MATERIALS

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Different things contain different kinds of matter. All these different kinds of matter may be called by a common name materials.

Classification of Materials

- **Natural Materials :** The materials which occur in nature and used as such are called natural materials.

  For example, Wood, Cotton, Coal, Graphite, Diamond and many minerals of metals and non-metals are natural materials. The man-made materials are also called synthetic materials.
- The materials obtained from natural materials (also called raw materials) by chemical processes are called man-made materials.

Synthetic Materials

The synthetic or man-made materials are of following two types :

(i) Synthetic Plastics (ii) Synthetic Fibres

Synthetic Plastics

We are probably passing through the plastic age. Almost everything around is made of one or the other kind of plastic. Here we describe some commonly used plastic materials.

A synthetic material which can be easily moulded into any desired shape on heating is called a plastic. Plastics are synthetic (man-made) actually polymers.

Some common plastics are,

(i) Bakelite (ii) Nylon (iii) Terylene (iv) Polythene (v) Polyvinyl chloride (PVC) etc.

Kinds of Synthetic Plastics

Plastics are of two types, viz . : (i) Thermoplastics (ii) Thermosetting plastics

- **Thermoplastics :** A plastic which can be softened on heating and moulded repeatedly in the desired shapes is called a thermoplastic. PVC, Polystyrene, Nylon, Polythene are some common thermoplastics. Thermoplastics are good for making pipes etc.
- **Thermosetting Plastics :** A plastic substance which once moulded into a shape cannot be softened or melted on reheating is called a thermosetting plastic. Thus, thermosetting plastics can be processed only once and cannot be reprocessed. This is due to the formation of cross-links between the adjacent polymer chain on heating.

  Bakelite, Melamine-formaldehyde are common thermosetting plastics.
- Thermosetting plastics are suitable for making handle of pressure cooker etc.

◈ Difference between thermosetting plastics and thermoplastics

Thermosetting plastics and thermo-plastics differ from each other in many ways.

S.No	Thermosetting plastic	Thermoplastic
1	Thermosetting plastics are the polymers in which chains get highly cross-linked on heating.	Themoplastics are long chain polymers with no cross-linking. Heating also does not produce any cross-linking between the chains.
2	Once molulded, thermosetting plastics cannot be reprocessed. Example : Bakelite, Melamine-formaldehyde resin.	Thermoplastic can be processed repeatedly. Example : Polythene, PVC, Polystyrene, Nylon, Polyesters, etc.

Raw Materials for Making Synthetic Plastics

All synthetic polymers are obtained from small organic molecules or from their suitable compounds. These small molecules are obtained from petroleum, and natural gas.

For example, the compounds which are used as raw materials for making synthetic polymers/synthetic fibres / synthetic plastics are :

- Methane
- Ethanol
- Ethyne
- Methanol
- Ethene
- Butene
- Ethane
- Propene
- Vinyl chloride etc.

Some Common Synthetics Plastics and Their Uses

Some common synthetic plastic of general use are described below :

◈ Polythene (or polyethylene)

Polythene (or polyethylene) is obtained from ethylene ($CH_2 = CH_2$) under high temperature, high pressure and in the presence of a catalyst.

Properties

- Polythene is a thermoplastic polymer. So, it can be moulded into any shape and any number of times.
- Polyethene is a whitish, translucent material.
- It is light weight and can be transported easily.
- It is unbreakable, corrosion-resistant, tough and flexible.
- It is not affected by acids, alkalies and most organic solvents.
- It is an insulator that is it does not allow electricity to flow through it.
- It is impermeable to water.

Uses : Polythene is used

- for making sheets, sachets for packaging.
- for making containers for storing water, oil and other materials.
- for making pipes for transporting water and other liquids.
- for water proofing.

◈ Polyvinyl chloride (PVC)

Polyvinyl chloride (PVC) is also a thermoplastic. It is obtained by the polymerisation of vinyl chloride. PVC is tougher than polythene.

Uses : Polyvinyl chloride is used

- for the manufacture of rain coats, hands bags, plastic dolls, bathroom curtains etc.
- for manufacturing flooring and floor / ceiling tiles.
- as an insulation cover in electrical wires / cables.
- for making shoe-soles, and shoes.

◈ Polystyrene

Polystyrene is obtained from the monomer styrene ($C_6H_5 - CH = CH_2$). Polystyrene is a thermoplastic. It is lighter than polythene. Polystyrene is a highly transparent polymer.

Uses : Polystyrene is used

- for making hot drink cups, toys, household articles, etc.
- as safe packaging material.
- for making styrofoam (or thermocole).
- as an insulating material.

◈ Acrylic (or perspex)

Properties :

- It is a highly transparent plastic resembling glass.
- It is soft and can be scratched.
- It dissolves in organic solvents.

Uses : Acrylic is used

- for making lenses, aircraft window screws
- for making transparent domes and skylights.

◈ Teflon

Teflon (PTFE) is a polymer of tetrafluoroethylene.

Properties

- is quite inert. Almost all chemicals has no effect on it.
- has very high melting point.
- has very very low friction.

Uses : Teflon is used

- for making non-stick cookware.
- in chemical industry as corrosion proof coating.

◈ Bakelite

Bakelite is a thermosetting polymer. Once set into a shape, bakelite does not melt/soften and retains its shape. Bakelite is obtained by reacting phenol with formaldehyde in the presence of a catalyst.

Properties

- Bakelite is hard and stiff.
- Bakelite is an insulator.

Uses : Bakeliteis used

- for making electrical switches and plugs.
- for making gear wheels and table top laminates.
- for making combs, fountain pen bodies, phonograph records

Melamine

Melamine is also a thermosetting polymer. It is hard and a high polish polymer. Melamine is used for making unbreakable dinnerware, and decorative objects.

Synthetic clothing Materials : Synthetic fibres

A fibre is a thread-like (thin and long) material. Broadly, fibres can be classified into the following classes.

- **Naturally-occurring fibres :** Cotton wool, silk fibres and naturally-occurring fibres.
- **Synthetic fibres :** Rayon, Nylon, Terylene are synthetic (man-made) fibres.

In this section, we will describe the synthetic fibres, or synthetic clothing materials.

Rayon

Rayon has a silky texture. Therefore rayon is also known as artificial silk. Rayon is made from cellulose obtained from wood pulp.

Cellulose is soaked in a 20% sodium hydroxide solution for about 3 hours. The purified cellulose is then treated with carbon disulphide (CS_2) to get a pale-yellow syrup-like liquid called viscose.

This viscose solution is forced through fine pores in a metal cylinder kept inside a dilute sulphuric acid bath.

Here, cellulose is regenerated in the form of lustrous continuous fibre, called rayon.

Uses : Rayon is used

- In the textile industry for making fabrics.
- In the manufacture of carpets.
- for the manufacture of tyre cord.

Nylon

Nylon is a synthetic polyamide fibre. In this respect, nylon resembles silk and wool. Silk and wool are natural polyamide fibres.

Properties

- Nylon fibres are very strong.
- Nylon fibres are elastic.
- Nylon can be drawn into very thin fibres.
- Nylon does not absorb water.
- Nylon is wrinkle resistant.
- Nylon is abrasion resistant.
- Nylon is abrasion resistant.
- Nylon is not attacked by fungus, moth etc.
- Nylon is insoluble in all common solvents.

Uses : Nylon is used

- for the manufacture of tyre cords, fabrics and ropes.
- for making fishing nets and parachute ropes.
- for fabricating sheets, bristles for brushes.
- for making sarees, socks, neckties.
- for making elastic hosiery.
- for making machine parts.

◈ **Polyesters**

Terylene, Decron, and Terene are polyesters fibres. Polyesters are made from petroleum products.

Properties

- Polyester fibres are quite strong. So, the fabrics made from polyesters last longer.
- Polyester fibres absorb very little water. Therefore, clothes made of polyester dry quickly after washing.
- Polyesters are wrinkle resistant. Therefore, the fabrics made from polyesters retain their crease.

Uses : Polyesters are used

- for manufacturing sarees, dress materials, curtain cloth etc.
- for making blends with other fibres e.g., terylene with cotton gives terycot, with wool it gives terywool. Clothes made from blends are more comfortable to wear.
- for making sails for sail boats.
- for making water hoses for fire fighting.
- for making conveyer belts.

◈ **Acrylic fibre**

Acrylic fibre has a feel similar to that of wool. It is used for making sweaters, shawls, blankets and carpets.

General Characteristics of Synthetic Plastics/Fibres

Synthetic polymers (or synthetic plastics) show the following general characteristics.

- **Light weight :** Synthetic plastics are much lighter in weight as compared to wood, metals etc. Synthetic fibres are much lighter than natural fibres such as cotton, jute, wool etc.
- **Toughness or Tensile strength :** Synthetic plastics vary in their tensile strength from material to material. In general, synthetic plastics have much less toughness as compared to metals and alloys like steel.

  Synthetic fibres have very high tensile strength as compared to the natural fibres such as cotton, silk, wool, jute etc. as compared to the natural fibres such as cotton, silk, wool, jute etc.
- **Insulating property :** Synthetic plastics/synthetic fibres are insulators. These do not allow heat and electricity to flow through them.
- **Reactivity towards air and water :** Synthetic plastics / synthetic fibres are not affected by water, air, soil etc. Thus these are biodegradable.
- **Chemical reactivity :** Synthetic plastics / synthetic polymers are not affected by acids and alkalies. The natural polymers such as cotton, wool etc. are damaged by acids and alkalies.
- **Appearance and workability :** Most plastics (except bakelite, melamine etc.) are transparent / translucent. These can be coloured in any colour and be given any shape.

EXERCISE - 1

VERY SHORT ANSWER TYPE QUESTIONS.

Q.1 What are natural fibres ?

Q.2 What are man made fibres ?

Q.3 Name two natural fibres obtained from plants.

Q.4 Name two natural fibres obtained from animals.

Q.5 What is a polymer ?

Q.6 Name a natural polymer ?

Q.7 Name a synthetic fibre which resembles silk.

Q.8 How is rayon prepared ?

Q.9 Name the first fully synthetic fiber.

Q.10 Name the raw material used in synthesis of nylon.

Q.11 Name the repeating unit of polyester.

Q.12 Name two common forms of polyester.

Q.13 Name the raw materials used for making synthetic.

Q.14 What are thermoplastics ?

Q.15 What are thermosetting plastics ?

Q.16 Give two examples of thermoplastics.

Q.17 Give two examples of thermosetting plastics.

Q.18 Why Bakelite is used in making electrical switches ?

Q.19 Name the chemicals which give fruits their characteristic smell.

Q.20 Name the different types of plastics.

Q.21 Name the man made fiber made of wood pulp.

Q.22 Name the fabric, which is used to imitate wool.

Q.23 Why nylon is used for making carpet, toothbrush bristles and tyre ?

Q.24 Handles of frying pans are made of plastic. Why ?

Q.25 Electrical wires have covering of plastic. Why ?

Q.26 How are clothes, fabrics are related to each other ?

Q.27 Define (i) Fabric (ii) Cloth.

Q.28 Why scientists tried to discover a fabric like silk ?

Q.29 Why nylon is used in making clothes ?

SHORT ANSWER TYPE QUESTIONS

Q.30 Although rayon is obtained from a natural source, wood pulp, yet it is a man-made fibre. Give reasons.

Q.31 Nylon is used in making many articles. Name four of them.

Q.32 Why polyester is suitable for making dress material ?

Q.33 What is PET ? What is its use ?

Q.34 What are acrylics ? What are its uses ?

Q.35 Why one should never wear polyester clothes while working in the kitchen or laboratory ?

Q.36 Why synthetic fibers are preferred as clothing material ?

Q.37 Why melamine is used for making kitchenware and fabrics which resist fire ?

Q.38 Why plastic containers are convenient to store different food containers ?

Q.39 Acrylic is considered cheap substitute of wool. Give reasons.

Q.40 Write the properties and uses of rayon.

Q.41 Write three characteristic of synthetic fibers.

Q.42 Write three properties of plastics.

Q.43 Write three disadvantages of synthetic fibers.

LONG ANSWER TYPE QUESTIONS

Q.44 What are the advantages of using synthetic fiber ?

Q.45 State True of False

(i) Nylon is a polymer.

(ii) All polymers are natural materials.

(iii) Polythene is thermosetting plastic.

(iv) Starch, cellulose, proteins, silk and rubber are natural polymers.

(v) Polyethylene terephthalate (PET) is used in making clothes.

Q.46 (i) The process of formation of polymers is called .....

(ii) Cotton is a natural polymer made of .....

(iii) Another name of ..... is artificial silk.

(iv) ..... has feel of wool.

(v) Bakelite is an examples of .....

Q.47 Match the column A and B

Column A	Column B
(i) Teflon	(a) Natural polymer
(ii) Terelene	(b) Artificial silk
(iii) Cellulose	(c) Acrylic
(iv) Rayon	(d) Non stick coating
(v) Synthetic fiber	(e) popular polyester

Q.48 State True or False (5 Marks)

(i) Plastic is also a polymer like the synthetic fibre.

(ii) Synthetic fabrics soak less water (sweat)

(iii) Rayon is modified glucose.

(iv) Polywood is mixture of polyster and wool.

(v) All plastics are biodegradable.

Q.49 What are the problems related to use of plastics.

EXERCISE - 2

SINGLE CORRECT ANSWER TYPE QUESTIONS

Q.1 Which of the following is obtained from hair of an animal ?
(A) silk (B) nylon
(C) cotton (D) wool

Q.2 The fibre that burns readily with the smell of burning paper is
(A) polyester (B) cotton
(C) rayon (D) acrylic

Q.3 Nylon is a polymer which is termed as,
(A) polyamide (B) polyester
(C) polyamine (D) polyol

Q.4 Which of the following is a polymer of tetrafluoroethene ?
(A) PVC (B) teflon
(C) bakelite (D) nylon

Q.5 Which of the following is a thermosetting plastic ?
(A) PVC (B) teflon
(C) bakelite (D) nylon

Q.6 Which of the following is a natural fabric ?
(A) Polythene (B) PVC
(C) Nylon (D) Wool

Q.7 ..... is an example of synthetic fibre.
(A) Wool (B) Cotton
(C) Acrylic (D) Polystrene

Q.8 Which of the following is used in automobile battery casings ?
(A) HDPE (High Density Polyethylene)
(B) PP (Polypropylene)
(C) PVC (Poly Vinyl Chloride)
(D) PTFE (Poly Tetrafloroethene)

Q.9 Which out of the following is used for making disposable cups ?
(A) LDPE (Low Density Polyethylene)
(B) PS (Polystyrene)
(C) PP (Polypropylene)
(D) PVC (Poly Vinyl Chloride)

Q.10 ..... is used for making parachutes and stockings.

(A) Cotton (B) Nylon
(C) Wool (D) Bakelite

Q.11 Which of the following is used for making nonstick pans ?

(A) Polystyrene (B) Polypropylene
(C) Teflon (D) Bakelite

Q.12 Which plastic is unbreakable and can be used as a substitute for glass ?

(A) Perspex (B) Teflon
(C) Celluloid (D) Bakelite

Q.13 The plastics are mostly formed by the process of

(A) Oxidation
(B) Neutralization
(C) Polymerization
(D) Combustion of pertrochemicals

ANSWER KEY

EXERCISE-1

VERY SHORT ANSWER TYPE QUESTIONS.

Sol.1 Fibers which are obtained from either plants or animals are called natural fibers.

Sol.2 The fibers which are made by human being are called synthetic fibres.

Sol.3 Cotton and jute are natural fibers obtained from plants.

Sol.4 Wool and silk are natural fibers obtained from animals.

Sol.5 Many small units combine to form single large unit called as polymer. They are building blocks of many synthetic fibers.

Sol.6 Cotton is a natural polymer.

Sol.7 Rayon is a synthetic fibre which resembles silk.

Sol.8 Rayon is prepared by chemical treatment of wood pulp.

Sol.9 Nylon is first fully synthetic fiber.

Sol.10 Nylon is prepared from coal, water and air.

Sol.11 The repeating units of polyester are ester.

Sol.12 Two common forms of polyester are terylene and PET.

Sol.13 The raw materials used for making synthetic fibers are of petroleum origin and are called petrochemicals.

Sol.14 A plastic which becomes soft on heating and can be repeatedly remolded into desired shape is called thermoplastic.

Sol.15 A plastic which once molded cannot be softened and molded into other shape on heating is called thermosetting plastic.

Sol.16 PVC(Poly Vinyl Chloride) and Polythene are examples of thermoplastics.

Sol.17 Bakelite and melamine are examples of thermosetting plastics.

Sol.18 Bakelite is used in making electrical switches because it is poor conductor of electricity.

Sol.19 Esters are the chemicals which give characteristic smell to fruits.

Sol.20 Two different types of plastic are-Thermoplastics and Thermosetting plastics.

Sol.21 Rayon is man made fiber made of wood pulp.

Sol.22 Acrylic is a fibre used to imitate wools.

Sol.23 It is used for making carpet, toothbrush bristles and tyre because it is a strong fiber.

Sol.24 Handles of frying pans are made of plastic because plastic is a bad conductor of heat.

Sol.25 Electrical wires have covering of plastic because plastic is bad conductor of electricity.

Sol.26 The clothes are made of fabrics. Fabrics are made from fibres which are obtained from either natural or artificial sources.

Sol.27 (i) Fabric is any material made by weaving, knitting, crocheting, or bonding. It is thermal insulation and prevents excessive heat-loss from the body.

(ii) Cloth is a finished piece of fabric that can be used for various a purposes like wearing over body or covering a bed.

Sol.28 The scientists tried to discover a fabric like silk because the fabric obtained from silk fibre was very costly. At the same its beautiful texture fascinated everybody and all wanted to wear it.

Short answer type questions

Sol.29 Nylon fibre was strong, elastic and light. It was lustrous and easy to wash. Therefore, it is used for making clothes.

Sol.30 The wood pulp contains cellulose. It is treated with chemicals and transformed in different form. Them rayon fibre is made from it. Therefore, rayon is man-made fiber.

Sol.31 Nylon is used in many articles, such as socks, ropes, tents, toothbrushes, car seat belts, sleeping bags, curtains and parachute ropes.

Sol.32 The fabric made from this fibre does not get wrinkled easily. It remains crisp and is easy to wash. Therefore, it is quite suitable for making dress material.

Sol.33 PET is a familiar form of polyester. It is used for making bottles, utensils, films, wires and many other useful products. PET bottles and PET jars for storing rice, sugar and other eatable things.

Sol.34 Acrylics are type of synthetic fibre. They resemble wool. They are available in a variety of colours. They are used for making sweaters, shawls and blankets. Many of these are actually not made from natural wool, through they appear to resemble wool. The clothes made from acrylic are relatively cheap.

Sol.35 Polyester is synthetic fiber. These fabric melts and sticks to the body of the person wearing it when they catch fire. Therefore, we should, not wear synthetic clothes while working in the kitchen or in a laboratory.

Sol.36 Synthetic fibres possess unique characteristics. They dry up quickly, are durable, less expensive, readily available and easy to maintain. So they are preferred as clothing material.

Sol.37 Melamine is resists to fire and can tolerate heat better than other plastics. Therefore, it is used for making kitchenware and fabrics which resist fire.

Sol.38 Plastic containers are convenient to store because of their light weight, lower price, good strength and easy handling.

Sol.39 Acrylic is warm, soft, lightweight fiber having wool like appearance. It is easy to wash and dries up quickly. It retains the shape. It can be dyed easily to different colours. Therefore, acrylic is considered cheap substitute of wool.

Sol.40 (i) Rayon is cheaper than silk and can be woven like fibres.

(ii) It can be dyed in a wide variety of colours.

(iii) Rayon is mixed with cotton to make bed sheets or mixed with wool to make carpets.

Sol.41 (i) Synthetic fibers are usually stronger than either natural fiber.

(ii) Synthetic fibers are lighter than natural fibers.

(iii) Synthetic fibers are cheaper.

Sol.42 (i) Plastic is non reactive.

(ii) Plastic is light, strong and durable.

(iii) Plastics are poor conductors of heat and electricity.

Sol.43 (i) Synthetic fibers are non-biodegradable.

(ii) Synthetic fibers do not absorb sweat (water). So they are not comfortable to wear on humid day.

(iii) The main source of synthetic fibers is petroleum. With increase in use of synthetic fibers this natural resource is depleting quickly.

Long answer type questions

Sol.44 (i) Synthetic fibers are cheap and affordable.

(ii) Synthetic fibers are wrinkle free. So they do not need ironing. They do not need maintenance like natural fibers.

(iii) Synthetic fibers dry quickly.

(iv) Synthetic fibers are more elastic as compared to natural fibers.

(v) Synthetic fibers are more durable as compared to natural fibers.

(vi) Synthetic fibers do not shrink.

Sol.45 (i) True

(ii) Flase

(iii) False

(iv) True

(v) False

Sol.46 (i) Polymerization

(ii) cellulose

(iii) rayon

(iv) acrylic

(v) thermosetting plastic

Sol.47 (i) (d)

(ii) (e)

(iii) (a)

(iv) (b)

(v) (c)

Sol.48 (i) True

(ii) True

(iii) False

(iv) True

(v) False

Sol.49 (i) Most of the plastics are non-biodegradable as result garbage is increasing at very fast rate and it is threat to environment.

(ii) The plastic/polythene bags thrown in garbage are consumed by cows along with the garbage thrown in dumps. The plastic gradually accumulates inside the cow's intestine and blocks them and the cows die.

(iii) Plastics are also carcinogenic.

(iv) Plastic is made from the conventional source of energy, petroleum, which is fast depleting resource.

(v) On burning plastic produces poisonous gases.

EXERCISE-2

Ques.	1	2	3	4	5	6	7	8	9	10
Ans.	B	C	A	B	C	D	C	A	B	B
Ques.	11	12	13							
Ans.	C	A	C							