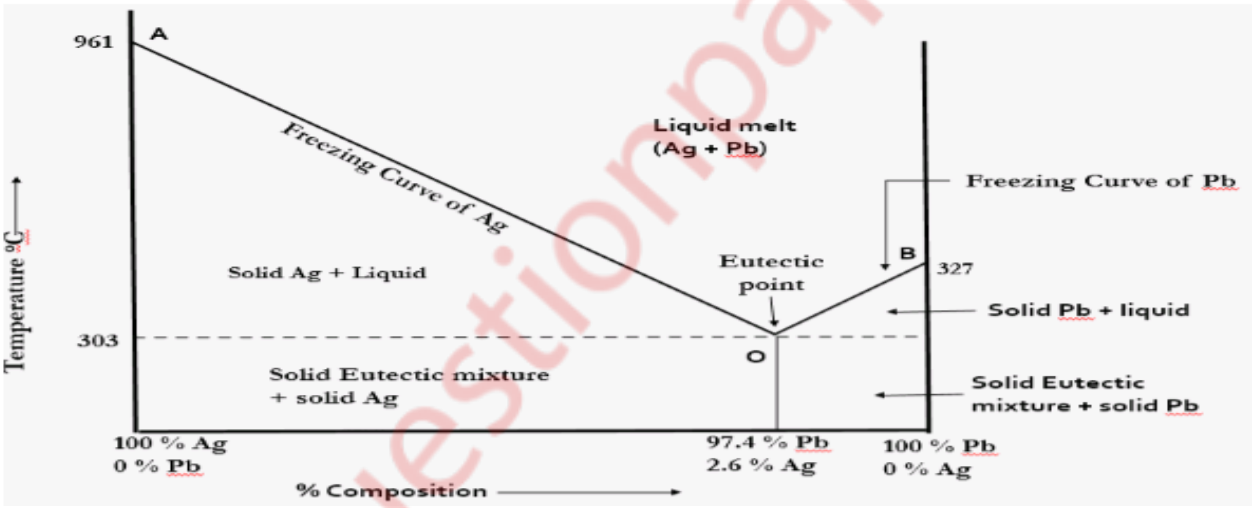
Q5](c) What is reduced phase rule? Draw the phase diagram of the Ag-Pb system with proper labelling. *(4)*

Ans:- *In some systems, an equilibrium exists between solid - liquid phases and gaseous phase is practically absent. Hence the effect of pressure on such system can be neglected. Then it is necessary to take into account only two variables viz. temperature and concentration.*

Such system showing solid-liquid equilibrium is called condensed system and phase rule applied to such systems is as follows:

F = C – P + 1 … known as condensed phase rule.

Phase diagram of Ag-Pb system



In two component systems there are four possible phases solid Ag, solid Pb, solution of Ag, + Pb and vapour. Since the pressure has no effect on equilibrium so the system can be represented by temperature concentration diagram at constant atmospheric pressure. As pressure is neglected the phase rule is called condensed phase rule.

1) Curve Ao. *It is a freezing point curve of Ag. Ag Co exists as solid and liquid. Melting point of Ag falls gradually on adding Pb till the lowest point is reached. The solution gets saturated with respective to lead.*

2) Curve Bo. *It is a freezing point curve of Pb. At this curve the melting point gradually falls on the addition of Ag till lowest point it reach.*

3) Point O. *It is eutectic point. Here 3 phases co-exists and point O represents a fixed composition and system is in variant.*

Below the temperature line of eutectic temperature, we have two regions.

a) The region marked eutectic plus solid Ag in which crystalline silver and solid eutectic are stable.

b) The region marked eutectic plus solid Pb in which crystalline lead and solid eutectic are stable.

***4) Area AOB.** It represents solution of Pb Ag. On lowering temperature the lead begins to separate out till the point O is reached.*

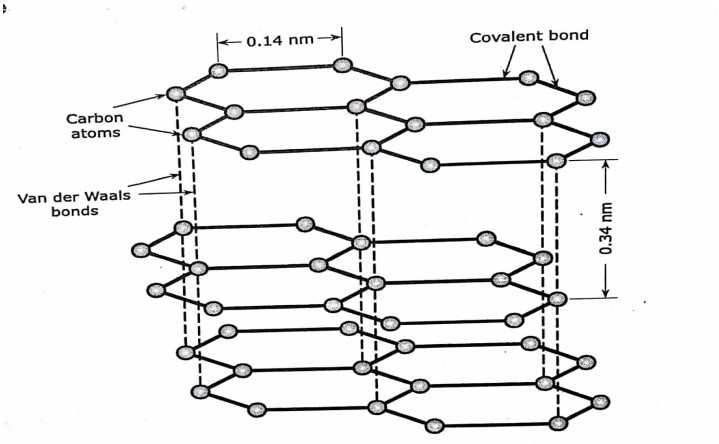
Q6](a)What are the conditions for use of solid lubricants? Discuss the structure and uses of Graphite. *(6)*

***Ans:-** Dry lubricants or solid lubricants are material which can reduce the friction without a liquid medium .they are used where,*

1. *Operating conditions are such that a lubricating film cannot be formed or maintained.*
2. *Contaminations of liquid or semi-solid lubricant , with dust or dirt is not desirable ;e.g., open gears.*
3. *Combustible lubricants must be avoided due to the high operating temperature and pressure.*
4. *Heavy machinery working on a crude job at very high loads and slow speed.*
5. *Where the parts to be lubricated are not easily accessible.*

GRAPHITE:

Graphite is the most widely used of all solid lubricants. It consists of a layered lattice structure. A layer of hexagonally arranged sp^2 hybridized carbon atom in the planar graphite molecule bonded covalently. The two neighbouring parallel layers are 3.7A° apart and are held together by weak vander waals forces. Therefore the forces required to shear layers is very low and the molecules can slip over each other easily by mechanical forces. Hence , graphite powder is very soapy to touch or vey soft and can act as lubricant. It is not inflammable and not oxidised in air below 375℃. In the absence of air , It can be used up to very high temperature. Usually some organic substances are mixed with solid lubricants so that they may stick firmly to the metal(called "Aqua dag") or oil(called "Oil dag"). Oil dag is used in IC engines. Aqua dag is useful in air compressors , general machine shop work, lathes and for machinery used in food industry. Graphite is also mixed with greases to form graphite greases , which are used at higher temperature.



Q6](b) i)Discuss triple point in one component system (3)

Ans:- *TRIPLE POINT:- The three curves OA, OB, and OC meet at O at which solid, liquid and vapour co-exist in equilibrium. This point at 273.16K (0.0075°C) and 4.58 mm of Hg pressure is called Triple point. The system is invariant.*

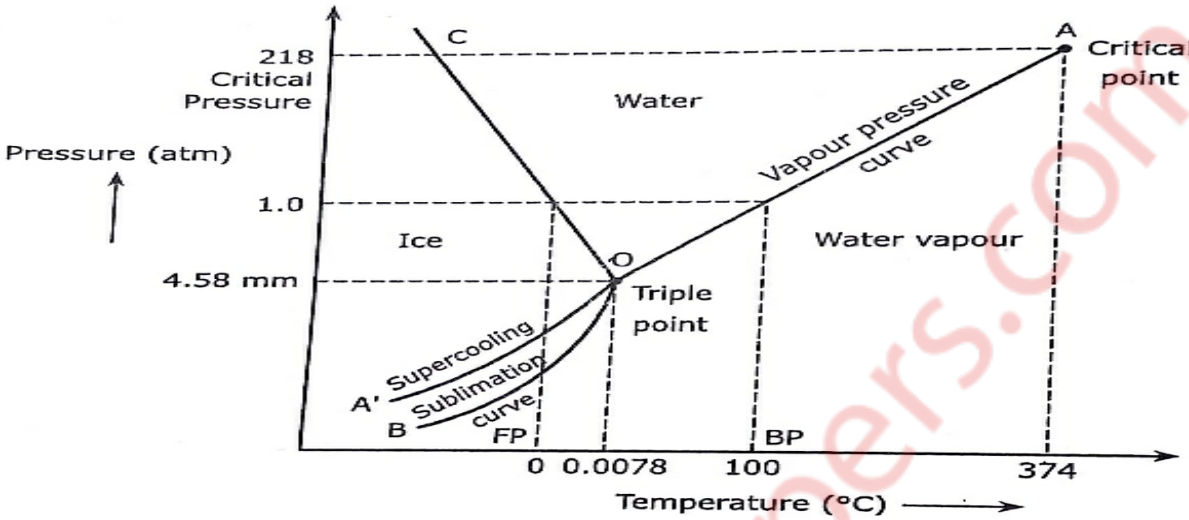


Fig. 4.1 : Phase diagram of water system

F=C-P+2 ∴ F=3-P=3-3=0 ∴ F=0

This means the degree of freedom is zero therefore neither pressure nor temperature can be changed without causing the disappearance of one of the phases. If either temperature or pressure is changed even slightly , one of the three phases disappears and the system changes from non-varient to univariant.

Q6](b) ii)Explain reverse osmosis. (2)

Ans:- *When two solutions of unequal concentrations are separated by a semipermeable membrane which selectively does not permit the passage of dissolved solute particles, i.e., molecules , ions etc flow of solvent takes place from dilute to concentrated sides due to osmosis. If a hydrostatic pressure in excess of osmotic pressure is applied on the concentrated side to dilute side across the membrane.*

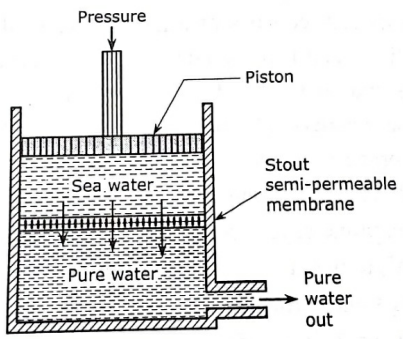


Fig. 1.14 : Reverse osmosis cell

This process is called as reverse osmosis. Thus in reverse osmosis methods pure solvent is separated from its contaminates, rather than removing contaminants from the water.

Q6](c)Write a note on fullerene. (4)

Ans:- *One of the nano-forms of the carbon is Buckminster fullerene (C_{60}). A fullerene is a molecule of carbon in the form of a hollow sphere, ellipsoid, tube and many other shapes. Spherical fullerene are also called as bucky balls and resembles football. Fullerene have 12 pentagons and 20 hexagons. A common method used to produce fullerene is to send a large current between two nearby graphite electrodes in an inert atmosphere of Argon. The resulting carbon plasma arc between the electrodes cools into sooty residues from which many fullerenes can be isolated.*

PROPERTIES OF FULLERENE:

- *It is mustard coloured solid, which appears brown to black with increasing thickness of its film.*
- *On sublimation , it forms translucent magenta face-centered cubic crystals.*
- *It is moderately soluble in aromatic hydrocarbons giving magenta solution.*
- *As a pure solid , it is electrically insulating. With proper impurity addition , it can be made highly conductive and super conductive.*

USES OF FULLERENE:

- *It is used for the preparation of electronic and microelectronic devices.*
- *It is used for the preparation of non-linear optical devices.*
- *It is used for the preparation of batteries as charge carriers.*
- *It is used for the preparation of super conductors.*
- *It is used for the preparation of soft ferromagnet with zero remanence.*
