Unit 2

Chemistry and Life

After studying this chapter the students will be able to:

- Identify the chemical composition of common materials such as plastic, polyester, nylon, polythene, rubber, glass, sugar, table salt, washing powder.
- Compare the physical and chemical properties of element and compounds to assess their potential uses and associated risks (e.g., hydrogen versus helium in balloons, copper versus aluminum in wiring, copper versus lead in plumbing, water and alcohol in thermometers, petrol and diesel in automobiles).
- Describe the recycling of elements and compounds (Cu, Fe, Al, plastic, glass and rubber) and its benefits.
- Investigate how the chemical products (aerosol, CFCs, fertilizers, pesticides) has an impact on our lives and environment.
- Find examples of chemical changes in the events that we encounter daily (burning, rusting, fermentation, respiration and decaying).

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Everything around us is composed of chemical elements. Elements are the basic building blocks of our lives. As you know that an element is a pure substance that cannot be decomposed (broken down) into simpler substances. There are about 92 naturally occurring elements. Elements combine with one another in different proportions to form compounds which are everything from the air that we breathe, to the wood that we use to build our homes. Compounds are pure substances made up of 2 or more elements. Compound can be decomposed into simpler pure substances. For example, an electric current can be passed through water to form the elements hydrogen and oxygen.

In our daily life we use variety of products made up of elements and compounds which have made our lives comfortable and enjoyable. At the same we see that due to their frequent use and applications in different activities of life has resulted in the generation wastes of different nature. In this chapter we will study about chemical composition of some common materials along with physical and chemical properties of some commonly used elements and compounds.

2.1 Common Elements and Compounds and their Physical and Chemical Properties

Most of the substances you see in your daily life are the result of chemistry. There are few things in the world on which chemistry has made no impact. If their had been no chemistry, we wouldn't have any plastic, any pharmaceuticals, gasoline, paint, synthetic fertilizer, cleaning products, or synthetic fabrics to name a few. Chemistry has also greatly impacted the fields of genetics, automobiles, information technology, nuclear

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energy, medicine, advanced materials, and many more. In this section we will study some common elements and compounds and their physical and chemical properties

a. Plastic

The word plastic is derived from Greek "plastikos" meaning to mold or form) has become a part of our life, and it is present all around us. It forms much of the packaging for our daily use items like foods, drinks etc.

Plastic is versatile, lightweight, flexible, moisture resistant, durable, strong and relatively inexpensive material. It can be clear or opaque. Due to these wonderful and useful qualities, plastic plays many important roles in life on Earth.

For Your Information

The first man-made plastic was created by Alexander Parkes who publicly demonstrated it at the 1862 Great International exhibition in London. The material called Parkesine was an organic material derived from cellulose that once heated could be molded, and retained its shape when cooled.

However, widespread use of plastic is also causing unprecedented environmental problems, and is causing serious health risks – especially for children.

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Chemically plastic refers to a synthetic high molecular weight chain molecule, or polymer, that may have been combined with other ingredients to modify its physical properties.

Most plastics are based on carbon or organic, materials. As plastics are heated to moderate temperatures, the polymer chains are able to flow past each other. Because of the organic nature of most plastics, they usually cannot withstand high temperatures and begin to decompose at temperature around 392°F (200°C).

Fig: 2.1 Most of our daily used items are made up of plastic.

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b. Polyester

Polyester is a manufactured product made from synthesized polymers. It is made from polyethylene terephthalate (PET).

Polyethylene is a type of polymer which is chemically synthesized from molecules that contain long chains of ethylene, a monomer that provides the ability to double bond with other carbon-based monomers to form polymers.

Polyester is mainly used in textile manufacturing. Polyester tends to be very resilient i.e returning to the original form or position after being bent, compressed, or stretched. It dries quickly and is resistant to biological damage such as mold and mildew attacks. polyester is easy to wash, and able to hold forms well.

Fig: 2.2 Textile products made up of polyester catch fire quickly.

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Polyester is highly flammable, so care should be taken when wearing it. Most synthetic fabrics are subject to flammability by nature, because they are made from polymers. Polyester is not just a textile. The same material used to make plastic drink bottles.

Many drink bottles are recycled by being reheated and turned into polyester fibers, which in addition to being an efficient use, also helps keep polymers out of landfills.

c. Nylon

Nylon belongs to a family of synthetic polymers known as polyamides. They can occur both naturally and artificially, examples being proteins, such as wool and silk. Nylon can be lustrous, semi lustrous or dull. It has an excellent abrasion resistance (The ability of a material to withstand mechanical action such as rubbing, scraping, or erosion that tends progressively to remove material from its surface.) and is highly resilient. Nylon is highly resistance to insects, fungi, animals, as well as molds, mildew and many chemicals.

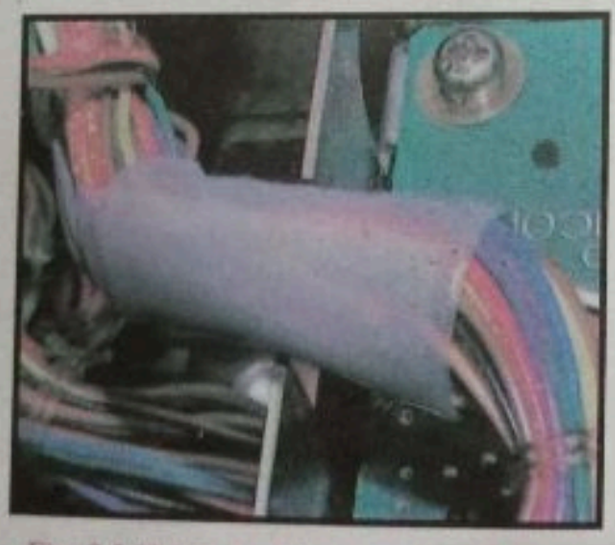

Fig: 2.3 Nylon used in electric cables

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Nylon melts instead of burning. Nylon is widely used in daily use products like electrical connectors, gear, bearings, fishing nets, brush bristles, fabric, carpeting, sportswear etc.

d. Polythene

Polythene is formed when polymers of ethene combined together. It is a tough, white, translucent, and waxy thermoplastic. Thermoplastics can be softened by heating. Polythene is produced in two forms: low-density polythene, made by high-pressure polymerization of ethene gas (the monomer), and high-density polythene, which is made at lower pressure by using catalysts.

Fig: 2.4 Polythene Packaging is common nowadays.

Polythene is used in the manufacturing of packaging, bottles, toys, milk containers and the common plastic bag (shopping bag).

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For Your Information

Polythene environmental hazards

Polythene may help to make numerous useful and durable products possible, however, its poses harmful impacts on environment. It does not readily biodegrade and can reside in a landfill for hundreds of years. Scientists are exploring the possibility of employing *Sphingomonas*, a bacterium shown to shorten biodegrading of some forms of polythene to just a few months.

e. Rubber

Natural rubber is an elastomer (high molecular weight compounds consisting of long chains of hydrogen and carbon molecules) that was originally derived from latex, a milky colloid produced by some plants. In such plants, an incision made into the bark and the sticky, milk colored latex sap collected and refined into a usable rubber.

Fig: 2.5 Rubber can be used in the production of several useful things.

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The purified form of natural rubber is the chemical polyisoprene, which can also be produced synthetically. Natural rubber is used extensively in many applications and products, as is synthetic rubber. It is normally very stretchy and flexible and extremely waterproof.

Synthetic rubber is an artificial elastomer which can undergo much more elastic deformation under stress than most materials and still return to its previous size without permanent deformation.

Synthetic rubber serves as a substitute for natural rubber in many cases, especially when improved material properties are required

Rubber is water repellent and resistant to alkalies and weak acids. Rubber's elasticity, toughness, impermeability, adhesiveness, and electrical resistance make it useful as an adhesive, a coating composition, a fiber, a molding compound, and an electrical insulator.

f. Glass

Glass is an amorphous solid (non-crystalline) solid material. Glasses are typically brittle and optically transparent. Glass has been around in various forms for thousands of years and has been manufactured for human use.

Glass occurs naturally when rocks high in silicates melt at high temperatures and cool before they can form a crystalline structure. When manufactured by humans, glass is a mixture of silica (SiO_2)., soda, lime and minor additives to add colour.

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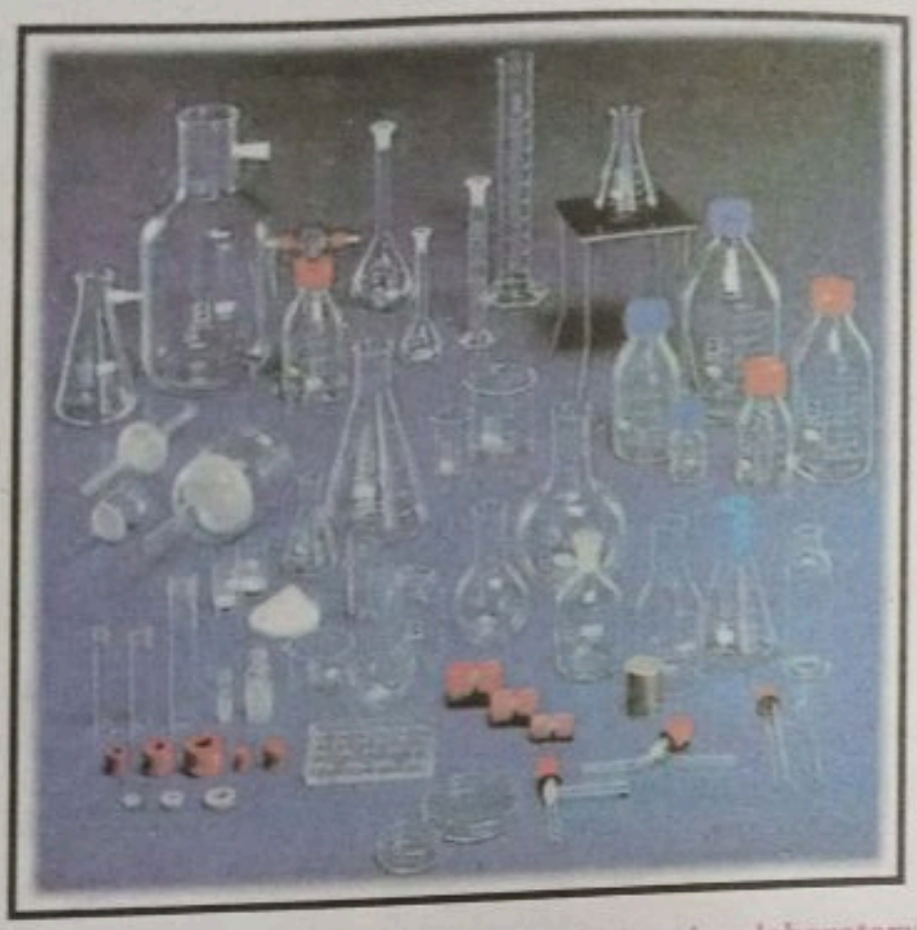

Fig: 2.6 Glass apparatus are common feature in a laboratory.

The elements of glass are heated to 1800° Fahrenheit (982° Celsius). The resulting fused liquid can be poured into molds or blown into various shapes, and when cooled, glass is a strong, minimally conducting substance that will not interact with materials stored inside. As a result, glass is frequently used in scientific laboratories.

Silica is found in a wide variety of natural sources, including, most commonly, sand. Sodium carbonate, or soda, is ed to lower the fusion point of silica, making glass light and kable.

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Do You Know?

Glass is a strange substance. It is not a solid, not a gas, and not quite a liquid either. Generally, it is classified as a rigid liquid, maintaining liquid properties while acting like a solid. Heat can return the glass to a liquid and workable form, making it easy to reuse and recycle.

g. Sugar

Sucrose is the organic compound commonly known as table sugar. A white, odourless, crystalline powder with a sweet taste, it is best known for its role in human nutrition.

The molecule is a disaccharide derived from glucose and fructose with the molecular formula $C_{12}H_{22}O_{11}$. Sugar forms a major element in confectionery and desserts. It can also act as a food preservative when used in sufficient concentrations.

Fig: 2.7 Sugar is a common household item of kitchen.

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. h. Table Salt

Salt, also known as table salt, or rock salt, is a mineral that is composed primarily of sodium chloride. The taste of salt (saltiness) is one of the basic human tastes. Salt for human consumption is produced in different forms: unrefined salt (such as sea salt), refined salt (table salt), and iodized salt. It is a crystalline solid, white, pale pink or light gray in color, normally obtained from sea water or rock deposits. Edible rock salts may be slightly grayish in colour because of mineral content.

Fig: 2.8 Think for a moment food without table salt?

i. Washing Powder

Washing powders are a combination of soaps, detergents and other chemicals. Sodium sulphate and sodium silicate are added to keep the powder dry. Sodium triphosphate or sodium carbonate is added to make the solution alkaline. This helps to remove dirt and also soften water. Carboxy methyl cellulose is added so that the dirt particles removed are kept suspended in the solution. For obtaining sparkling white clothes, a bleaching agent is added. The bleaching agent is in the form of sodium perborate.

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2.2 Physical and chemical properties of elements and compounds

Elements in their individual capacity possess certain properties which play an important role in our daily life activities. When elements combine them form compounds which exhibits their own unique properties. For instant carbon in combination with hydrogen forms hydrocarbons fuels which burns and steer our life engine. However, when carbon combines with oxygen it forms carbon dioxide, a gas which extinguishes fire.

These and some other unique examples have given element and compound a special place in our life. Now when we have enough knowledge about the physical and chemical nature of elements and compounds we have the liberty to pick and choose what suits us most.

In the following section let's study a comparative account of some of the elements in relation to their uses.

a. Hydrogen

Hydrogen is the most abundant element in the universe. Hydrogen is a colourless, highly flammable and light in weight. Pure hydrogen is a gas under normal conditions.

Hydrogen is diatomic i.e exists as pairs of atoms. It has such small mass that it can escape earth's gravitational pull and fly off into space. The gas mixes well with air, explosive mixtures are easily formed.

Hydrogen is slightly more soluble in organic solvents than in water. It does not usually react with other chemicals at room temperature.

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b. Helium

Helium is a member of the noble gas family. The noble gases are also called the inert gases. Inert means that an element is not very active. It will not combine with other elements or compounds. In fact, no compounds of helium have ever been made.

Helium is the second most abundant element in the universe. Only hydrogen occurs more often than helium. Helium is also the second simplest of the chemical elements.

Its atoms consist of two protons, two neutrons, and two electrons. Only the hydrogen atom is simpler than a helium atom. The hydrogen atom has one proton, one electron, and no neutrons.

For Your Information

Helium has some interesting and unusual physical properties. For example, at very low temperatures it can become superfluid.

A superfluid material behaves very strangely. It can flow upwards out of a container, against the force of gravity. It can also squeeze through very small holes that should be able to keep it out. The Nobel Prize in physics for 1996 was awarded to three Americans who discovered superfluidity. They were David M. Lee, Douglas D. Osheroff, and Robert C. Richardson.

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Hydrogen versus Helium in balloons

Although not used much anymore, hydrogen balloons were once quite popular. However, it is highly flammable, so the slightest spark can cause a huge explosion. Hydrogen is explosive and helium is inert. Helium is less dense. Because helium is lighter than air, a helium balloon rises. Hydrogen is another gas lighter than air; it is even lighter than helium.

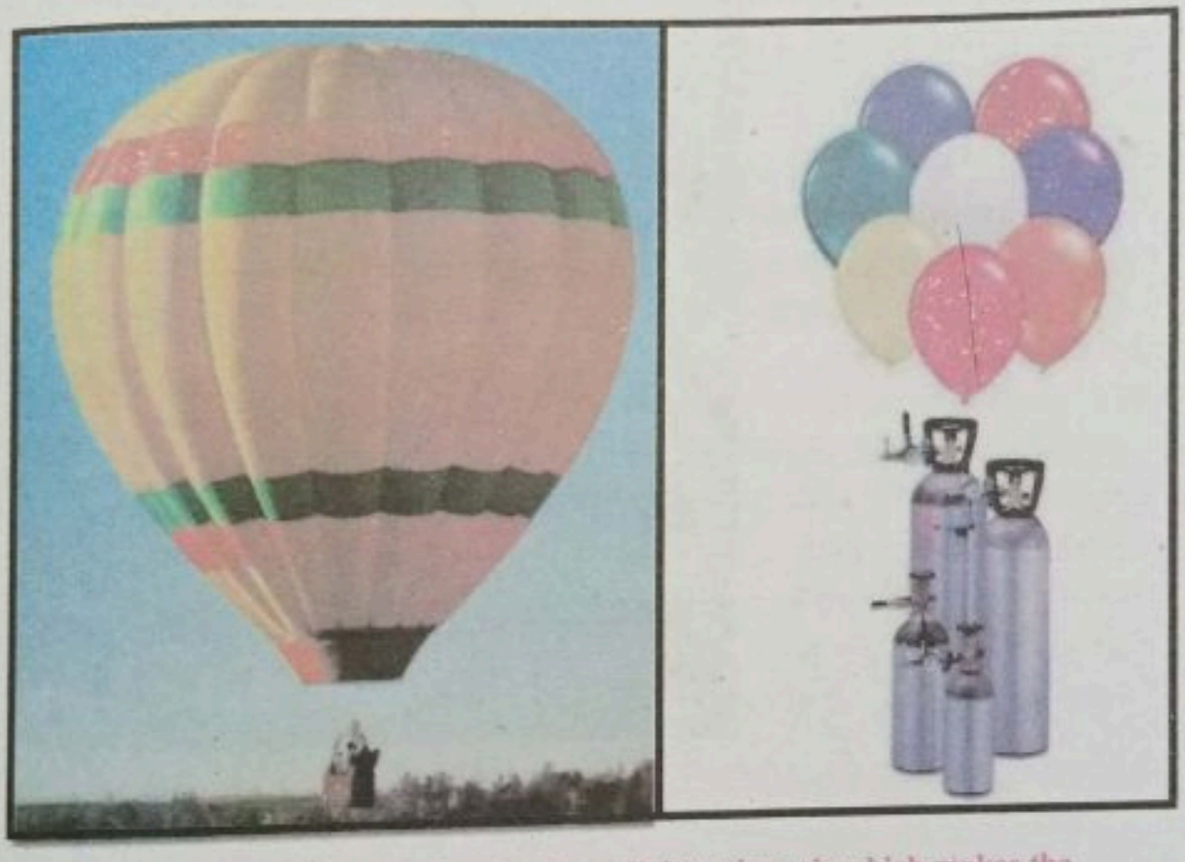

Fig: 2.9 Hydrogen and helium both are lighter than air which makes the balloons to rise in the air.

c. Copper

Copper is **malleable** that is, it can be bent and shaped without cracking, when either hot or cold. It can be rolled into sheets as thin as 1/500 of an inch.

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Copper is ductile, that is, it can be drawn out into thin wire. Copper is second only to silver in its ability to conduct electricity. Besides electricity, copper also is an excellent conductor of heat, making it an important metal in cookware, refrigerators, and radiators.

Fig: 2. 10 Copper is used in the production of various useful products.

Copper is resistant to corrosion, that is, it will not rust. Copper is a moderately active metal. It dissolves in alkalis e.g Sodium hydroxide. An important chemical property of copper is the way it reacts with oxygen. In moist air, it combines with water and carbon dioxide. The product of this reaction is called hydrated copper carbonate ($Cu_2(OH)_2CO_3$).

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d. Aluminum

Aluminum is a shiny, silvery white colored metal that is light in weight and strong. The surface of aluminum metal is covered with a thin layer of oxide that helps to protect the metal from attack by air. So, normally, aluminum metal does not react with air. If the oxide layer is damaged, the aluminum metal is exposed to attack. Aluminum will burn in oxygen with a brilliant white flame to form the aluminum oxide, Al_2O_3.

Copper versus Aluminum in wiring

Copper is the most efficient and reliable electrical conductor for commercial and industrial wire and cable. When compared to aluminum, copper has a significant (1.6 times) ampacity advantage (current carrying capacity). It is easier to install, and is resistant to corrosion.

The true cost of a cable, often referred to as its "life cycle cost," includes the preliminary cost of the cable, as well as the cost of installation, maintenance, repairs, and replacement. While aluminum cable wire is sometimes less expensive to buy than copper, aluminum cable is more difficult to install and is more prone to failure. Therefore, the full life cycle cost of copper cable is lower than aluminum cable.

e. Lead

Lead is one of only a few elements known to ancient peoples. Although lead is a known poison, the mechanical and chemical characteristics of the metal continue to keep lead as an important component in society. Lead is a heavy, soft, gray solid poor electrical conductor, resistant to corrosion. It is both ductile and malleable. It has a shiny surface when first cut, but it slowly tarnishes (rusts) and becomes dull. Lead can be easily bend, cut, shaped, pull and otherwise change shape of the metal.

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Copper versus Lead in plumbing

Copper pipes are the standard plumbing material for potable water and heating systems in most of the developed countries of the world. Copper has been used to make drinking vessels, water pipes and containers for thousands of years. Copper is durable. It is strong and resists damage, so copper tube and fittings can be relied on for decades Due to bacteriostatic quality it inhibits the growth of bacterial and viral organisms in water systems.

Copper tube and fittings can be used in every part of plumbing and heating systems. Copper is strong, it can easily be formed into bends and systems can be assembled. It is capable of withstanding extremes of heat without suffering any degradation. It is resistant to corrosion and high water-pressure. It doesn't burn, it keeps its shape and strength in high temperature environments. In addition, copper piping gives excellent protection against contaminants to the domestic water supply. Copper is completely recyclable without loss of quality, which benefits the environment. However, copper is a considerably more expensive material. Another disadvantage of copper pipe plumbing deals with water acidity. This type of plumbing is only suitable for water that has a pH between 6.5 and 8.5.

Lead comes from many sources, such as car exhausts and old paint work. It may be naturally present in air, food, soil and in water. Lead can be harmful to health, especially for young children and unborn babies. The water from our treatment works supplied through our mains to the boundary of properties contains virtually no lead. But the water can dissolve tiny amounts of lead from the inside of lead supply pipes and internal plumbing. As a result, the water coming out of your pipe may contain more lead than the drinking water standards allow.

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f. Water

Water is unique in that it is the only natural substance that is found in all three states - liquid, solid (ice), and gas (steam). Pure water is colourless and has no taste or smell. A molecule of water (H_2O) is composed of one atom of oxygen bound to two atoms of hydrogen. The hydrogen atoms are "attached" to one side of the oxygen atom, resulting in a water molecule having a positive charge on that side where the hydrogen atoms are present and a negative charge on the other side, where the oxygen atom is present. Since opposite electrical charges attract, water molecules tend to attract each other, making water kind of "sticky.

Tidbit

At 0° Celsius waters freezes and at 100° Celsius water boils.. Water is unusual in that the solid form, ice, is less dense than the liquid form, which is why ice floats.

Water is called the "universal solvent" because it dissolves more substances than any other liquid. Pure water has a pH of 7 which is regarded as neutral neither acidic nor basic. Water can absorb a lot of heat before it begins to get hot. This is why water is valuable to industries and in car's radiator as a coolant.

g. Alcohol

Most of the common alcohols are colourless liquids at room temperature. Methyl alcohol, ethyl alcohol, and isopropyl alcohol are free-flowing liquids.

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Alcohols have an odour that is often described as "biting" and as "hanging" in the nasal passages. Alcohols have applications in industry and science as reagents or solvents. Because of its low toxicity and ability to dissolve non-polar substances, ethanol can be used as a solvent in medical drugs, perfumes, and vegetable essences such as vanilla. Ethanol can be used as an antiseptic to disinfect the skin before injections are given, often along with iodine. Alcohol is also used as a preservative for specimens.

Tidbit

Some alcohols, mainly ethanol and methanol are now being used as fuel.

Alcohol and Water in Thermometers

Most often thermometers use mercury, but alcohol could be used as well since it has a freezing point below 100 degrees celsius.

Water cannot be used in a thermometer because it will freeze at 0°C which will make the use of a thermometer impossible when freezing outside. That's why liquids like alcohol or mercury are used in the thermometers which have a very low freezing point so the liquid thermometer stays a liquid and doesn't start to harden.

The bulb thermometer is the common glass thermometer you probably have used since your childhood. Bulb thermometers rely on the simple principle that a liquid changes its volume relative to its temperature.

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Liquids take up less space when they are cold and more space when they are warm. All bulb thermometers use a fairly large bulb and a narrow tube to accommodate the change in volume. The main reason that mercury or alcohol is used in thermometers instead of water is due to the fluctuations that are seen in the boiling and freezing points of water which vary with pressure.

Water is also used as a standard by which the thermometer is calibrated by. Alcohol's low freezing point makes it perfect for measuring low temperatures, but it's low boiling point means that high temperatures are hard to measure. Plus, it expands very nicely within the capillary tubes in which it is held. Mercury's low freezing point and high boiling point make it ideal for measuring most temperatures. However, mercury is also very expensive and dangerous.

2.3. Recycling of material

Recycling is reusing materials in original or changed forms rather than discarding them as wastes. In today's world the importance of recycling is of great concern both for the general public and in terms of economy.

The earth's natural resources are being consumed at an alarming rate. Recycling has become a major issue as scientific research has been suggesting for years that the earth is being depleted too fast to sustain a healthy balance. Recycling along with reducing consumption is our best means to counter the damage we have been doing to the earth for centuries.

Let's see how can we recycle some of our daily use products and what benefits we can achieve in this process.

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a. Recycling of Glass

It is important to recycle glass because it is 100 percent recyclable. Glass can be recycled endlessly without any loss in purity or quality. Recycling glass lowers manufacturing costs and benefits the environment. Raw materials are conserved, and less energy demand reduces CO_2 emissions.

Recycling of glass is a simple process. Used glass in various forms are collected from consumers. Glass is then taken to a glass treatment plant. The glass is sorted by colour and washed to remove any impurities. It is then crushed and melted, then moulded into new products such as bottles and jars. Or it may be used for alternative purposes such as decorative uses.

Fig: 2.11 Glass bottles are used as container for variety of materials.

The glass is then sent back to be used for a variety of purposes again. Glass does not degrade through the recycling process, so it can be recycled again and again.

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b. Recycling of Copper

Copper is a ductile metal with very high thermal and electrical conductivity. Pure copper is soft and malleable. It is used as a conductor of heat and electricity, a building material, and a constituent of various metal alloys. Copper is mined to be used for various purposes. It is cheaper to recycle copper than to mine and extract new copper.

Recycled copper is worth up to 90% of the cost of the original copper. Recycling helps to keep the cost of copper products down. Recycling a tone of copper uses 15% of the energy that would be used to mine and extract the same copper. So, recycling helps to conserve fossil fuels and reduce carbon dioxide emissions.

The process of transforming copper scrap into new copper products begins with copper scrap. There are two types of copper scrap: Old scrap comes from the public. It is collected from discarded, dismantled or obsolete products.

For example: copper pipes from old buildings, old taps from a bathroom renovation, old hot water cylinders or disused electrical cable.

Fig: 2.12 Copper scrap ready to be recycled.

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New scrap comes from factories which make articles from copper, brass or bronze. Their machines will produce off cuts and shavings that can be collected and returned for recycling.

Activity

Write an article to motivate people to recycle things to avoid production of unnecessary waste produced in daily life.

When copper scrap is received for recycling it is visually inspected and graded, and analyzed chemically if necessary. Scrap material is directly melted and in some cases brought to higher purity while molten (fire refined). Chemical analysis checks the purity level of the copper when the charge is fully melted, and the molten copper is deoxidized and cast into an intermediate shape (billets, cakes, ingots) for further processing.

c. Recycling of Aluminium

Aluminium is the most abundant metal in the Earth's crust, and the third most abundant element, after oxygen and silicon. Aluminium is a soft, durable, lightweight, ductile and malleable metal. It has opened up new dimensions in the last decades. Countless objects that simplify as well as increase the quality of our daily life are partly made of aluminum, for example, CDs, cars, refrigerators, kitchenware, electric power lines, packaging for food and medicine, computers, furniture and aircrafts.

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Recycling aluminum saves precious natural resources, energy, time and money. Aluminum cans are unique in that in about 60 days a can is recycled, turned into a new can and is back on store shelves. Aluminum is a sustainable metal and can be recycled over and over again.

Fig: 2.13 Aluminum cans are being collected and large blocks are ready to be recycled as new cans.

The consumer throws aluminium cans and foil which are collected and taken to a treatment plant. In the treatment plant the aluminium is sorted and cleaned and is ready for reprocessing. It then goes through a re-melt process and turns into molten aluminium. This removes the coatings and inks that may be present on the aluminium.

The aluminium is then made into large blocks called ingots. The ingots are sent to mills where they are rolled out, this gives the aluminium greater flexibility and strength. This is then made into aluminium products such as cans, chocolate wrapping and ready meal packaging. In as little as 6 weeks, the recycled aluminium products are then sent back to the shops ready to be used again.

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d. Recycling of Plastic

All plastic can be recycled. However, it is difficult to separate (by hand), and different plastics use different amounts of energy to get them back to their original condition.

If there is a mixture of different kinds of plastics in the melt they can separate and degrade the final product. With extra effort and energy, plastic can be re-made into the same quality as the original.

Some plastics can be "upcycled", that is, made into plastic of higher quality than the original. However, much plastic recycling is "downcycling", that is, it is made into materials of lesser quality than the original (garden furniture, garbage bins etc).

Fig: 2.14 Used plastic bottles are being collected for recycling.

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During the recycling process the plastic recyclables are sorted at the recycling center and baled. At the mill they are chopped into little bits and cleaned. They are further washed and purified. They are then melted, extruded and chopped into tiny pellets from these pellets various things like plastic bottles are formed.

e. Recycling of Rubber

Rubber recovery can be a difficult process. There are many reasons, however why rubber should be reclaimed or recovered. Recovered rubber can cost half that of natural or synthetic rubber. Recovered rubber has some properties that are better than those of virgin rubber.

Fig: 2.15 Imagine what would have happen if rubber could not be recycled?

Activity

Survey your surrounding to find out where your local recycling sites are present.

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Producing rubber from reclaim requires less energy in the total production process than does virgin material. It is an excellent way to dispose off unwanted rubber products, which is often difficult. It conserves non-renewable petroleum products, which are used to produce synthetic rubbers.

f. Recycling of Iron

Iron is an important metal used in a variety of ways for different purposes. Scrap iron is an important source for recycling of iron.

The scrap metals is collected and then melted at high temperature. Any of the impurities if present is scraped off from the top of the container of molten metal. The pure molten iron is then poured into casts and cooled.

The blocks of iron can now be used again. It is cheaper and less environmentally damaging to recycle iron rather than to extract it from its ores, in the ground.

Fig: 2.16 Iron scrap being collected for recycling.

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2.4 Impact of Chemical Products on our Lives and Environment

In the pervious chapter you have studied how scientific development has made its impact on our lives. Some of the prominent development has been in the field of agriculture, medicine and communication technology. Modern day electronics devices and equipments have raised the standard of living. Now we need not to worry if it is hot and humid summer one can enjoy the coolness and fresh atmosphere created by an air conditioner.

We can now enjoy the freshness of vegetables and fruits for weeks without compromising taste and nutrients. In the agricultural field farmers are using fertilizers, pesticides, high quality seeds for increasing the overall yield of the crops. Fertilizers reenergizes soil by adding necessary nutrients to the soil.

Pesticides and insecticides kills pests and insects which otherwise have a devastating potential to wipe out the whole field in days. All these and other facilities which we have today are not free from harmful side effects.

a. Impact of Fertilizers

The toxic chemicals found in fertilizers can be absorbed into the plants and enter the food chain via vegetables and cereals, although the biggest health risk is when the chemicals seep into the ground water which is then extracted for drinking water.

Fig: 2.17 Adding fertilizers do increase the over all yield but it also have negative impacts on the environment.

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This water can contain high levels of nitrates and nitrites which can cause blue-baby syndrome (methemoglobinemia). women.

Mercury, lead, cadmium and uranium are some of the toxic heavy metals that have been found in fertilizers and can cause distrubances of the kidneys, lungs and liver.

b. Impact of Pesticides

Pesticides are designed to kill pests. Many pesticides can also pose risks to people. Health effects of pesticides depend on the type of pesticide. Some, such as the organophosphates and carbamates, affect the nervous system.

Fig: 2.18 Pesticides are used to kill insects damaging the crops.

Others may irritate the skin or eyes. Some pesticides may be carcinogens. Others may affect the hormone or endocrine system in the body.

c. Impact of CFCs

The invention of chlorofluorocarbons (CFCs) in the late 1920s and early 1930s was regarded as safe alternatives to the sulfur dioxide and ammonia refrigerants used at the time. Chlorofluorocarbons were chosen for their safety and for their advantageous chemical properties.

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These compounds are low in toxicity, nonflammable, noncorrosive, and nonreactive with other chemical species, and have desirable thermal-conductivity and boiling-point characteristics. These features led to increased demand as more applications arose for CFC use.

Appliances such as refrigerators, freezers, air conditioners and dehumidifiers started using chlorofluorocarbons (CFCs).

However, it is now being proved that these CFCs when released, reacts with ozone in the upper atmosphere, reducing this layers protective properties against ultraviolet radiation.

Scientists have found that overexposure to UV radiation can cause skin cancers and it may suppress proper functioning of the body's immune system and the skin's natural defenses.

d. Impact of Aerosols

Aerosol Spray product are a popular and convenient way to dispense a wide variety of products used in industry today and is one of the most effective and practical packaging methods available.

Fig: 2.19 Aerosol sprays are commonly used in daily life activities.

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Aerosol Spray Cans have a sealed container that is made from more than 25 percent recycled metals and is designed for easy recycling when the Aerosol Spray product is empty. Aerosol Products and Aerosol Sprays are easy to use and provide a targeted stream that reduces waste, saves money and are able to reach both large and small spaces very effectively.

Activity

Make a list of aerosol spray generally used in your daily life and list down its contents.

However, use of aerosols products such as air fresheners, polish, deodorants and hair sprays increase the risk of diarrhoea, earache and other symptoms in infants as well as headaches and depression in adults. High levels of Volatile organic compounds (VOCs) may contribute to asthma in toddlers. Air fresheners combined with other aerosol and household products contribute to a complex mixture of chemicals and a build-up of VOCs in the home environment.

2.5 Chemical Change and its Common Examples

Chemical changes take place at the molecular level. A chemical change produces a new substance that wasn't there before. In our daily life we frequently encounter various situations where we experience various examples of chemical changes.

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Some of the more prominent among those are discussed below.

a. Burning

Burning or combustion reactions are example of chemical change. These always involve molecular oxygen O_2. Anytime anything burns (in the usual sense), it is a combustion reaction. Combustion reactions are almost always exothermic (i.e., they give off heat). For example when wood burns, it must do so in the presence of O_2 and a lot of heat is produced. Wood as well as many common items that combust are organic (i.e., they are made up of carbon, hydrogen and oxygen). When organic molecules combust the reaction products are carbon dioxide and water (as well as heat).

b. Rusting

Rusting of iron is an example of chemical change. During rusting the iron (Fe) combines with oxygen (O_2) in the atmosphere and produce iron oxide. In iron, the iron atoms are arranged in a metallic crystalline matrix. When rust occurs, oxygen bonds to the iron atoms (which were not chemically bonded to anything before) to create an oxide of iron.

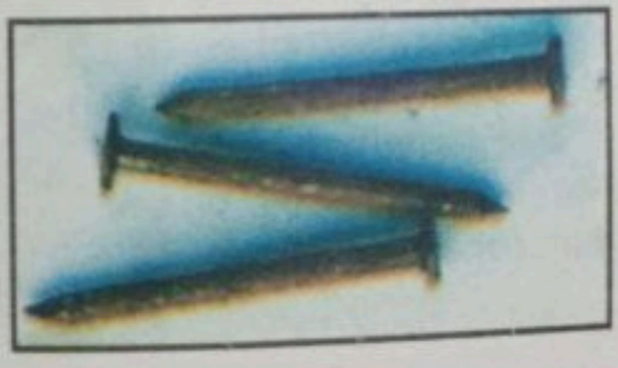

Fig: 2.20 Rust formed on iron nails exposed to air

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c. Respiration

Respiration can be divided into two steps:

1. One of the step in respiration is breathing process during which the body draws fresh air into the lungs. However, this leads to chemical changes - oxygen diffuses out of the air in the lungs into the blood, and carbon dioxide diffuses out of the blood into the air in the lungs.

2. The second step is cellular respiration, in which every cell in the body "burns" sugar (in which energy is stored) in the presence of oxygen to make adenosine triphosphate (ATP), the form of energy storing molecules in the cell. Carbon dioxide and water are the by-products.

d. Fermentation

Fermentation is yet another example of chemical change. It occurs naturally in some foods, such as dough and curds.

It is the process of using yeast or bacteria to convert sugar or other carbohydrates into either an acid or alcohol.

Fermentation only happens in oxygen-free or anaerobic conditions

Fig: 2.21 In industries large scale fermenters are used for the production of various fermentation products.

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e. Decomposition

You have studied in your pervious classes that in an ecosystem bacteria are acting as decomposers of dead bodies of plants and animals. Decomposition is the break down of complex bodies into their simpler components.

As the bodies of animals and plants are made up of complex chemical compounds and these by the action of bacteria are broken down into simple compounds which are used in the recycling of various elements in nature.

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KEY POINTS

- An element is a pure substance that cannot be decomposed (broken down) into simpler substances.
- We use variety of products made up of elements and compounds which have made our lives comfortable and enjoyable.
- Plastic is versatile, lightweight, flexible, moisture resistant, durable, strong and relatively inexpensive material. It can be clear or opaque. Chemically plastic refers to a synthetic high molecular weight chain molecule, or polymer.
- Polyethylene is a type of polymer which is chemically synthesized from molecules that contain long chains of ethylene.
- Nylon belongs to a family of synthetic polymers known as polyamides.
- Polythene is formed when polymers of ethene combined together.
- Natural rubber is an elastomer (high molecular weight compounds consisting of long chains of hydrogen and carbon molecules) that was originally derived from latex, a milky colloid produced by some plants.
- Glass is a mixture of silica (SiO_2)., soda, lime and minor additives to add color.
- Hydrogen is a colourless, highly flammable and light in weight.
- Helium is the second most abundant element in the universe.

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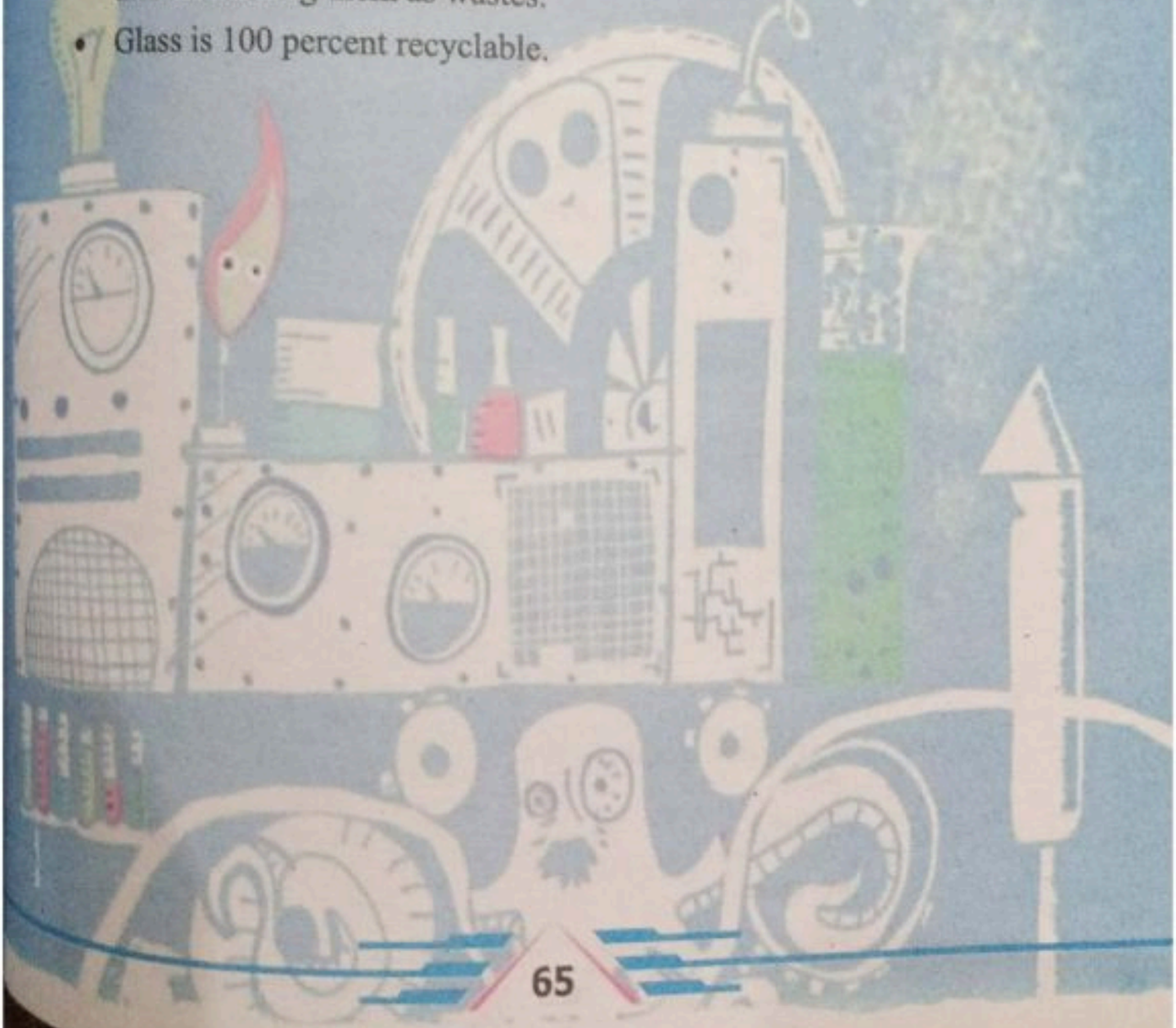
KEY POINTS

- Copper is second only to silver in its ability to conduct electricity.
- Water is the only natural substance that is found in all three states - liquid, solid (ice), and gas (steam).
- Alcohol is used as a preservative for specimens.
- Recycling is reusing materials in original or changed forms rather than discarding them as wastes.
- Glass is 100 percent recyclable.



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EXERCISE

A. Select the correct answers for the following questions.

1. Plastic chemically refers to as
   a. synthetic high molecular weight chain molecule
   b. natural high molecular weight chain molecule
   c. synthetic low molecular weight chain molecule
   d. natural low molecular weight chain molecule

2. Polyethylene is chemically synthesized from
   a. long chains of ethylene
   b. short chains of ethylene
   c. some are long and some are short chains of ethylene
   d. long chains of ethane

3. Why it is not desirable to wear clothes made up of polyester?
   a. it does not clean easily
   b. it is out of fashion
   c. it is highly flammable
   d. it fibres thread apart easily

4. The polymers from which the nylon is made up of are:
   a. polyethylene
   b. polyether
   c. polyesters
   d. polyamides

5. One of the following is a product of polymerization of ethane gas.
   a. polyethylene
   b. polythene
   c. polyesters
   d. polyamides

6. Latex is a natural source of :
   a. rubber
   b. plastics
   c. nylon
   d. polythene

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7. Polyisoprene is a purified form of
   a. rubber
   b. plastics
   c. nylon
   d. polythene
8. A prefect storage container material of chemicals is:
   a. plastic
   b. polythene
   c. rubber
   d. glass
9. Sand acts as a natural source for the production of which of the following product?
   a. plastic
   b. polythene
   c. rubber
   d. glass
10. Which of the following chemicals make the washing powder dry?
    a. sodium triphosphate or sodium carbonate
    b. sodium triphosphate or sodium bicarbonate
    c. sodium biphosphate or sodium tricarbonate
    d. sodium sulphate and sodium silicate
11. Identify the correct statement in the following:
    a. hydrogen is inert and helium is explosive
    b. hydrogen is explosive and helium is inert
    c. hydrogen is light and helium is explosive
    d. hydrogen is gas and helium is solid at room temperature

12. If copper, aluminum, iron and lead are left in open air which one will rust?
    a. copper
    b. aluminum
    c. lead
    d. iron
13. Which one of the following will have lower life cycle cost if used as electrical cables?
    a. copper
    b. aluminum
    c. lead
    d. iron

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14. One of the limitations for copper plumbing is
    a. it leaks easily
    b. it is capable of carrying water with a specific pH
    c. it is not easy to bend and cut
    d. it works only in cold environment

15. Pure water has a pH of :
    a. 8
    b. 7
    c. 6
    d. 5

16. Thermometer is filled with material which should have:
    a. high freezing point
    b. moderate freezing point
    c. low freezing point
    d. no fixed freezing point

17. Which one of the following ideal to be used in thermometers:
    a. water
    b. alcohol
    c. benzene
    d. mercury

B. Write answers for the following questions.

1. Write in detail the chemical composition and some of the prominent chemical and physical properties of the following material.
   a. Plastic

   b. Polythene

   c. Glass

2. Compare hydrogen with helium. Which element is better to be used in balloons?

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3. Write the chemical and physical properties of copper and compare it with aluminum. Justify which element is better suited to be used in wiring.

4. Give a brief description about different materials which can be used in thermometers. Based on their nature justify which is the most suited material for thermometer.

5. Write three examples of chemical changes which we encounter in our daily life.

6. Describe the harmful impacts of CFCs, pesticides and fertilizers.

7. Recycling is the need of the day. Different types of waste material like plastic, glass, rubber etc if not recycled can pose serious threats to environment. Elaborate the statement.

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