CHAPTER

12

Man Made Materials

Soaps

- Soaps are the sodium or potassium salts of long chain carboxylic (fatty) acids *e.g.*, sodium palmitate, sodium stearate and sodium oleate etc.
- Animal fat or vegetable oil, sodium hydroxide, sodium chloride acts as a raw material for manufacture of ordinary soap. (process of making soap is called saponification).
- Soaps do not leather with hard water due to formation of scum.

Detergents

- Also called "soap-less" soaps.
- It is the long chain benzene sulphonic acid or the sodium salt of the long chain alkyl hydrogen sulphate.
- Long chain hydrocarbons, sulphuric acid and sodium hydroxide are raw material for manufacturing of detergents.
- These are non-biodegradable. However, straight chain detergents are biodegradable.
- They leather with soft as well as hard water.

Polymers

- A polymer is a compound of high molecular weight formed by the union of a larger number of molecules of one or two types of low molecular weight (known as monomers) and the process involving the formation of a polymer is called polymerisation.

Types of Polymers

These are classified on the basis of origin

(a) **Natural polymers** These are found in nature *e.g.*, cellulose, starch, rubber etc.

(b) **Synthetic polymers** These are prepared in the laboratory by synthetic means *e.g.*, polythene, nylon, orlon, dacron etc.

(c) **Semisynthetic polymers** These are synthesised by man from natural substances. *e.g.*, rayon (a polymer of cellulose nitrate).

- Rayon is called artificial silk due to its silk like appearance.
- On the basis of intermolecular forces these are classified as:

(a) **Elastomers** In these polymers, the polymer chains are held together by weak van der Waals' forces *e.g.*, vulcanized rubber.

(b) **Fibres** In this type, polymer chains are attached with one another through H–bonds *e.g.*, nylon– 66.

(c) **Thermoplastics** In these, the intermolecular forces are intermediate between those of elastomers and fibres, *e.g.*, polystyrene, polythene, PVC etc.

(d) **Thermosetting** These are highly cross-linked, hard, non-fusible and insoluble polymers *e.g.*, bakelite (phenol formaldehyde resin), melamine etc.

Some Important Synthetic Polymers

- **Polyethylene** (polythene) The monomer units are ethylene molecules. It Is frequently used in making coats, milk cartons and electrical insulation.
- **Polystyrene** The monomer units are styrene molecules. It is a white thermoplastic material and is used for making toys, combs, lining material for refrigerators and TV cabinets.
- **Teflon** (Poly tetrafluoroethylene) The monomer unit is tetrafluoroethylene molecule. It is very tough material. It is a bad conductor of electricity and is used in coating utensils, making seals and gaskets etc.
- **Poly vinylchloride** (PVC) The monomer units are vinyl chloride molecule. PVC is a hard horny material. It is resistant to chemicals as well as heat. It is used for making rain coats, hand bags, electrical insulators and floor covering.
- **Neoprene** It is synthetic rubber which resembles natural rubber in its properties. It is obtained by polymerisation of chloroprene. It is superior to natural rubber in its stability. It is generally used for making hoses, shoe heels, stoppers etc.
- **Buna-S** It is a copolymer of 1, 3-butadiene and styrene. It is also known as SBR (styrene-butadieme rubber). It has slightly less tensile strength than natural rubber. It is used in the manufacture of automobile tyres, rubber soles etc.
- **Nylon or Nylon- 66** It is a synthetic fibre and has good elasticity, low water absorption and is wrinkle resistant. It also has high tensile strength. It is used in making fishing nets, tyre cord, parachute fabrics, ropes etc.
- **Phenol formaldehyde resins** (Bakelite) These are made by the reaction of phenol and formaldehyde in basic medium. Bakelite is a cross linked thermosetting polymer. It is used for making combs, fountain pen barrels, electrical goods. Sulphonated bakelites are used as ion-exchange resins for softening of hard water.

- **Rubber** It is a polymer of isoprene. It is insoluble in water, dilute acids and alkalies, absorbs a large amount of water, has low tensile strength and elasticity.
- **Vulcanization of rubber** is heating of rubber with sulphur. It makes the rubber hard, strong and more elastic.
- **Terylene or dacron or phthalate** It is a polymer of ethylene glycol and terephthalic acid *i.e.*, it is an polyester. It is used for making wash and wear fabrics, tyre cords, safety belts, tents etc.
- **Kevlar** It is a polymer of terephthalic acid and 1,4-diaminobenzene so it is a polyamide. It is used for making bullet proof vests.
- **Lexan or polycarbonate** It is a polymer of diethyl carbonate and bisphenol A. It is used in making bullet proof windows and safety helmets.
- **Polyurethanes** It is a polymer of toluene diisocyanate and ethylene glycol. It is used for making washable and long lasting mattresses, cushions.
- **Lucite** It is a polymer of methyl methacrylate. It is used for making contact lenses. Plexiglass, acrylite or perspex are other terms, used for lucite.
- **Orlon or polyvinyl cyanide** It is a polymer of vinyl cyanide or acrylonitrile. It is used as a substitute for wool in making synthetic blankets. (Acrylic fibres)

Fertilizers

- Repeated cultivation of crops makes the soil deficient in some elements, mainly nitrogen, phosphorus and potassium. The substances which are added to the soil to make up the loss 'of these elements are called fertilizers.

Some Important Fertilizers

- **Basic calcium nitrate** (Nitrate of lime) $[CaO{\cdot}Ca(NO_3)_2]$ It is a good nitrogeneous fertilizer, used in acidic soil.
- **Ammonium sulphate** $[(NH_4)_2SO_4]$ Its repeated use makes the soil acidic and unfit for germination of seeds. Hence, addition of lime to the soil become necessary. It contains 21.2% nitrogen.
- **Calcium cyanamide** $(CaCN_2)$ [Nitrolim] Nitrolim is black in colour because of the presence of carbon. It contains 19% nitrogen.
- **Urea** $[NH_2CONH_2]$(carbamide) It is the best nitrogenous fertilizer. It contains 46.6% nitrogen. Its repeated use does not change the pH of the soil.
- **Super phosphate of lime** $[Ca(H_2PO_4)_2 + 2\,CaSO_4{\cdot}H_2O]$ It is phosphatic fertilizer.

Fuels

- The substance compound (etnyl mereaptan) which on combustion produces energy in the form of heat, is called a fuel *e.g.*, coal, wood, kerosene, petrol, diesel, cooking gas etc.
- Sulphur compound (ethyl mercaptan) is added to odourless LPG gas for imparting a detectable smell to the gas.
- LPG contains mainly butane along with some propane. CNG (compressed natural gas) contains mainly methane.
- Methane is obtained in mines and from marshy land plants.
- Petrol is used as a fuel to .run cars and aeroplanes whereas diesel is used to run trucks, buses, trains and ships.
- Quality of petrol or gasoline is expressed in the terms of octane number and of diesel in terms of cetane number.
- Synthetic rubber, liquid ammonia, liquid hydrogen are used as propellents.

Petroleum

- Also called rock oil, mineral oil, crude oil or black gold.
- On fractional distillation, it gives different substance at different temperatures.

Fractions obtained by Fractional Distillation of Petroleum

Fraction	Boiling range
Uncondensed gases	Room temp
Crude naptha (on refractionation, it gives	30-150°
(i) Petroleum ether	30-70°
(ii) Petrol or gasoline	70-120°
(iii) Benzene derivative)	120°-150°
Gas oil, Kerosene Fuel oil, Diesel oil	150-250° / 250-350°
Lubricating oil	350-450°
Paraffin wax	> 500°C
Pitch	–

Biogas and Gobar gas

- The gaseous mixture obtained by the degration of animal and plants wastes by anaerobic microorganisms in the presence of water is called **biogas**. It is a convenient fuel for domestic use. It is used for street lighting.
- Constituents of biogas are—methane (45-70%), carbon dioxide, hydrogen, hydrogen sulphide.
- **Gobar gas** is produced by fermentation of cow dung. It contains CH_4 (main component), CO_2 and H_2.

Flame

- A flame is a region where combustion of gaseous substances take place. Blue flame shows complete combustion while yellow shows partial combustion of fuel.

Points to be Remember

- The destructive distillation of wood yields : Wood gas (gaseous), tar (liquid), charcoal (solid residue), methyl alcohol (liquid) and acetic acid vinegar).
- Various products obtained by the destructive distillation of coal are coal gas $H_2 + CH_4 + CO$), ammoniacal liquor, coal tar and coke.
- Water gas ($CO + H_2$), semiwater gas (water gas + producer gas) producer gas ($N_2 + CO$) are obtained from CO.
- Iodine tincture is an antiseptic.

Exercise

1. Contact lenses are made from **(CDS 2011 I)**
   (a) polyvinyl chloride (b) polystyrene
   (c) lucite (d) teflon

2. End of detergent have
   (a) ester group (b) aldehyde
   (c) amine group (d) sodium sulphate

3. Soaps can be classified as
   (a) carbohydrates (b) ethers
   (c) salt of fatty acids (d) None of these

4. Match Column I with Column II and select the correct answer using the codes given below the Columns.

Column I	Column II
A. Sodium palmitate	1. Ore
B. Galena	2. Fertilizer
C. NPK	3. Soap
D. Cellulose	4. Natural polymer
	5. Artificial fibre

Codes

	A	B	C	D		A	B	C	D
(a)	5	4	1	2	(b)	5	2	1	4
(c)	3	1	2	4	(d)	3	1	4	2

5. Man made synthetic fibre is
   (a) wool (b) rayon
   (c) nylon (d) cotton

6. Which one among the following is a strong smelling agent added to LPG cylinder to help in the detection of gas leakage? **(CDS 2011 I)**
   (a) Ethanol (b) Thioethanol
   (c) Methane (d) Chloroform

7. Match Column I (Industrial process) with Column II (Industry with which associated) and select the correct answer using the code given below the Columns.

Column I	Column II
A. Cracking	1. Rubber
B. Smelting	2. Petroleum
C. Hydrogenation	3. Copper
D. Vulcanization	4. Edible fats

Codes

	A	B	C	D		A	B	C	D
(a)	3	2	1	4	(b)	2	3	4	1
(c)	2	3	1	4	(d)	3	2	4	1

8. The polymeric fibre used as a substitute for wool in making synthetic blankets, sweaters, etc., is **(CDS 2010 I)**
   (a) nylon (b) teflon
   (c) orlon (d) bakelite

9. An example of synthetic fibre is
   (a) nylon (b) wool
   (c) cotton (d) silk

10. Which one of the following pairs is not correctly matched ?

(Plastic)	(Type)
(a) Nylon	Fibres
(b) PVC	Thermosetting
(c) Phenol formaldehyde	Thermoplastic
(d) Polypropylene	Thermoplastic

11. Some statements about the benefits of organic farming are given below. Indicate whether they are true or false using the codes given below the statements. **(CDS 2010 I)**
    1. It reduces CO_2 emission.
    2. It does not lead to toxic effect.
    3. It improves the water-retention capacity of the soil.

    Codes

	False	True	False		True	False	False
(a)	1	2	3	(b)	1	2	3
	False	True	True		False	False	True
(c)	1	2	3	(d)	1	2	3

12. Raw rubber on vulcanization becomes
    (a) plastic (b) soft
    (c) less elastic (d) more elastic

13. Which one of the following fuels causes minimum environmental pollution?
    (a) Diesel (b) Hydrocarbon
    (c) Hydrogen (d) Kerosene

14. Which one of the following has the highest fuel value?
    (a) Hydrogen (b) Charcoal (c) Natural gas (d) Gasoline

15. Natural fibre is
    (a) polyester (b) wool (c) nylon (d) cashmillon

16. The gas supplied in cylinders for cooking is
    (a) marsh gas
    (b) LPG
    (c) mixture of CH_4 and C_2H_6
    (d) mixture of ethane and propane

17. Match Column I with Column II and select the correct answer using the codes given below the Columns.

Column I (Item)	Column II (Toxic substance)
A. CFL lamp	1. Nitrogen oxides
B. Automobile battery	2. Phthalates
C. Polymer	3. Lead
D. Diesel engine	4. Mercury

(CDS 2010 I)

Codes

	A	B	C	D		A	B	C	D
(a)	4	2	3	1	(b)	4	3	2	1
(c)	1	2	3	4	(d)	1	3	2	4

18. Which of the following is biodegradable?
    (a) Polythene (b) BHC
    (c) Paper (d) Copper

19. Water gas is a mixture of
    (a) $CO+N_2$ (b) $CO+H_2$
    (c) CH_4+CO (d) None of these

20. Oil gas is a mixture of
(a) H_2+CH_4+CO (b) $H_2+CH_4+C_2H_4+CO$
(c) $CO+N_2$ (d) All of these

21. The cleaning of dirty clothes by soaps and detergents is due to a type of molecules called surfactants, which are present in soaps and detergents.The surfactant molecules remove the dirt by **(CDS 2010 I)**
(a) making the cloth slippery
(b) producing some gases between the dirt and the cloth
(c) dissolving the dirt
(d) forming some aggregates of themselves and take away the dirt in the core of the aggregates

22. Candles contains a mixture of
(a) bees wax and paraffin wax
(b) bees wax and stearic acid
(c) paraffin wax and stearic acid
(d) higher fatty acid

23. Nylon is a
(a) polyester (b) vinyl polymer
(c) polyamide (d) synthetic rubber

24. An ideal fuel should have
(a) high calorific value
(b) low ignition temperature
(c) regulated and controlled
(d) All of the above

25. Consider the following statements regarding the properties and uses of glass wool.
1. Glass wool has tensile strength greater than steel.
2. Glass wool is fire proof.
3. Glass wool has high electrical conductivity and absorbs moisture.
4. Glass wool is used to prepare fibre glass.

Which of the statements given above are correct? **(CDS 2010 II)**
(a) 1 and 2 (b) 1, 2 and 4
(c) 2 and 4 only (d) 1, 3 and 4

26. A mixture of carbon monoxide and hydrogen is called
(a) producer gas (b) water gas
(c) natural gas (d) None of these

27. Chemically, soaps are
(a) acids (b) alkalies
(c) paraffins (d) salts

28. **Statement I** Superphosphate of lime can be assimilated by plants.
Statement II Superphosphate of lime is soluble in water. **(CDS 2010 II)**
(a) Both—the statements are individually true and statement II is the correct explanation of statement I.
(b) Both the statements are individually true but statement II is not the correct explanation of statement I.
(c) Statement I is true but statement II is false.
(d) Statement I is false but statement II is true.

29. Sodium salt of fatty acid is
(a) soap (b) detergent
(c) cake (d) vinegar

30. Commercial vulcanization of rubber involves **(CDS 2009 I)**
(a) sulphur (b) carbon
(c) phosphorus (d) selenium

31. Polyethene is a polymer of
(a) ethane (b) ethene
(c) ethyne (d) methane

32. **Statement I** Soaps do not form lather with water containing salts of calcium and magnesium.
Statement II Calcium and magnesium salts of long chain fatty acids are insoluble in water. **(CDS 2009 I)**
(a) Both the statements are individually true and statement II is the correct explanation of statement I.
(b) Both the statements are individually true but statement II is not the correct explanation of statement I.
(c) Statement I is true but statement II is false.
(d) Statement I is false but statement II is true.

33. The quality of gasoline sample is determined by its
(a) iodine value (b) cetane number
(c) octane number (d) mass density

34. Arrange the folowing fertilizers according to the decreasing order of their nitrogen content.
I. Ammonium sulphate II. Ammonium nitrate
III. Potassium nitrate IV. Urea
(a) II, IV, III, I (b) IV, III, II, I
(c) IV, II, I, III (d) IV, II, III, I

35. Which one of the following substances is made from natural raw materials? **(CDS 2007 II)**
(a) Rayon (b) Nylon
(c) Polyester (d) Polystyrene

36. Which one of the following is used in the preparation of antiseptic solution? **(CDS 2009 I)**
(a) Potassium nitrate (b) Iodine
(c) Iodine chloride (d) Potassium chloride

37. Match Column 1 (Fuel gases) with Column II (Major constituents) and select the correct answer using the codes given below the Column.

Column I	Column II
A. CNG	1. Carbon monoxide, hydrogen
B. Coal gas	2. Butane, propane
C. LPG	3. Butane, ethane
D. Water gas	4. Hydrogen, methane, CO

Codes

	A	B	C	D
(a)	2	1	3	4
(c)	2	4	3	1

	A	B	C	D
(b)	3	4	2	1
(d)	3	1	2	4

38. Ammonium sulphate and lime should be applied to the soil at the same time because
(a) nitrogen would be lost as ammonia
(b) it support fungal growth
(c) soil structure would be adversely affected
(d) harmful bacterial population would get activated

39. The major portion of combustiable part of gobar gas is
(a) methane (b) ethane
(c) ethylene (d) acetylene

40. Match Column I with Column II and select the correct answer by using the codes given below the Columns.

Column I (Textile fibres)	Column II (Chemical nature)
A. Nylon	1. Polyester
B. Terylene	2. Cellulose
C. Cotton	3. Protein
D. Silk	4. Polyamide

Codes

	A	B	C	D		A	B	C	D
(a)	4	1	2	3	(b)	3	4	2	1
(c)	1	2	3	4	(d)	1	4	2	3

41. Which one of the following polymeric materials is used for making bullet proof jacket? **(CDS 2009 I)**
(a) Nylon-66 (b) Rayon
(c) Kevlar (d) Dacron

42. Consider the following statements.
1. Liquified natural gas (LNG) in liquified tinder extremely cold temperatures and high pressure to facilitate storage of transportation in specially designed vessels.
2. First LNG terminal in India was built in Hassan.
3. Natural gas liquids (NGL) are separated from LPG and these include ethane, propane, butane and natural gasoline.

Which of the statement given above is/are correct?
(a) 1 only (b) 1 and 3
(c) 2 and 3 (d) 1, 2 and 3

43. The process by which vegetable ghee is manufactured is known as
(a) saponification (b) hydrogenation
(c) esterificaiton (d) hydrolysis

44. Soft soaps are
(a) sodium salt (b) calcium salt
(c) magnesium salt (d) potassium salt

45. Octane number of fuel can be increased by
(a) isomerisation (b) alkylation
(c) reforming (d) All of these

46. The order of apperance of the following with increasing temperature during the refining of crude oil is
(a) kerosene, gasoline, diesel (b) diesel, gasoline, kerosene
(c) gasoline, kerosene, diesel (d) gasoline, diesel, kerosene

47. Which hydrocarbon is mainly present in gobar gas?
(a) Butane (b) Propane (c) Methane (d) Ethane

48. **Assertion (A)** Phenyl is used as a household germicide.
Reason (R) Phenyl is phenol derivative and phenol is an effective germicide.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

49. **Assertion (A)** The main constituent of the liquified petroleum gas in methane.
Reason (R) Methane can be used directly for burning in homes and factories where it can be supplied through pipelines.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

Answers

1. (c)	2. (d)	3. (c)	4. (c)	5. (c)	6. (b)	7. (b)	8. (c)	9. (a)	10. (c)
11. (c)	12. (c)	13. (c)	14. (a)	15. (b)	16. (b)	17. (b)	18. (c)	19. (b)	20. (b)
21. (d)	22. (c)	23. (c)	24. (d)	25. (b)	26. (b)	27. (d)	28. (a)	29. (a)	30. (a)
31. (b)	32. (a)	33. (c)	34. (c)	35. (a)	36. (b)	37. (b)	38. (a)	39. (a)	40. (a)
41. (c)	42. (b)	43. (b)	44. (d)	45. (d)	46. (c)	47. (c)	48. (a)	49. (d)	