Dr. N.G.P INSTITUTE OF TECHNOLOGY, COIMBATORE – 48

DEPARTMENT OF CHEMISTRY

CHEMISTRY QUESTION BANK FOR- PART A

UNIT – I

WATER TECHNOLOGY

1. Define hardness of water.

Hardness is the property or characteristics of water which does not produce lather with soap.

Hardness can be detected by treating water with soap.

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

(Soap) (Hardness causing Substance) (Hard soap)

2. What are the salts responsible for carbonate and non-carbonate hardness of water?

Carbonate hardness: $Ca(HCO_3)_2$ and $Mg(HCO_3)_2$

Non- Carbonate hardness: $CaCl_2$, $CaSO_4$, $MgCl_2$, $MgSO_4$.

3. What are the constituents that cause hardness in water? (or) Explain the terms Carbonate hardness and non- carbonate hardness.

$CaCl_2$, $CaSO_4$, $MgSO_4$, $Ca(HCO3)_2$, $Mg(HCO_3)_2$

Carbonate hardness: This is due to the presence of bicarbonates of calcium and magnesium.

Non- Carbonate hardness: This is due to the presence of chlorides and sulphates of calcium and magnesium.

4. Explain what is meant by soft water and hard water.

a) Hard water

Water which does not produce lather with soap solution but produces white precipitate (scum) is called hard water.

This is due to the presence of dissolved Ca and Mg salts.

$2C_{17}H_{35}COONa + Ca^{2+}$ ---------> $(C_{17}H_{35}COO)_2Ca + 2Na^+$

Sodium Soap (Water soluble) Hardness causing ion Calcium soap (Water insoluble)

b) Soft water.

Water which produces lather readily with soap solution is called soft water.

This is due to the absences of dissolved Ca and Mg salts.

5. Distinguish between hard and soft water.

S.No	Hard water	Soft water
1	Hard water does not produce lather with soap solution.	Soft water produces very good lather with soap solution.
2	It gives wine red colour with EBT indicator.	It does not give wine red colour with EBT indicator.

6. Distinguish between Carbonate (Temporary) hardness (CH) and non - Carbonate (permanent) hardness (NCH).

S.No	**Carbonate hardness (or) Temporary hardness**	**Non carbonate hardness (or) Permanent hardness**

1	It is due to bicarbonates of calcium and magnesium.	It is due to chlorides and Sulphates of Calcium and magnesium.
2	It can be removed by boiling the water.	It can not be removed by boiling the water.
3	It is also called as alkaline hardness.	It is also called as non alkaline haedneess

7. How is hardness of water expressed (or) Bring out the significance of Calcium Carbonate? Equivalents (or) Why is hardness expressed in terms of calcium carbonate equivalents.

The concentration of hardness producing salts are usually expressed in terms of an equivalent amount of $CaCO_3$.

Significance: it's molecular weight is whole number and it is the most insoluble salt.If the Concentration hardness producing salt is X mgs/lit, then

$$\text{Amount equivalent to } CaCO_3 = \frac{X \times \text{molecular weight of } CaCO_3}{\text{Molecular weight of hardness producing substance}}$$

8. A water sample contains 73mgs of $Mg(HCO_3)_2$ per lit. Calculate the hardness in terms of $CaCO_3$ Equivalent.

Given: Amount of $Mg(HCO_3)_2$ = 73mgs per liter
Molecular weight of $Mg(HCO_3)_2$ = 146

$$\text{Amount equivalent to } CaCO_3 = \frac{73 \times 100}{146} = 50 \text{mgs/lit}$$

10. How does EBT indicator function as an indicator in EDTA titration? (Or) Why NH_4Cl-NH_4OH buffer is used in EDTA titration.

This complexation by EDTA and EBT with Ca^{2+} and Mg^{2+} ions is possible only at pH =8-10 let can be maintained by this buffer.

$[Ca^{2+}, Mg^{2+}]$ + EBT --------- -- [Ca, Mg-EBT]
(Hardness Causing ion) Indicator (wine red colour unstable compound)

[Ca,Mg-EBT] + EDTA ---------- -- [Ca,Mg-EDTA] + EBT
(Stable complex) Steel blue

11. What is mean by permanent hardness of water? Mention the salts responsible for the permanent hardness of water.

This is due to the presence of chloride and sulphates of calcium and magnesium.
$CaCl_2$, $CaSO_4$, $MgCl_2$ and $MgSO_4$ are responsible for the permanent hardness of water.

12. Define alkalinity.

Alkalinity of water is a measure of its acid neutralizing ability. The natural alkalinity in water is imported by the hydroxide, carbonates, and bicarbonates.

13. How is alkalinity classified?

Depending upon the anion present in water alkalinity is classified into three types

1. Hydroxide alkalinity-due to (OH^-)
2. Carbonate alkalinity- due to (CO_3^{2-})
3. BiCarbonates alkalinity- due to (HCO_3^{-})

14. How is alkalinity determined?

Alkalinity can be determined by titrimetry using standard acid phenolphthalein and methyl orange as an indicators. The determination is based on the following reactions.

(i) $[OH^-] + [H^+] \text{ -------} \rightarrow H_2O$

(ii) $[CO_3]^{2-} + [H^+]$ --------→ $[HCO_3^-]$

(iii) $[HCO_3^-] + [H^+]$ --------→ $H_2O + CO_2$

15. Why is water softened before using in boiler?

If hard water obtained from natural sources is fed directly in to the boilers, the following troubles may arise

1. Scale and sludge formation.
2. Priming and foaming (carry over).
3. Caustic embrittlement.
4. Boiler corrosion.

16. What are scales and sludges?

SLUDGE:

If the precipitate is loose and slimy it is called sludge. Sludges are formed by substances like $MgCl_2$, $MgCO_3$, $MgSO_4$ and $CaCl_2$. They have greater solubilities in hot water than cold water.

SCALE:

On the other hand, if the precipitate forms hard and adherent coating on the inner walls of the boiler, it is called scale. Scale are formed by substances like $Ca(HCO_3)_2$, $CaSO_4$ and $Mgcl_2$.

17. What are the disadvantages of scale formation?

Scales act as thermal insulators. It decreases the efficiency of boiler. Any crack developed on the scale leads to explosion.

18. What is meant by priming and foaming? How it can be prevented?

Priming is the process of production of wet steam. Priming can be prevented by controlling velocity of steam and keeping the water level lower.

Foaming is the formation of stable bubbles above the surface of water. Foaming can be prevented by adding coagulants like sodium aluminate and antifoaming agent like synthetic poly amides.

19. What is meant by caustic embrittlement? How is it prevented?

Caustic embrittlement means inter crystalline cracking of boiler metal.

PREVENTION:

Caustic embrittlement can be prevented by

1. Using sodium phosphate as softening agent instead of sodium carbonate.
2. By adding tannin, lignin, to the boiler water blocks the hair cracks.
3.

20. Indicate the reasons for boiler corrosion?

Boiler corrosion arises due to the presence of

1. Dissolved oxygen.
2. Dissolved carbon dioxide.
3. Dissolved salts.

21. What are the requisites of drinking and boiler feed water?

1	Boiler feed water	Must have zero hardness and free from dissolved gases like O_2, CO_2.
2	Drinking water	1. pH of water should be in the range of 7.0 to 8.5.
		2.total hardness and dissolved solids of water should be less than 500ppm

22. Define softening of water. How is it carried out?

The process of removing hardness producing salts from water is known as water softening or conditioning of water. Softening of water can be done in two methods,

1. External treatment
2. Internal treatment

23. Soft water is not DM water? Where as DM water is soft water" Justify.

The soft water produced by lime soda and zeolite process, does not contain hardness producing Ca^{2+} and Mg^{2+} ions, but it will contain other ions like Na^{+}, K^{+}, SO_4^{2-}, Cl^{-} etc. On the other hand DM water does not contain both anions and cations.

24. What are the ad vantages of ion- exchange process?

1. Highly acidic or alkaline water can be treated by this process
2. Water obtained by this process will have very low hardness.

25. How is exhausted resin regenerated in ion-exchange process?

When the cation exchange resin is exhausted, it can be regenerated by passing a solution of dil HCl or dil H_2SO_4.

$RCa + 2HCl$ ---------- RH^{2+} $CaCl_2$

$RNa + HCl$ ---------- $RH + NaCl$

Similarly, when the anion exchange resin is exhausted, it can be regenerated by passing a solution of dil. NaOH. **$R'Cl_2 + 2NaOH$ ----------$R'(OH)_2 + 2NaCl$.**

27. Give some examples for cation exchange resin.

1. Sulphonated coals.
2. Sulphonated polystyrene.

28. Give some examples for anion exchange resin.

1. Cross-linked quaternary ammonium salts.
2. Urea – formaldehyde resin.

29. How is water demineralised in an ion-exchanger?

When the water containing ions (both anion and cation) are passed through ion exchange colums, it absorbs all the ions (anions and cations) as shown below.

Cation exchanger: $R(H)_2 + CaCl_2$ ----------$RCa + 2HCl$

Anion exchanger: $R(OH)_2 + 2HCL$ ----------$RCl_2 + 2H_2O$.

30. Give the description of sand filter.

The sand filter consists of a tank containing a thick top layer of fine sand followed by coarse sand, fine gravel and coarse gravel.

31. How is boiler corrosion, due to dissolved oxygen, removed.

Sodium sulphite, hydrazine are some of the chemicals used for removing dissolved oxygen from water.

$2Na_2SO_3 + O_2$----------$2Na_2SO_4$

$N_2H_4 + O_2$ ---------- $N_2 + 2H_2O$

32. How does carbon dioxide cause boiler corrosion?

Dissolved carbon dioxide in water produces carbonic acid, which is acidic and corrosive in nature.

$CO_2 + H_2O$----------H_2CO_3

Carbon dioxide gas is also produced from the decomposition of bicarbonate salts present in water.

$Ca(HCO_3)_2$ ----------$CaCO_3 + H_2O + CO_2$

33. What is aeration of water? Mention its purpose.

The process of mixing water with air is known as aeration. The main purpose of aeration is

1. To remove gases like CO_2, H_2S and other volatile impurities causing bad taste and odour to water.
2. To remove ferrous and manganese salts as insoluble ferric and manganic salts.

34. Explain the function of a coagulant with example.

When the coagulant is added to water, it gets hydrolyzed to form a gelatinous precipitate of coagulant

$Al(OH)_3$. The gelatinous precipitate, $Al(OH)_3$, entraps the finely divided and colloidal impurities , settles to the bottom and can be removed easily.

35. What is carbonate conditioning for, what type of boilers it is used?

Scale formation can be avoided by adding Na_2CO_3 to the boiler water. It is used only in low pressure boilers. The scale forming salt like $CaSO_4$ is converted into $CaCO_3$, Which can be removed easily.

$CaSO_4 + Na_2CO_3$---------- $CaCO_3 + Na_2SO_4$

36. What is the role of phosphates in the internal treatment of water?

Scale formation can be avoided by adding sodium phosphate. It is used in high pressure boilers. The phosphate reacts with Ca^{2+} and Mg^{2+} salts to give soft sludges of Calcium and Magnesium phosphates.

$3CaSO_4 + 2Na_3PO_4$ ----------$Ca_3(PO_4)_2 + 3Na_2SO_4$

37. What are boiler compounds? Mention two different boiler compounds and their actions.

Scale forming substances can be removed by adding chemicals directly to the boiler. These chemicals are called boiler compounds.

Examples:

Sodium carbonate and Sodium phosphate.

1. **$CaSO_4 + Na_2CO_3$---------- $CaCO_3 + Na_2SO_4$**
2. **$3CaSO_4 + 2Na_3PO_4$----------$Ca_3(PO_4)_2 + 3Na_2SO_4$**

38. What is calgon conditioning? How is it functioning in water treatment?

Or

What is calgon? What is its use in water technology?

Calgon is sodium hexa Meta phosphate $Na_2[Na_4(PO_3)_6]$. This substance interacts with calcium ions forming a highly soluble complex and thus prevents the precipitation of scale forming salt.

$CaSO_4 + Na_2[Na_4(PO_3)_6]$ ----------→ $Na_2[Na_4[Ca_4(PO_3)_6] + 2Na_2SO_4$

39. Mention requires of potable water.

1. It should be clear, colourless and odourless.
2. It should be cool and pleasant to taste.
3. It should be free from harmful bacteria and suspended impurities.
4. It should be free from dissolved gasaes like CO_2, H_2S, NH_3 etc., and poisonous minerals like lead, arsenic, manganese, etc.,
5. Hardness should be less than 500 ppm.

40. Write briefly on disinfection of water by UV treatment.

Or

How is UV light useful for achieving disinfection of water.

When the water containing bacteria is irradiated by UV light, all the bacteria's are killed out. This process is known as disinfection. This is useful for sterilizing water in swimming pool.

41. What are the various stages in the treatment of water for domestic supply?

Sources of water → screening ------→ Aeration ------→ sedimentation -------→coagulation -----

→ Filtration --------→ sterilization (or) Disinfection

42. Explain the function of bleaching powder as a germicide.

When bleaching powder is added to water, it produces hypochlorous acid (HOCl). HOCl is a powerful germicide.

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

Bleaching powder

$Cl_2 + H_2O \longrightarrow HCl + HOCl$

HOCl + Bacterias ----------→ Bacterias are killed.

43. What is meant by disinfectant? What is the advantage of using chloramines as a disinfectant?

The chemicals used for destroying the harmful bacteria's are known as disinfectants.

Advantages of Chloramines

Chloramines compounds decompose slowly to give chlorine. It is better disinfectant than chlorine. It also gives good taste to the treated water.

44. Mention the requisites of water used for potable water.

1. P^H of the water should be in the range of 7.0-8.5.
2. Total hardness and dissolved solids should be less than 500 ppm.

45. Write the principle involved in the desalination of water by reserve osmosis.

Or

What is meant by "reserve osmosis"? How is it applied in the desalination of water?

If pressure in excess of osmotic pressure is applied on the higher concentration side, the solvent flow is reversed, ie., solvent flows from higher concentration to lower concentration , this process is called reverse osmosis.

Salt water is taken as higher concentration and water is taken as solvent. If pressure is applied on the salt water, the water flows from salt water to water side.

46. Define the term break point chlorination.

Or

What is break-point chlorination? Explain

Break point chlorination is the point at which all the impurities are removed and free chlorine begins to appear.

47. Name some of the membranes employed in reverse osmosis process. State the advantages of this process.

Example: cellulose acetate, cellulose butrate.

Advantages

(i) It removes ionic as well as non-ionic, colloidal impurities.

(ii) The life time of the membrane is high and it can be replaced within few minutes.

48. Name the method which separate both ionic and non-ionic impurities from water?

Reverse osmosis process.

49. **What are the disadvantages of using ozone in disinfection of water?**

(a) This process is costly and cannot be used in large scale.

(b) Ozone is unstable and cannot be stored for long time.

50. **What are the advantages of reverse osmosis method?**

1. The life time of the membrane is high, and it can be replaced within few minutes.
2. It removes ionic as well as non-ionic, colloidal impurities.
3. Due to low capital cost, simplicity, low operating this process is used for converting sea water into drinking water.

51. **What is blow-down operation?**

Blow-down operation is a process of removing a portion of concentrated water by fresh water frequently from the boiler during steam production.

52. **What are the advantages of ion-exchange process.**

(i) Water containing turbidity, Fe and Mn cannot be treated, because turbidity reduces the output and Fe, Mn form stable compound with the resin.

(ii) The equipment is costly and more expensive chemicals are needed.

53. **What is it necessary to chlorinate drinking water supply beyond break point?**

It is necessary to chlorinate drinking water supply beyond break point because at that point only all the impurities are destroyed and free chlorine begins to appear.

54. **Define desalination.**

The process of removing common salt (sodium chloride) from the water is known as desalination. The water containing dissolved salts with a peculiar salty or brackish taste is called brackish water.

55. Draw the structure of EDTA. What happens when EDTA is added to the hard water?

56. Demineralised water is a soft water but soft water is not a demineralised water justify?

(Or)

How will you compare the soft water and demineralised water?

The soft water produced by zeolite process does not contain hardness producing Ca^{2+} &Mg^{2+} ions. But it will contain other ions like Na^{+},K^{+},SO_4^{+},Cl^{-}etc. on the other hand, demineralised water does not contain both anions & cat ions. Thus soft water if not demineralised water, where as demineralised water is soft water.

57. **What are ion exchange resins?**

Which are long chain, cross linked, insoluble organic polymers with a microporous structure. The functional groups attached to the chains are responsible for the ion- exchanging properties.

58. What is cation exchanger and anion exchanger?

Materials capable of exchanging cations are called cation exchangers. They are usually a high molecular weight, cross linked polymer containing sulphonic, phenolic groups. They are capable of exchanging their H^{+} ions with other cations of hard water.

Materials capable of exchanging anions are called anion exchanger. It may be defined as a polymer containing amine (or) quaternary ammonium groups as integral parts of the resin and equivalent amount of anions.

59. What is deminralisation (or) deionization process?

In this process almost all the ions (both anions and cations) present in the hard water are removed .hence the process is also called de-ionisation process. In the demineralization process, the ions present in water are removed by ion-exchangers. Which are long chain, cross linked and insoluble organic polymer with a microporous structure.

60. Why calgon conditioning better than phosphate conditioning?

In Calgon conditioning the added calgon forms soluble complex, compound with $CaCO_3$. There by it prevents the formation of scale and sludge in boiler. Since the complex formed is soluble, it does not cause any problem in the boiler.

On the other hand, in phosphate conditioning sodium phosphate is added to the boiler water so that calcium phosphate precipitates if formed. Although the precipitate is non adherent and soft, yet it has to be removed by frequent blow down operation.

Hence, calgon conditioning is definitely better than phosphate conditioning.

61. Differences between sludge and scale.

Sludges	Scales
It is a soft loose and slimy precipitate	Scales are hard and adherent deposits.
Sludges are formed by the substances like $MgCl_2$, $CaCl_2$	Scales are formed by the substances like $Ca(HCO_3)_2$,$CaSO_4$
It is a poor of heat .Hence the excess of sludge formation decreases the efficiency of boiler.	It is thermal insulator. Hence efficience of the boiler is decreased. Any crack in the boiler scale leads to explosion
Sludges formation can be prevented by using soft water.	Scales formation can be prevented by using acids.
Sludges can be removed by scrapping off with a wire brush.	Scales may be removed by giving thermal shocks, scrapping, and chemical reaction.

62. What are internal and external treatments?

Removal of scale forming substance by adding chemicals directly in the boiler is called internal treatment.

Removal of hardness producing salts from the water before feeding into the boiler is called external treatment.

63. What is carbonate conditioning?

Scale formation in this method can be prevented by adding Na_2CO_3 to the boiler water. Any scale forming salt like $CaSO_4$ present in the water is precipitated in the form of insoluble $CaCO_3$ by the addition of Na_2CO_3

$$\mathbf{CaSO_4 + Na_2CO_3 \longrightarrow Na_2SO_4 + CaCO_3}$$

64. What are boiler compounds? Mention two different boiler compounds and their action?

The removal of scale forming susbstance by adding chemicals directly into the boiler is called internal treatment. The chemicals used for this purpose is called boiler compounds.

The boiler compounds kerosene tannin, gelatin, agar agar, etc.these substance get coated over the scale forming particles and convert them into non sticky, non adherent, and loose precipitate in boilers.

$$\mathbf{3CaSO_4 + 3Na_3PO_4 \longrightarrow 3Na_2SO_4 + Ca_3(PO_4)_2}$$
$$\mathbf{CaSO_4 + Na_2CO_3 \longrightarrow Na_2SO_4 + CaCO_3}$$

UNIT-II
POLYMERS

1. **Define polymers and monomers.**

Polymers are macro molecules (giant molecules of higher molecular weight) formed by the repeated linking of large number of small molecules called monomers.

Monomers is a micro molecule (small molecule) which combines with each other to form a polymer.

2. **What is degree of polymerization?**

The number of repeating units (n) in a polymer chain is known as the degree of polymerization. It is represented by the following relationship.

$$\text{Degree of polymerization (n)} = \frac{\text{molecular weight of the polymeric network}}{\text{molecular weight of the repeating unit}}$$

3. **Explain functionality of a monomer with suitable example.**

The number of bonding sites or reactive sites or functional groups present in a monomer is known as its functionality.

S.No	Example	Functionality
1.	$CH_2=CH_2$ (ethylene)	-2 (Two bonding sites are due to the presence of one double bond in the monomer. Therefore ethylene is a bifunctional monomers)

2.	H_2N-$(CH_2)_6$-NH_2 Hexa methylene diamine	-2 (This monomers contains two functional groups, hence it is a bifunctional monomers)

4. Explain condensation polymerization with a suitable example.

It is a reaction between simple polar groups containing monomers with the formation of polymers and elimination of small molecules like H_2O, HCl.,

Ex: Hexamethylene diamine and adipic acid condense to form a polymer, Nylon 6:6 (polyamide).

n H_2N-$(CH_2)_6$-NH_2 + n HOOC- $(CH_2)_4$-COOH ⟶ [HN- $(CH_2)_6$-NH- C-CH_2- C]n -

Hexamethylene diamine — Adipic acid — Nylon 6:6 (polyamide).

5. What are additional polymers? Give one example.

It is a reaction that yields a polymer, which is an exact multiple of the original monomers molecule. The original monomers molecule, usually, contains one or more double bonds. In addition polymersation there is no elimination of any molecule.

Ex: polyethylene is produced from ethylene.

$$n\ CH_2{=}CH_2 \xrightarrow[\text{Catalyst}]{\text{Heat/Pressure}} n\text{---}\ CH_2{-}CH_2\text{-}\ \text{-----}\ +\ \text{---}\ (\ CH_2{=}CH_2\ )_n\ \text{---}$$

Ethylene — Bifunctional monomer — Polyethlene (PE)

6. What is polymerization?

Polymerization is a process in which large number of small molecules (called monomers) combine to give a big molecule (called polymers) with are without elimination of small molecules like water.

7. Name the various polymerization.

- Addition polymerization
- Condensation polymerization
- Co- polymerization
-

8. What are the various steps of free radical mechanism?

Free radical mechanisms occur in three major steps namely,

1. Initiation, 2. Propagation and 3.terminatiom

9. What is dead polymer?

The product of addition polymerization is known as dead polymer.

10. What is copolymerization? Give an example.

It is the joint polymerization in which two (or) more different monomers combine to give a polymer.

Example: butadiene and styrene copolymerize to give GR-s rubber.

$$n\ [CH_2{=}CH\text{-}CH\text{-}CH_2] + n\ CH_2{=}\ CH\text{-}\ C_6H_6 \longrightarrow (CH_2\text{-}CH{=}CH\text{-}CH_2\text{-}CH_2\text{-}\underset{\displaystyle |\ C_6H_6}{CH}\text{-})_n$$

Butadiene — Styrene — GR-S rupper

11. How is polymerization classified? Give one example for each class.

Polymerization is classified into three types

1.addition polymerization

Example : polyethylene is produced form ethylene.

2.condensation polymerization

Example : nylon 6;6 is produce form hexamethylene diamine and adipicacid.

3.copolymerisation

Example : GR-S rubber is produced from butadiene and styrene.

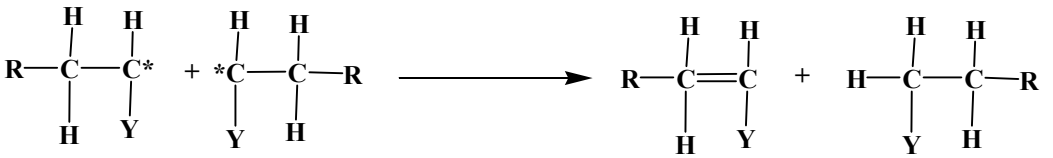
12. Distinguish between additional polymerization and condensation polymerization.

S.No	Additional polymerization	Condensation polymerisation
1	The monomer must have at least one multiple bond.	The monomer must have at least two identical or different functional groups.
2	Monomers add on to give a polymer and no by products are formed.	Monomers condense to give a polymer and by products are formed.
3	Homo- chain polymers obtained.	Hetero-chain polymer obtained

13. What do you understand by disproportion of polymer chains?

Disproportion is splitting of a polymer chain into two new compounds.

Example; it involves transfer of a hydrogen atom of one radical center from one polymer chain to another polymer chain's radical centre, forming two macromolecules , one saturated and another unsaturated.



(Dead polymers)

14. How is nylon 6;6 formed/ bring out its important properties and uses.

Preparation: it is obtained by the polymerization of adipic acid with hexamethylene diamine.

$$n\,H_2N\text{-}(CH_2)_6\text{-}NH_2 + n\,HOOC\text{-}(CH_2)_4\text{-}COOH \downarrow$$

$$\text{-}[HN\text{-}(CH_2)_6\text{-}NH\text{-}CO\text{-}(CH_2)_4\text{-}CO]_n\text{-} + 2n\,H_2O$$

Nylon 6:6

Properties

- It is translucent, white, horn, like material.
- It posses high temperature stability and good abration-resistance.

Uses: it is used for fibres, which is used in making socks, dresses, carpets,etc.

15. What are plastics?

Plastics are high molecular weight organic materials, that be moulded into any desired shape by the application of heat and pressure in the presence of a catalyst.

16. What are the disadvantages of plastics?

- softness
- Embrittlement at low temperature,
- Deformation under load.
- Low heat-resistant and poor ductility.
- Combustibility
- Polymers tend to degrade upon exposure to heat and UV-radiation.

17. List out the various ways by which polymer can be classified.

- Classification based on structure
  a. Thermoplastics.
  b. Thermosetting plastics.
- Classification based on usage
  a. General purpose plastics
  b. Engineering plastics.

18. What are engineering plastics?

Engineering plastics are a group of materials obtained from high polymer resins. They possess high mechanical strength, toughness and higher use temperature. They are mainly used in load

bearing applications, generally to replace conventional materials like metal, wood, glass and ceramics.

19. What are the important applications of high performance plastics?

- They can be used alone or in combination with metals, ceramics or glasses, etc.,
- They find application in demanding areas like automobiles, defence, electrical and electronics, telecommunications, textiles, satellite robots, computer components, etc.,

20. Difference thermoplastics and thermosetting plastics.

S.No	Thermoplastics	Thermosetting Plastics
1.	They are formed by addition polymerization	They are formed by condensation polymerization
2.	They consist of linear long chain polymers.	They consist of three dimensional network structure.
3.	All the polymer chain are held together by weak Vander Waals forces. Eg: Polyethelene	All the polymer chain are linked by strong covalent bonds. Eg: Bakelite.

21. Distinguish between commodity and engineering plastics.

(Or)

Bring out the difference of general purpose plastics and engineering plastics.

No	**Commodify**	Engineering plastics
1.	It possesses low abrasion resistance	It possesses high abrasion resistance
2.	It possesses poor dimensional stability.	It possesses good dimensional stability.
3.	It possesses low mechanical properties.	It possesses high mechanical properties.
4.	It cannot be used at high temperature.	It can be used at high temperature.
5.	It is general purpose plastics.	It is high performance plastics.

22. Mention preparation and uses of PVC (Or) write any two uses of PVC.

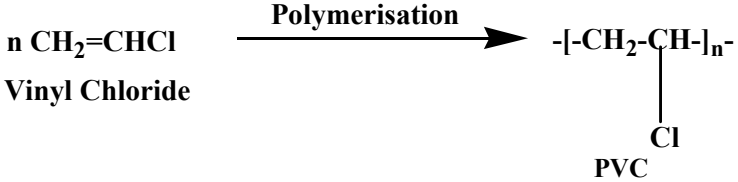
Preparation of PVC involves the following two steps.

I-Step: vinyl chloride is prepared by treating acetylene with HCl at 60-80 °C in the presence of metal chloride as catalyst.

$$CH{\equiv}CH + HCl \longrightarrow CH_2{=}CHCl$$

Vinyl chloride

II- Step: PVC is obtained by heating water emulsion of vinyl chloride in presence of H2O2 under pressure.

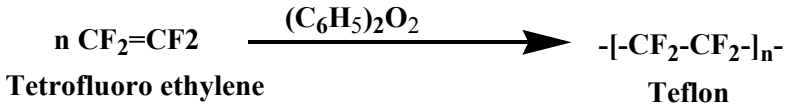


Uses: It is used in the production of pipes, cable insulations, table covers and rain-coats, etc.

It is also used for making sheets, which are employed for tank-linings, light fittings, refrigerator components,etc.,

23. What is fluon? Mention its uses?

Teflon (or) Fluon is polytetrafluoroethane, obtained by polymerization of water- emulsion of tetrafluoroethylene in presence of benzoyl peroxide under pressure.



Uses:

- It is used as a very good electrical insulating material in motors, cables, transformers, electrical fittings.
- It is also used for making non-lubricating bearings, chemical carrying pipes,etc.
- It is also used for making gaskets, packings, pump parts,tank linings etc.
- It is used in making non-sticking stop cocks for burettes.

24. Mention some important applications of polycarbonate.

They are used for making electrical insulator, housing apparetus, plugs, sockets, switche strerilizable transparent containers, cameras, photographic films, hair drier bodies, baby bottles, safely windows in prison and jewellery shops,etc.

25. Give two properties and uses of perlon-U.

- It possesses excellent flexibility, toughness even at sub-zero temperature.
- It is stable than polyamides.

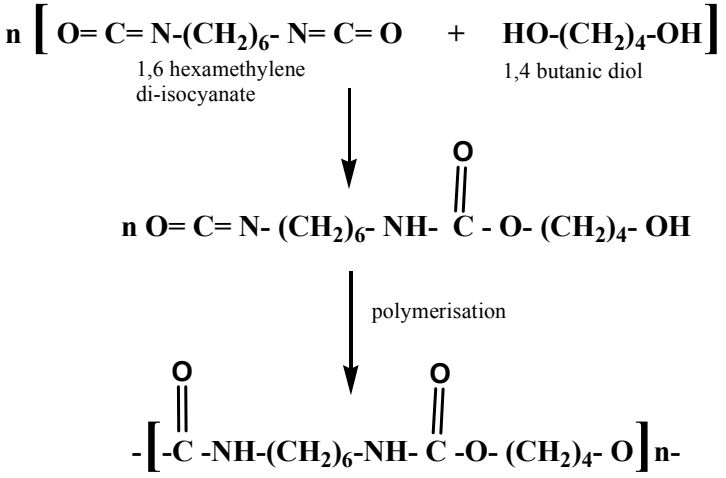
Uses

Polyurethanes are used as coatings, films, foams adhesives and elastomers.

They are also used in defense, oceanographic research, mountaineering.

26. How is Perlon-U prepared?

It is obtained by the reaction of 1, 4- butane diol with 1, 6- hexane di-isocyanate.



27. How is PET prepared?

It is saturated polyester, prepared by condensation of ethylene glycol and terephthalic acid.

E

28. Why is Teflon behaving non- sticking?

Since the fluorine atoms are the strong electronegative elements, they tightly bonds with carbon atoms in Teflon. As C-F bond is stronger it is non-reactive and hence it is not wetted by oil and water. So, Teflon is non- sticky.

29. What are elastomers?

Rubber (or) elastomers are non-crystalline high polymers (linear polymers), having elastic and other rubber – like properties.

30. Raw rubber cannot be used why?

- It is plastic in nature, ie., becomes soft at high temperature,
- It has poor strength.
- It has large water- adsorption capacity
- It is non polar solvents like benzene and vegetable and mineral oils.
- It is attacked by oxidizing agents like HNO_3, H_2SO_4.
- It swells and disintegrates gradually in organic solvents.
- It has little durability.

31. What is meant by vulcanization of rubber?

The process of vulcanization consists of heating the raw rubber with sulphur to about 100-140.C

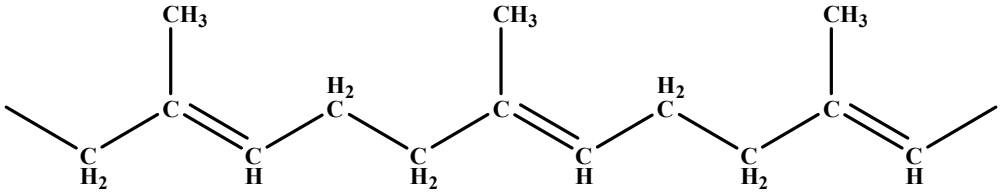
32. What are the characteristics of FRP.

- It possess superior properties like higher yield strength, fracture strength and fatigue life.
- Since fiber prevents slip and crack propagation, the mechanical properties of FRP gets increased.
- It possess high corrosion resistance and heat resistance property

33. How is natural rubber obtained?

Natural rubber is obtained from the tree as latex, which is a dispersion of isoprene.

34. Draw the general structure of rubber.



35. What are composites?

A composite material may be defined as, "a material system consisting a mixture of two or more micro- constituents. Which are mutually insoluble, differing in form or composition and forming distinct phases", such a combination possesses properties different from those of any of its constituents.

36. Write the characteristics of composites?

- They possess higher specific strength and lower specific gravity.
- They possess lower electrical conductivity and thermal expansion.
- They possess better creep, fatigue strength, corrosion and oxidation resistance.
- They maintain very good strength, even up to high temperatures.

37. What are the constituents of composites?

Composites consist of two important constituents.

- Matrix phase.
- Dispersed phase.

38. How are composites classified?

Composites are classified into three major types

- Metal Matrix Composites (MMC)
- Ceramic Matrix Composites (CMC)
- polymer Matrix Composites (PMC)

39.What are FRPs?

FRPs are fibre reinforced plastics obtained by reinforcing plastics with a high strength fibre material.

40. Explain the properties of FRP.

It possess superior properties like higher yield strength fracture strength life.

Since fibre prevents slip and crack propagation, the mechanical properties of FRP gets increased.

It possesses high corrosion resistance and heat resistance property.

41.Name any two resins used as matrix forming materials in the manufacture of composites.

Polyester resin, epoxy resin, phenoic resin.

42.Name some important FRPs.

Carbon fibre reinforced plastics
Glass fibre reinforced plastics
Aramid fibre reinforced plastics
Alumina fibre reinforced plastics.
Boron fibre-reinforced plastics.

43.**Mention important applications of FRPs**.

(i) Since FRPs are very good corrosion resistants they are used for making acid and alkali storage tanks cloth washing tanks,etc.

(ii)FRPs are used in mining industries for making digesters solvent extraction tanks and filtration tanks.

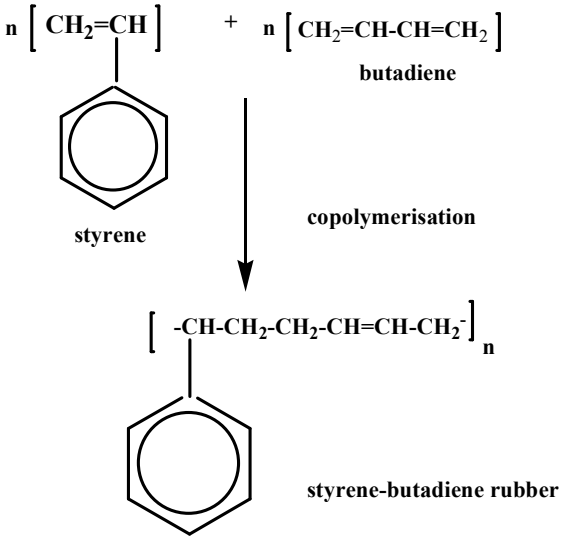
(iii)FRPs are also used in making sports equipments like boots sports cars, gold clubs, etc.

44.What is SBR?

SBR is styrene-butadiene rubber consisting 75% butadiene and 25% styrene.

45.How is SBR prepared?

SBR is obtained by co-polymerizing an aqueous emulsion of the mixture containing 75% butadiene 25%styrene and an emulsifying agent (cumene hydroperoxide).



46.Mention some important uses of SBR.

SBR is used mainly for making light duty tyres, belts, floor tiles, gaskets, gum, hoses, adhesives and electrical insulation.

47.What is GR-I rubber?

It is a butyl rubber obtained by copolymerizing isobutylene with 1.5 to 4.5% isoprene in methyl chloride.

48.What are the characteristics of butyl rubber?

- Butyl rubber is amorphous under normal conditions.
- Unstabilized polyisobutylenes are degraded by light or heat to sticky low molecular weight products.
- It has low permeability to gases.
- It is soluble in hydrocarbon solvent.
- It possesses good electrical insulating property and resistance to heat and abrasion.

49.What is a homochain polymer? Give one example.

If the main chain of a polymer is made up of same species of atoms, the polymer is known as homochain polymer.

– C – C – C – C – C –

Examples: polyethylene, polyvinyl chloride.

50. Define degree of polymerization.

The number of repeating unit present in a polymer is known as degree of polymerization. Polymers with low degree of polymerization are known as "oligopolymers" or "oligomers" and those with high degree of polymerization are known as "high polymers".

51. What are branched chain polymers?

A branched chain polymer forms when a tri functional monomer is mixed in small amounts with a bifunctional monomer and polymerized.

52.What is a heterochain polymer? Give one example.

If the main chain of a polymer is made up of different species of atoms, the polymer is known as heterochain polymer.

– C – C – O – C – C – O –

Examples: terylene, Nylon 6, 6

53. What is tacticity? Give one example of stereo polymers.

The orientation of functional group of a polymer can take place in an orderly or disorderly fashion with respect to the main chain is known as tacticity. This result in three types of stereo polymers.

- Isotactic polymer - Cis – isoprene
- Syndiotactic polymer - Trans – isoprene
- Atactic polymer - Polypropylene

54. Why thermosetting plastics cannot be remoulded?

They are prepared by condensation polymerization. The polymer chains are held together by strong covalent bonds (cross links).

55. What is the role sulphur in the vulcanization of rubber?

The added sulphur combines chemically at the double bonds of different long chain Rubber springs. Thus the vulcanization prevents intermolecular movement of rubber springs. The extent of stiffness of vulcanized rubber depends on the amount of sulphur added.

UNIT III
SURFACE CHEMISTRY

1. Define adsorption and Adsorbate.

Adsorption

(i) The phenomenon of concentration of molecule of a gas or liquid at a solid surface is called adsorption. The adsorption of gas on a solid is sometimes called occlusion.

Adsorbate

(ii) The substance which is held on the surface on the solid is called adsorbate.

2. What is sorption?

Sorption is the process in which both adsorption and absorption takes place simultaneously.

3. Define the terms adasorbent and adsorbate give suitable example.

Adsorbate: the substance which is held on the surface of the solid is called the adsorbate ,
Eg: $Ni_{(s)}$

Adsorbent: the solid that takes up a gas or solute from the solution is called the adsorbent

Eg: $H_{2(g)}$

4. What are chemisorptions? Give an example.

Chemical adsorption is the one in which the adsorbed molecules are held on the surface of the adsorbent by chemical bonds (covalent bond or ionic bond) Eg adsorption of H_2 on Ni

5. What is physical adsorption (or) physisorption? Give an example.

Physical adsorption is the one in which the adsorbed molecules are held on the surface of the adsorbent by weak physical(or)vander walls forces of attraction. Eg. Adsorption of H_2 (or) O_2 on charcoal.

6. Mention some important characteristics of adsorption.

(i) Adsorption on surface of a solid is always spontaneous.
(ii) Adsorption is aiways accompanied by evolution of heat.
(iii) Adsoption is accompanied both by decreased in enthalpy and entropy of the system.
(iv) Adsorption is a selective process.

7. What are the difference between absorption and adsorption?

S.No	Adsorption	Absorption
1.	Adsorption is a surface phenomenon.	Absorption is a surface phenomenon.
2.	It is a rapid process	It is a slow process
3.	Equilibrium is attained easily.	Equilibrium is attained easily.
4.	The concentration of molecules are more on the surface and less in the bulk.	But, distribution is uniform.

8. How does chemisorptions differ from physisorption?

Or Write any two differences between chemisorptions differ from physisorption?

S.No	physisorption	chemisorptions
1.	It is caused by intermolecular Vander Waal's forces (weak)	It is caused by chemical bond formation (strong)
2.	Heat of adsorption is low (20-40 k.cal/mol)	Heat of adsorption is high (40-400 k.cal/mol)
3.	Adsorption is completely reversible.	Adsorption is irreversible.
4.	Adsorption decreases with increase in temperature.	Adsorption increases with temperature
5.	Multilayer adsorption occurs.	Only monolayer adsorption occurs.

9. How will you increase the activity of an adsorbent?

Activation leads to increase in the surface area of the adsorbent, which increases adsorption.
Activation is achieved by the following ways

(i) Creation of rough surface

(a) By mechanical rubbing of the solid adsorbent.
(b) By the subjecting to some chemical reaction on the solid adsorbent**.**

(ii) **Increasing effective area of the surface**

(a) By sub dividing the solid adsorbent into finer particles.
(b) By heating of solid adsorbent into superheated steam, now its pores are opened and adsorption increases.

10. Explain the effect of temperature on adsorption.

Physical adsorption: It occurs rapidly at lower temperature and decreases with increase in temperature.

Chemical adsorption: It increases with increase in temperature and then decreases.

11. Explain the function of activated charcoal with example.

(i) It adsorbs coloring matter present in sugar solution.
(ii) It also adsorbs certain acids like CH_3COOH and $(COOH)_2$ present in water, thereby acid concentration in water decreases.
(iii) It also absorbs out NH_3 from the solution of NH_4OH and phenolphthalein.

12. Define adsorption? What is an adsorption isotherm?

Adsorption

The phenomenon of concentration of molecules of a gas or liquid at a solid surface is called adsorption.

Adsorption isotherm

Adsorption isotherm is a relationship between magnitudes of absorption with pressure.

$x/m = KP^{1/n}$ (Draw a graph)

13. What is Freundlich's adsorption isotherm?

The relationship between between the magnitude of adsorption (x/m) and pressure (p) can be expressed mathematically by an equation known as freundlich adsorption isotherm.

$$x/m = KP^{1/n}$$

14. Write a suitable equation commonly applied to the adsorption of liquids on solids?

$x/m = KC^{1/n}$ (or) $\log x/m = \log K + 1/n \log C$

Where 'k' and 'n' = constants

x= mass of adsorbate

m= mass of the adsorbent.

15. Explain the limitation –s of Freundlich's adsorption isotherm.

(i) freundlich equations is purely empirical and has no theoretical basis.

(ii) The equation is valid only upto a certain pressure and invalid at higher pressure.

(iii) The constant K and 'n' are not temperature independents, they vary with temperature.

(iv) Freundlich adsorption isotherms fail, when the concentration of adsorbate is very high.

16. What is langmuir's adsorption isotherm? How it is mathematically represented?

The relationship between the amounts of gas adsorbed to the pressure of the gas at constant temperature is known as Langmuir's adsorption isotherm.

It is represented mathematically as

$$X = \frac{k' KP}{1+KP}$$

17. What are the demerits of Langmuir's adsorption isotherm?

Langmuir's adsorption isotherm holds good at lower pressure but fails at high pressure.

18 What are promoters?

Promoters are define as " the substances which increase the activity of a catalyst".

19. What is catalytic poisoning?

"A substance which destroys the activity of the catalyst to accelerate a reaction' is called catalytic poisoning

20. What is the effect of temperature and pressure on the adsorption of hydrogen gas on charcoal?

Adsorption of H_2 on the charcoal is rapid at lower temperature and decrease with increase in temperature, but the rate of adsorption increases with the increase of pressure.

21. What are the effects of increase in temperature and increase in pressure on the adsorption of a gas on a solid?

(i) Effect of increase in pressure: Adsorption generally increases with increase of pressure.

(ii) Effect of increase in temperature:

(a) Physical adsorption: It increases with increase in temperature.

(b) Chemical adsorption: It increases with increase in temperature and then decreases.

22. How is arsenic poisoning removed from the body?

Colloidal ferric hydroxide is administered, which adsorbs arsenic poison and is removed from the body y vomiting.

23. Define ion- exchange adsorption.(or)What do you understand by ion exchange adsorption? Give one example

Ion – exchange adsorption is "the process of releasing the ion and adsorbing another like ion".

Example: Water softening using zeolite.

When water containing Ca^{2+} and Mg^{2+} ions are allowed to pass over a zeolite bed, Ca^{2+} and Mg2+ ions are replaced by Na+ ions

$2R\text{-}Na^{+} + Ca^{2+} \text{--------} \rightarrow 2RCa + 2Na^{+}$

24. How is evaporation of water in lake minimized?

Due to scarcity of water during summer a layer of stearic acid is spread over water lakes and reservoirs. The adsorbed stearic acid on the surface of water minimizes evaporation of water.

25. What is the role of adsorbent in catalysis?

(i) The catalyst (adsorbent) adsorbs the reactant molecules on its surface and brings them in close proximity for the reaction to occur.

(ii) It helps in the formation of activated complex, where in bonds in the reactants are easily broken and the products are easily formed.

26. Where is ion exchange adsorption applied?

Ion exchange adsorption is applied, where the dissolved ions are exchanged with the ions of the adsorbents.

Example

In water softening $Ca^{2+,}$ Mg^{2+}, SO_4^{2-} ions are removed by ion exchange resins.

$RCa + 2HCl \text{-----} \rightarrow RH_2 + CaCl_2$

$RSO_4 + 2NaOH \text{------} \rightarrow R(OH)_2 + Na_2SO_4$

27. Mention any three factors that influence the adsorption of gases on solids.

- The nature of adsorbent
- The area of adsorbent
- The nature of gas adsorbed
- The temperature and pressure of the gas

28. Mention the factors which influence the adsorption of solutes from solution.

- The nature of adsorbent
- The nature of solute adsorbed
- The temperature
- The concentration of solution.

29.List the factors affect the adsorption?

- Nature of gases
- Nature and surface area of adsorbent.
- Heat of adsorption.
- Reversible character of adsorbed gases.
- Pressure of gas
- Temperature of gas
- Thickness of adsorbed layer of gas
- Activation of adsorbent.

UNIT- IV
Non-Conventional Energy Sources

1 .Define nuclear fission. Give an example.

Nuclear fission is defined ass the process of splitting of heavier nucleus into two
(Or) smaller nuclei with simultaneous liberation of large amount of energy.

2. Mention few important characteristics of nuclear fission.

(i) A heavy nucleus (U^{235} (or) Pu^{239}) when bombarded by slow moving neutrons split into two or more nuclei.

(ii) Two or more neutrons are produced by fission of each nucleus.

(iii) Large quantities of energy is produced as a result of conversion of small mass of nucleus into energy.

3. What is nuclear fusion? Give an example.

The process of combination of lighter nuclei into heavier nuclei with simultaneous liberation of large amount of energy. Nuclear fusion occurs in sun.

Ex: $_1H^2 + _1H^2 \longrightarrow {}_2He^4$ + energy

4. What is nuclear chain reaction?

A fission reaction where the neutrons from the previous step continue to propagate and repeat the reaction is called nuclear chain reaction.

5. Give any two differences between nuclear fission and nuclear fusion .

S.No	Nuclear fission	Nuclear fusion
1.	It is the process of breaking a heavier nucleus.	It is the process of combination of lighter nuclei.
2.	It emits radioactive rays.	It does not emit any kind of radioactive rays.
3.	It occurs at ordinary temperature.	It occurs at high temperature ($>10^6$ k).

6. What is super critical mass and sub-critical mass of U^{235}?

(a) Super Critical mass

If the mass of the fissionable material (U^{235})is more than the critical mass, it is called super critical mass.

(b)Sub- Critical mass

If the mass of the fissionable is more than the critical mass, it is called sub critical mass.

7. What is nuclear energy? Explain using a suitable example.

The energy released by the nuclear fission is called fission energy (or)nuclear energy.

Ex: when U235 nucleus is hit by a thermal neutron the following reaction occurs with the release of energy.

$$U_{92}^{235} + n_0^1 \longrightarrow Ba_{56}^{39} + Kr_{36}^{94} + 3_0n^1 + \text{Energy}$$

8. Give any one nuclear fission reaction mention the factors that impede the nuclear chain reaction.

$$\mathbf{_{92}U^{235} + {}_0n^1 \longrightarrow [_{92}U^{236}] \longrightarrow {}_{56}Ba_{140} + {}_{36}Kr^{93} + 3_0n^1}$$

The factors that impeded the nuclear chain reaction are

(i) Some of the neutrons may escape from the surface to the surroundings.

(ii) Some of the neutrons may be absorbed by U238 present as impurity.

9. Write any one nuclear fusion and fission reaction.

(a) Nuclear fusion reaction

$_1H^2 + {}_1H^2 \longrightarrow {}_2He^4$ + energy.

(b) Nuclear fission reaction

$$\mathbf{_{92}U^{235} + {}_0n^1 \longrightarrow [_{92}U^{236}] \longrightarrow {}_{56}Ba^{140} + {}_{36}Kr^{93} + 3_0n^1}$$

10. What are the types of nuclear fission reaction?

The nuclear fission reactions are of two types.

(i) Uncontrolled fission reactions – Atom bomb.

(ii) Controlled fission reactions - nuclear reactor.

11. What is a nuclear reactor?

The arrangement or equipment used to carry out fission reaction under controlled conditions is called a nuclear reactor.

12. What is light water nuclear – power plant?

Light – water nuclear-power plant is the one in which U^{235} fuel rods are submerged in water. Here the water acts as coolant and moderator.

13. What are moderators? Give some examples.

The substances used to slow down the neutrons are called moderators.

Ex: Ordinary water, heavy water graphite, beryllium.

14. What is the major role of pressure vessel in the nuclear reactor?

It withstand the pressure as high as 200 kg/cm^2

15. What is fissile nuclides and fertile nuclides?

(i) The fissionable nuclides such as U^{235} & Pu^{239} are called fissile nuclides.
(ii) The non- fissionable nuclides such as U^{238} &Th^{232} are called fertile nuclides.

16. Mention any two difference s of a nuclear reaction and a chemical reaction.

S.No	Nuclear reaction	Chemical reaction
1	Rabid exothermic reaction	Slow reaction
2	Initiate by neutrons	Initiated by heat (or) cold

17. What are the general components of a nuclear reactor?

1. Fuel rods, 2.Control rods, 3.Coolents, 4, Moderators, 5.Pressure vessel, 6. Protective shield 7. Turbine.

18. What is Breeder reactor?

Breeder reactor is the one which converts non- fissionable material (U^{238}, Th^{232}) in to fissionable material (U^{235}, Pu^{239})

19. What is meant by solar energy conversion? How is it done?

Solar energy conversion is the process of conversion of direct sunlight into more useful forms. This solar energy conversion occurs by the following two mechanisms.

1. Thermal conversion.
2. Photo conversion.

20. What is thermal conversion?

Thermal conversion involves absorption of thermal energy in the form of IR radiation .Solar energy is an important source for low –temperature heat (temperature below 100 °C), which is useful for heating buildings, water and refrigeration.

21. Define photo conversion.

Photo conversion involves conversion of light energy directly into electrical energy.

22. What is photo galvanic cell (or) Solar cell?

Photo galvanic is the one, which converts the solar energy (energy obtained from the sun) directly into electrical energy.

It consists of a p-type semiconductor (such as Si doped with B) and n-type semiconductor (such as Si doped with P) They are in closed contact with each other.

23. Explain the application of solar cells.

1. Solar cells are used in calculators, electronic watches, radios and TVs.
2. Solar cells are superior to other type of cells, because these are non- polluting and eco-friendly
3. Solar energy can be stored in Ni- Cd batteries and lead-acid batteries.
4. Solar cells can be used to drive vehicles.
5. Solar cells, made of silicon, are used as a source of electricity in space craft and satellite.

24. What are fuel cells?

Fuel cell is a voltaic cell, which converts the chemical energy of the fuels directly into electricity Without combustion. It converts the energy of the fuel directly into electricity. In these cell, the reactants, product and electrolytes pass through the cell.

Fuel + Oxygen ------→ Oxidation products + Electricity.

25. What are the electrodes used in the fuel cells porous?

Compressed carbon containing a small amount of catalyst like Pt, Pd, Ag, are used in the fuel cells porous

26. What are the applications of H_2-O_2 fuel cell?

1. H_2-O_2 fuel cells are used as auxiliary energy source in space vehicles, submarines or other military- vehicles.
2. In case of H_2-O_2 fuel cells, the product of water is proved to be a valuable source of fresh water by the astronauts.

27. What is wind energy? How is it obtained?

Moving air is called wind. Wind energy recovered from the force of the wind is called wind energy. The energy possessed by the wind is called wind energy. The energy possessed by wind is because of its high speed. The wind energy is harnesses by making use of wind mills.

28. What are the drawbacks of wind energy?

- Public resists for locating the wind forms in populated areas due to noise generated by the machines and loss of aesthetic appearance.
- Wind forms located on the migratory routs of birds will cause hazards.

29. Write any four methods adopted for the harnessing wind energy.

- Sky sail
- Ladder mill
- Kite ship (large free flying sails)
- Sky wind power (flying electric generator)
- Briza technologies (hovering wind turbine)
- Sequoia automation (the kite wind generator)

30. What are thermonuclear reactions?

Nuclear fusion is supposed to be responsible for the enormous large energy of starts and stellar bodies. But the reactions take place at the extreme high temperature of about 10 million degree centigrade. Such nuclear reactions are therefore called as thermonuclear reactions.

31. What is the basic principle used in hydrogen bomb?

The hydrogen bomb is the result of thermonuclear reactions. In this device, deuterium or tritium atoms or mixture of the two are allowed to react at extremely high temperatures, which is obtained when a nuclear fission bomb (atom bomb) explodes. But the energy released during fusion brought about by this method is not controllable.

32. What is the basic principle of solar cells?

Solar cells are made of thin wafers of semiconductor materials like silica or gallium. When solar radiations falling on them, a potential difference are produce and this causes flow of electrons and produces electricity.

33. Distinguish between primary cells and secondary batteries.

Primary cells: they are unchangeable cells because the active materials consumed during the discharge process cannot be regenerated by passing electric current.

Examples: Dry cell, Zn-HgO cell.

Secondary batteries: they are known as chargeable batteries because the active materials consumed during the discharge can be regenerated back into their original form by passing electric current.

34. Explain charging and discharging characteristics of a battery?

Discharging: It is an electrochemical process by which a battery delivers current to an external circuit at the cost of the consumption of electrode materials is known as discharging.

Charging: It is an electrolytic process by which a constant current is passed through a battery in order to regenerate the active materials back into their original form is known as charging.

35. Mention the various components of a lead-acid accumulator.

Anode	Negative plate: Pb-Sb grid filled with spongy lead.
Cathode	Positive plate: Pb-Sb grid filled with PbO_2
Electrolyte	21.4%H_2SO_4(sp.gr=1.25-1.26gm/cc at 25.C)
Separator	Nylon cloth
Container	Polypropylene (pp)
Cell representation	Pb,$PbSO_4$/H_2SO_4 (21.4%)/$PbSO_4$,PbO_2

36. Mention the various components of nickel cadmium batteries.

Anode	Cadmium as cadmium hydroxide
Cathode	Nickel as nickel hydroxide
Electrolyte	Aqueous KOH (6M)
Cell representation	Cd,$Cd(OH)_2$/ aq.KOH/Ni,$Ni(OH)_3$

37. What are non-conventional energy sources?

Wind energy, solar energy, hyro power, tidal energy.

38. Write the discharging reaction in lithium ion battery?

At anode: $2\,Li$ ---------- $2\,Li^+ + 2\,e^-$

At cathode: $S + 2e^-$ ---------- S^{2-}

Over all reaction: $2\,Li + S$ ---------- $2Li^+ + S^{2-}$

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39. What are the merits of wind energy ?

- It does not cause any air pollution.
- It is cheap and economic.
- It is renewable
- It doesn't cause any pollution

40. Why do fission and fusion reactions produce large quantities of energy?

The enormous amount of energy released during the nuclear fission is due to loss in some mass, when the reaction takes place. The loss in mass get converted into energy according Einstein's equation,

$E=mc^2$

41. Furnish the sequence of reaction in proton cycle nuclear fusion.

In a nuclear fusion reaction, two protons(hydrogen atoms) combine to give a helium with liberation of large amount energy

$_1H^2 + {}_1H^2 \dashrightarrow {}_2He^4$

42.What is a battery? How does it differ from a cell?

A battery is an arrangement of several electrochemical cells connected in series that can be used as a source of direct electric current. Thus,

A CELL : Contains only one anode and cathode.

A BATTERY: Contains several anodes and cathodes.

43. What are the important requirements of a battery?

A useful battery should fulfill the following requirements

(i) It should be light and compact for easy transport.

(ii) It should have long life both when it is being used and when it is not used.

(iii) The voltage of the battery should not vary appreciably during its use.

44.What is a primary battery? Give an example.(or)What are primary cells?

Primary cells are cells in which the electrode and the electrode reactions cannot be reversed by passing an external electrical energy. The reactions occur only once and after use they become dead. Therefore they are not chargeable.

Ex: Leclanche's cell

45.What are secondary cells?

Secondary cells are cells in which the electrode reactions can be reversed by passing an external electrical energy. Therefore they can be recharged by passing electric current and used again and again. These are also called storage cells (or) Accumulators.

46.Write the overall equation for the reaction taking place in an alkaline battery.

At anode: $Zn(s) + 2OH^-(aq)$ ---------- $Zn(OH)_2(s) + 2e^-$

At cathode: $2MnO_2(s) + H_2O(l) + 2e^-$ ---------- $Mn_2O_3(s) + 2OH^-(aq)$

Overall cell reaction

47. What are the advantages of alkaline battery over dry battery?

(i) Zinc does not dissolve readily in a basic medium.

(ii) The life of alkaline battery is longer than the dry battery because there is no corrosion on Zn.

(iii) Alkaline battery maintains its voltage as the current is drawn from it.

48. Write the cell representation of lead storage cell.

The cell may be represented as

$Pb/PbSO_4//H2SO4\ (aq)\ /PbO_2/\ Pb.$

49. State the reaction when a lead storage battery is recharged.

The cell can be recharged by passing electric current in the opposite direction. The electrode reaction gets reversed. As a result Pb is deposited on anode and PbO_2 on the cathode. The density of H2SO4 also increases.

The net reaction during charging is

$2PbSO_{4(s)} + 2H_2O + Energy$ ----------> $Pb_{(s)} + PbO_{2(s)} + 2H_2SO_{4\ (eq)}$

50.Write the charging and discharging reaction of lead accumulators.

$Pb_{(s)} + PbO_{2(s)} + 2H_2SO_{4\ (aq)}$ ---------- $2PbSO_{4(s)} + 2H_2O + Energy.$

51. What are the applications of lead acid storage cell?

(i) lead storage cell is used to supply current mainly in automobiles such as cars buses trucks etc.,

(ii) it is also used in gas engine ignition telephone exchanges hospitals power stations etc.,

52. Write the cell representation of NICAD battery.

$Cd/\ Cd(OH)_2//KOH_{(aq)})/NiO_2/Ni$

53. What are the advantages and disadvantages of NICAD battery?

Advantages:

(i) It is smaller and lighter.

(ii) It has longer life than lead storage cell.

(iii) Like a dry cell it can be packed in a sealed container.

Disadvantage

It is more expensive than lead storage battery.

54. How are anodic and cathodic electroactive materials made in Ni-Cd battery?(or)
How is NICAD battery constructed?

Nickel-cadmium cell consists of a cadmium anode and a metal grid containing a paste of NiO_2 acting as a cathode. The electrode in this cell is KOH.

55. Which is the anode and cathode in a Nickel-cadmium battery?

Anode: anode in NICAD battery is cadmium.

Cathode: cathode is a metal grid containing a paste of NiO2.

Electrolyte: KOH.

56. Describe lithium battery.

The lithium battery consists of a lithium anode and a TiS2 cathode. A solid electrolyte generally a polymer is packed in between the electrodes. The electrolyte (polymer) permits the passage of ions but not that of electrons.

57. What are the advantages of Li-S battery?

- Li-S battery has light weight unlike the lead acid battery.
- It possesses a high energy density.
- It is used in electric cars.

58. List any two advantages of lithium batteries.(or)lithium battery is the cell of future why?

Its cell voltage is high 3V

Since Li is a light weight metal only 7g material is required to produce l mole of electrons.

Since Li has the most negative E^0 value it generates a higher voltage than the other types of cells.

Since all the constituents of the battery are solids there is no risk of leakage from the

battery.

This battery can be made in a variety of sizes and shapes.

59.What are the advantages of using lithium as anode in batteries?

- Since Li has the most negative E^0 value it generates a higher voltage than the other types of cells.
- Since Li is a light weight metal only 7g material is required to produce l mole of electrons.
- Its cell voltage is high 3.0 V.

UNIT – V
ENGINEERING MATERIALS

1. **How are refractories classified? Give one example each.(or)give two examples for neutral refractory.**

   Refractories are materials that can withstand high temperature without softening or deformation in shape. They are used for the construction of lining in furnaces, kilns etc.,

   Refractories are classified into 3 types

   (i) Acidic refractories: alumina, fireclay.
   (ii) Basic refractories: magnetite, dolomite.
   (iii) Neutral refractories: graphite, carborundum.

2. **Mention the characteristics (or) requisites of a good refractory.**

   (i) It should be infusible at the operating temperature.
   (ii) It should be chemically inert towards the corrosive gases metallic slags and liquids.
   (iii) It should resist the abrading action of flue gases flames etc.,
   (iv) It should not crack and suffer loss in size at the operating temperature.

3. **What is meant by refractoriness of a refractory?**

   It is the ability of a material to withstand very high temperature without softening or deformation under particular service condition. It is expressed in terms of pyrometric cone equivalent.

4. **What is meant by pyrometric cone equipment (PCE) of a refractory?**

   Pyrometric cone equipment is the number which represents the softening temperature of a refractory specimen of standard dimension and composition.

5. **Name the stages in the manufacture of refractory.**

   (i) Grinding (ii) Mixing (iii) Moulding (iv) Drying (v) Firing

6. **What are the important uses of refractories?**

   - Refractories are mostly used for the construction of the lining of the furnaces, tanks,converters,kins,crucibles,ladles,etc.,
   - They are employed for the manufacture of cement,glass,ceramics,paper,metals(both ferrous and non-ferrous),etc.,

7. **What is RUL? How is RUL rest carried out?(Or) How is RUL performed?**

   RUL test is conducted by applying a constant load of 3.5 or 1.75 kg/cm2 to the refractory specimen of size base 5 cm2 and height 75 cm and heating in a furnace at a standard rate of 100° C per minute. The temperature at which the refractory deforms by 10% is called refractoriness under load (RUL).

   A good refractory should have high RUL value.

8. **What are the important properties of high alumina bricks?**

   (i) They possess very low coefficient of expansion high porosity and high temperature load-bearing capacity.
   (ii) They are inert to the action of gases like CO_2, H_2 and natural conditions.
   (iii) They are also very stable to both in oxidizing and reducing conditions.

9. **What are neutral refractories? Give one example.**

   Neutral refractories and refractories are made from weakly acidic and basic materials like carbon, chromite, zirconia, etc. they are not attacked by both acidic and basic materials.

   Examples: Graphite, Chromite, Zirconia, Carborundum refractories.

10. **Name any one of the natural refractories and its synthesis.**

    Zirconia bricks are neutral refractories. They are prepared by mixing zirconite mineral(ZrO_2) with colloidal zirconia or alumina as binder and finally heated to 17000° C. small amount of

MgO or CaO is added as stabilizer because mineral zirconite undergoes volume changes on heating and cooling.

11. How is refractoriness of a refractory material determined?

It is determined by pyromertric cone equipment test which measures the softening temperature.

12. Mention the objectives of PCE test?

- To determine the softening temperature of a test refractory material.
- To classify the refractories.
- To determine the purity of refractories.
- To check whether the refractory can be used at the particular servicing temperature.

13. Why is silica bricks expand on heating?

Silica bricks expand on heating due to the transformation of one form to another forms. This is accompanied by a considerable increase in volume.

Quartz ----------→ Tridymite ----------→ Cristobalite

(Crystalline) (α - form) (β - form)

14. Define porosity of a refractory.

It is defined as the ratio of its pore volume to the bulk volume. Thus,

$$\textbf{Porosity (P)} = \frac{\textbf{W-D}}{\textbf{W-A}} \textbf{ X 100}$$

15. What is meant by dimensional stability? Mention their types.

It is the resistance of a refractory to any volume changes when exposed to high temperature over a prolonged time.

These dimensional changes are of two types.

(i) Reversible
(ii) Irreversible.

16. What is meant by thermal spalling? How to avoid it?

Thermal spalling is the property of breaking, cracking or peeling off a refractory materials under high temperature.

Thermal spalling can be decreased by

(i) Using high porosity, low co-efficient of expansion and good thermal conductivity refractory.
(ii) Avoiding sudden temperature changes.
(iii) By modifying the furnace design.

17. Name two refractories which should not be place in direct contact with fire clay refractory. Why?

Magnesite and dolomite refractories cannot be placed in direct contact with fire clay refractory because they are basic and react with acidic fire clay refractory.

18. What are abrasives? How are they classified?(Or) mention any four natural abrasives.

Abrasives are hard substances used for polishing, shaping, grinding operations. They are characterized by high melting point, high hardness and chemically inactive.

Natural abrasives - diamond, quartz, corundum, emery

Artificial abrasives - Silicon carbide, boron carbide, alundum.

19. What are soft abrasives?

Abrasives having their hardness 1-4 in Moh's scale are known as soft abrasives.

20. What is abrasive power?

It is the strength of an abrasive to grind away other materials. It dependents on hardness toughness and refractoriness.

21. What is hardness of an abrasive? What are its units?

It is the ability of an abrasive to grind or scratch away other materials. The harder the abrasive quicker will be its abrading action. Hardness of the abrasive is measured on Mho's scale or Vicker's scale

22. Explain moh's scale for different abrasives.

Moh's scale is a scale, in which common abrasives are arranged in the order of their increase in hardness.

23. Mention some important applications of abrasives.

- To clean the surface prior to coating abrasives powders are used. Eg;Quartz, garnet.

- To prepare smooth wood, metal and plastic surfaces, abrasives paper is used: eg alumina silicon carbide.
- To remove the scale from iron surfaces, grinding wheels are used.

24. Mention some important characteristics of abrasives.

- It should be very hard
- It should be chemically inactive.
- It should resist the abrading action.
- It should posses high refractoriness
- It should have high melting point

25. **How are abrasives used?**

Abrasive are used in three forms

- As loose power.
- As abrasive paper or cloth.
- As grinding wheels.

26.What is emery?

It is a fine grained, opaque mineral and black in colour.It consists of 55-75% crystalline alumina 20-40% magnesite and 12% other minerals. Its hardness is 8 on Mho's scale.

27.How is carborundum prepared?

It is prepared by heating a mixture of sand (SiO_2) and coke (carbon) with small amount of saw dust in an electric furnace to about 2200·C

$$SiO_2 + 3C \text{ ------}\rightarrow SiC + 2CO\downarrow$$

28.What is diamond? Mention its types.

It is pure crystalline carbon. It is the hardest known its hardness is 10 on Mho's scale.It is chemically inert and not affected by acids or alkalis. The off-colour diamond is called borts and black colour diamond is called carbonado.

29.How is alundum prepared?

It is prepared by heating a mixture of calcinied bauxite, coke and iron in an electric furnace to about 4000.C.It is artificial corundum.

30. What is norbide mention its properties?

Norbide is boron carbide, prepared by heating a mixture of boron oxide (B_2O_3) and coke (carbon) in an electric furnace to about 2700.C

$$2B_2O_3 + 7C \xrightarrow{2700^\circ C} B_4C + 6CO\uparrow$$

Properties

- Its hardness is 9 on mho's scale
- It is light weight and black coloured compound.
- It is highly resistant to chemical attack and erosion.
- It resists oxidation much better than diamond.

31.What is carnet? Give its uses.

It is a mixture of trisilicates of alumina, magnesia and ferrous oxide. Its hardness ranges from 6-7.5 on Mho's scale.

Uses : It is used in making abrasives paper and abrasive cloth, and also in glass grinding and polishing metals.

32.Explain the uses of alundum.

It is used in grinding of hard steels and other materials of high tensile – strengths.

It is also used in the manufacture of abrasive wheels.

LUBRICANTS

33.Define the terms "Lubricant" and "Lubrication".

Lubricant is a substance used in between two moving surface to reduce the friction

Lubrication is a process of reducing friction and wear between two moving surfaces by adding lubricant in between them.

34.Mention the function of a lubricant.

- It prevents the direct contact between the moving surfaces and reduces wear, tear, and surface deformation of the concerned parts.
- It reduces wastage of energy so that efficiency of the machine in enhanced.

- It reduces the frictional heat and thus prevents the expansion of metals.

35. **Mention some important characteristics of a lubricant.**
    - A good lubricant should not undergo any decomposition, oxidation, reduction at high temperature.
    - A good lubricant should have higher flash and fire points than the operation temperature.
    - Good lubricants should have high oiliness, viscosity index, and aniline point.
    - A good lubricant should not corrode the machine parts

36. **Give two examples each for liquids, semi- solid and solid lubricants.**

(or)

How are lubricants classified? Give one example for each class.

Lubricants are classified into four types.

1) Liquid lubricants 2. Semi solid lubricants 3. Solid lubricants 4. Emulsion

Examples

Liquid lubricants	Palm oil, castor oil,
Semi solid lubricants	Greases, vaselines
Solid lubricants	Graphite, molybdenum disulphide.
emulsions	Cutting emulsions, cooling liquids

37.**Give two examples of synthetic lubricating oils.**

1. Silicones 2. Polyglycol ethers.

38.. What are extreme pressure additives ? Give examples.

They react with metal surface forming surface film of lower shear strength and high melting Point.

Eg. Organic chloride, sulphur, phosphorus compound.

39. What are oiliness carriers? Give examples (or) Define Oiliness of a lubricant" How can this be improved.

Oiliness is the capacity of a lubricating oil to stick on to the surface of the machine parts under heavy load or pressure. Eg. Veg.oil.

Oiliness can be improved by adding additives such as oleic acid, stearic acid, etc.

40. What are viscosity index improvers? Give examples.

Viscosity index improvers are substanaces, added to prevent the oil from thining at higher temperatures and thickening at lower temperatures.

Eg. N-hexanol, poly isobutylene , polyalkyl benzene.

41.. Define viscosity index.

Viscosity index is defined as the average decrease in viscosity of oil per degree rise in temperature between 100 F and 210 F.

42. What is the significance of pour point of a lubricant?

Most of the petroleum based lubricating oils contain dissolved paraffin wax and asphaltic impurities. When the oil is cooled these impurities undergo solidification which cause jamming of the machine. So the cloud and pour points indicate the suitability of the lubricants in cold condition. A good lubricant must have low cloud point and pour point.

43. What are pour point depressants? Give examples.

Pour point depressants are substances used to prevent separation of wax from the lubricating oil.
Eg. Phenols, polyalkyl benzene.

44. What should be the flash point of a good lubricant? Give reason.

A good lubricating oil should have flash and fire points higher than the operating temperature of the machine.

Reason. It under goes decomposition.

45. Define the terms Flash point and Fire point.

Flash point: It is the lowest temperature at which the oil gives off enough vapour that ignites for a moment, when a small flame is brought near it.

Fire point: It is the lowest temperature at which the vapour of the oil burns continuously for atleast 5 seconds when a small flame is brought near it. Generally the fire point 5-40 C higher than flash point.

46. What are greases? How are they classified?

Greases are semi-solid lubricants obtained by thickening of lubricating oil by the addition of metallic soap. They are classified as soda-base grease, lime –base grease, barium –soap grease, lithium-soap grease, aluminium soap grease, axle grease.

47. How is lithium based grease prepared? Mention the properties and uses.

Lithium based grease is prepared by thickening of petroleum oil with lithium soap.

Properties.

It is a water and heat resistant.

It is expensive and superior to all other types of greases.

Uses:

It is used at lower temperatures for lubricating engines.

48. Mention the differences between soda-base and lime –base greases.

Soda-base grease	Lime –base grease
Petroleum oil + Sodium soap	Petroleum oil+ Calcium soap
It can be used upto 175° C	It can be used only upto 70° C
It is soluble in water	But it is water insoluble

49. What are greases? How are they prepared?

Greases are semi-solid lubricants, obtained by thickening of lubricating oil by the addition of metallic soap.

50. What are solid lubricants? Mention their application.

Solid lubricants are the one, Which is used in high temperature and load. Solid lubricants are also used where oils, and greases cannot be used.

Eg. Graphite, MoS_2.

Uses: They are used in air compressors, ICE's, food –stuff industries and railway track joints.

51.. What are the types of mechanism of lubrication?

Fluid film (or) Hydrodynamic lubrication

Boundary lubrication

Extreme pressure lubrication

52. Under what conditions extreme pressure lubricant is used.

Under the conditions of high load and high speed where more heat is generated extreme pressure lubricant is used.

Under the conditions of high load (high pressure) and high speed, where more heat is generated, extreme pressure lubricants is used.

53. Explain the lubrication action of graphite.

The adjacent layers of graphite are held together by weak vander walls forces. Since dthe distance between the adjacent layers is high (3.14A°), the layers can slide easily one over the other with little friction. As a result graphite's possess very low co-efficient of friction. This property makes use of graphite as a lubricant.

54. Why is graphite used as a lubricant where as other allotropes of carbon are not?

The carbon layers are held together by weak vander walls forces. Since the distance between the adjacent layers is high and posses very low co-efficient of friction, it acts as a lubricant.

But other allotropes of carbon do not have such properties.

55. What do you mean by bort and carbonado and what are their uses?

Borts, Carbonado are hard, tough, off-coloured broken fragments of diamonds, not suitable for making gems. They are consider as intermediate forms of diamond and graphite and are used as industrial abrasives.

- Diamond tipped tools for turning and lapping materials such as glass, bronze, fibers and hard rubber
- Diamond toothed (segmented) saws and rim-impregnated (continuous rim) saws for sawing stones, glass, quartz, and metals.

56. What are the characteristics and uses of quartz?

- Quartz is a very pure form of silica and has a scratch hardness of about 7 in Mhos scale and on the knoop scale is 800kg/mm2.
- Quartz is crushed to suitable size and glued on thick paper to produce abrasive paper

Quartz pebbles are used for grinding pigments in ball mills..

57. What are nanomaterials? Mention any two of their characteristics properties.

Nanomaterials are the materials having components with size less than 100 nm at least in one Dimension.

Characteristics :

Nanomaterials are very strong and withstand extreme strain and tension.
It possess very good electrical property and thermal conductivity.

58. What are carbon nanotubes?

Carbon nanotubes are allotropes of carbon with a nanostructure having a length-to-diameter ratio greater than 1,000,000. When graphite sheets are rolled into a cylinder, their edges joined and from carbon nanotubes i.e, carbon nanotubes are extended tubes of rolled graphite sheets.

59. How are carbon nanotubes calssified?

Carbon nanotubes are classified into two types as

1. single- walled nanotubes (SWNTs)
2. multi – walled nanotubes(MWNTs)

60. Mention the important forms of SWNTs.

SWNTs consist of one tube of graphite. It is one- atom thick having a diameter of 2 nm and a length of 100μm.It forms the following three types of structures.

1. Armchair structure.
2. Zig-zag structure.
3. Chiral structure.

61. Name some important methods of manufacture of CNTs.

Carbon nanotubes can be made by any one of the following three methods.

1. Pyrolysis
2. Carbon arc methods.
3. Laser evaporation.
4. Chemical vapour deposition

62. How are CNTs used in the fuel cell?

SWNTs is used in the form of place or paper as anode in the fuel cell.

63. What is the main requirement for fuel cell containing CNTs.?

This system needs sources of hydrogen, which can be stored inside the carbon nanotubes.

64. Give some examples for catalytic reaction, carried out by using CNTs.

1. Reduction of nickel oxide (NiO) to the base metal Ni.

$NiO \xrightarrow{\text{----------}} Ni$

2. Reduction of $AlCl_3$ to its base metal.

$AlCl_3 \xrightarrow{\text{----------}} Al$

65. How is pyrolysis carried out.

Carbon nanotubes are synthesized by the pyrolysis of hydrocarbons such as acetylene at about 700.C in the presence of Fe-Silica or Fe-Graphite catalyst under inert conditions.

66. How is CNT produced in carbon arc method?

It is carried out by applying direct current (60-100A and 20-25 V) arc between graphite electrodes of 10-20μm diameter.

67. Mention some important applications of CNTs.

1. It is used in storage devices.

2. It is used as catalyst.
3. It is used as protective shields.
4. It is a very good reinforcing element in composites.
5. It is used as sensor for gases like NO_2 and NH_3

68. Under what operating conditions would you use lubricating oils and solid lubricants.

Lubricating oil – it is used under low load and high speed.

Solid lubricants - it is used under high load high temperature.

69. Distinguish between acidic and basic refractoriness.

s.no	Acidic refractories	Basic refractories
1	It is made of acidic materials like alumina &silica	It is made of basic materials like CaO, MgO etc.
2	They are easily attacked by basic materials	They are easily attacked by acidic materials

70. Under what situations solid lubricants are used?

i) where the operating temperature and load is too high.

ii) where contamination of lube oils or grease by the entry of dust particles are avoided.

iii) where combustible lubricants must be avoided.

Dr. N.G.P INSTITUTE OF TECHNOLOGY, COIMBATORE – 48

DEPARTMENT OF CHEMISTRY

(PART- B)

UNIT- I - WATER TECHNOLOGY

1. **Discuss in detail the problems caused due to the usage of hard water in boilers**
2. **Describe the principle and method involved in the determination of different types and amount of alkalinity of water.**
3. **How is internal treatment of boiler water carried out using phosphate, carbonate and calgon**
4. **Explain the principle and estimation of hardness of water by EDTA method**
5. **Explain in detail the demineralization process for softening of water.**
6. **Explain the softening of water by deionization process.**
7. **How is temporary and permanent hardness of water determined?**
8. **Discuss the Chlorination, Ozonation and UV methods of disinfection.**
9. **Calculate the total hardness of a water sample containing 4.6mg/litre of magnesium chloride$MgCl_2$, 2.6mg/litre of calcium sulphate$CaSO_4$, 6.4mg/litre of magnesium bicarbonate Mg $(HCO_3)_2$ and 6.2 mg/litre of Calcium bicarbonate Ca $(HCO_3)_2$.**
10. **Explain the following terms with diagram : aeration, coagualation, filteration, Sedimentation**
11. **200ml of a sample of water required 22ml of N/50 H_2SO_4 using methyl orange as indicator but did not give any colourination with phenolphthalein. What type of alkalinity is present? Express the same in mg/lit. of $CaCO_3$**
12. **Explain the necessity for sterilization of domestic water and discuss the various methods of sterilization. Discuss in detail about the break point chlorination.**

UNIT- II - POLYMER

1. **Explain the various types of polymerization with suitable examples.**
2. **Explain the mechanism of free radical polymerization.**
3. **What are the drawbacks of raw rubber? How to improve the properties of rubber? Explain the process of vulcanization of rubber.**

4. **Write a note on the preparation, properties and uses of nylon 6:6, nylon6, and nylon11?**
5. **How are the following polymers prepared? (i) Teflon (ii) poly urethane**
6. **Discuss the synthesis, properties and uses of poly carbonate and Butyl Rubber**
7. **Give an account on fiber reinforced plastics.**
8. **Discuss in detail about the composites and FRPs**
9. **Distinguish between addition and condensation polymerization.**
10. **Explain condensation polymerization taking one example. Give any three important properties of condensation polymers.**
11. **Describe the synthesis and uses of Lexan and polyester**

UNIT- III – SURFACE CHEMISTRY

1. **Derive the Langmuir and Freundlich adsorption isotherm and discuss the effect of pressure on the isotherm.**
2. **Explain the role of adsorption in catalysis using an appropriate example.**
3. **Briefly explain the factors which influence adsorption of a gas on a solid.**
4. **Discuss the role of adsorbents in pollution abatement?**
5. **Discuss the application of Adsorption**
6. **Define adsorption isotherm and explain the types of adsorption isotherm**
7. **Explain in detail the demineralization process for softening of water**
8. **Explain in detail about Physical and chemical adsorption.**
9. **Mention the factors which influence adsorption of a solute on a solid**
10. **Explain the classification and functions of ion-exchangers**
11. **illustrate how the ion exchange adsorption is useful in the demineralization of water**
12. **State Freundlich adsorption isotherm and explain the terms in it. Explain the different types of adsorption isotherms of gases on solid.**

UNIT- IV – NUCLEAR ENERGY

1. **What is a nuclear reactor? Describe the components of a light water nuclear power point with a neat diagram.**
2. **What is Breeder reactor? Explain the principles with an example.**
3. **Describe the construction and working of H_2 – O_2 fuel cell.**
4. **Explain the construction and working of NICAD battery with cell reaction.**

5. **What is reversible battery? Describe the principle, construction and working of Lead – storage battery with reaction**
6. **Give a brief notes on lithium battery.**
7. **Explain the construction and working of Ni - Cd battery with cell reaction**
8. **Give an account of solar cells and its application.**
9. **Explain the following terms: Wind energy, Nuclear fusion and primary battery**
10. **State the principle and application of solar batteries**
11. **Describe the conversion of solar energy into electrical energy.**
12. **Discuss the characteristics of the reaction when uranium undergoes nuclear fission.**
13. **Explain the construction and working of any one secondary battery with cell reaction**

UNIT- V – ENGINEERING MATERIALS

1. **indicate the preparation and uses of lithium grease.**
2. **How are Alumina bricks, Magnesia bricks manufactured?**
3. **What are abrasives? How are they classified? Give examples for each category with their important properties.**
4. **Discuss the structure, properties and uses of Graphite.**
5. **Define and signify flash, fire point.**
6. **Give a brief account of PCE test**
7. **Discuss the following properties of lubricants: pour point and cloud point.**
8. **Discuss the structure, properties and uses of MoS_2**
9. **Give an account of the important properties of lubricating oil.**
10. **Explain the properties and applications of carbon nanotubes (CNTs)**
11. **Explain the preparation, properties and uses of carbon nanotubes(CNTs)**
12. **Name the additives for lubricating oils. Indicate their function**
13. **Explain the mechanism of lubrication.**
14. **Explain the terms: viscosity index, dimensional stability and Porosity**
15. **Discuss the properties and uses of high alumina and zirconia bricks**
16. **Explain the general methods of manufacture of refractories.**