



Chemical Reactions and their Practical Applications



Unit 7

After studying this chapter the students will be able to:

- Recognize those characteristics which indicate that a chemical reaction has taken place.
- Use scientific nomenclature to identify common consumer products (e.g., identify ingredients in food products or cosmetics from the labels).
- Investigate application of acid-base reactions in common products and processes (e.g., prepare soap from oil and sodium hydroxide and compare its lather formation with that of commercial soaps).
- Relate chemical reactions to familiar processes encountered in everyday life (e.g., reactions in film processing, food processing, fabric and hair dyeing, agriculture, pulp-and-paper and mineral processing) and identify careers that require knowledge of such processes.
- Research the methods, impact and safety consequences of chemical disposal in Pakistan, and recommend appropriate disposal methods (e.g., dumping car batteries, tyres, plastics, paints, or metals in landfill sites).



INTRODUCTION

The ever increasing importance of chemistry has grown tremendously due to its application in all aspects of daily life. Our own existence is a result of various chemical processes. If any vital process ceases to function, even our survival becomes difficult. From diagnosis to the treatment of diseases, chemicals and chemical processes are of vital importance. Metallurgy is a process of extraction of metals from ores. It is a chemical process which has revolutionized the whole economy of the world. The big complicated machines which are the backbone of modern civilization, are the direct result of the present growth of iron and steel industry. Materials like cement, paints, varnishes, glass, fertilizers, synthetic fibers, plastics, soaps, dyes, preservatives and countless other useful and productive materials are because of different types of chemical reactions. In this chapter you will study various chemical reactions which we encounter in our daily life and their practical applications. you will also study methods for the disposal of waste chemicals.

7.1 CHEMICAL REACTIONS IN EVERY DAY LIFE AND THEIR PRACTICAL APPLICATIONS

When a chemical change occurs, a chemical reaction is said to have taken place. In chemical reactions atoms combine with each other forming new substances. The substances which take part in chemical reactions are called reactants. The new substances formed as a result of a chemical reaction are called products. Generally, the chemical properties of the reactants and products are different from each other.

An example of a chemical reaction is rusting of iron. Rusting occurs because the iron (Fe) reacts with oxygen (O_2) in the atmosphere. Chemical bonds are formed and broken to finally make iron oxide (Fe_2O_3) which is rust.



Fig: 7.1 Car is being rusted.



In physical change only the physical state of matter is changed, for example, melting of ice. These changes are temporary and can be easily reversed. The substances retain the properties during a physical change. Thus, no new thing is formed in this type of change. On the other hand, a chemical change is permanent and it cannot be reversed easily. In a chemical change new things are formed which have chemical properties different from the original substances, for example, pure hydrogen gas (H_2) and pure oxygen gas react violently in the presence of spark to form water. This chemical reaction is exothermic and it will release energy.

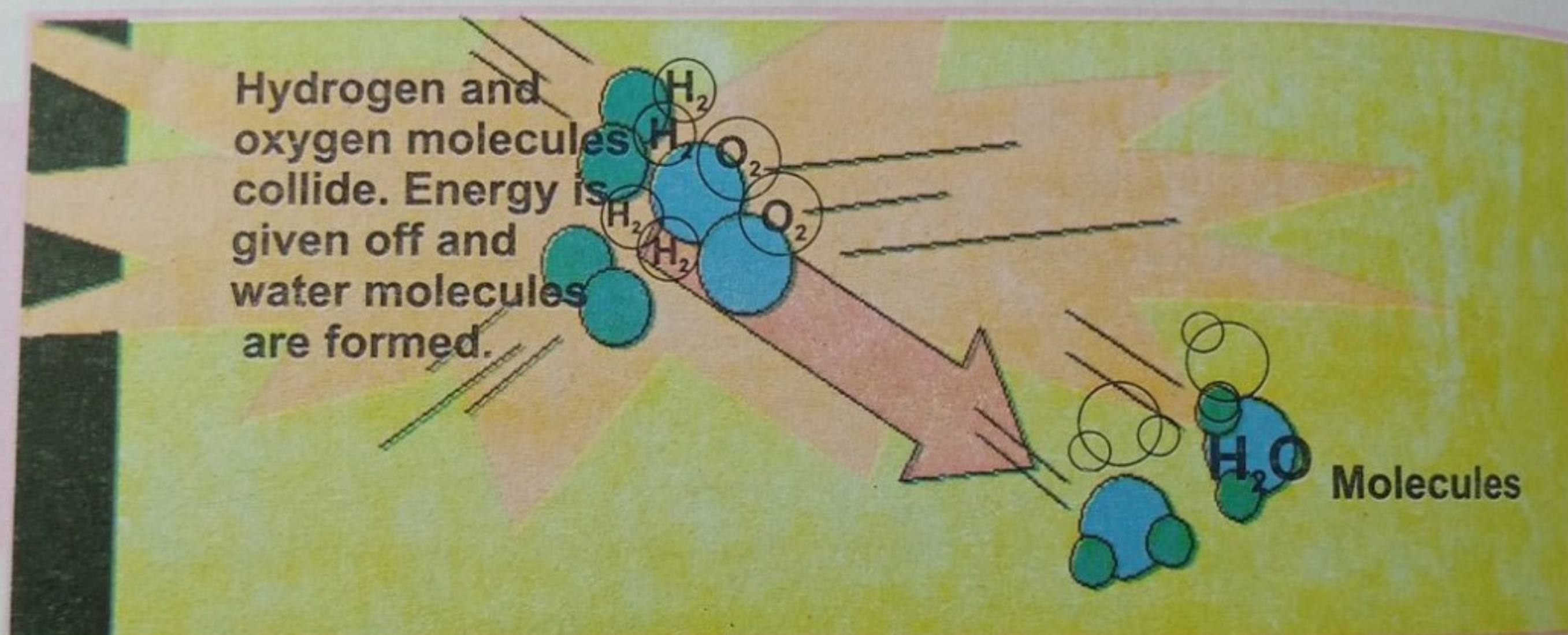


Fig: 7.2 Formation of water.

A. INDICATIONS OF A CHEMICAL REACTION

When a chemical reaction takes place, different types of changes occur. One or more of the following observations may indicate that a chemical reaction has taken place.

- ◆ A change in colour is seen.
- ◆ A solid (precipitate) forms on mixing liquids.
- ◆ A gas evolves on mixing two substances
- ◆ A change of temperature may occur.

B. Some Chemical Reactions in Everyday Life

Different things that are being used by us in our day to day activities are products of chemical reactions. For example; toothpaste, soap, shampoo, washing powder etc. are all results of chemical reactions. Following are some of the significant examples of chemical reactions, which we encounter in everyday life.

i. Photosynthesis

You are familiar with the term photosynthesis. It is the process by which green plants manufacture their own food. Water and carbon dioxide act as raw materials in the process. The chlorophyll pigment, present in the leaves, traps energy from sunlight. Chemical reactions take place whereby raw materials are converted into glucose and oxygen gas.

The overall equation of the process of photosynthesis is given below.

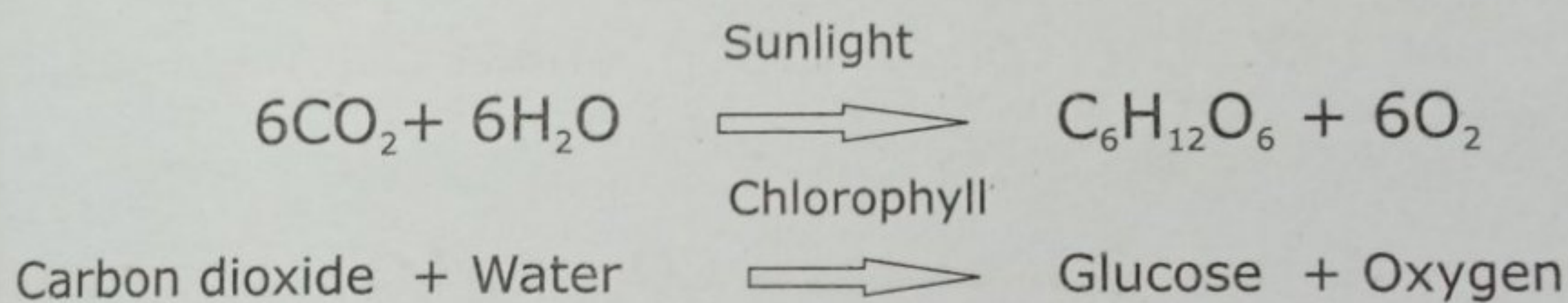
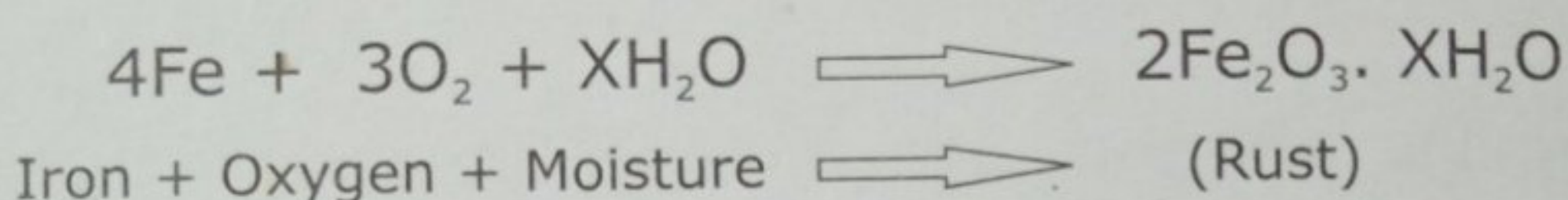


Fig: 7.3 Photosynthesis.

ii. Rusting of Iron

You might have seen a layer of rust over unpainted iron surfaces. This layer gradually leads to disintegration of iron. In rusting process iron combines with oxygen in the presence of atmospheric moisture resulting in formation of iron oxide (Fe_2O_3) which is rust. The chemical reaction of the process can be simply represented as:



iii. Burning of Coal/Natural Gas

Coal and natural gas are fossil fuels and are important means of energy. Coal mainly contains carbon and natural gas contains methane. The chemical reaction of burning of carbon in coal and methane in natural gas involves combustion process where carbon and methane react with oxygen to release energy used for domestic and industrial consumption. These chemical reactions are shown below.

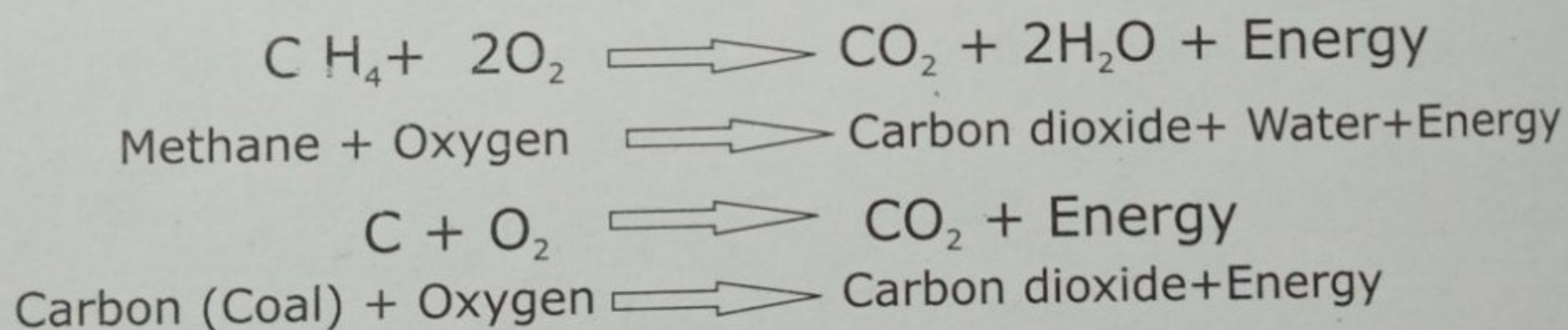


Fig: 7.4 Burning of coal.

7.1.1 SCIENTIFIC NOMENCLATURE AND COMMON CONSUMER PRODUCTS

Different chemical compounds have scientific names based upon their chemical structure. Chemical nomenclature or scientific nomenclature is the term given to the naming of chemical compounds. Often, these names are complicated, long and understandable only to those who have background knowledge of chemistry. Commonly used chemical compounds may have several names. For example, Baking soda is white substance usually available in powder form. It is one of the important edible items used in every kitchen. Chemical name of this compound is sodium bicarbonate (NaHCO_3). Generally chemists use common chemical names more when it comes to mentioning certain ingredients in everyday consumer products.

Table: 7.1 Names of edible chemical compounds.

Common Name	Chemical Name
Vitamin B9	Folic acid
Vinegar	Acetic acid
Vitamin C	Ascorbic acid
Baking soda	Sodium bicarbonate
Vitamin D	Ergocalciferol
Aspirin	Acetylsalicylic acid
Margarine	Partially saturated fatty acid

Table: 7.2 Names of chemical compounds and their use in cosmetics

Chemical name	Use in cosmetics
Lead	Used as a constituent in over 650 cosmetic products, including sunscreens, foundation, nail colors, lipsticks and whitening toothpaste.
Triclosan	Used in antibacterial soaps, deodorants and toothpastes.
Phthalates	Found in nail polish and in synthetic fragrance.
Ethylene Oxide	It is used in shampoos and body washes.
1,3-butadiene	This chemical is used in Shaving creams, sprays sunscreens and foundations, and as anti-fungal.

A. How To Read a Label

You might have seen certain details written on canned and packaged food items. These are known as food labels. Food labels provide an important source of information about the food items present in the container especially, in terms of calories and the nutritional value of the foods you eat. Ingredient lists are a good way to know exactly what a packaged food contains.



Nutrition Facts	
1 Serving size: 250 ml	
2 Amount per serving % Daily Value	
3 Calories 140	
Fat 3.5 g	5%
4 Saturated 1g +Trans 0 g	5%
Cholesterol 10 mg	
5 Sodium 640 mg	
Potassium 400mg	11%
6 Carbohydrate 19 mg	6%
Dietary Fibre 3g	12%
Sugar 4g	
Protein 8g	
7 Vitamin A 20%	Vitamin C 2%
Calcium 5%	iron 10%

Fig: 7.5 Food label.



Similarly, in the cosmetic industry proper labeling is an important aspect for marketing a cosmetic or personal care product. Labeling is used to help inform consumers of the ingredients present in a particular cosmetic product. It also gives you information regarding its method of use and any other related warnings, expected allergies associated with its use. It also gives a list of ingredients and net quantity of contents, and its place of manufacture or distribution.

pearl collection™



Aloe Vera CONDITIONER

Moisturizing

**for normal, dry &
chemically treated
hair**

The ALOE VERA plant and its benefits have been known since ancient times. This conditioner is specially formulated with ALOE VERA to promote healthy hair. Panthenol has been added to help repair damaged hair.

INGREDIENTS

WATER, HYDROGENATED CASTOR OIL AND STEARALKONIUM CHLORIDE, ALOE VERA GEL, PANTHENOL HYDROLIZED ANIMAL PROTEIN, METHYPARABEN, FRAGRANCE, CITRIC ACID, PROPYLPARABEN, FD&C YELLOW NO. 5 FD&C BLUE NO.1

NET WT 16 OZ



Fig: 7.6 A typical Cosmetic label.

7.1.2 Application of Acid-Base Reactions in Common Products and Processes

Acid base reaction have a wide range of application in the preparation of useful daily life products. For example, soap preparation etc.

Preparation of Soap From Oil and Sodium Hydroxide

Soaps are chemically sodium or potassium salts of long chain fatty acids, such as stearic, oleic or palmitic acid. These acids are present in vegetable oils or animals fats. When vegetable oils or animals fats are treated with sodium hydroxide, soaps are formed along with glycerin. This process is called saponification. Let's study this process in some detail.

The mixture of fat or vegetable oil and caustic soda (NaOH) is put in a steel tank fitted with steam coils. The tank has an outlet at the bottom. Steam is passed through the mixture. The heat of the steam first melts the fat. Sodium hydroxide then combines with fat or oil to form soap.

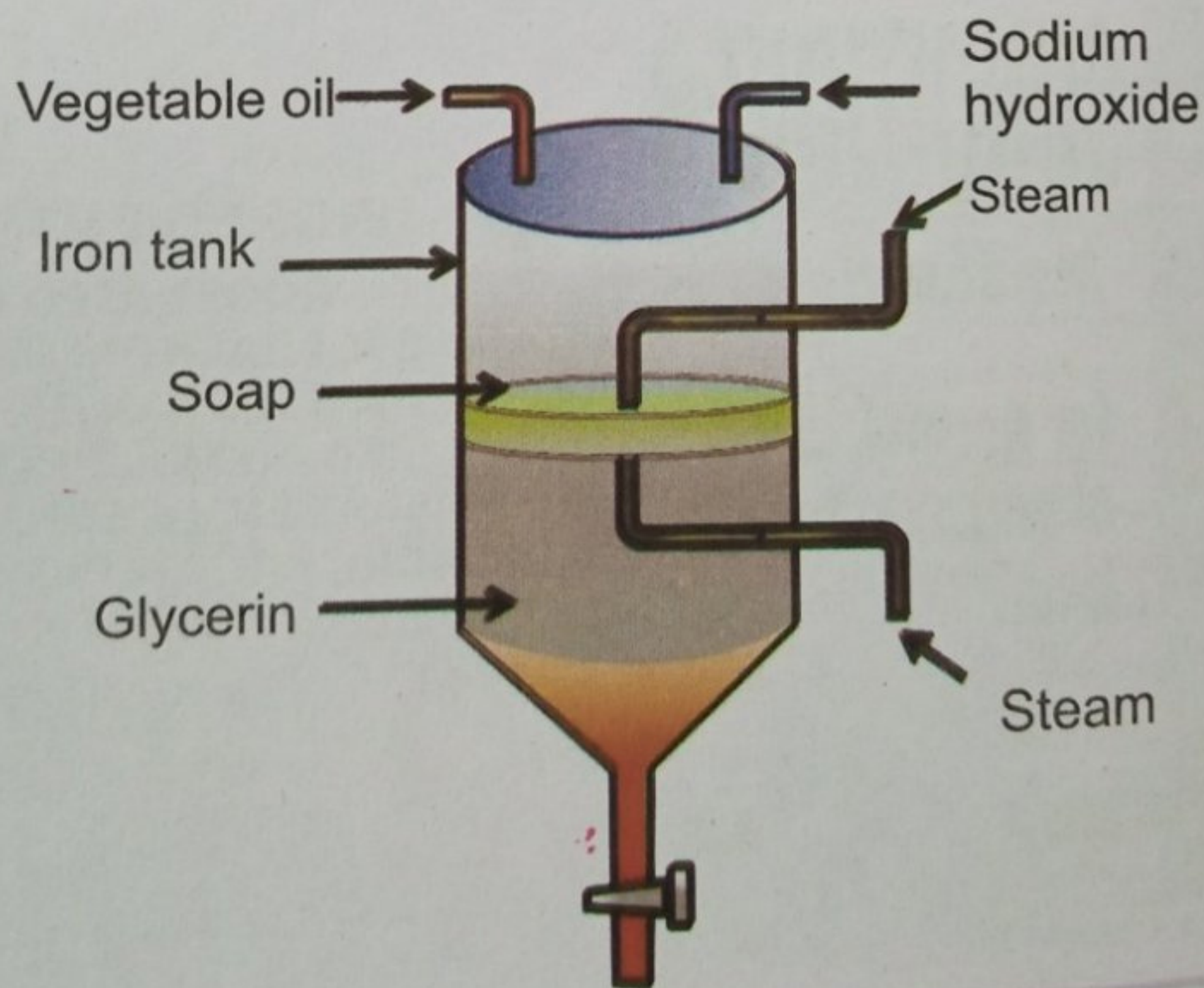


Fig: 7.7 Soap preparation tank.



FOR YOUR INFORMATION

Protective equipment such as rubber gloves, safety clothing, face mask and eye protection should always be used when handling Sodium Hydroxide or its solutions. Proper ventilation should always be used when handling or reacting Sodium Hydroxide. Sodium Hydroxide should be stored in airtight containers because it readily absorbs the water in the air.



In order to separate glycerin from soap sodium chloride is added to the soap mixture. Glycerin dissolves in sodium chloride solution. Being heavier than the soap, the glycerin solution settles down at the bottom. The soap floats at the surface. The glycerin solution is removed by opening the tap at the bottom of the tank. Thus, soap is separated from the solution mixture. Soap produced for commercial purposes contain synthetic lathering agents, artificial colors, and a range of chemicals. The molecules that are found in soap play a large role in the lathering process. In fact, soap molecule is actually made up of two parts, those that are attracted to water and others that are attracted to oil. When soap molecules and water are combined with friction, lathering usually occurs.

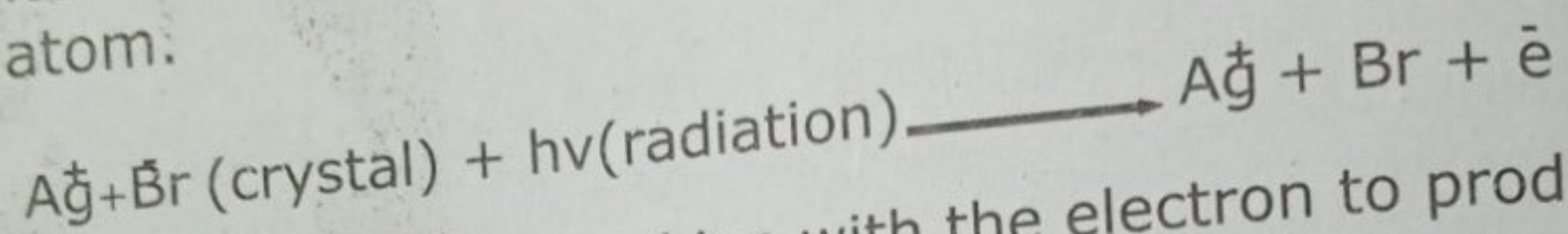
7.2 CHEMICAL REACTIONS IN TECHNOLOGICAL PRODUCTS AND PROCESSES

Chemical industries have an important role to play in the development of a country. It is the use of various chemical reactions which have resulted in the production of some of the vital products used in our daily life. Pharmaceuticals, sugar, fertilizers, synthetic fibers, cement, glass, paints, steel etc are some of the examples in this regard. In the following section you will study some of the important technological products and processes.

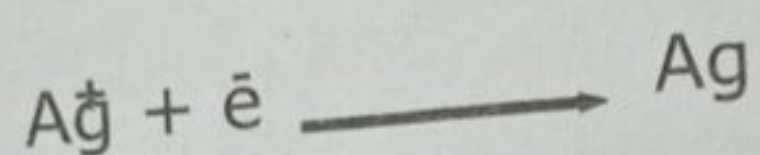


7.2.1 REACTIONS IN FILM PROCESSING

The photographic film on which image is to be produced is made up of silver halide salts, for example, silver bromide (AgBr). This compound is in the form of crystals. When light of a particular wavelength hits silver bromide crystals, chemical reaction starts and results in the formation of a free silver ion along with a free bromine atom.



The free silver ion can then combine with the electron to produce a silver atom.



In this process the free silver atoms produce a "latent image". This latent image is further refined in the development process. When an exposed film is placed in a developer solution, the grains containing silver ions are reduced much faster than those that do not. The more ions present in a given grain (i.e., the greater the exposure of that grain), the faster the reaction with developer and the darker the image at that site in the film.



Fig: 7.8 Steps in film processing.



Once the developed image is obtained, a large amount of unexposed and undeveloped silver halide remains in the emulsion. If that silver halide is not removed before the image is exposed to radiation capable of producing a latent image, the image will continue to darken. The process of removing the residual silver halide from the image is called "fixing," which is done by washing with Sodium thiosulfate before final print is obtained.

7.2.2 REACTIONS IN FOOD PROCESSING

Chemical reactions have an important role in the food processing industry. Processed food means a food transformed in a way suitable for better consumption and use. Sometime raw food items are not suitable for consumption. In food processing technique, food is fortified by the addition of vitamins and minerals. This improves its nutritional value. Sometimes addition of artificial flavors makes the food more tasty for consumption. A common example of food processing is the fermentation process which was first studied by Louis Pasteur. He demonstrated that during glucose metabolism yeast and certain bacteria can be employed in the formation of ethanol and carbon dioxide. Ethanol fermentation is used in the production of beer, wine and bread.

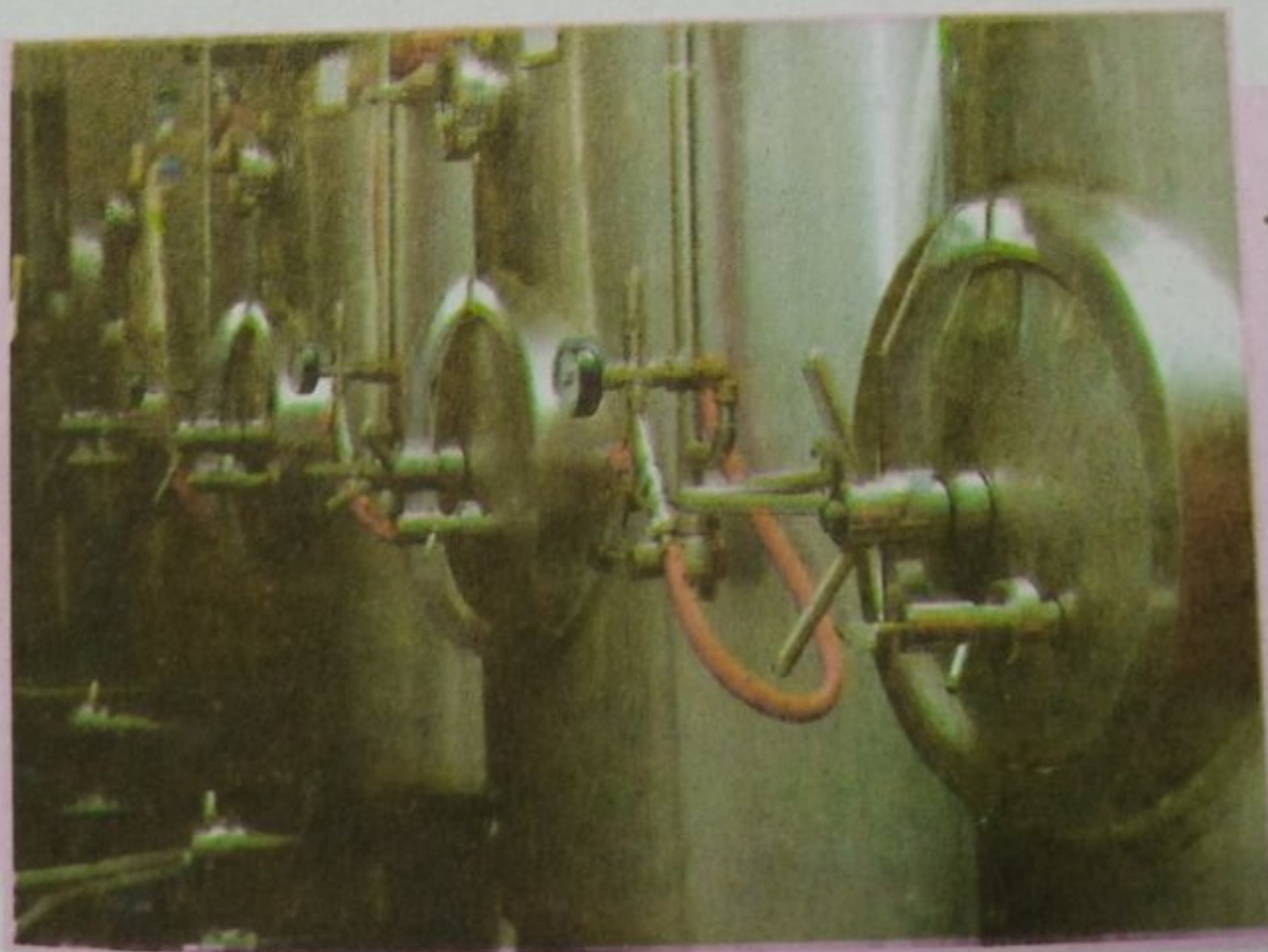
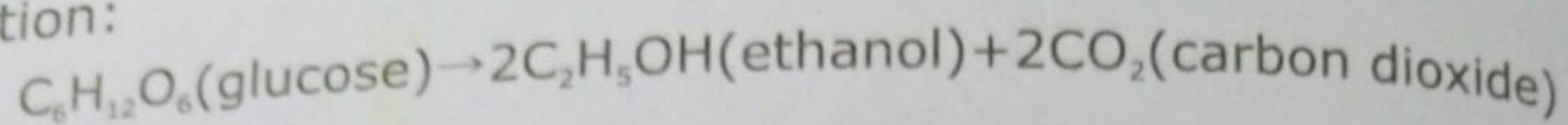
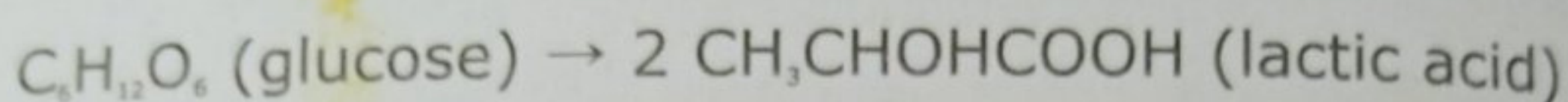


Fig: 7.9 Fermenters used in industries.

This process can be represented by the following chemical equation:



The pyruvate molecules from glucose metabolism also may be fermented into lactic acid. Lactic acid fermentation is used to convert lactose into lactic acid in yogurt production.



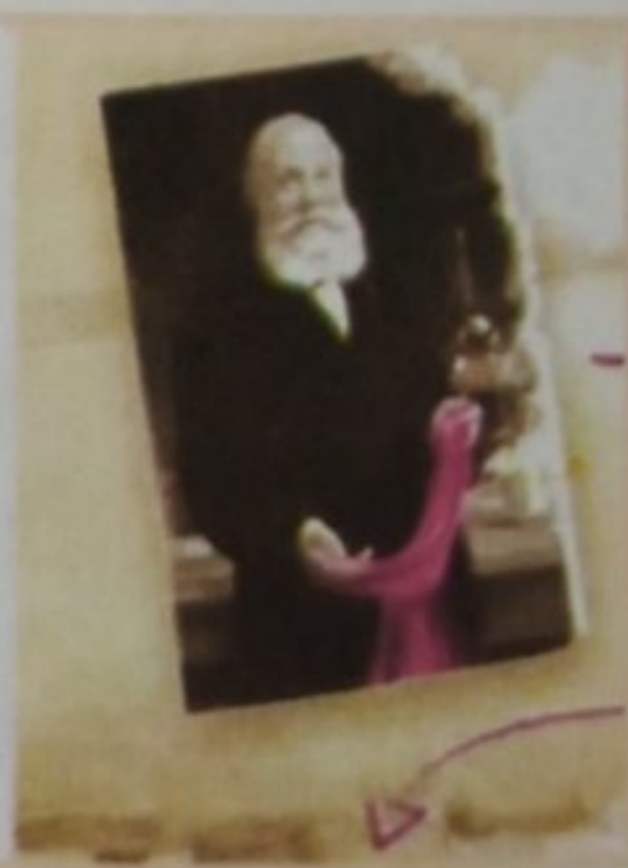
7.2.3 Fabric and Hair Dyeing

Different colours and shades are employed in the process of dyeing fabrics to make them attractive and beautiful. Technically dyes are molecules which absorb and reflect light at specific wavelengths to give human eyes the sense of color.

One simple way of dyeing is to add dye in water and dissolve it completely. Now immerse the fabric within the dye solution for some period of time. Dye being a chemical sticks and forms chemical bonds with fabric. The chemical nature of the dye and the material to be dyed both have role in the dyeing process.

TIDBIT

The first synthetic dye used, mauveine, was discovered in 1856 by teenage William Henry Perkin. He created this dye out of coal tar.



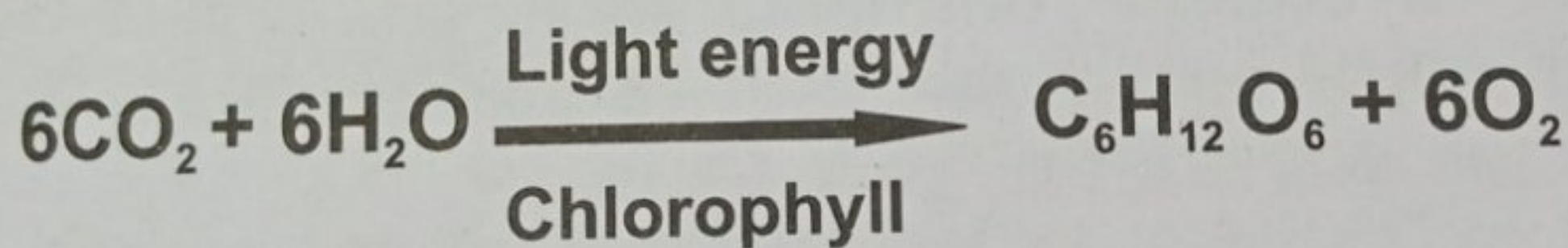
Biologically hair provide insulation from the atmospheric conditions. It is also an important aspect of one's personality.



Human hairs have natural colour and shades. From black to brown different types of colours are present. Although hair are mainly composed of a protein called keratin, the natural colour of hair depends on the ratio and quantities of two other proteins, phaeomelanin and eumelanin. Phaeomelanin controls the expression of golden blond, ginger, and red colors while eumelanin is responsible for brown to black hair shades. If one of these two proteins is lacking, hair colour turns white/grey. Hair dye provide every one with an option to gets hair dyed as per his or her desire.

7.2.4 AGRICULTURE

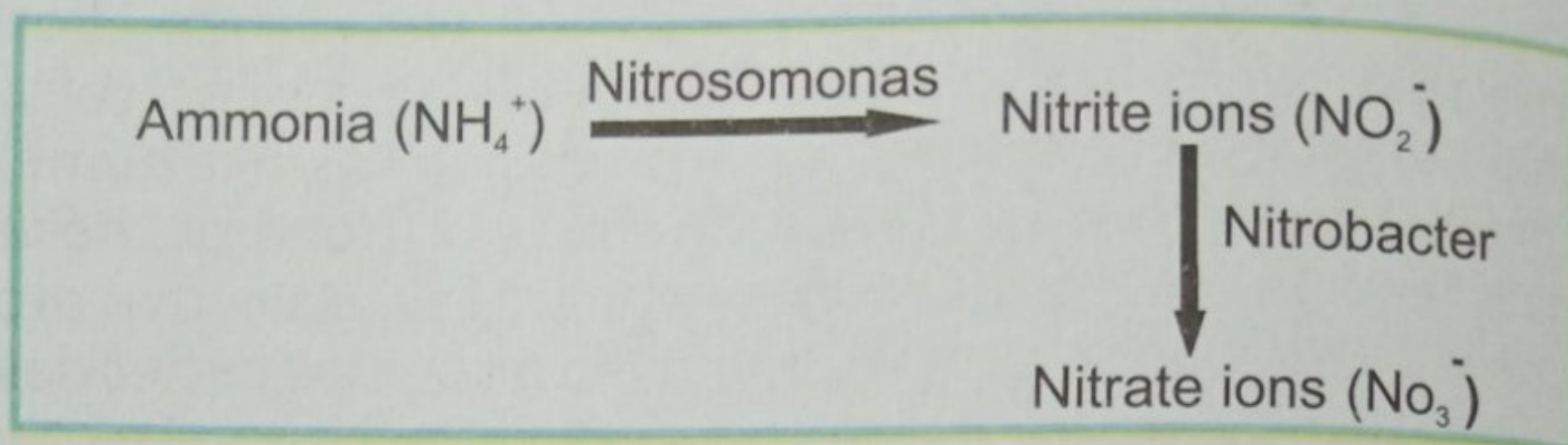
You have already studied the process of photosynthesis in the pervious section. Recall the chemical equation of the process. You will see plants convert six molecules of carbon dioxide and six molecules of water into one sugar molecule which provides the essential energy for different types of life activities and in the process releases six oxygen molecules into the atmosphere.



Plants need mineral nutrition for their growth and development. One of the essential element needed for this purpose is nitrogen. Plants are unable to consume free nitrogen present in the air. However, it is because of some vital chemical reactions which are helped by nitrogen-fixing bacteria that live in soil and in the roots of leguminous plants which ensure its availability to the plants in the form suitable for consumption.

These bacteria fix free nitrogen by using hydrogen ions found in the soil and form ammonia which is later converted to nitrite ions by

the action of bacteria like *nitrosomonas*. Nitrite is then converted to nitrate ions by *nitrobacter*, another kind of bacterium. Plants can use nitrate for their growth and development.



FOR YOUR INFORMATION

The German scientist Fritz Haber synthesized the nitrogen-fixing reaction, which earned him Nobel Prize in chemistry in 1918. Haber process combines nitrogen and hydrogen gases at high temperatures and pressures to create ammonia used in chemical fertilizers.



7.2.5 PULP AND PAPER

Paper is one of the useful products obtained from trees. It has multidimensional usage. In the field of publishing it has a vital role in the production of books, note books, play cards, dairies and other related items. In the packaging industry card boards and brown paper are also obtained from the paper industry. Chemicals and chemical reactions play an important role in the production of paper from its raw material.

Bark of the tree is first removed from the tree trunks and it is cut into small pieces. Then these pieces are put in solution of NaOH and Na₂S to remove lignin.



This material is heated in a pressure cooker where after sometime the pressure is suddenly released. This sudden release of pressure causes the wood pieces to fly apart into fibres. The material which is known as pulp is washed again treated with more NaOH in the presence of oxygen to remove any left over lignin. The fibres are bonded together and chemicals are added to make the paper water resistant and to give colour to the paper. From this material water is squeezed out and the pulp is rolled and dried. These rolls are further processed and paper is produced which is ready to be used for different purposes.

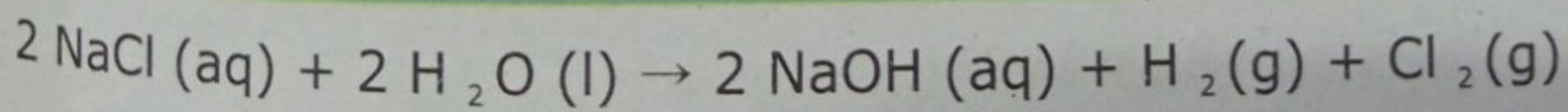


Fig: 7.10 Paper sheets.

7.2.6 MINERAL PROCESSING

Mineral is defined as any naturally occurring homogenous inorganic substance distributed in the earth crust. Chemical reactions are employed in the refinement and production of various useful products from minerals. For example gypsum or calcium sulphate dihydrate ($\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$) when ground into fine powder and this powder is heated at temperature between 150°C to 165°C , water content present in the gypsum is removed and hemi-hydrate plaster ($\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$), which is commonly known as the 'Plaster of Paris' is produced. This again changes into gypsum on adding water into it.

Sodium chloride commonly known as table salt occurs naturally as a mineral, also called rock salt. It can be processed into useful products with the help of chemical reactions. For example, chlorine and sodium hydroxide are manufactured by electrolysis of sodium chloride solution as shown in the following chemical reaction.



Sodium Chloride + Water $\Rightarrow$ Sodium Hydroxide + Hydrogen + Chlorine

FOR YOUR INFORMATION

◆ Careers Related to Chemical Reactions in Technological Processes

Knowledge of chemical reactions and chemical processes open a door of opportunities for growth in career. Following are some of the careers related to chemical reactions in technological processes.

◆ Film Developer

Film developers create photographic prints from raw film using chemicals, highly technical instruments and, in some cases, photographic processing machines.

◆ Food processors

Food processors work to turn raw goods into finished products for grocers, wholesalers, restaurants, and institutional food services.

◆ Textile dyeing technician

As a textile dyeing technician you would create dyes to colour fibres, yarns and fabrics.

◆ Agriculture

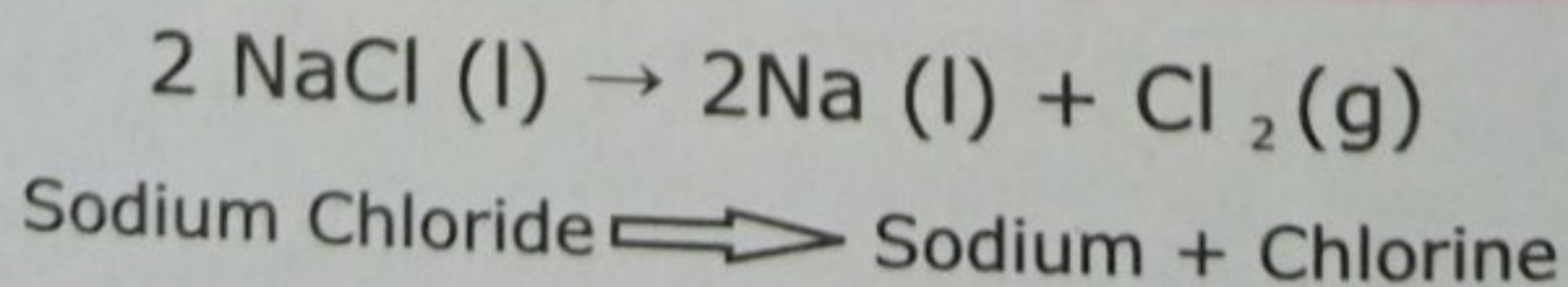
A degree in agriculture provides you with the knowledge and skills to manage agricultural businesses. Jobs include:

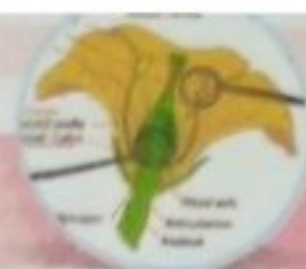
Agricultural consultant, Farm manager, Fish farm manager Soil scientist etc.

◆ Mineral Processing Operators

Mineral processing operators use equipment to process mineral ores until the final form or a concentrate is produced.

Sodium **metal** and chlorine gas results from the electrolysis of molten sodium chloride. This chemical reaction can be shown as:





7.3 Disposal of waste chemicals

Industrialization has brought tremendous economic development but globally people have to pay the price of this development in the form of environmental pollution. Consumption of chemicals and their products by the large industrial units and households have resulted in the generation of chemical wastes which pose great threats to the human health and environment. These wastes are known as hazardous wastes. Technically a chemical waste is regarded as hazardous waste if it is ignitable, corrosive, reactive and toxic. Hazardous waste is a serious threat if it is not properly managed or disposed. In Pakistan different types of industries produce large quantities of chemical waste which need proper management and disposal mechanism. Let's study various aspects of chemical disposal in Pakistan.

7.3.1 Methods of disposal of wastes in Pakistan

Like any other country in the world chemical industries in Pakistan generate large amounts of hazardous wastes. Unfortunately there is no proper mechanism and infra structure for the disposal of chemical wastes in Pakistan. The necessary infrastructure for the treatment, recycling and waste disposal facilities in the country are still in the developmental stage. In most cases hazardous wastes produced by the chemical industries are given to contractors who are least bothered about the safety precautions to be taken while dealing with such materials. So often these contractors release hazardous wastes in nearby water bodies, residential areas or cultivable lands from where these wastes manage their way to the food chain.



Fig: 7.11 A waste picker burns tires in order to retrieve wire to sell as scrap metal.

In tanneries and textile industries different types of chemicals are used in various processes. These chemicals include bleaching agents, toxic and inflammable solvents, acids and alkalis. These chemicals are not treated properly and most often these are discharged in the nearby water bodies or in open land. As a result the people living in such localities are becoming victim of several dangerous diseases including cancer.

7.3.2 Impacts and Safety Consequences of Chemical Disposal

Industrial chemicals have a profound role to play in the production of various useful products like soaps, detergents, fertilizers, pesticides, paints, varnishes, plastic etc. However, the processing and production of these products have been associated with the release of harmful chemicals which have become a source for serious diseases. Improper disposal of these chemicals are also contributing to the creation of different environmental problems like different types of pollution, improper storage and management of chemical wastes and accidents during the transport and distribution of chemicals affecting a particular ecosystem etc. Agriculture has a key role in Pakistan's economy. Use of fertilizers, pesticides, insecticides and herbicides is common practice in our farmlands. Most of the time these practices are not properly used and managed. In this way these are contributing in producing health and environmental concerns.

Development demands that proper planning must be done for safe disposal of these harmful wastes. In the following section you will study about the disposal mechanism of some of these wastes.



Fig: 7.12 Pesticides are excessively used in agricultural activities.



7.3.3 Effective Disposal Methods

Following are some of the effective disposal methods for hazardous wastes.

1. Reducing the use of hazardous materials

One of the option in minimizing the generation of hazardous waste is to minimize its consumption in different chemical industries. This in turn will generate less amount of hazardous waste.

2. Reuse and recycle

One of the effective strategies is to reuse and recycle the hazardous wastes if possible. Recycling is actually reusing materials in its original or changed forms rather than throwing them as wastes. This could ensure the safe disposal of the waste as well as it will be cost effective. For example acetone can be recovered from spent solvents, hydraulic fluids, used oils can be recovered from automobiles etc.

- ♦ Hazardous waste is produced from batteries used in automobiles. Lead-acid batteries also include batteries in motorcycles, emergency lighting etc. One of the safest ways of their disposal is to recycle them and reuse them. In Pakistan it is common to use recycled batteries in cars, and other automobiles.

- ♦ When rubber is reclaimed and recycled less energy is used than producing new rubber. Recovered rubber can cost half that of natural or synthetic rubber and the recovered rubber has some properties that are better than those of fresh rubber. At the same time recycling rubber would save the rubber tree plantations too. Tyres are one of the serious issue when rubber waste in landfill is concerned. At the international level rubber tyres are disposed by incineration, retreading, recycling or simply throwing in landfill. One of the better option for tyre recycling is the retreading where old tyres produce functional tyres.



Fig: 7.13 Retreading in process



- ◆ Plastic is used in various daily use products. Plenty of plastic waste is generated on daily basis in almost every home. The good thing about plastic is that it can be recycled and reused again and again. On the recycling center different types of plastic are separated from the pile. It is then processed for recycling. Recycled plastic could be used in the manufacturing of various daily use items. In this way recycling and reuse of plastic makes it sure that the waste plastic is not thrown in open spaces or in drainage lines.
- ◆ There are many metals which are used in packaging materials. Of these aluminium, tin and steel are widely used. Once used these are part of waste and are useless. But proper collection and processing through the recycling units can make these metals to be used again without compromising quality and strength.

3. Disposal of wastes in land based disposal areas

One of the easiest way for the disposal of hazardous wastes is to throw them in a landfill, waste pile, injection well or other land based disposal areas. However, this disposal method must be supported by proper precautions and necessary regulations which can help protect the people living adjacent to it. And this method must ensure that the environment and natural resources of that locality are safe and protected.



Fig: 7.14 Waste being dumped in landfill.

KEY POINTS

- ◆ A chemical change or chemical reaction is a process in which one or more substances are converted into one or more different substances.
- ◆ The starting substances used in the chemical reaction are collectively called reactants, while the final substances formed after the reaction are known as products.
- ◆ Indications of a chemical reaction include: a colour change, appearance of solid in solution, evolution of a gas and a change of temperature.
- ◆ Photosynthesis is the process by which green plants manufacture their own food.
- ◆ Iron combines with oxygen in presence of atmospheric moisture resulting in the formation of iron oxide (rust).
- ◆ Chemical nomenclature or scientific nomenclature is the term given to the naming of chemical compounds.
- ◆ Food label provides information about the food items present in a container.
- ◆ Proper labeling is an important aspect of marketing a cosmetic or personal care product.
- ◆ The reaction of acids and bases to form water and salts is called neutralization.
- ◆ Soaps containing sodium salts are formed by heating oil with aqueous sodium hydroxide solution in a reaction known as saponification.
- ◆ Chemicals are added to food for their preservation and processing, enhancing their appeal and adding nutritive value in them.

- ◆ Dyes are molecules which absorb and reflect light at specific wavelengths to give human eyes the sense of colour.
- ◆ The nitrogen fixation process breaks apart free nitrogen and combines nitrogen atoms with other substances to form compounds plants can use.
- ◆ Minerals are not found just lying around waiting to be picked up, but rather are embedded in rocks and combined with other elements.
- ◆ Hazardous wastes can be potentially harmful to both the health of humans and animals as well as to the environment.
- ◆ In Pakistan the chemical industries regardless of their size generate huge quantities of hazardous waste. But proper chemical waste disposal facilities do not exist.

EXERCISE

A. Select the correct answers of the following questions.

1. Which of these shows that a chemical reaction has taken place?

- a. Change in state
- b. Evolution of a gas
- c. Change in color
- d. All of these

2. What is rust?

- a. Sodium Oxide
- b. Iron oxide.
- c. Copper Oxide
- d. Silver Oxide.

3. In glucose metabolism the pyruvate molecules may be fermented into:

- a. Ethanol
- b. Carbonic acid
- c. Lactic acid
- d. none of the above

4. A chemical reaction involves:

- a. Only breaking of bonds
- b. Only formation of bonds
- c. Both breaking and formation of bonds
- d. None of these

5. Which among the following is not a chemical change?

- a. Melting of ice
- b. Soap making
- c. Rusting of iron
- d. Fermentation of substances

6. Formation of water needs:

- a. Hydrogen
- b. oxygen
- c. a spark
- d. All of them

7. Retreading is used for the recycling of:

- a. Car batteries
- b. Motor oils
- c. Tyres
- d. Metals

8. Chemical name of Vitamin C is:

- a. Ascorbic acid
- b. Magnesium silicate
- c. Acetylsalicylic acid
- d. Sodium bicarbonate

B. Write short answers of the following questions.

1. Recognize those characteristics which indicate that a chemical reaction has taken place.
2. How iron get rusted?
3. Write the common names of four chemical compounds along with their scientific names.
4. Define saponification reaction.
5. What do you mean by fermentation process.

C. Write detailed answers of the following questions.

1. What do you mean by the term scientific nomenclature? Explain it with examples.
2. How soap is prepared from oil and sodium hydroxide?
3. Relate chemical reactions to familiar processes encountered in everyday life.
4. List the methods of chemical disposal and briefly describe each method.
5. Describe how old tyres can be recycled and reused.
6. Explain the impacts and safety consequences of chemical disposal in Pakistan.