
UNIT 16 THE CHANGING ENVIRONMENT

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16.1 INTRODUCTION

The early human was a nomad, and he spent a lot of time in search of food. He was close to nature because his existence depended directly on plants and animals. He, then made the leap from hunting and food gathering to farming, creating conditions of living in small village communities. If we compare the life of early man with that of today, we find a tremendous difference. Today, most of the people are better off, in regard to food and other basic necessities of life. There is production of goods and provision of services of various kinds for health and communication etc. Much of it has been made possible by the application and improvement of technology. Man has constructed dams on rivers; cut down forests, ploughed land and grown crops; built towns, cities, canals and roads. No doubt, all these developments have made his life easy and comfortable, but in the process he has altered his environment, and often short-sightedly or even recklessly damaged it. Today, there is clear evidence of man induced harm in many regions of the earth such as: the dangerous levels of pollution in water, air and soil; the disturbances in the ecological balance of the biosphere; and the destruction and depletion of irreplaceable natural resources. There is, therefore, need to identify the areas and causes of the degradation of environment that have occurred over the years, so as to take steps to preserve the heritage of mankind and live in harmony with the environment. In the previous two units you have studied the basic components of the environment and their relationship. In this unit, we would briefly touch upon a few problems of global concern regarding our environment.

Objectives

After studying this unit you would be able to:

- define pollution, and list the sources and effects of primary air pollutants
- describe how photochemical smog and acid rain are formed, and how they affect the living beings
- list the major sources of water, soil, noise and radiation pollution and describe their impact on environment
- realise how technology, over the years, has contributed to the degradation of environment
- understand the reasons for tremendous increase in population in our country and the role education can play in finding a solution.

16.2 POLLUTION

Now-a-days, you might have heard every one talking about pollution. What does pollution mean? Pollution is the addition to the environment (air, water, soil) of substances or energy (heat, sound, radioactivity, etc.) at a rate, and in quantities that are harmful to life.

Pollution has a long history. It became noticeable when larger and larger numbers of people began to live in cities. Unplanned growth of the cities led to difficulties in the disposal of garbage and sanitary wastes. Living space was often shared with animals as is sometimes done in India even now. Mud, slush and dusty roads added to the pollution. Air, water and soil, acquired many harmful substances, in the form of wastes, from human activities.

The waste materials (pollutants) that cause pollution are of two types:

- i) those that remain in an unchanged form for a long time and are known as **persistent pollutants**, e.g. pesticides, nuclear wastes, and plastics etc. Many of these are toxic;
- ii) those that **break down, into simple products, and are known as non-persistent pollutants**, e.g., garbage. If this break down process is facilitated by living organisms, then such pollutants are referred to as **biodegradable pollutants**, e.g., wastes from animal sheds.

Pollution has disturbed the ecological balance in so many ways that can be disastrous for mankind. Presently, we have reached a stage where we must begin to protect our environment in order to protect ourselves. In the following pages, you will study how different wastes have entered into air, water and soil, and how noise and radiation have caused immense damage to our environment, and ultimately to us.

16.2.1 Air Pollution

Air pollution is one of the major problems created by modern man. It is estimated that about 100 million tons of waste are poured into our atmosphere each year. Wastes in the form of smoke from industry, power plants, automobiles and homes; and also due to burning of fossil fuels, spread pollution into our atmosphere (see Fig. 16.1). Aircrafts also release large amounts of burnt or unburnt fuel into the air. You may have seen a long trail of smoke left behind by a climbing jetliner.

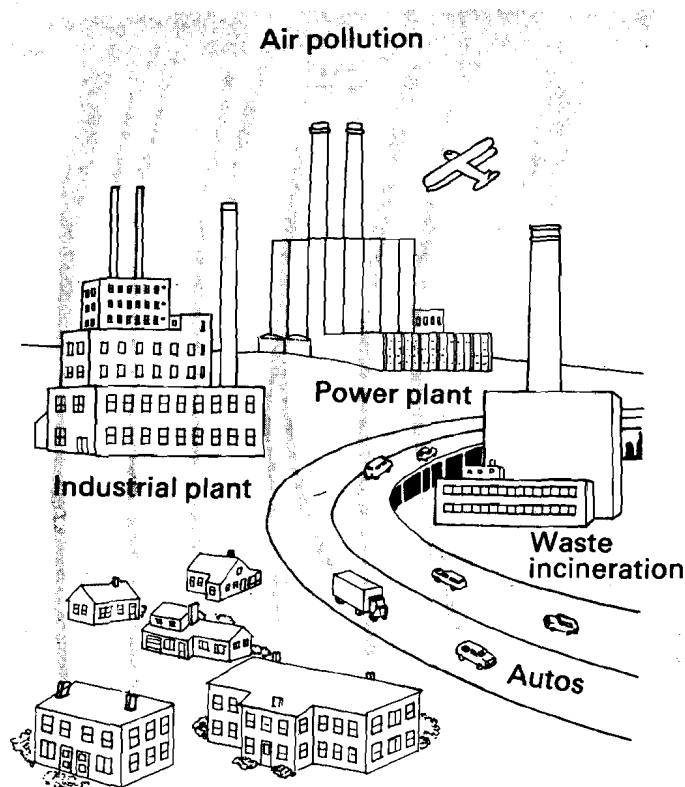


Fig. 16.1: The causal agents of air pollution in most cities.

The burning of coal, wood, diesel oil, kerosene, petrol etc. produces the following five categories of pollutants:

- i) Carbon monoxide
- ii) Hydrocarbons
- iii) Particulates

iv) Sulphur dioxide

v) Nitrogen oxides

These five categories of primary pollutants react with one another, producing secondary pollutants that are even more dangerous to animal and plant life. First, we shall discuss each of the primary pollutants separately.

Carbon monoxide is produced when organic materials such as gasoline, coal, charcoal, and trash are incompletely burnt. Virtually all stoves, furnaces, fires in open places and forests, factories, power plants give off carbon monoxide. The other significant source is from the incomplete burning of tobacco when smoked. This gas combines with hemoglobin, and reduces the oxygen carrying capacity of blood, causing blurred vision, headache, and in extreme cases, unconsciousness, and even death.

Automobiles emit a variety of **hydrocarbons**. These are a group of organic compounds consisting of carbon and hydrogen. They are either evaporated from the fuel or are the remnants of fuel that did not burn completely. Hydrocarbons in air, are washed down by rains, and eventually they run off into surface water. They form an oily film on the surface of water. Hydrocarbons are mostly only a nuisance except when they react to form secondary pollutants.

Particulates constitute the third category of air pollutants. These are mostly fine carbon particles (less than 0.002 mm in diameter) formed by the combustion of fossil fuels. They remain suspended in the air, where they absorb other substances such as lead, hydrocarbons, sulphur and nitrogen oxides. These particles enter the lungs during breathing and increases the chances of lung cancer, and other respiratory diseases. Diesel automobiles and trucks emit between 30 and 100 times more carbon particles than other vehicles. Asbestos is also an air pollutant in the form of particles that enter the atmosphere from asbestos mining and milling operations and from the manufacture, disposal and use of asbestos containing products such as insulation devices. Asbestosis, a cancerous disease caused by deposition of asbestos in the lungs, is widely prevalent among the people working with this material. Several miners are known to have died in Singhbhum, Bihar due to this disease. Recently, this disease has been classified as a killer disease under the Factories Act.

Silicosis, another cancerous disease caused by deposition of silica in the lungs, is prevalent among the people working in the mining, potteries, foundries, stone cutting and finishing, and glass manufacturing industries. It is also a fatal disease.

The air in most of the urban areas in India has a very high level of particulates. In fact, an unpleasant haze of dust and smoke particles has become almost an integral part of our urban environment. For example in cities like Delhi and Bombay, during rush hours in the mornings or evenings, it becomes difficult to breathe if you are caught for long at traffic crossings. There is so much of vehicular exhaust fumes.

One of the most harmful pollutants is **sulphur dioxide**. It is a compound containing sulphur and oxygen and is produced when fossil fuels contaminated by sulphur are burned. Sulphur dioxide has a sharp odour and irritates the respiratory tissues. It also reacts with water, oxygen and other materials in air to form sulphur containing acids. The acids also become attached to particles in the air. When, inhaled, such particles are very corrosive to lung tissue. Sulphur dioxide also adversely affects the plants and reduces their growth. Steel gets corroded 2 to 4 times faster in sulphur-laden air. Sulphur dioxide also corrodes other metals like zinc as well as building stone.

Oxides of nitrogen are also major primary air pollutants. As a result of a variety of combinations of nitrogen and oxygen, a number of compounds, oxides of nitrogen, are formed. The primary source of nitrogen oxides is automobile engines. Oxides of nitrogen react with other compounds to produce photochemical smog which we will describe now.

Photochemical Smog

Photochemical smog, a secondary Pollutant, results when the two pollutants, nitrogen oxide and hydrocarbons found in automobile exhausts, react with one another in the presence of sunlight to produce nitrogen dioxide (NO_2), ozone (O_3) and a compound called PAN (Peroxylacetyl nitrate), which then appear as a yellowish brown haze. Breathing ozone affects the respiratory and nervous system. It causes respiratory distress, affects eye membranes and stimulates tears. It also causes headache. Ozone also damages rubber articles, textiles and discolours paintings. It has been recently found that smog is harmful to timber. PAN is especially damaging to plants. Plants exposed to PAN exhibit leaf mottling and

Acid Rain

A side effect of air pollution is acid rain, which is now of common occurrence. You might have seen, that some industries build very tall smoke stacks to protect the air quality in their immediate vicinity. But this allows wind currents to carry the fine particles that have absorbed sulphur dioxide and nitrogen oxides to far off places. Sulphur dioxide and nitrogen oxides react with water in the atmosphere to give rise to sulphuric acid and nitric acids.

These acids, formed in the air, come down to the earth along with rain. The pH of acid rain depends on the concentration of sulphur dioxide and nitrogen dioxide in the atmosphere.

The pH of acid rain varies from 5.6 to as low as 3.0, which makes it almost as acidic as vinegar (also see Fig. 16.2). The pH of natural rainfall is also slightly acidic and is 5.6. This is because rain water reacts with carbon dioxide in air and forms weak carbonic acid.

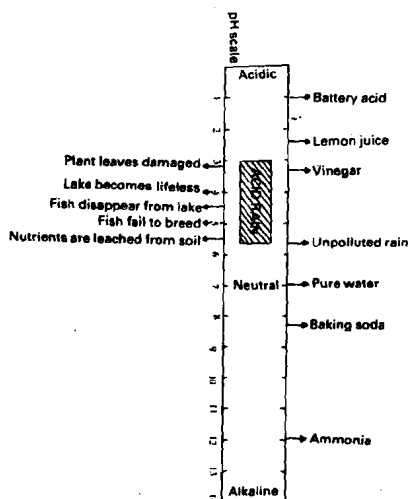


Fig. 16.2: pH scale showing the range of acid rain (see the shaded region). The top scale indicates the pH of various substances, and the lower scale indicates the effect of acid rain on the ecosystem.

Now let us see the effects of acid rain on the ecosystem. It causes direct damage to the leaves of plants. Forests in many parts of the industrialized world are drying because of acid rain. It also causes the leaching of nutrients out of the soil, some of which are very essential for plant growth, e.g., calcium and magnesium. These nutrients are carried out of soil into streams and ponds. Besides this, it causes a lot of other effects, as indicated in Fig. 16.2. Acid rain also affects lakes. Their waters become devoid of life, except for some algae and fungi that grow at the bottom. Acidity leads to increase in dissolved metals, particularly aluminium. This element affects the gills of the fish, and they die of suffocation. Birds living near lakes that have high aluminium content, are poisoned by aluminium because they feed on the aquatic insects. Acid rain also corrodes materials such as marble stonework and metals.

Then, how could one minimise the occurrence and the effects of acid rains? Most of the sulphur dioxide produced, that leads to acid rain, is due to the burning of sulphur-containing coal. Coal, therefore, could be washed prior to burning. Low sulphur coal could be substituted for high sulphur coal. Devices such as scrubbers could be installed in tall chimneys of furnaces to prevent sulphur dioxide from entering the air. A new method of burning coal in which a mixture of coal and limestone are used, is now under development. This technique could reduce the emission of sulphur and nitrogen oxides. Experiments have been done to restore the lakes, streams and soils that have been affected by acid rain. Lime is added to lakes and in fields where soil becomes too acidic. But it helps only for a short time and does not completely solve the problem. However, limestone cannot be spread in the forests. So, don't you think, the most effective solution is to reduce the emission of sulphur and nitrogen oxides from all devices that produce them?

Weather

Scientists have reason to believe that air pollution, both due to carbon particles or soot and carbon dioxide would affect weather. A rise in surface temperature of land and water due to, what is called, the **greenhouse effect** is predicted.

When sun's rays fall on the atmosphere containing carbon dioxide, some of the heat is reflected towards the sky but much of it passes down to the earth. Heat from the earth enters the atmosphere and some of it is again reflected back to the earth, while the rest passes through the atmosphere. Thus, the surface of the earth, i.e., the surface of land and water are net gainers of heat during the day, and this establishes a certain temperature on the surface of the earth. If the amount of carbon dioxide in the air increased, the net gain of heat and

The strength of acids and alkalies is measured on a pH scale which goes from 0 to 14 and on which pure water which is neither acidic nor alkaline stands at the neutral, i.e., pH 7. Substances having pH less than 7 are acidic and those having pH more than 7 are alkaline.

hence temperature on the earth would be greater. The earth would warm up in such a case. A greenhouse is a glass house often used in cold weather to grow plants of warmer climates and it works on the same principle. The greenhouse has glass walls, and the glass prevents all the heat inside the house from being lost to the atmosphere. You would, perhaps, have experienced the inside of a closed car parked in the sun becoming unbearably hot. The reason is the same.

Since 1958, the concentration of carbon dioxide in the atmosphere has risen by almost 6 per cent and is expected to increase in future. What leads to the increase in carbon dioxide level in the atmosphere? We shall discuss that now. You have already studied in Unit 14, that plants take up carbon dioxide and use it for making food. Forests comprising of enormous vegetation remove a lot of carbon dioxide from the air. The destruction of forests significantly increases the proportion of carbon dioxide in the atmosphere. The burning of fossil fuel by industry and transport vehicles also keeps adding carbon dioxide to the air. Thus, there is a continual build up of carbon dioxide in the atmosphere. If the present trend continues, it is feared that a doubling of atmospheric carbon dioxide could occur sometime towards the middle of the next century, and this would cause an average annual temperature rise of 3 to 8°C. This rise in temperature could have a disastrous impact on all life. It will affect agriculture, resulting in problems in the availability of food and other agriculture-based activities. Melting of polar ice would result in the rise of sea level. This could submerge many coastal areas and farmlands. It is feared that cities like London, Glasgow, Florida, Tokyo, Osaka, Montreal, Stockholm, Copenhagen and Calcutta would lose much of their territory to the rising waters.

Another scenario has also been predicted, i.e., the earth's temperature will be lowered because of the increasing number of suspended particles in the air, coming not only from soil erosion and dust but also because of soot and smoke from industries, fires in forests, automobiles or from bombs and other weapons used during hostilities and war. The clouds of suspended particles would prevent solar heat from reaching the earth and thus lower the surface temperature of land and water. It has, indeed, been calculated that if even a small fraction of nearly 50,000 nuclear bombs in the possession of the USSR and the USA are used in an unfortunate war, so much debris, dust and soot will be thrown up in the atmosphere from burning of fuel dumps, buildings, bridges and other objects, that solar heat will be shut off from the earth for a considerable period causing, what is called, a **nuclear winter**. The cold will destroy crops and vegetation and starve and kill all animals everywhere on the planet earth. No wonder, people everywhere in the world are agitated and look to the great powers to solve their disputes peacefully. The first step towards this would be to destroy the nuclear weapons in stock and stop their production.

Depletion of Ozone Layer

Since the last decade or so, there is concern about the possible reduction in the ozone layer surrounding the earth. Now the question arises, what had led to the depletion of this layer. The reasons are many. The foremost is the widespread usage of chlorofluorocarbons. These are gases which readily liquify when compressed. This makes them useful as refrigerants, propellants in aerosol cans, and in plastic foams. Chlorofluorocarbons are very stable and accumulate in the atmosphere, where they react with ozone. Nitrogen oxides also play a significant role in ozone destruction. It is being felt that the introduction of more nitrogen oxides into the upper atmosphere by jet planes flying there could decrease the ozone to dangerously low level.

The fear is that chlorofluorocarbons will deplete the ozone layer and allow more ultraviolet radiations to reach the earth's surface. An increased level of ultraviolet radiations would cause more skin cancer, affect crops, interfere with oxygen cycle and even distort weather patterns.

Controlling Air Pollution

So far, you have studied, how air pollution of various kinds is caused, and what are its effects. Now let us see, how air pollution can be controlled.

- i) Photochemical smog—eliminating this would require large scale changes in life style and culture. Life has become fast, and quicker modes of transport are preferred. Every year hundreds of thousands of vehicles are added to the existing large number of automobiles. So the net result is an increased production of oxides of nitrogen, and the photochemical smog. The alternative is to develop transport of a very different kind, perhaps electrically operated cars and two wheelers rather than those burning petrol, or to make the automobile industry develop devices that could be fitted to the vehicles to minimise the discharge of pollutants.

- ii) Particulates generated largely by industries, can be controlled by scrubbers, precipitators, and filters. These devices cost money but they save lives. So far, owners of industries have thought only of cost and profit. They have not cared as to what happens to plants and animals that are exposed to the soot and smoke which their factories pump into the air.
- iii) To control sulphur dioxide, which is produced largely by coal furnaces and coal-fired steam generators, several possibilities are available. One is to change from high sulphur to low sulphur fuel, such as natural gas, oil or nuclear fuel. This is, however, not a long term solution, as low sulphur fuels are in short supply and nuclear fuels have problems of their own. The other possibility is to remove sulphur from fuel, before use. Scrubbing the gases is the third alternative you have studied about it earlier.
- iv) The amount of smoke emanating from the kitchens can be minimised by the use of **smokeless chulhas, solar cookers and biogas**. These have dual advantage. One, they are within the easy reach of people and secondly, there is minimum pollution.

So you can see, air pollution is related to technological development and industrialisation. Technologies were available in the past to speed up transport or to release the energy of fossil fuels for increasing production. There was little concern about the pollution that was caused, until the use of technologies became more widespread and the hazards became too great to ignore. But for the poorer countries, air pollution means many other things. The housewife who burns cowdung or dry leaves or splintered wood to cook food is exposed to intense heat and smoke. It is known that a lot of people, particularly in rural areas, go half-blind due to such exposure. People live in very dusty atmospheres—again very much so in rural areas, and their lungs often get damaged. Those working in mines and small workshops are exposed to air, that contains substances which irritate the breathing system causing disease, and often, early death. Air also carries foul odours, flies and mosquitoes which make life unpleasant and cause communicable diseases. Our priorities in combating air pollution have to be intelligently determined. Perhaps, it can be said that the greatest hazard is poverty which obliges people to live in dirt and squalor and work under conditions, to which, even animals should not be exposed.

Before we proceed further, how about trying a couple of SAQs first?

SAQ 1

Fill in the blank spaces in the following statements with appropriate words given below:

- a) is anything produced by humans in a quantity that interferes with the health or well-being of organisms.
- b) The main primary pollutants are,,, and
- c), and constitute the photochemical smog.
- d) causes leaching of nutrients from the soil; and increase in the quantity of certain metals such as aluminium that dissolves in water and may prove toxic to many organisms.
- e) Increased in the atmosphere may contribute to the greenhouse effect and may lead to an overall of earth's temperature.
- f) Activities like emission of into the upper atmosphere by jet planes and wide spread use of in refrigeration, have adversely affected the ozone layer in the atmosphere.

(carbon monoxide, chlorofluorocarbons, ozone, sulphur dioxide, pollution, hydrocarbons, peroxyacetyl nitrate, particulates, acid rain, nitrogen oxides, carbon dioxide, nitrogen dioxide, warming, nitrogen oxides).

SAQ 2

List three health effects of air pollution.

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16.2.2 Water Pollution

Pollution of fresh water is one of the most serious environmental problems of the world as a whole. In our country most of the rivers and lakes are polluted and their waters are unfit for drinking. According to an estimate nearly 2/3rds of all illness in India is related to water - borne diseases such as typhoid, hepatitis, jaundice, cholera, diarrhoea and dysentery. About 73 million workdays are lost due to these diseases every year. Pollutants from different sources enter surface waters as depicted in Fig. 16.3. Now we shall take up these sources one by one and discuss how they cause pollution.

- i) Water is required in large quantities in industrial processes, for cooling, washing, diluting chemicals or cleaning purposes. Power plants, fertiliser factories, steel mills, paper mills, refineries, sugar factories and automobile factories are examples of industries which mostly dump their wastes in rivers or into the sea. It is not a rare sight to see the used water with foul smelling chemicals just standing around the factories as a symbol of total disregard of civic responsibility.
- ii) Community wastes (sewage and garbage) from urban and rural settlements account for four times as much water as industrial wastes. Most of these wastes are discharged untreated into the water courses. Out of India's 3119 towns and cities, only 217 have partial (209) or full (8) sewage treatment facilities. It is not unusual to find whole localities where waste water, with all its filth, just stands around the houses where poor people live.
- iii) Water that flows on the surface of cultivated fields where fertilisers, pesticides, insecticides and other agrochemicals are used, contributes much to the pollution of water. This water, on absorption also pollutes the underground sources.

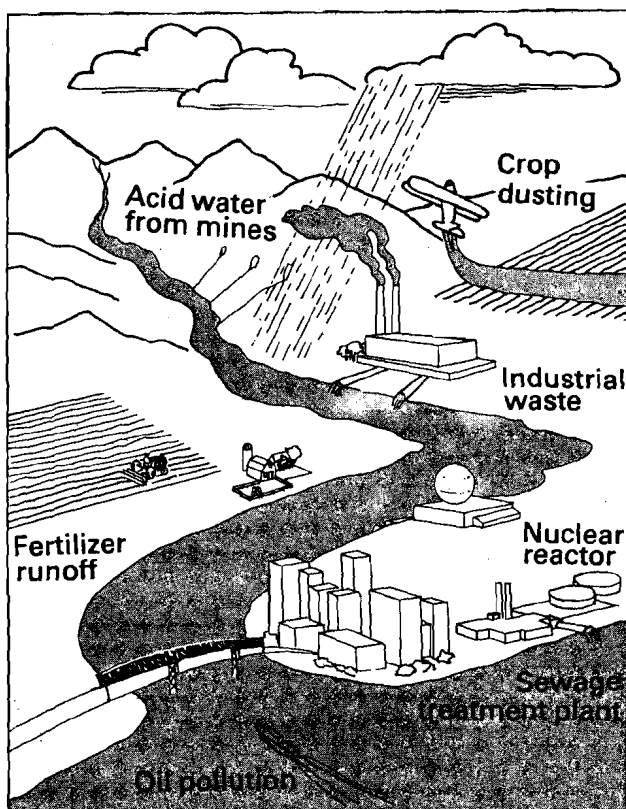


Fig. 16.3 : Human beings bring about water pollution in many ways as shown here.

- iv) Nuclear and thermal power stations use large quantities of water for cooling purposes. They discharge the resultant hot water often containing chemicals, into water streams. This results in increase in temperature of the water of the stream, which is injurious for fish, and other aquatic organisms.
- v) Pollution of river water by ferries which leave a certain amount of oil on river surfaces and similar pollution by ships on the high seas interferes with the supply of oxygen needed for plants, and animals such as fish etc. in water. Offshore exploration for petroleum, and accidental oil spills cause similar problems for under-water life.
- vi) Acid water from mines, and also from rain pollutes water in rivers and in the sea.

- vii) Suspended particles in the air, such as the pesticides sprayed through an aircraft are brought down into the water bodies by rain and thus cause pollution of water.

So far, you have seen, how water on the surface of the land is polluted by various means. Now, let us talk about our underground water resources and see if they are free of pollution. Ordinarily one would expect underground water to be free of pollutants, because bacteria and decay-causing fungi present in the soil can remove most organic contaminants before water reaches the water body underneath the soil. But sometimes, the underground water is polluted with heavy metals, nitrates, chlorides etc.

You may wonder how do pollutants enter the groundwater? Previously, industries were accustomed to running waste waters to pits. There the pollutants would seep into the ground. Also some of the wastes, were buried in deep wells made in the soil, from which pollutants were constantly discharged. Another reason is excessive use of fertilisers in the fields, which gradually seep down to the ground water.

Having seen how our water resources both on surface and underground, are polluted, we shall now discuss the effects of **water pollution** on the life forms. Some of the worst problems have been created by pollution of streams with heavy metals such as lead and mercury coming out of industrial wastes. These pollutants make bathing and drinking water from such sources dangerous. Fish from such sources are also not safe to eat.

Mercury, especially, is a heavy metal that builds up in the food chain. Industrial activities such as mining, paper making, manufacture of electrical equipment, have increased the concentration of mercury in the aquatic environment. Mercury is not easily excreted. Once it enters the food chain its concentration goes on increasing at each level. For example, from plants → large fish → human beings. In countries like Japan which depend largely on fish and other sea food, there is a distinct danger of mercury poisoning resulting from the industrial discharge into the sea. In the 1950s an outbreak of mercury poisoning in Japan raised awareness of the hazard. Residents who ate sea food from Minimata Bay that had been contaminated with methyl mercury developed numbness of the limbs, lips and tongue and lost muscle control. Deafness, blurring of vision, clumsiness, apathy and mental derangement also occurred. Of the 52 reported cases, 17 people died and 23 were permanently disabled.

Pollution due to oil and petroleum products from refineries, drilling and pumping operations, shipyards and oil spills, have destroyed wildlife and made water unfit for use. Many of the sea birds die, because their feathers get soaked with oil, and they lose buoyancy and hence get drowned. Thermal pollution is caused by the addition of heat to a body of water. Power plants and other industry use water to cool their machinery. Then they discharge the heated water back into a stream or lake. This changes the temperature of nearby water environment and may kill many of the aquatic plants and animals that are less tolerant.

Eutrophication

Materials such as sewage or organic wastes from milk plants, canneries, slaughter houses, paper mills, starch factories and fish processing plants, and runoff from agricultural lands greatly increase the productivity of waters and cause algae to grow in abundance, so that sometimes water surface gets entirely covered by algae. This is called 'algal bloom'. In general, the entire water body becomes a green nourishing soup. Eventually, the death of this algae promotes the growth of a very large 'decomposer' population. The decomposers break down the dead algae using a lot of oxygen present in the water. In addition, the living algae also consume oxygen from water at night for their respiration. The decomposers, and the algae cause decreased amounts of oxygen available to fishes, ultimately causing them to die. The problem of eutrophication or excessive nourishment leading to loss of life in water bodies mainly occurs in ponds and lakes and not in flowing water.

Now the question arises what is the solution to this problem? One solution is to process the sewage thoroughly, to remove nutrients to prevent 'algal bloom'. Since such a treatment is expensive, other ways are being explored. One suggestion is to use this water to irrigate crops and/ or to grow algae and aquatic plants in a man made shallow pond which can be used for making biogas.

SAQ 3

Fill in the empty spaces picking up the right word(s) from the list given below.

Major sources of water pollution are and Organic

matter in water requires high amount of for its decomposition. depletion can result in the death of fish along with many aquatic organisms. Many of the pollutants such as organic matter, some industrial wastes etc. enrich the water with, and result in Algal blooms occur in the, polluted waters.

(oxygen, municipal sewage, nutrients, industrial wastes, eutrophication, non-flowing, oxygen, agricultural runoff.)

16.2.3 Soil Pollution

The problem of soil pollution is rapidly increasing in the rural, urban and industrial areas due to unscientific and irrational disposal of solid wastes generated by human beings from their domestic and industrial activities. In many rural parts of our country, daily thousands of people pollute the soil through their wastes, as toilet facilities are not available. In industrial areas heavy metals, plastics and other persistent organic compounds including pesticides, are the major causes of soil pollution. Hazardous wastes in soil, often accumulate in the bodies of organisms including man, because they are not excreted. Once they enter the food chain, they become more concentrated at each level. Note in Fig. 16.4, how DDT, a pesticide, becomes more concentrated as it passes along from producer to consumers. The story of DDT is one everybody should know. It was once a widely used pesticide. It is a substance that does not easily break down. It can persist in the environment for as long as fifteen years. It enters birds through the organisms they feed on which in turn get it from the organisms lower in the food chain (see Fig. 16.4). When a high concentration builds up in birds, their reproductive systems are affected. As a result they lay fragile eggs that easily break in the nests. Similarly other pesticides are also major soil pollutants, because of their retention in soil. The pesticides not only kill the targeted pests, but also kill many harmless and even beneficial insects. They cause more harm than benefit. Therefore, DDT and many such agrochemicals have been banned in many parts of the world.

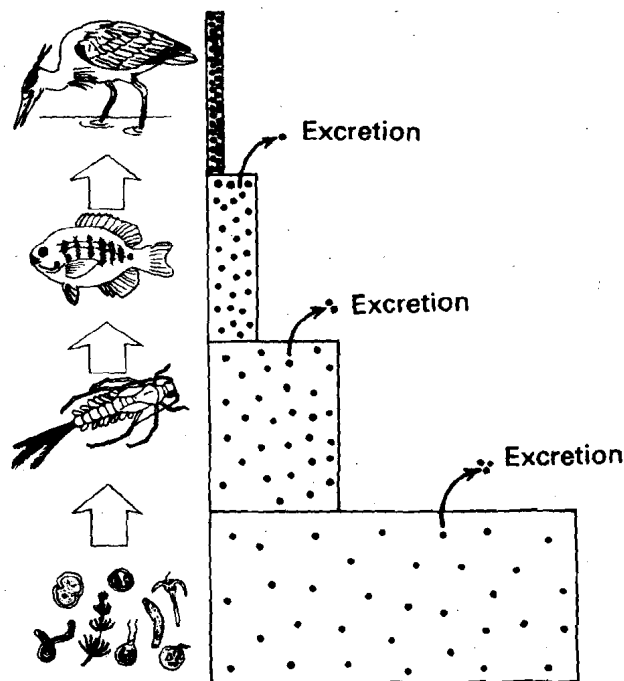


Fig. 16.4: The accumulation of DDT in living organisms. Dots represent the density of accumulation.

What should be done to minimise soil pollution? First of all, in India, the use of open fields and banks of ponds and tanks as open toilets should be stopped, by providing latrines. Care should be taken while dumping wastes in the soil. Substances such as heavy metals, plastics and other substances that remain unchanged for very long time should not be added to the soil. Instead ways should be found for their reutilisation by various recycling processes. Utmost care should be taken so that the minimum necessary pesticides or other agrochemicals are used. In fact, biological control of pests and fixation of nitrogen should be urgently developed by research, so that dependence on widespread use of toxic chemicals is reduced.

SAQ 4

Name three common soil pollutants.

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SAQ 5

List the ways in which the soil pollutants harm the living beings? Complete the answer given below, by picking up the appropriate word(s) from the list provided.

Firstly, many of these pollutants enter the and eventually get concentrated at each trophic level. At the last, their concentration becomes so much that it does considerable to a variety of organisms. Secondly, pollutants like the not only destroy the harmful organisms, but also wipe out a large number of beneficial organisms.

(pesticides, trophic level, food chain, damage)

16.2.4 Pollution due to Noise

Sound is an important means of communication, but high levels of noise could damage hearing, and cause deterioration in capacity to concentrate on work. Noise is referred to as unwanted sound that is usually unpleasant. The loudness of noise is measured in decibels (db). The quietness of a lonely place at night may be represented by, 20 db; a library where people are not supposed even to talk loudly, by 40 db; the sound level when you hear a radio broadcast, by 60 db; a factory or a motor-cycle may produce uncomfortable noise at 100 db, if you stand near a jet engine of the airlines it may be hard to bear the noise of 120 db level. High level of noise is harmful to man. Hearing loss begins with prolonged exposure (8 hours or more) to noise at 80-90 db or more.

Can you think of some places where there is high level of noise? The level of noise is very high in certain industries, such as the ones dealing with iron and steel manufacture, motor vehicle production, metal products fabrication, printing and publishing, lumbering and wood products, and textile manufacturing. Busy streets in big towns, and the places near the railway tracks are so noisy that if you were living there, you would hardly be able to sleep.

It is often said that noise pollution is different from air, soil and water pollution, let us see how? Noise pollution differs significantly from air, soil and water pollution in the sense that it decays almost instantaneously and leaves no residues, whereas a majority of pollutants of air, soil and water remain as such for very long durations.

Now the question arises how can noise pollution be reduced? Maintenance of machinery and automobiles, etc. in good condition reduces noise. Loudspeakers which blare music at night during celebrations of festivals or marriages cause tremendous strain on the whole neighbourhood. Rules that already exists to stop such noise should be enforced by local administration. Planting of trees along roads also reduces noise levels in residential areas or in work places.

SAQ 6

List three places where high level of noise, could harm your sense of hearing.

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16.2.5 Pollution due to Radiations

Hazards of nuclear radiations are extremely serious, because they upset the genetic make up of the living beings. Environmental pollution from nuclear radiations is increasing rapidly due to proliferation of nuclear power plants. All nuclear power plants produce large quantities of nuclear wastes, which remain radioactive for long periods of time. These wastes need to be stored and disposed off in a manner that prevents the contamination of the environment with radioactivity. But no satisfactory way has yet been developed to store the radioactive waste material over long periods, without running the risk of leakage. Nuclear wastes include radioactive elements that will be dangerous for thousands of years. For example, Plutonium-239 remains in the biosphere for 2,00,000 years, with all its ill-effects before it loses its radioactivity. Unfortunately, the developed countries which produce such waste in huge quantities are known to be cleverly dumping this waste in the poor countries, producing grave hazard to their people who do not at all benefit from the positive side of nuclear energy.

Whenever nuclear explosions occur, radioactive particles are carried to great distances by air currents. The radioactive material eventually settles on earth and is then taken up from the soil by plants. If these plants are eaten by animals or man, these radioactive particles get deposited in flesh, milk or bones of the animals. Once a certain concentration of these radioactive substances is reached, their radiations can destroy tissue and cause death from cancer or tissue damage. Unfortunately nuclear bombs were used by USA against Japanese cities of Hiroshima and Nagasaki in 1945. Apart from the deaths caused by heat and blast, tens of thousands of people died from damage caused by radiation, even the babies born afterwards were affected by radiation that brings about genetic change. Testing of nuclear weapons over the ground also creates increasing danger from radiation and so there has been a worldwide movement to ban nuclear tests. India has played a big role in this movement.

Now a days, many people talk of the devastating effects of a nuclear war. There are now enough nuclear warheads to destroy all military installations, most concentrations of industry and almost every city on the globe. If even 1% of existing weapons are used, then for months after the explosions, radioactive ash would continue to fall upon us from the upper atmosphere. The dust and smoke raised by these nuclear explosions might create a nuclear winter about which we have talked earlier, and all life and the whole civilisation may be extinguished. The attacker as well as the attacked, and all the other nations would be there no more to shed tears over their fate. Therefore, concern to bring about nuclear disarmament has become the most important problem of the world.

SAQ 7

Identify the following statements as true or false. Write T for the correct statement and F for the wrong statement in the boxes provided.

- a) Radioactive wastes do not require any special treatment. ☐
- b) Exposure to a large amount of radiations can cause a number of diseases. ☐
- c) Radioactive waste materials are biodegradable. ☐
- d) Nuclear radiations disturb the genetic make up of the living beings. ☐
- e) Nuclear wastes belong to the category of persistent pollutants. ☐

16.3 IMPACT OF TECHNOLOGY ON ENVIRONMENT

Since the mid 1950s, in most parts of the world, growth and development have vastly improved living standards and quality of life. This improvement is largely due to the application of technology. Technology, however, has also produced a new set of problems concerning environmental stress due to industrial effluents and emissions, use of chemicals in agriculture, clearing forests, converting cultivable land into a maze of cement concrete roads, buildings and embankments, noise and radioactivity that are added to the atmosphere. The consequent impact on human environment is greater than ever before in human history.

The increasing use of coal and oil as energy sources, the release of non-degradable or very slow-degrading wastes from industry, and some of its products such as plastics and stainless steel alloys have the potential of accumulating in the environment. Environmental stresses also arise from more traditional form of production. More land has been cleared for cultivation in the past 100 years, than in all the previous centuries of human existence. The loss of forests and other wild vegetation wipes out whole species of plants and animals, and drastically reduces the genetic diversity of the world's ecosystems. This process robs present and future generations of the genetic material to improve crop varieties, such as to make them less vulnerable to weather stress, pest attack and disease. The loss of species, many of which have not yet been studied by science deprives us of important potential sources of medicines and industrial chemicals. The loss of forests could also bring in its wake disastrous effects such as erosion, siltation, floods and local climatic changes. Massive dams, most of them built after 1950, impound a large proportion of the river water, submerge agricultural land and drive away wild animals.

Many of the risks arising from productive activity and the technologies we use, cross national boundaries. Many of them cause global risks. Though the activities that give rise to these dangers tend to be concentrated in a few countries, the risks are shared by all, rich and poor, those who benefit and those who do not. A variety of air pollutants are killing trees and lakes and damaging buildings and cultural treasures, close to, and sometimes thousands

of kilometers from the points of emission. The acidification of environment and the greenhouse effect etc. are threats to life-support system. It springs up directly from increased use of resources. Another threat arises from the depletion of atmospheric ozone layer, by the gases released during the production of foam, and the use of refrigerants and aerosols. A substantial loss of ozone could have catastrophic affect on human and livestock health, and effect on other life forms.

Political and technological ambitions have led to dangerous arms race which is not confined to the two big powers only. Even the production and testing of armaments affect the environment. The missiles, aircraft and space rockets leave burnt fuel in the upper atmosphere, which affects the ozone layer adversely. A war involving the use of nuclear weapons by the big powers can be totally destructive to all living beings including humans. It can cause so much destruction to the atmosphere, the earth and the oceans, that they cannot, probably, recover their original state.

In many cases, the present practice of disposing off of toxic wastes, such as those from chemical industries, involves unacceptable risks. Radioactive wastes from nuclear industry remain hazardous for centuries. Many people, who have to actually bear the risks of these harmful wastes, do not benefit in any way from the activities that produce the wastes.

All the above-mentioned environmental stresses are linked to one another. For example, deforestation is linked to increasing water runoff, it accelerates soil erosion and silting of rivers and lakes. Air pollution and acid rain may kill forests and destroy life in the lakes. Such links mean that **several problems must be tackled simultaneously. Success in one area, such as forest protection, can improve chances of success in another area, such as soil conservation.**

Industries, that constantly burden the environment with pollutants, also pose another kind of danger, namely that of industrial accidents. These of course, are rare, but can additionally endanger people far and near. We shall discuss here two such instances that most of you might be familiar with.

Bhopal Disaster

All of you must have heard of the Bhopal disaster that occurred on 3rd December, 1984. It is considered to be the worst industrial accident till today. Poisonous MIC (methyl isocyanate) vapours, leaked out in large amounts, from a pesticides manufacturing plant owned by a multinational company called Union Carbide. About 2,50,000 people were exposed to this gas, and thousands of human beings and animals died after inhaling large quantities of this gas. The surviving people who had lesser exposure, now suffer miserably with respiratory, eye, gastrointestinal, neuromuscular and gynaecological problems. The plant, handling highly toxic and poisonous substances, was situated right in the midst of a populated area.

Besides this, there are other possible Bhopals in India. Baroda with a population of a million, has the country's single largest concentration of heavy petrochemical industries. In West Bengal, too, there are 400 chemical factories that deal with poisonous gases. Even though such factories manufacture chemicals which may be very useful, they should have been installed at safer places, away from centres of population. In addition to this, the factories must be well equipped with safety devices which would automatically minimize the untoward effects of an accident.

The Chernobyl Disaster

This disaster that has happened in the Ukraine (USSR), has highlighted the dangers of nuclear radiation. On April 26th, 1986, one of a cluster of four power reactors got over-heated and is reported to have melted. As a result, radioactive material from this reactor evaporated and spread into the atmosphere.

Places as far as Western Europe were soon showered with radioactive dust. It is the biggest disaster in the history of nuclear power generation resulting in the death of 31 persons in the vicinity and affecting a large population which was exposed to radiation. According to some estimates, over 6000 additional deaths are likely from cancer, over the next 70 years.

Problem of Disposal of Industrial Effluents

Rapid population growth, in combination with industrial and technological growth, represents the potential danger to earth's ecosystems. It is believed that by the year 2000, the production of various basic items like petroleum products, nitrogen fertilisers, coal, cement and steel will increase by 6 to 20 times. If technologies and present practices remain the same, the pollution of air, water and soil will also increase to an unbearable extent.

Ganga Action Plan

Of all the environment protection measures India has taken, the Ganga project is the biggest and the boldest. The water of the Ganges, once considered the purest and sacred, has over the years become polluted with industrial effluents and the other wastes like garbage from the cities, partially burnt human bodies etc. Even mass bathing of thousands of people leave a load of infectious material in the water. Efforts are now being made to make it fit for human, industrial and agricultural consumption.

The Rs. 292 crore project is planned to be carried out in different phases. In the first phase, treatment of sewage from big cities on the bank of the river is planned. It is also being planned to control the discharge of industrial effluents, which are the other major sources of pollution. As many as 4159 large and medium-size industrial units are responsible for causing pollution.

SAQ 8

Match the items of the first column with that of the second. Write the number of the appropriate match from the second column, in the bracket of the matching statement of the first column.

Column 1		Column 2
a) Ganga Action Plan	[]	a) methyl isocyanate vapours
b) The Chernobyl Disaster	[]	b) application of technology
c) Disposal of industrial wastes on land	[]	c) to restore the quality of water for human, industrial and agricultural use.
d) Bhopal Disaster	[]	d) radioactive material evaporated and spread into the atmosphere over large areas
e) Improved living standards and quality of life	[]	e) pollution of ground-water

16.4 IMPACT OF POPULATION INCREASE ON ENVIRONMENT

Early human hunted and killed wild animals for food, and they also gathered and ate many plants. When they discovered that food crops could be grown and animals could be confined and bred, their nomadic life came to end. Smaller areas could support more people, and human populations began to increase. Since the number of children born was proportional to the size of the population, the increase in population every year became greater than in the previous year. From an estimated world population of about 10 crores in 3000 B.C., we increased five times by the year 1650 A.D., or in about 4600 years. The next increase by a factor of five took only about 300 years, or in about 1950. Today world population has already exceeded 500 crores. The remarkable fact is that much of this increase takes place in the poorer countries such as Asia, Africa and Latin America. Population of USA or U.K. is not increasing as rapidly as that of China or India. If we examine increase of population in India, we find that family size is smaller among the well to do people than among the poor. Again, among Indian states, those with high level of education have a lower rate of population growth than the others.

There is a high correlation between rate of growth of population, poverty and lack of education. This is understandable because education would lead to better understanding of one's own difficulties about providing food, shelter, clothing and education to children if there are too many children to share an income. Education would also lead to knowledge about how birth control can be achieved without too much expense or trouble, overcome cultural factors which lead to large families, for example too much importance to male children. In search of having one boy, a family may sometimes produce 3, 4 more children. Education would also lead to better health care of the children, so that those who are born have a greater chance to survive. Educated population would also increase economic productivity which could lead to removal of poverty, and greater pressure to improve benefits of production so that social justice is achieved.

However, here our concern is the strain which increasing population puts on the resources of the world, including the environmental resource. All the things we dig out of the earth such as coal, iron, petroleum, copper, and so on, are available in limited supply and all of them

are going to be exhausted within a limited number of years—and if population keeps growing, world consumption of these materials will keep increasing, advancing the date of resource exhaustion. Already there is a world crisis of energy, and we are obliged to examine how to use renewable sources of energy like solar or wind energy, etc. We have to use more of nuclear energy, rather than energy obtained from coal, diesel or petroleum. Larger and larger population also requires more production of food. Agriculture requires land and in many countries land is not available to grow the crops needed for the doubling or tripling population. There is tremendous strain in resources of drinking water, and on facilities to remove filth and muck. Larger population could mean shortage of housing, congestion on roads, slums going from bad to worse, and pollution—which we have described in this unit, becoming increasingly active. Are we to keep poisoning the air we breathe, polluting the water that we drink or otherwise use, and polluting the soil at an increasing pace? The rich countries have to cut down on excessive consumption of world's resources and their technologies must evolve so that they do not poison the air we breathe and the water in which vast resources of food and medicine flourish. The poor countries have to make massive efforts to educate their people, to control growth of their population and to evolve a society which does not make the rich, richer and the poor, poorer. They have also to evolve a technology that doesn't just copy what has been done in the past when pollution and limitation on resources was not a looming danger, and a technology which increases harmony between environment and living style.

SAQ 9

What factors do you think could motivate persons to have smaller families?

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16.5 SUMMARY

In this unit you have learnt that:

- Wherever organisms live, the environment is affected. The wastes from human community, and the industry are eventually deposited in water, air or soil.
- Persistent pollutants are those that remain in the environment for many years in an unchanged condition. Many of these are toxic. The non-persistent pollutants break down into simpler forms. Many a time, the break down is brought about by living organisms, and we say such pollutants are biodegradable.
- Carbon monoxide, hydrocarbons, particulates, sulphur dioxide and nitrogen oxides are the primary air pollutants, which combine to form secondary pollutants, some of which are deadly.
- The major sources of water pollution are municipal sewage, industrial wastes and agricultural runoff. Organic matter in wastes, requires oxygen for their decomposition. Oxygen depletion can result in the death of fish and other aquatic organisms. Addition of excessive nutrients to a water body, in the form of wastes such as sewage etc., results in problems like eutrophication.
- Hazardous wastes from industry have become a threat to life. These wastes require special treatment to render them harmless or to isolate them from human beings. Radioactive wastes are another special category of wastes that require special handling to protect the public. Because of the high levels of some dangerous pollutants that have accumulated in the environment, the very existence of mankind is in danger. Immediate attention or/and remedial measures are required to tackle the problems such as: depletion of ozone layer, change or suspended particles in the atmosphere, and consequences of nuclear winter.
- The developments in technology have made our life easy and comfortable but it has happened at the cost of the environment. Pollution from the industries has caused maximum damage to environmental quality. The accidents like those of Bhopal and Chernobyl have not only resulted in heavy casualties, but also caused long term damage to the environment.
- The reasons for tremendous increase in population in our country are : economic backwardness, illiteracy, socio-cultural attitudes, and the increasing difference between death and birth rate. Now a growing number of people are becoming aware of the critical

state of our environment. It is hoped that use of modern technology, and educating people would take us towards the preservation and improvement of the environment.

16.6 TERMINAL QUESTIONS

- 1) How much do you and your family contribute to the pollution of your environment? Look carefully around your house, make a list of every thing that your family adds to the air, water or soil. What suggestions can you make to reduce your family's contribution to the local pollution?**
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- 2) In the space provided put a tick mark for the correct statement and cross for the wrong statement.**
- i) Tall smoke stacks contribute to the acid rain problem. _____
- ii) Eutrophication is caused by the inhibition of algal blooms. _____
- iii) Water pollution is related to agricultural practices. _____
- iv) The level of dissolved oxygen decreases in the ponds or any standing water body that receives organic wastes. _____
- v) Technological developments are in no way responsible for increased pollution. _____
- vi) Photochemical smog belongs to the category of primary pollutants. _____
- vii) There is a positive correlation between the rate of growth of population and lack of education. _____
- viii) Air pollution decays instantaneously whereas noise pollution does not. _____
- ix) Many of the hazardous wastes in the soil tend to accumulate in the bodies of organisms. _____
- x) The air in most of the rural areas in India have a very high level of particulates. _____

16.7 ANSWERS

Self Assessment Questions

- 1) a) pollution
- b) carbon monoxide, sulphur dioxide, hydrocarbons, particulates, nitrogen oxides
- c) nitrogen dioxide, ozone, peroxyacetyl nitrate
- d) acid rain

- e) carbon dioxide, warming
 - f) nitrogen oxides, chlorofluorocarbons
- 2) headache, eye membrane affected, respiratory diseases such as lung cancer etc.
 - 3) municipal sewage, industrial wastes, agricultural runoff, oxygen, oxygen, nutrients, eutrophication, non-flowing.
 - 4) Heavy metals, plastics, agrochemicals.
 - 5) food chain, trophic level, damage, pesticides.
 - 6) textile loom, newspaper press, metal product fabrication plant.
 - 7) a) F
b) T
c) F
d) T
e) T
 - 8) a) [c]
b) [d]
c) [e]
d) [a]
e) [b]
 - 9) education and sound economic conditions.

Terminal Questions

1) Your choice

Hint: While cooking food by various means, pollutants are added to the air. Similarly, we add pollutants to water when we take bath or brush our teeth. If you have a small garden or a farmland, surely you must be adding fertilisers or pesticides etc. from time to time. If these agrochemicals, are added in excess, they may also cause soil pollution.

- 2) i) √
ii) ×
iii) √
iv) √
v) ×
vi) ×
vii) √
viii) ×
ix) √
x) ×