CHAPTER 23

ENVIRONMENTAL CHEMISTRY

After completing this lesson, you will be able to:

- Recognize various chemical reactions occurring in the atmosphere. (Understanding)
- Recognize that the release of COX SOX NOX VOCs is associated with the combustion of hydrocarbon-based fuels. (Applying)
- Outline problem associated with release of pollutants including acid rain and the formation by free radical reaction of hazardous inorganic and organic compound e.g., PAN. (Analyzing)
- Describe causes and impacts of urban smog. (Analyzing)
- Explain greenhouse effect and global warming as resulting in climate change. (Analyzing)
- Explain the buildup to and recognize the adverse effects of ozone.in the troposphere. (Applying)
- Describe the role of CFCs in destroying ozone in the stratosphere. (Applying)
- Describe the role of ozone in the stratosphere in reducing the intensity of harmful UV radiation reaching the earth. (Understanding)

- List possible alternatives to the use of CFCs. (Applying) Recognize and describe various water pollutants. (Applying)
- Explain the various parameters of water analysis. (Applying)
- List some major products of the petrochemicals together with their uses. (A l ing)

It is the branch of chemistry which deals with the chemicals and other pollutants in the environment resulting directly and indirectly from human activities.

In this we study the sources, chemical reactions, transportation of the chemicals and their adverse effects on human beings.

QI. What are different components of environment?

Answer

Components of the Environment:

I) Atmosphere → We will study it in detail

2) Hydrosphere → Concerned with all bodies i.e. ocean, rivers, streams lakes, glaciers and ground water reservoirs.

3) Lithosphere → Concerned with hard and rigid rocky earth crust.

4) Biosphere →Area on earth with support life i.e. air, lakes, etc.

Atmosphere: Our surrounding on earth is called atmosphere. It consists of gases i.e.

N_2, CO, He, Ne, Kr, Xe and water vapours. Its thickness is about 1000 km above the surface of earth.

The gases present in the atmosphere are very important in the following ways:

I) These gases absorb harmful radiations (cosmic rays and electromagnetic radiation) of Sun to protect life on earth. Otherwise these rays are very harmful to living things on earth.

2) N_2 is used by nitrogen fixing bacteria

3) 02 is necessary for breathing in animals.

4) C02 is necessary for photosynthesis in plants and

5) Water vapours are responsible for sustaining life on earth.

6) Actually our atmosphere has been divided into four layers:

I) Troposphere 2) Stratosphere 3) Mesosphere 4) Thermosphere.

We are concerned here with only first two layer i.e. troposphere and stratosphere.

Q2. Write a note on chemistry of troposphere.

Answer

Troposphere is very close to earth in which we live. It extends up to 20km. it contains all those gases which are present in our atmosphere.

In this part of our atmosphere, we will discuss

I) Different pollutants (Their sources and effects and smog (development and chemistry)

2) Effects and chemical reactions occur during acid rain, green effect and global warming

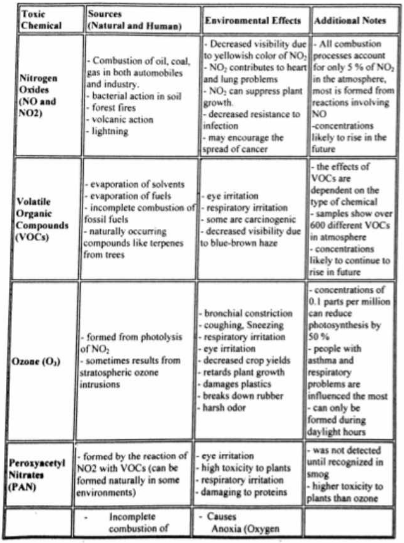
3) Role of automobile in air pollution

Smog

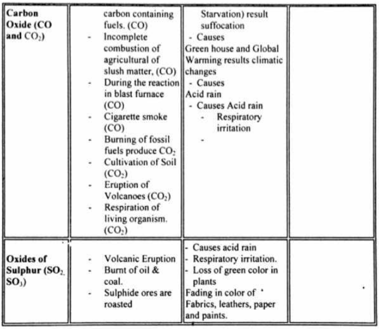
"It is a combination of smoke and fog i.e. 'sm' from smoke and 'og' from fog"

Under the right conditions, the smoke and sulfur dioxide produced from the burning of coal can combine with fog to create industrial smog.

Photochemical smog is a condition that develops when primary pollutants (oxides of nitrogen and volatile organic compounds created from fossil fuel combustion) interact under the influence of sunlight to produce a mixture of hundreds of different and hazardous chemicals known as secondary pollutants. Major Chemical Pollutants in Photochemical Smog: (Sources and Environmental Effects).



Toxic Chemical	Sources (Natural and Human)	Environmental Effects	Additional Notes
Nitrogen Oxides (NO and NO2)	- Combustion of oil, coal, gas in both automobiles and industry. - bacterial action in soil - forest fires - volcanic action - lightning	- Decreased visibility due to yellowish color of NO_2 - NO_2 contributes to heart and lung problems - NO_2 can suppress plant growth. - decreased resistance to infection - may encourage the spread of cancer	- All combustion processes account for only 5 % of NO_2 in the atmosphere, most is formed from reactions involving NO -concentrations likely to rise in the future
Volatile Organic Compounds (VOCs)	- evaporation of solvents - evaporation of fuels - incomplete combustion of fossil fuels - naturally occurring compounds like terpenes from trees	- eye irritation - respiratory irritation - some are carcinogenic - decreased visibility due to blue-brown haze	- the effects of VOCs are dependent on the type of chemical - samples show over 600 different VOCs in atmosphere - concentrations likely to continue to rise in future
Ozone (O_3)	- formed from photolysis of NO_2 - sometimes results from stratospheric ozone intrusions	- bronchial constriction - coughing, Sneezing - respiratory irritation - eye irritation - decreased crop yields - retards plant growth - damages plastics - breaks down rubber - harsh odor	- concentrations of 0.1 parts per million can reduce photosynthesis by 50 % - people with asthma and respiratory problems are influenced the most - can only be formed during daylight hours
Peroxyacetyl Nitrates (PAN)	- formed by the reaction of NO2 with VOCs (can be formed naturally in some environments)	- eye irritation - high toxicity to plants - respiratory irritation - damaging to proteins	- was not detected until recognized in smog - higher toxicity to plants than ozone
	- Incomplete combustion of	- Causes Anoxia (Oxygen	



Carbon Oxide (CO and CO_2)	carbon containing fuels. (CO) - Incomplete combustion of agricultural of slush matter, (CO) - During the reaction in blast furnace (CO) - Cigarette smoke (CO) - Burning of fossil fuels produce CO_2 - Cultivation of Soil (CO_2) - Eruption of Volcanoes (CO_2) - Respiration of living organism. (CO_2)	Starvation) result suffocation - Causes Green house and Global Warming results climatic changes - Causes Acid rain - Causes Acid rain - Respiratory irritation -	
Oxides of Sulphur (SO_2, SO_3)	- Volcanic Eruption - Burnt of oil & coal. - Sulphide ores are roasted	- Causes acid rain - Respiratory irritation. - Loss of green color in plants Fading in color of Fabrics, leathers, paper and paints.	

Q3. Give Chemistry of Photochemical Smog (Chemical Reactions in the Atmosphere)

Answer

The previous section suggested that the development of photochemical smog is primarily determined by an abundance of nitrogen oxides and volatile organic compounds in the atmosphere and the presence of particular environmental conditions. To begin the chemical process of photochemical smog development the following conditions must occur:

I) Sunlight.

2) The production of oxides of nitrogen (NOx).

3) The production of volatile organic compounds (VOCs).

4) Temperatures greater than 18 degrees Celsius.

If the above criteria are met, several reactions will occur producing the toxic chemical constituents of photochemical smog. The following discussion outlines the processes required for the formation of two most dominant toxic components: ozone (03) and peroxyacetyl nitrate (PAN). Which is primarily created from volatile organic compounds.

Nitrogen dioxide can be formed by one of the following reactions. Notice that the nitrogen oxide (NO) acts to remove ozone (03) from the atmosphere and this mechanism occurs naturally in an unpolluted atmosphere.

$$O_3 + NO \rightarrow NO_2 + O_2$$

$$NO + RO_2 \rightarrow NO_2 + \text{other products}$$

Sunlight can break down nitrogen dioxide (NO_2) back into nitrogen oxide (NO).

$$NO_2 + \text{sunlight} \rightarrow NO + O$$

The atomic oxygen (O) formed in the above reaction then reacts with one of the abundant oxygen molecules (which makes up 20.94 % of the atmosphere) producing ozone (O_3).

$$O + O_2 \rightarrow O_3$$

Nitrogen dioxide (NO_2) can also react with radicals produced from volatile organic compounds in a series of reactions to form toxic products such as peroxyacetyl nitrates (PAN).

$$NO_2 + R \rightarrow \text{products such as PAN}$$

It should be noted that ozone can be produced naturally in an unpolluted atmosphere. However, it is consumed by nitrogen oxide as illustrated in the first

reaction. The introduction of volatile organic compounds results in an alternative pathway for the nitrogen oxide, still forming nitrogen dioxide but not consuming the ozone, and therefore ozone concentrations can be elevated to toxic levels.

Q4. What is Acid Rain? Give its harms.

Answer

Air contains SO_2, NO_2 and CO_2.

I) SO_2 present in air undergoes photolytic and catalytic oxidation to form S03 which reacts with rainy water or moisture to form H_2SO_4 i.e. $SO_3 + H_2O$ H_2SO_4

2) NO_2 reacts with rainy water or moisture in the presence of 02 and 03 and produces

HNO_3 i.e. $4N_2 + H_20 + O_2 \rightarrow 4HNO_3$, $2NO_2 + H2O \rightarrow O_3 \rightarrow 2HNO_3$ O_2

3) CO_2 reacts with rainy water or moisture to form H_2CO_3 i.e. $CO_2 + H_2O \rightarrow H_2CO_3$

4) In some countries due to release of HCl by volcanic eruption, there is temporary acid rain.

H_2SO_4, HNO_3 and H_2CO_3 formed as above come down the atmosphere as acid rain or acid snow. As far as H_2CO_3 is concerned, it has no severe effects on animals, plants or any other things.

Impacts:

I) It makes the lakes so acidic that they can no longer support fish life.

2) The yield of agricultural crops is also reduced.

3) HNO_3 acid rain gradually eats up lime stone and marble of the buildings and corrodes metals.

4) It fades the color of fabrics (e.g. cotton, nylon and rayon), leather and paper

5) Causes extensive leaf-drop in plants.

6) It is very corrosive and attacks skin.

7) Acidification of soil and rocks can leach metals like Al, Hg, Pb and Ca and discharge them into water bodies. Then these heavy metals are eaten by fishes which proves very much dangerous for those animals and birds which eat these fishes.

8) It also damages steel, paint, plastic, cement, masonry work and sculptural materials.

Q5. What is Green House Effect and Global Warming?

Answer

There is a protective layer O_3 gas in the atmosphere at a height between 15 km and 60 km. (The thickest layer of O_3 exists at a height of 23 km from the surface of the earth) and then a blanket of CO_2 gas exists in lower part of the atmosphere (i.e. below 15 km). Now when sunlight, consisting of ultra-violet rays, visible light and infra-red rays falls on the top of the atmosphere, the harmful ultra-violet rays are absorbed by the 03 layer and hence do not reach the earth's surface. On the other hand, the visible light and infra-red rays pass through the CO_2 layer and fall on the earth. Since the infra-red radiations have heating effect, they heat the earth and its various objects.

Now since the earth and its various objects become hot (of course, less hot than the sun), they start emitting infra-red rays) heat rays), which are of long wavelength (note that the infra-red ray emitted by the extreme hot bodies like sun are of short wavelength). The infra-red radiations of long wavelength emitted by the earth and its objects are absorbed by the CO_2 layer in the atmosphere. Thus, we see that the presence of CO_2 in the atmosphere does not allow the infra-red radiation reflected by the earth's surface to go out of the atmosphere. In other words, we can say that the layer of CO_2 gas in the atmosphere traps all the infra-

red radiations coming from the earths' surface. These trapped infra-red rays heat the earths' atmosphere. *The heating up of earth due to the trapping of infrared radiations (reflectedfrom the earth 's surface by CO_2 laver in the amosphere is called "green-house-effect ".* Since the infrared rays coming from the earth cannot pass through the CO_2 layer, the temperature of the earth is raised. The rise in the temperature produced by the green-house-effect in the earth's atmosphere depends on the amount of CO_2 gas present in the atmosphere. The name green-house effect comes from the fact that this effect is used in horticulture for the upbringing of green plants in a small house, whose walls and roof are made of glass-sheet. The glass walls and glass roof of the house allow the short wavelength infrared radiations, contained in sunlight, to go into green-house freely, but do not allow the long wavelength infrared radiations, reflected by the soil, plants and other contents of the green-house to go out. These trapped infrared radiations raise the temperature inside the green house. Thus, even without the internal supply of heat, the temperature inside the green house higher than that outside it.

Importance of green-house effect:

The green house effect, produced by the presence of CO_2 layer in the atmosphere is, very necessary for our existence on the earth. We have seen that, due to green house effect CO_2 gas in the atmosphere does not allow the long wavelength infrared

radiations reflected by the earth. to go out of the atmosphere and hence the of the earths' and its atmosphere is increased. The rise in temperature of the earth is very necessary) for our existence on earth, because without it the whole earth would be converted into extremely cold planet and consequently we shall not be able to have a normal life.

Effect of excess of CO_2 present in the atmosphere:

If the atmosphere contains too much quantity of CO_2. the green house effect is considerable increased i e. due to excess quantity of CO_2 present in the atmosphere; the temperature of the earth is increased too much. This much high temprature melts all the glaciers (sno-mountains) floods the low-lying areas of the earth, changes the biological Activity) of oceans and the patterns of cropping etc. Thus we see that the presence of the excess of CO_2 in the atmosphere brings about climate changes·

Q6. Give pollutants produced by automobiles. What controls measures have made modem science in auto-mobiles?

Answer

In automobiles during incomplete combustion of petrol. we get smoke of different gases pollute atmosphere the engine used in these motor are called internal combustion) engines because the petrol Which is used as a fuel is burnt inside the engine separately contains CO. NO, N02, un-burnt carbon panicles, some alcohol and acids. All these substances are poisonous and hence pollute air.

Production of Pollutnts

Now let us see how they (CO, NO, NO_2) pollutants are produced in an engine of a car (automobile). Petrol is used as a fuel in automobile (car) engine. The main components of petrol are hydrocarbons. They hydrocarbons have general formula C_8Hl_8 and hence arc called octane.

Petrol burns very fast in a car engine. Due to short time available for burning. Incomplete combustion of petrol takes and CO, unburnt particles, CO_2, water some alcohol and acids arc produced. CO and panicles are emitted the air and thus air is polluted.

When petrol bums in a cu engine, a very high temperature is produced. At this high temperature, N: and O_2 present in air of engine combine together and form NO and NO: The gases pollute the air.

Control Measure:

In order to control the air pollution caused by hydrocarbons and CO etc the following methods used.

1) By adding lead tetraethyl $Pb(C_2H_3)_4$, to petrol:

Suppose a used petrol as fuel. Petrol bums very fast in the vehicle engine, e.g. the rate of combustion of petrol is very high and hence the time taken by the petrol for its combustion is short. Due to this short time. the combustion of petrol is incomplete.

$Pb(C_2H_5)_4$ is sued to the petrol to slow down the of combustion of provides $Pb(C_2H_5)_4$ more time to the petrol for its combustion and hence enables it to burn more completely'. Due to this the quantity of unburnt hydrocarbons and CO coming out of the engine. with exhaust gases is reduced and hence air pollution is also minimized. is oxidized to PbO which gets deposited on the spark plugs and valves. In order to prevent the deposition of PbO, suitable amount of $C_2H_4Cl_2$ and $C_2H_4Br_2$ are also added to the petrol along with $Pb(C_2H_5)_4$. These halides convert PbO into PbCI) and $PbBr_2$ both of which are volatile and hence come out along with the exhaust gases emitted by the vehicle engine.

$$Pb(C_2H_5)_4 + O_2 + C_2H_4Cl_2 + C_2H_4Br_2 \rightarrow CO_2 + H_2O + PbCl_2 + PbBr_2$$

Although the addition of minimize the air pollution caused by unburnt hydrocarbons and Co, the air gets polluted with dangerous $PbCl_2$ and $PbBr_2$.

2) Catalytic oxidation/Converter:

The pollution of air caused by unburnt hydrocarbons and CO present in the exhaust gases of the vehicle's engine can also be reduced by attaching gas device with the vehicle's engine, in which the exhaust gases can be mixed with more air and then burnt completely in the presence of platinum catalyst before they are discharged into the environment. Hydrocarbons and CO are oxidized by 02 of the air in presence of platinum catalyst.

$$2C_8H_{18} + 25O_2 \rightarrow 16CO_2\ 18H_2O$$

$$2CO + O_2 \rightarrow 2CO_2$$

The disadvantage of this method is that the platinum catalyst gets poisoned by PbC12 and PbBr2 which are produced by the reaction between $Pb(C_2H_5)_4$. $C_2H_4Cl_2$ and $C_2H_4Br_2$ (these compounds are added to the petrol) in presence of CO_2.

Q7. Give chemistry of the stratosphere in detail.

Answer

This layer of atmosphere is present 20-40 km above the earth and ozone is present in this layer at a height of about 28 kilometers. The concentration of ozone in this layer is 10 ppm (10 parts per million)

In this layer of atmosphere, we will discuss comprehensively about ozone.

a) Production of O_3 and its toxic effects

Some O_3 is produced during various combustion processes taking place in the air around us. Traces of O_3 in air do not harm but O_3 of concentration more than 0.1 ppm is toxic and harmful to human beings. O_3 also attacks rubber products. O_3 is also produced in the upper part of the atmosphere by the action of sunlight on O_2.

$$3O_2 \rightarrow 2O_3$$

b) Protective action of ozone layer in the atmosphere

The thickest layer of O_3 exists at a height of 23 km from the surface of the earth. Since O_3 presets in this layer absorbs harmful ultraviolet radiations coming from the sun. If these radiations reach the earth, they will cause skin cancer and will destroy the organic molecules necessary for life.

Thus, we see that O_3 does not allow the ultra-violet radiations to reach the earth and we

are thus saved from the harmful effects caused by these radiations. If O_3 layer in the atmosphere disappears completely, then all the harmful ultra-violet radiations coming from the sun would reach the earth and would cause skin cancer in men and animals and will also damage the plants. All the life on earth would then gradually be destroyed.

c) Sources of destruction/destroying the ozone layer present in stratosphere.

In 1980 scientists showed that there is a hole in the O_3 layer. This hole was detected over the region of Antarctica. Due to the presence of O_3 layer, the ultraviolet rays coming from the sun can pass through the hole and thus can reach the earths' surface. The presence of O_3 in the atmosphere is due to the fact that the amount of O_3 present in stratosphere is getting reduced day by day and thus the ozone layer is becoming thinner and thinner. The depletion of the ozone layer is due to the following sources.

1) Oxides of Nitrogen:

The oxides of nitrogen present in the atmosphere decompose O_3 into O_2 and are themselves regenerated.

$$NO + O_3 \rightarrow NO_2 + O_2$$

$$NO_2 + 0 \rightarrow NO + O_2$$

Thus we see that the presence of nitrogen oxides in the atmosphere destroys the ozone layer. These oxides destroy about 70% of O_3 found in the stratosphere.

Greater is the amount of the oxides in the atmosphere greater is the percentage of O_3 which is destroyed.

2) Nuclear Tests:

Nuclear tests being conducted in the world generate high temperature. At high temperature, atmospheric nitrogen is favorably oxidized to NO. NO thus formed destroys ozone layer, as shown above at (I)

3) Use of Chloro-Flouro Carbons:

Fluoro-chloro-carbons are the fluoro-chloro methanes like, Freon-I ($CFCl_3$) and Freon 12 (CF_2Cl_2). These are stable compounds. These are chemically inert and hence do not react with the substances. These are used as aerosol spray propellants, refrigerants, firefighting reagent and solvents for cleaning electronic components. When they enter stratosphere, they absorb ultraviolet solar radiations and get broken down into free atomic chlorine. This atomic chlorine decomposes O_3 into O_2 (NO also breaks O_3 into O_2).

$$Cl + O3 \rightarrow Cl + O_2$$

$$ClO + O \rightarrow Cl + O_2$$

d) How to protect the ozone layer:

Scientists are worried over the gradual destruction of ozone layer by the oxides of nitrogen and fluoro carbons. In order to save the destruction of O_3 layer by fluorochloro carbons, their use should be banned or some new types of substances should be discovered which may be used as aerosol spray propellants and should not react with O_3 layer, so that it may be saved.

Some Alternatives to Chloro-Fluoro Carbons (CFCs):

The first CFC substitutes to be introduced were HCFCs such as CF_3CHCl_2 and CHF_2Cl compounds that have fewer chlorine atoms than other CFCs. HCFCs break down more readily in the atmosphere than CFCs and thus are less likely to

reach the stratosphere. However, because they can cause some O_3 destruction, they are scheduled to be phased out by 2030.

Much better substitutes for CFCs are hydrofluoro carbons which contain no chlorine. One of them CF_3CH_2F has been used successfully as a refrigerant and Since 1994 has replaced Freon in nearly all car air conditioners. In electronic industries, soapy water followed by rinsing and air drying is now used instead of CFCs to clean micro circuits. Unfortunately, a serious problem is associated with the long term use of HFC. Like CFC and HCFCs they contribute to climate change. However researches are going on to find chemicals that are both effective refrigerant and environmental friendly.

Q8. What is water pollution and water treatment?

Answer

The contamination of water with the substances which have aaverse effects on human beings, animal and plants is called water pollution

And the substances whose presence in the water makes it polluted are called pollutants.

Types of Water pollutants

These are of following types:

Suspended Solid and Sediments:

These are wastes which are not completely soluble but suspended in the water. These wastes include:

1) Oil spillage 2) Live-stock waste

3) Industrial wastes and 4) Leather tanneries

1) Oil Spillage:

Petroleum is a complex mixture of many compounds which are mainly hydrocarbons. It is transported from one place to another through sea. We know that petroleum products are used as:

1) Fuel
2) Lubricants manufacture of petrochemicals
3) Plastics
4) Electrical appliances
5) Synthetic rubber
6) Detergents

In order to prepare such a large variety of substances, petroleum is handled on large scale in the world. So, the oil spillage can take place and it creates serious problems.

Pollution of water by petroleum:

Water gets polluted by:

1) accidental oil spills
2) leakage from cargo oil tankers in sea
3) tanker trucks
4) pipelines leakage during offshore exploration
5) leakage of underground storage tanks

Oil Spillage and animal life:

Many petroleum products are poisonous and create serious health problems to:

1) Humans
2) Animals
3) Aquatic life

Polycyclic hydrocarbons are carcinogenic even at very low concentration. Marine animals are seriously affected by soluble aromatic fractions of oil. The spilled oil damages the feather of the birds or fur of animals and sometimes causes their death.

Petroleum and under water plants:

When oil is spilled on the surface of sea then the light transmission is affected. The process of photosynthesis of plants does not remain much efficient moreover, the concentration of oxygen in water is decreased.

2) Live-Stock Waste:

Livestock waste is damped on open land. Sometimes it is discharged into sewage, canals or rivers. This practice pollutes the surface and ground water. In this way serious problem are created for the population.

Bacteria are present in the livestock waste. It contaminates the surface and ground water. This causes the diseases like:

a) Dysentery b) Typhoid c) Hepatitis

3) **Industrial Wastes:**

Sources:

Industries which are producing large quantities of industrial effluents are leather, tanneries, fertilizers, oil refineries, petrochemicals, textiles, foods, sugar, paper, pulp, paper board, rubber products etc. the waste products may be waste heat, smoke solid or water effluent.

Pollutants:

The industrial pollutants are highly toxic organic compounds and heavy metals like Pb, Cd, Cr, Hg, As, Sb etc. Oil greases, Mineral acids are also release in small quantities. These pollutants result in contamination of water and make it unsuitable for irrigation and drinking purposes.

Effects of Industrial pollutants:

Heavy metal particles are highly toxic and do not have any safe limits. When they are continuously ingested through food or water they get accumulated in the organisms and cause serious health problems like anemia, kidney diseases, nervous disorder, high blood pressure etc.

4) Leather Tanneries:

There are many leather tanning units working in Pakistan. Their sizes vary from cottage scale to big industrial units.

Leather industries use chromium salts which have +6 oxidation state of chromium. Only a few industries have the facility of waste treatment. This can be done by reducing Cr+6 oxidation states to Cr^{+3} oxidation state. Cr^{+3} is precipitated as $Cr(OH)_3Cr^{+6}$ salts are highly toxic and cause cancer.

Dissolved Solids

These are wastes which are dissolved/soluble in water completely. These wastes include:

I) Detergents

2) Pesticides

3) Chemical fertilizers

1) **Detergents:**

Detergents are used in homes and industries for washing. After washing these detergents are thrown into water reservoirs. The amount of detergents in reservoirs is increasing day by day. This waste water containing detergents goes into rivers and finally reaches the ocean; which is harmful for life in seas. The detergents bound heavy metal ions like Pb, Cd and Hg and transport it from sediments into water. These metals particles are very toxic.

2) **Pesticides:**

The pesticides are both toxic and persistent. Analysis of polluted water has shown that it contains pesticides which are toxic to fish. Endrin, even in traces, is reported to be toxic for catfish and other varieties of fish. DDT. affects the central nervous system of fish and toxaphene has been reported to cause bone degeneration in fish.

3) **Chemical Fertilizers:**

Nitrate/phosphate salts are generally used as fertilizers, to increase the yield of the crops. When these fertilizers are used in excess, some of their unused quantity is washed away from the agriculture lands into the ponds, lakes and river with rain water and thus pollute the water. This water is polluted, since it contains unused nitrate/phosphate salts. Similarly, the waste water coming from the fertilizer industries also contains nitrogenous/phosphatic fertilizers which, when washed away into the lakes and river with rain water, make the water polluted. The presence of nitrogenous/phosphatic fertilizers in water is harmful to the aquatic life and human beings in the following ways:

a) The presence of the fertilizers in the polluted water increases the growth of algae and other aquatic plants which, later on undergo decomposition and produce disagreeable odor. These plants also deplete the amount of O_2 dissolved in water and hence the survival of aquatic life becomes difficult or impossible.

b) After a long period, the lakes and slow-moving waters which contains plant nutrients are converted into swamps (A swamp is an area of very wet land with wild plants growing in it) and marshes (A marsh is an area of land which is very wet and muddy).

c) The water containing nitrate salt is not fit for drinking by human beings. Moreover, this polluted water cannot be purified for drinking purposes.

Thermal Pollution

Thermal pollution takes place because many electric generating companies use water in the process of cooling their generator. This heated water is then

released into the system from which it was drawn, causing a warming trend of the surface, water. Thermal pollution results when the heated effluent is released into poorly flushed system. In these cases, permanent temperature increase often result, which tend to decrease the solubility of dissolved oxygen. In lakes it also becomes possible to bring about nutrient redistributions and prolong summer stagnation periods.

When heated water gets released into large, well-flushed marine systems there is little if any permanent temperature rise. There are however problems related to the operation of plants utilizing marine water in the cooling process. Evidence reveals that seawater tends to corrode the cooling pipes, which are generally constructed of a copper nickel alloy termed Monel. These metals readily dissolved in the heated seawater and are then released into the marine environment together with the heated effluent. This adds to the nickel and copper concentrations of these systems. In addition, the screens covering the water intake pipes rapidly foul with marine organism, which decrease the flow of water into the plant. The screens have been commonly cleaned by using a concentrated detergent solution or copper sulphate. These cleaning materials have been then released into the contaminated the surrounding waters.

Q9. Write a detailed note on: Waste Water Treatment

Answer

i) Analysis/Purification of Water

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Industrial wastewater treatment

Covers the mechanisms and processes used to treat waters that have been contaminated in some way by man's industrial or commercial activities prior to its release into the environment or its re-use.

Most industries produce some wet waste although recent trends in the developed world have been to minimize such production or recycle such waste within the production process. However, many industries remain dependent on processes that produce water based waste stream.

Treatment of industrial wastewater

The different types of contamination of wastewater require a variety of strategies to remove the contamination.

a) Solids removal

Most solids can be removed using simple sedimentation techniques with the solids recovered as slurry or sludge.

b) Oils and greases

Many oils can be recovered from open water surfaces by skimming devices. However, hydraulic oils and the majority of oils that have degraded to any extent will also have a soluble or emulsified component that will require further to eliminate.

c) Soft organics

Organic material of plant or animal origin is usually possible to treat using extended conventional Wastewater treatment processes. Problems can arise if the wastewater is excessively diluted with washing water or is highly concentrated such as neat blood or milk. The presence of cleaning agents, disinfectants, pesticides, or antibiotics can have detrimental impacts on processes.

d) Hard organics

Synthetic organic materials including solvents, paints, pharmaceuticals, pesticides, coking products etc can be very difficult to treat. Treatment methods are often specific to the material being treated. Methods include distillation, adsorption, nitrification, incineration, chemical immobilization or landfill disposal.

e) Acids and alkalis

Acids and alkalis usually be neutralized under controlled conditions. Neutralization frequently a precipitate that will require treatment as a solid residue that may also be toxic. In some cases, gasses may be evolved requiring treatment for the gas

f) Toxic materials

Toxic materials including many organic materials, metals (such as zinc, silver, cadmium, thallium etc.) acids, alkalis, non-metallic elements (such as arenic or selenium) are generally resistant to biological processes unless very dilute. Metals can often be precipitated out by changing the pH or by treatment with other

chemicals. Many, however, are resistant to treatment or mitigation and may require concentration followed by land filling or recycling.

Various Parameters of Water Analysis

Following table will help us to determine the water quality.

Table Water — Quality Indicators

Parameter	Significance	Level
Dissolved oxygen	General indicator of water quality; source of O_2 for respiration	Minimum acceptable level, 4-5 mg/liter; 10-15 mg/liter for reproduction of desirable fish
Total suspended solids	Clog fish gills, bury eggs educe ight penetration increase heat absorption	Dependent on location
Total dissolved solids	Represents total mineral content which may or may not be toxic	A maximum of 400 mg liter for diverse fish populations
BOD	Amount of dissolved oxygen removed during decomposition of organic matter in a gives time; a general indicator of contamination due to biodegradable organics	BOD Water Status 1 mg/liter Very clean mg/liter Clean 2 mg/liter Fairly clean 5 mg/liter Doubtful 10 mg/liter Contaminated
COD	Indicates the concentration of materials oxidizable by chemical reaction	0.5 mg/liter indicates very clean streams

pH	Indicates the addition of acid or bases	H depends on actual system
Iron	Excessive amounts can clog fish grills; indicates drainage fro ron bearing sediments, mines ndustrial processes	A maximum of 0.7 mg/liter fo diverse fish populations
Manganese	Concentration low in natural systems due to low solubility high concentrations indicates contamination	maximum of I mg/liter is common criterion for quality

Table (Contd.)

Parameter	Significance	Level
Copper	Indicates drainage from copper-bearing sediment, mines, plating, or other industrial sources	A maximum of 0.02- I O mg/liter is a common criterion for stream quality
Zinc	Indicates mine drainage or industrial input	A maximum of I mg/liter is common criterion for stream quality
Hg, Cd, Pb, Ni, r, Ag, etc.	Indicates industrial input	A maximum of I mg/liter is common criterion for stream quality
Nitrate	A major plant nutrient; in high-concentration it can promote excessive plant growth; major sources are fertilizers, sludge, and sewage	A maximum of 0.3 mg/lite to prevent excessive fertilization of streams
Phosphate	A major plant nutrient; major sources are detergents, fertilizer, sewage	A maximum of 0.03-0.4 mg/liter total inorganic phosphate is a common criterion

Q10.What is Green Chemistry? Give its importance.

Answer

The term green chemistry, coined in 1991, is defined as "the design of chemical products and processes that reduce or eliminate the use and generation of hazardous substances."

Green chemistry emphasizes the design and creation of chemicals that are not hazardous to people or the environment. It has been applied to a wide range of industrial and consumer goods, including paints, dyes, fertilizers, pesticides plastics, medicines, electronics, dry cleaning, energy generation, and water purification.

Why Green Chemistry?

Green chemistry is effective in reducing the impact of chemicals on human health and the environment. In addition, many companies have found that it can be cheaper and even profitable to meet environmental goals. Profits derive from higher efficiency, less waste, better product quality, and reduced liability. Many environmental laws and regulations target hazardous chemicals, and following all these requirements can be complicated. But green chemistry allows companies to comply with the law in much simpler and cheaper ways. Finally, green chemistry is a fundamental science-based approach. Addressing the problem of hazard at the molecular level, it can be applied to all kinds of environmental issues.

Since 1991, there have been many advances in green chemistry, in both academic research and industrial implementation. For example, Spinosad, an insecticide manufactured by fermenting a naturally occurring soil organism, was registered by the EPA as a reduced-risk insecticide in 1997. Spinosad does not leach, bioaccumulate, volatilize, or persist in the environment and in field tests left 70 to 90 percent of beneficial insects unharmed. It has a relatively low toxicity to mammals and birds and is slightly to moderately toxic to aquatic organisms, but is toxic to bees until it dries.

The 12 Principles of Green Chemistry

The aim of green chemistry is to reduce chemical related impact on human health and virtually eliminate contamination of the environment through dedicated, sustainable prevention programs. Green chemistry searches for alternative, environmentally friendly reaction media and at the same time strives to increase reaction rates and lower reaction temperatures. The green chemistry concept applies innovative scientific solutions to solve environmental issues posed in the laboratory. Paul T. Anastas, an organic chemist working in the Office of Pollution Prevention and Toxins at the EPA, and John C. Warner developed the Twelve Principles of Green Chemistry in 1991. These principles can be grouped into "Reducing Risk" and "Minimizing the

Environmental Footprint."

I. Reducing Risk in the Laboratory

Sigma-Aldrich is dedicated to providing alternative products designed with the health and safety of its employees, customers, and the public in mind.

i) Use Safer Chemicals — Utilize performance chemicals that have the lowest levels of toxicity.

ii) Design Less Hazardous Synthesis Methods — Where feasible, make use of synthetic or biosynthetic methods that pose little or no toxicity to human health and the environment.

iii) Use Safer Solvents and Reaction Conditions Search for the most up-to-date information on green solvents that will optimize your process and provide a safer working environment.

iv) Accident Prevention — Select substances that minimize the potential for explosions, fires and chemical releases into the environment.

II. Minimizing the Environmental Footprint

The 12 Principles focus on reducing the volumes of chemicals used and pollution prevention.

i) Waste Minimization and Prevention — Develop chemical synthesis techniques, which reduce or prevent waste. It is better to prevent waste than to clean it up after its creation.

ii) Use of Catalysts Instead of Stoichiometric Quantities — Catalytic reactions inherently use smaller quantities of chemicals to carry out a specified transformation.

iii Reduce the Use of Chemical Derivatives — The use of protecting groups or other forms of temporary modification of a functionality adds to the total waste incurred in a synthetic route.

iv) Synthetic Efficiency (Atom Economy) — An efficient chemical process ensures the maximum amount of your starting materials is used in the final product so that no atom is wasted.

v) Taking Advantage of Chemicals Designed for Degradation — Reduce the effect on the environment by using chemicals that are designed to be biodegradable.

vi) Establishment of In Process Controls for Pollution Prevention — To avoid the formation of hazardous substances, adopt real-time analysis and in process monitoring during synthesis.

vii) Use of Renewable Feedstocks — Use raw materials or renewable feedstocks (waste from other processes or products derived from agricultural streams) whenever technically or economically feasible.

viii) Encourage Energy Efficiency — The realization of the economic and environmental impact of energy use in a chemical process and the development of alternative means to reduce the impact.

Q11. What is radioactive radiation pollution? Give its control.

Answer

Radiation Pollution

What is radioactive pollution?

Radioactive substances and nuclear radiations produced during nuclear reaction affect our environment adversely and thus radioactive pollution created.

Sources of radioactive pollution and its effects

1. Low level radioactive liquid wastes, radioactive gaseous wastes, and dusts are released during nuclear explosions. The radioactive gaseous wastes are injected into the upper layer of atmosphere where, due to cooling they condense to fine dust particles and thus radioactive cloud is formed. This cloud moves in the direction of the wind, settles down slowly to the surface of the earth and thus pollutes air, water and soil.
2. The radioactive substances produce energy which is so strong that the living cells are damaged or destroyed.
3. People working with radioactive elements develop tumors.
4. Radioactive element like strontium 90 affects our soil and through this human beings and animals are also affected adversely.

5. Nuclear explosions which are operated in sea make sea water polluted. This affects the aquatic life.
6. Among the radioactive radiations, gamma radiations are the most dangerous, since they have high energy and big penetrating power. These radiations can, therefore, pass freely in the human body, where they lose energy, which destroys the living cells by converting them into charged particles (ions). These charged particles are chemically very reactive and hence disrupt cell membrane, reduce the effectiveness of enzymes and even damage genes and chromosomes. All this results in diseases like leukemia and cancer.
7. We know that in a nuclear reactor U 235 is used as a nuclear fuel, which undergoes nuclear fission and energy is produced. Nuclear radiations are produced in the processes viz mining and enrichment of U 235 taking place in the nuclear reactor. These radiations can leak from the reactor and therefore, damage the health of the human beings and animals.

Control measures for minimizing radioactive pollution

The waste material produced in the mining, enrichment and fission of U 235 inside the rector are collectively called nuclear wastes. At present most of the nuclear wastes are being sorted in strong leak proof containers. These will be disposed ofd whenever a safe method of their disposal is found out.

Using catalytic Converters

A catalytic converter removes pollutant gases from the exhaust by oxidizing or reducing them. The exhaust gases pass through a converter containing a precious metal catalyst, usually an alloy of platinum and rhodium. Several reactions may take place. NOX and Co may take part in a redox reaction which neatly removes both of them at the same time: NOX oxidizes CO to C02 and is reduced to harmless nitrogen gas.

$$2NO + 2CO \rightarrow N_2 + 2CO_2$$

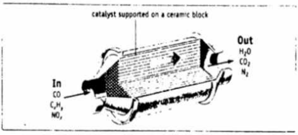
CO and CxHx are oxidized by air;

$$2CO + O_2 \rightarrow 2CO_2$$

$$C_7H_{16} + 11O_2 \rightarrow 7CO_2 + 8H_2O$$

(Using C_7H_{16} to represent a typical hydrocarbon.)

For all three of these reactions happen, it is necessary to use a three way converter and to have an oxygen monitor fitted to the engine, this checks the quantity of oxygen going into the engine to make sure there is enough to carry out the oxidation reactions.



The overall result of passing exhaust gases through this kind of catalyst system is to convert CO, NOX and CxHy to relatively harmless N_2, CO_2 and H_2O.

The catalytic reactions do not stat working until the catalyst has reached a temperature of about 200°C so they are not effective until the engine has warmed up.

Catalyst systems of this type cost several hundred pounds, mainly because of the high cost of the precious metal they contain. The catalyst is poisoned by lead, so unleaded fuel must always be used.

Q12.Why waste water from household and industries without treatment to river is dangerous?

Answer

When we think about river pollution, we might assume it comes from places like factories, farms and industry. Waste water from manufacturing or chemical processes in industries contributes to water pollution. Industrial waste water usually contains specific and readily identifiable chemical compounds yet, in many cases the pollution in our rivers comes from a much less obvious source - our homes. Incorrect plumbing could mean that waste water from dishwashers, washing machines, sinks, baths and even toilets other impurities includes organic materials and plant nutrients that tend to rot. The main organic materials are food and vegetable waste, plant nutrient come from chemical soaps, washing powders, etc. These flushed directly into a local river. These 'misconnected' pipes are a common cause of pollution to rivers and streams, especially in towns and cities.

There are normally two forms of drainage -surface water and foul water.

Surface water drains, or 'storm drains carry rainwater from road surfaces and rooftops into local rivers and streams and flows into the river untreated.

Foul water drains carry waste water from toilets, sinks, baths and household appliances to the sewage treatment works. This water is treated before it can safely flow back into river and streams.

Today, many people dump their garbage into streams, lakes, rivers, and seas, thus making water bodies the final resting place of cans, bottles, plastics, and 6ther household products. The various substances that we use for keeping our houses clean add to water pollution as they contain harmful chemicals.

Americans generate 1.6 million tons of household hazardous waste per year. The average home can accumulate as much as 100 pounds of household hazardous waste in the basement or garage and in storage closets. When improperly disposed of, household hazardous waste can create a risk to people and the environment. Paints, cleaners, oils, batteries, and pesticides are

examples of just a few of the common household hazardous wastes that need special disposal.

When fresh water is artificially supplemented with nutrients, it results in an abnormal increase in the growth of water plants. This is known as eutrophication. The discharge of waste from industries, agriculture, and urban communities into water bodies generally stretches the biological capacities of aquatic systems. Chemical run-off from fields also adds nutrients to water. Excess nutrients cause the water body to become choked with organic substances and organisms. When organic matter exceeds the capacity of the micro-organisms in water that break down and recycle the organic matter, it encourages rapid growth, or blooms, of algae. When they die, the remains of the algae add to the organic wastes already in the water; eventually, the water becomes deficient in oxygen. Anaerobic organisms (those that do not require oxygen to live) then attack the organic wastes, releasing gases such as methane and hydrogen sulphide, which are harmful to the oxygen-requiring (aerobic) forms of life. The result is a foul smelling, waste-filled body of water. Untreated sewage effluent in the water causes oxygen levels to drop drastically, sewage fungus covers the bed of the watercourse like a blanket and in more severe cases the river can no longer support fish, insects and animals that live in and around the water.

Polluted water is unsuitable for drinking, recreation, agriculture, and industry. It diminishes the aesthetic quality of lakes and rivers. More seriously, contaminated water destroys aquatic life and reduces its reproductive ability. Eventually, it is a hazard to human health. Nobody can escape the effects of water pollution.

Once an aquifer is contaminated, it may be unusable for decades. The residence time, as noted earlier, can be anywhere from two weeks or 10 000 years.

Q13. What are different alternatives to ozone-depleting halocarbons?

Answer

Hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) are alternative halocarbons being used to replace ODS in industrial and commercial applications and their use is becoming more widespread. Other alternatives to ODS include ammonia, carbon dioxide and hydrocarbons.

The relationship between ozone-depleting substances and their halocarbon alternatives and global warming

Ozone-depleting substances (ODS) and their halocarbon alternatives have a direct global warming potential and contribute to climate change. The production of some ozone depleting substances (e.g. CFCs) has been ceased worldwide resulting in emission reductions of ozone-depleting substances into the atmosphere. However, emissions of other ODS (e.g. hydrochlorofluorocarbons [HCFCs]) and ODS alternatives (e.g. hydrofluorocarbons [HFCs]) is expected to continue to increase.

HFCs are ODS refrigerants alternatives and their use is becoming more widespread. Although HFCs have no ozone-depletion potential they do have high global-warming potential and are thousands of times more potent greenhouse gases than carbon dioxide.

Regulations that prevent or minimize ODS and other halocarbons emissions serve a dual environmental benefit of lowering emissions that destroy the ozone layer and contribute to climate change.

Q14.Are ozone-depleting substances still an important environmental concern?

Answer

Although the production and use of many ODS has been phased out, the control of ODS emissions continues to be an important environmental issue, as the destruction of the earth's protective stratospheric ozone layer causes increased health risks and environmental impacts, such as cataracts, skin cancer and climate change.

Air Pollution

1. In past there was bull cart, donkey carts animals were used by but now a days Aeroplane, cars, buses and trains are used for transportations. These vehicles need energy for their working in the formal petrol or gas to provide energy for motion of vehicle. The end product of this burning includes energy' plus different gasses include hydrocarbons, Nitrogen oxides carbon monoxide, Benzie, sulphur heavy metals and particles, these gases enter into air and pollute in when human breath in such polluted environment it causes asthma, coughi9g nausea, chest pain, bronchitis diseases etc.
2. It is estimated that usually 24000 deaths occur due to air pollution because pollution damage central Nervous System.
3. Automobiles are responsible for depletion of ozone in stratosphere sheet because of source of CFCs entering the atmosphere which is escape from vehicle air condition (ACS)

   Vehicles are responsible for 80% pollution in metropolitan region three fold increases in per capita energy consumption for global warming as burning of fuel produces CO_2.
4. Ways to improve impacts of car like uses of small cars, clearer cars, efficient engine catalytic, converters are compulsory and use of biocheral.

A. Fuel cell causes only water comes out as its exhaust electrical vehicle pose problem because of range of batteries and sepe. Hybrid electric petrol they are providing solution for this pollution they cut down the fuel wastage and effect the high energy fuel on board e.g. in Delhi they demolished the buses run on diesel

B. Restricts the occurs to the cities or part of cities e.g. Chester York, oxford have driven the apparently to pack ad ride they have given free space for parking the edge of town.

C. improve information about road condition and public transport e.g. Zwich zone referendum eh priority is given to tarns trolleys, buses, parking prohibitions 50% of all the trips as by means of public transport

Polluter pay is another solution where the pollution emitted by the car is measured and the driver is changed on the buses of level multiplies the distance travel.

Technological changes to reduce cooling zone of engine wall and reduce hydrocarbon and carbon monoxide emission. Computer control at IC engine. Catalytic converter technology (CCT) emission

Trap oxidizers ad ceramic filter a Diesel vehicles

Direct injection fuel efficient Diesel

Ozone

Ozone layer is found in the stratosphere approximately 10-50 Km above the earth surface. Ozone molecules have three atoms of oxygen instead of the normal tow. The ozone layer protects us from the harmful effects of certain wave lengths of ultra violet (UV) light coming from the sun, socially UVB. Any significant decrease in ozone in the atmosphere would result in an increase of UV.B radiation reaching the earth surface. Increase in levels at UV.B radiation can result in the increase in skin cancer; suppress the immune system, eye disorder including catavart and effect plants, animals and plastic materials.

Ozone Depletion

In 1985, scientists discovered that there is severe ozone depletion in the Antarctic region, which was confirmed by American Satellite observations.

Chlorofluorocarbons (CFCs) were invented in 1928 found many used in foams, refrigeration, air conditioners, solvent, five extinguishers etc. these CCs are long lied and their emissions reach stratosphere and cause ozone depletion. This has been dramatically confined through Antarctic ozone hole.

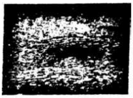
The United Nations Environment Programme (UNEP) has been addressing the issue of depletion of the ozone layer since 1977 and in 1981 UNEPs Governing Council set up a working group to prepare nine global framework conventions for protection of ozone layer.

By reducing the use of CFCs we can protect ozone layer for saving the environment from harmful effects.

Montreal protocol on substances the deplete the ozone layer was finally agree upon on 16th September 1987 and adopted by the Government in this protocol ozone depleting substances are banned.

Q15. What are different natural water purification methods?

Answer



There are several, natural ways that you can purify water.

In the event of an emergency it may become necessary to purify the water that you drink to avoid getting sick. Though many people think purifying water is difficult, there are a number of simple, natural means of water that can easily be used in an emergency.

1) Sand

One of the most common ways that water is purified is by passing it through sand and soil. If contaminated water (say urine) is poured onto fine sand, the

water is going to travel down until it reaches the saturation level. The other chemicals that are mixed with the water, though, will be held back by the sand until only the water is left. This is the same method of water purification used in many sewage treatment facilities as a big part of separating water out of the waste that goes through the plant.

2) Boiling

Water can be boiled to make it purer. Boiling water kills bacteria and other germs in the water, which makes it safer to drink. Or, build a water still that functions off boiling. Water is poured into a sealed pot, with a tube leading out of it. The water turns into steam, and the steam escapes through the tube. The tube transports the steam to another container, where the steam condenses back into water. This process can eliminate more contaminants from water (such as salt), but it's also more complicated.

3) Cloth Filtration

Cloth filters can be used to help keep larger contaminants out of water. This process is very simple; pour the water through a cloth, or through several layers of cloth, and the cloths' weave will strain the water and hold back impurities. This is the same process that happens when a coffee filter is used, except that the filter is paper rather than cloth. Paper can work as well, and if you have coffee filters or similar devices you can easily use those instead of a clean cloth to strain your water.

Q16.How rain water seepage through hazardous waste dumpsites can dissolve in drinking water supplies Hazardous waste:

Answer

Hazardous waste is waste that is dangerous or potentially harmful to our health or the environment. Hazardous wastes can be liquids, solids, gases, or sludges.

They can be discarded commercial products, like cleaning fluids or pesticides, or the by-products of manufacturing processes. It's very important to dispose off hazardous waste carefully otherwise it contaminates the air, water, and soil.

Groundwater:

Groundwater is rain water or water from surface water bodies, like lakes or streams, that soaks into the soil and bedrock and is stored underground in the tiny spaces between rocks and particles of soil.

Groundwater contaminants come from two categories of sources: point sources and distributed, or non-point sources. Landfills, leaking gasoline storage tanks, leaking septic tanks, and accidental spills are examples of point sources. Infiltration from farm land treated with pesticides and fertilizers is an example of a non-point source.

1. Among the more significant point sources are municipal landfills and industrial waste disposal sites. When either of these occur in or near sand and gravel aquifers, the potential for widespread contamination is the greatest.
2. Leaks of petroleum products have been increasing over the last two decades because underground steel tanks installed in large numbers in the 1950s and 1960s have become corroded. Before 1980, most underground tanks were made of steel. Without adequate corrosion protection, up to half of them leak by the time they are 15 years old. Groundwater dissolves many different compounds, and most of these substances have the potential to contaminate large quantities of water. For example, one litre of gasoline can contaminate 1 000 000 litres of groundwater. This problem is particularly severe in the Atlantic provinces where there is a high usage of groundwater. In many cases, the problem is noticed long after the aquifer is contaminated, for example, when consumers start tasting or smelling gasoline.

3. Groundwater can become contaminated in many ways. Chemicals from hazardous wastes buried in unsecured landfills If rain water or surface water comes into contact with contaminated soil while seeping into the ground, it can become polluted and can carry the pollution from the soil to the groundwater. From here, contaminants can spread to wells or surface water, making it unsafe to drink.
4. Groundwater can also become contaminated when liquid hazardous substances themselves soak down through the soil or rock into the groundwater. Some liquid hazardous substances do not mix with the groundwater but remain pooled within the soil or bedrock. These pooled substances can act as long-term sources of groundwater contamination as the groundwater flows through the soil or rock and comes into contact with them. Groundwater contamination is extremely difficult, and sometimes impossible, to clean up.
5. Apart from chemical pollutants the major culprits are Bacteria and Viruses which cause most of the commonly found water borne diseases.
6. Bacterial diseases: Gastro-enteritis, Typhoid, Cholera, Paratyphoid, Dysentery and Diarrhea.

   Viral diseases: Polio, Dysentery, Gastro-enteritis, Diarrhea and Jaundice (Hepatitis)

Replacing Chlorofluoro Carbons

Few compounds have CFCs combination of non-flammability, non-toxicity and inertness, and for uses such as refrigeration and aerosols it is necessary to find compounds wit exactly the right boiling point.

Some of the important replacements for these uses are the hydrofluorocarbons, CFCs (also known as hydrofluorocarbon or HFAs.). An example is I , I , I ,2-tetrafluoroethane, CH_3CH_2F, which is used as a refrigerant. HFCs have the advantage that they contain no Cl atoms, so they do not release damaging Cl radicals in the stratosphere. Moreover, their molecules include C-H bonds, which

are relatively reactive, which means that these compounds break down in the atmosphere more quickly than CFCs so they do not persist for so long.

EXERCISE

Q1. Select the right answer from the choices given with each question.

1. **Air is polluted by:**

a) Toxic materials b) Hydrocarbons

c) Harmful gases d) All of above

2. **Which of following gas is not pollutant?**

a) SO_2 b) CO c) CO_2 d) NO_2

3. Oxides of sulfur and nitrogen react with oxygen to form:

a) Bases b) Acids c) Salts d) All of above

4. Oxidizing smog consists of high concentration of:

a) SO_2 b) Ozone c) N02 d) C12

5. Thickness of ozone is:

a) 20-25KM b) 25-28Km c) 30-32Km d) 20-30Km

6. Ozone is destroyed by:

a) S02 b) NO2

c) Chlorofluorocarbons d) None of above

7. In leather industry:

a) Chromium (IV) is used b) Chromium (III) is used

c) Nickel is used d) Aluminum is used

8. Water is purified:

a) Aeration b) Coagulation c) Disinfection d) All of above

9. The Ecosystem is the smaller unit of:

a) Biosphere b) Lithosphere

c) Atmosphere d) Hydrosphere

10. When chlorine is passed through water then the disinfection is done due to the production?

a) HCl b) HOCl c) OCl d) $HC1O_4$

11. **Peroxyacetyl nitrate (PAN) is an irritant to human beings and it affects**

a) eyes b) ears c) stomach d) nose

12. Fungicides are the pesticides which

a) control the growth of fungus
b) kill insects
c) kill plants
d) kill herbs

Answer:

1)	d	2)	C	3)	b	4)	c
5)	a	6)	C	7)	b	8)	a
9)	a	10)	b	11)	a	12)	a

Q1. Select the right answer from the choices given with each question.

QI. What are components of environment?

Answer

I) Atmosphere
2) Hydrosphere
3) Lithosphere
4) Biosphere

Q2. Briefly discuss the role of atmosphere in our environment?

Answer

Our surrounding on earth is called atmosphere are very important because:

I) These gases absorb harmful radiations of sun to protect life on earth.

2) N_2 is used by nitrogen fixing bacteria.

3) O_2 is necessary for breathing.

4) CO_2 is necessary for photosynthesis.

Q3. What are sources of air Pollution?

Answer

Sources of air pollution are:

I) Nitrogen oxides (No and N02)

2) Volatile organic compounds (VOCs)

3) Oxides of sulphur (S02 and S03)

4) Carbon oxides (CO and C02)

Q4. What are the important air pollutants?

Answer

Important air pollutants are:

I) Nitrogen dioxide

2) Peroxyacetyl nitrates (PAN)

3) Volatile Organic Compounds

4) Carbon Monoxide releasing from automobiles

Q5. What are the sources of CO emission? Discuss its effects?

Answer

Source of CO

I) Incomplete combustion of fuel.

2) During reaction in blast furnace.

3) Burning of fossil fuels.

Effects

I) Causes Anoxia (Oxygen starvation)

2) Greenhouse effect.

3) Global Warming

Q6. Differentiate between:

a) Industrial and Photochemical smog

b) Primary and secondary pollutants.

Answer

a. Industrial Smog	**Photochemical Smog**
Smoke and sulphur dioxide produced from burning of coal when combine with fog it forms industrial smog.	Photochemical smog is formed when oxides of nitrogen and VOCs interact under sunlight.
b. Prima Pollutants	**Secondary Pollutants**
Oxides of nitrogen and volatile organic compounds are called primary pollutants.	When oxides of nitrogen and volatile organic compound interact under sunlight they form secondary pollutants.

Q7. How does photochemical smog differ from reducing smog?

Answer

Photochemical smog is a condition that develops when primary pollutants interact under the influence of sunlight while reducing smog is formed when smoke and sulphur dioxide produced from burning of coal combine with fog.

Q8. What is global warming?

Answer

When sunlight consists of ultraviolet rays, visible light and infra-red rays falls on the top of the atmosphere the harmful ultra-violets rays are absorbed by 03

layer and hence do not reach on the other hands, the visible light and infra-red rays pass through the C02 layer and fall on the earth. Since the infrared radiations have heating effect, they heat the earth and its objects. This is called Global Warming.

Q9. What are the latest predictions about global warming?

Answer

If the atmosphere contains too much quantity of C02, the temperature of the earth is increased too much. This melts all glaciers floods the low lying areas of the earth and changes the biological activity of oceans.

Q10. What gases are responsible for. Green House Effects?

Answer

These are as follows:

I) CO_2 and CO	2) Methane
3) CFCs	3) Nitrogen Oxides

11. Briefly discuss effects of acid rain.

Answer

Effects of acid rain

1) It makes lakes so acidic that they can no longer support fish life.

2) Causes extensive leaf-drop in plants.

3) It is very corrosive and attacks skin.

4) Fades the color of fabrics.

12. What are source' and environmental effects of:

a) vocs **b) PAN**

Answer

I) Evaporation of solvents

2) Evaporation of fuels.

3) Incomplete combustion of fossil fuels.

Environmental effects of VOCs

1) Eye irritation

2) Carcinogenic

3) Respiratory irritation

Source of PAN

Formed the reaction of NO_2 with VOCs.

Environmental Effects of PAN

I) Damaging to protein

2) Highly toxic to plants

3) Eye irritation

14. What are effects of excess of CO_2 present in atmosphere?

Answer

The excess of CO_2 present in atmosphere causes melting of glaciers, floods the low laying areas of earth and changes the patterns of cropping.

15. Discuss the sources and typical effects of CO_2 as pollutant.

Answer

Sources of SO_2

I) Volcanic Eruption

2) Burnt of oil and coal

3) When sulphide ores are roasted.

Effects:

I) Loss of green color in plants.

2) Fading of color of fabric.

3) Causes acid rain.

Q16. Briefly discuss the sources and typical effects of oxides of nitrogen.

Answer

Sources of Nitrogen Oxides:

I) Bacterial action in soil.

2) Forest fires.

3) Volcanic action.

Effects:

I) Heart and lung problems.

2) Suppress plant growth.

3) Decreased resistance to infection.

Q17. What is Ozone? How does it work as safeguard?

Answer

Ozone:

Ozone (O_3) is the protective layer in the atmosphere, at a high between 15km to 60km.

How does it safeguard:

When ultra-violet rays, visible light and infrared rays falls on the top of the atmosphere the harmful ultra-violet rays are absorbed by the 03 layer and hence do not reach the earth surface directly and thus safeguard us from these harmful radiation.

Q18. How Ozone is formed in stratosphere?

Answer

Formation of Ozone:

Ozone is produced in the upper part of the atmosphere by the action sunlight on O_2. $3O_2 \rightarrow 2O_3$

Q19. What do you know about "Ozone hole"?

Answer

Ozone hole:

In 1985, scientists discovered that there is seven ozone depletion in Antarctic region.

The UNEP, has been addressing the issue of depletion of ozone layer since 1977 and in 1981 UNEP, Governing council set up a working group frame work for protection of ozone layer. No life is supported under the depleted ozone called ozone hole in Antarctic region.

Q20. How is ozone layer depleting?

Answer

Depletion of Ozone layer:

I) Oxides of Nitrogen in the atmosphere converts 03 into 02.

Example:

$NO + O3 \longrightarrow NO_2 + O_2$

$NO + O \longrightarrow NO_2$

2) Nuclear tests generate high temperature. At high temperature atmospheric nitrogen is favourably oxidized to NO. NO thus destroy Ozone layer.

3) Use of Chloro-Flouro carbons destroy ozone layer by decomposing 03 into 02.

Examples:

$Cl + O_3 \longrightarrow ClO + O_2$

$ClO + O_3 \longrightarrow Cl + 2O_2$

Q22. What should we do to save ozone?

Answer

I) Banned on the use of CFCs.

2) Use anti-knocking agent in the automobiles.

3) Industrial gases should be treated to non-toxic before exaction.

Q23. What is water pollution? Write different types of water pollutions?

Answer

Water Pollution:

The contamination of water with the substances which have adverse effects on human beings, animal and plants is called water pollution.

Water Pollutants:

1) Oil spillage.

2) Live-stock waste.

3) Industrial wastes.

4) Weather tanneries.

Q24. Briefly discuss the effects of water pollution?

Answer

Effects of Water Pollution:

Effects of Water Pollution are devastation. It effects entire life i.e. animals, humans and plants. Marine or fresh water life undergoes threatening condition or even they die similarly when waste mires with the drinking waters of humans and animals, it generates several diseases or even deaths in some cases.

Q25. How preliminary treatment of waste water is done?

Answer

Preliminary treatment is the treatment in which major conspicuous elements in the waste water is removed. It also involves the detoxification of waste water.

Q26. What is primary treatment of waste water?

Answer

Primary treatment involves the removal of sand particles are other particles which are conspicuous.

Q27. What is secondary treatment of waste water?

Answer

Secondary treatment involves

1) Solids removal

2) Oils and greases

3) Soft organics

4) Hard organics

5) Acid and Alkalis

6) Toxic Materials

Q28.How would avoid from thermal pollution?

Answer

We can avoid thermal pollution if electric generating companies decreases the temperature of water before releasing into the environment. Water is used in cooling their generators. As when hot water is released in water bodies, it

decreases the solubility of dissolved oxygen. Thus causes serious threat to life in water.

Q3. Give detailed answers of the following questions.

QI. Describe different chemical reaction occurring in our atmosphere.

Answer

Please see answer ofQ3. of chapter notes.

Q2. Write a comprehensive note on acid rain.

Answer

Please see answer of Q4. of chapter notes.

Q3. How would you control air pollution? Describe different methods.

Answer

Please see answer of Q6. of chapter notes.

Q4. What is Thermal Pollution? Discuss its sources and environmental effects.

Answer

Please see answer of Q8. of chapter notes.

Q5. What is waste water treatment? Discuss different methods of it.

Answer

Please see answer of Q9. of chapter notes.

Q6. Write a note on Green Chemistry.

Answer

Please see answer of QI 0. of chapter notes.

Multiple Choice Questions

1)The branch of chemistry which deals with the transformation of natural raw materials is called.

a) Analytical chemistry
b) Biochemistry
c) Industrial chemistry
d) Biotechnology

2) What do you mean by BOC.

a) Basic organic chemicals
b) Biological organic chemicals
c) Basic organic carbons
d) Bio — organic chemicals

3) An example of BOC is:

a) Asters
b) Ethylene
c)Ethanol
d) Butyne

4) What does BIC stands for:

a) Biological inorganic chemicals
b) Basic inorganic chemicals
c) Basic iodine and carbon
d) Bio — inorganic cosmetics

5) An example of BIC:

a) Ethylene
b) Sulphuric
c)Propane
d) Butene

6)Low valued products produced in large quantities are called:

a) Commodity' Chemicals
b) Specialty Chemicals
c) Performance Chemicals
d) Fine Chemicals

7)High valued products produced in low volumes are called:

a) Commodity Chemicals
b) Specialty Chemicals
c) Performance Chemicals
d) Fine Chemicals

8)High valued pure chemicals are known as:

a) Commodity Chemicals
b) Fine Chemicals
c) Both a and b
d) None

9)In global market commodities are present in:

a) 80%
b) 60%
c) 40%
d) 90%

10)Which raw materials we can get from atmosphere:

a) Nitrogen b) Oxygen

c) Sodium Chloride d) Both a and b

11)Which raw materials are obtained from hydrosphere:

a) Sodium chloride b) Carbon

c) Natural gas d) Oxygen

12)Which raw materials are obtained from Lithosphere:

a) Magnesium b) Bromine

c) Hydrocarbons d) Fats

13)The coloured compound, normally used in solution which is capable of being fixed to a fabric is:

a) Dyes b) Fats

c) Oils d) Both a and b

14)Those dyes which can be applied to a fabric by direct immersion in a water solution of the dyes are:

a) Vat Dyes b) Mordant Dyes

c) Azoic Dyes d) Direct Dyes

15)Those dyes which are insoluble in water but on reduction with sodium hydrosulphicle from colourless soluble compound are:

a) Vat Dyes b) Mordant Dyes

c) Azoic Dyes d) Direct Dyes

16)Those dyes which have no natural affinity for the fabric and are applied with the help of salts are:

a) Mordant Dyes b) Direct Dyes

c) Vat Dyes d) Disperse Dyes

17)Any chemical which is used to kill pets are called:

a) Pesticides b) Fungicides

c) Insecticides d) Herbicides

18)Chemicals which kill insects are called:

a) Pesticides b) Insecticides

c) Herbicides d) None of these

19)Those chemicals which control mites are called:

a) Miticides b) Rodenticides

c) Acaridies d) Fungicides

20)Chemicals which kill fungi are:

a) Miticides b) Herbicides

c) Rodenticides d) Fungicides

21)Chemicals used to kill rats, mice, bats etc are:

a) Rodenticides b) Fungicides

c) Herbicides d) Miticides

22)Chemicals which control unwanted plants are:

a) Rodenticides b) Herbicides

c) Fungicides d) Miticides

23)Chemicals control snails and slugs are:

a) Nematicides b) Repellent

c) Molluscicides d) Miticides

24)Chemicals which derived from petroleum are called:

a) Aromatics b) Petrochemicals

c) Olefins d) Detergents

25) High molecular weight compounds whose structures are made up of a large number of simple repeating units are called:

a) Polymers b) Monomers

c) Oligomers d) Both a and c

26) Polymers which are synthesized from only one kind are:

a) Additional Polymers b) Homopolymers

c) Heteropolymers d) None of these

27) Polymers formed by alkenes monomers are:

a) Additional Polymers b) Polythene

c) PVC d) Homopolymers

28) Ethylene on polymerization gives

a) Polyvinyl chloride b) Polyethylene

c) Mesitylene d) x — heptane

29) Which catalysts contain trialkyl aluminium and titanium tetrachloride in an insert solvent:

a) Ziegler catalysts b) Nickie catalyst

c) Potassium dichromate d) Both a and c

30) Polymerization of vinyl chloride gives:

a) Polythene b) Polyvinyl chloride

c) Naphthene d) Trivinyl chloride

31) Heating adipic acid with hexamethylene diamine under nitrogen at $2000^{0}C$ gives:

a) 1,3 — Butadiene b) ADIPIC ACID

c) Nylon — 6,6 d) Vinyl chloride

32) Those polymers which hard on heating are:

a) Thermosetting polymers b) Thermosetting polymers

c) Both a and b d) Additional polymers

33) Polymers which softens on heating are:

a) Thermoplastic polymers b) Thermosetting polymer

c) Additional polymers d) None of these

34) Which is the first synthetic fiber:

a) PVC b) Nylon

c)Anthracene d) Both a and b

35) Glass fiber is used for:

a) Insulation b) Reinforcement

c)Automotive d) All of these

36) Which is used as nail polish remover:

a) Acetone b) Ethyl acetate

c)Both a and b d) Ethyl alcohol

37)Ethyl acelate is belong to the group of organic molecules called as:

a) Alcohols b) Esters

c) Ethanol d) Ketone

38)Which is one of the oldest known beauty preparations and was used by ancient cultures:

a) Hair dye b) Bleaching

c) Nail polishing d) All of these

39)Which is an organic liquid that is colourless, flammable and miscible with water and nearly all other organic liquids is:

a) Ethyl acelate b) Acetone

c) Adipic acid d) Ethyl alcohol

40)Metallic fiber is used for:

a) Clothes b) Fish nets

c) Carpets d) None of these

Answer

1)	c	2)	a	3)	b	4)	b
5)	b	6)	a	7)	b	8)	b
9)	a	10)	d	11)	a	12)	C
13)	a	14)	d	15)	a	16)	a
17)	a	18)	b	19)	a	20)	d
21)	a	22)	b	23)	c	24)	b
25)	a	26)	b	27)	a	28)	b
29)	a	30)	b	31)	c	32)	b
33)	a	34)	b	35)	d	36)	c
37)	b	38)	a	39)	b	40)	a

Short Answers and Questions

QI: Define industrial chemistry?

Answer

The branch of chemistry which applies physical and chemical procedures towards the transformation of natural raw materials and their derivatives to products that are benefit to humanity.

Q2: Give some benefits of chemistry in the field of science and technology.

Answer

There are immense benefits of chemistry in the field of science and technology. Some of these are food production health, hygiene, shelter, protection, decoration, recreation and entertainment.

Q3: Define industrial inorganic chemistry?

Answer

Industrial inorganic chemistry is the branch of chemistry which extract inorganic chemical substances make composites of the same and also synthesize inorganic chemicals.

Q4: Define industrial organic chemistry?

Answer

Industrial organic chemistry deals with the extraction and production of petroleum fuels, polymers, petrochemicals and other synthetic materials mostly from petroleum.

Q5: What are light organic industrial chemicals? Give examples.

Answer

The chemicals which are produced by the light organic industrials are termed as light organic industrial chemicals.

Examples

Pharmaceuticals, dyes, pigments, paints, pesticides, soaps, detergents and cosmetics.

Q6: What are heavy industrial organic chemicals? Give examples.

Answer

Heavy industrial organic chemicals are the chemicals which are produce from heavy organic industries.

Examples: Polymers, petroleum, petrochemicals.

Q7: What do you mean by BOC? Give examples.

Answer

BOC are basic organic chemicals which are produced directly from natural resources.

Example: Ethylene, propylene etc.

Q8: What do you mean by BIC?

Answer

BIC are basic inorganic chemicals which are produced directly from natural resources. Example: Sulphuric acid, nitrogen, oxygen etc.

Q9: What are Commodity chemicals? Give examples.

Answer

Low — valued products produced ph large quantities in continuous processes and have general purpose grade.

Example: pigment flavours fragrance etc..

Q 10: What are specially chemicals? Give examples?

Answer

Hign value adding involves the production of small quantities of chemical products for specific end uses, these are called specially chemicals. Examples: surfactants, adhesives, agrochemicals etc..

Q11: What are fine chemicals? Give examples?

Answer

High values pure chemicals are called fine chemicals. Examples: pharmaceutical ingredients, etc.

Q12: What is atmosphere? With raw materials we can get from it?

Answer

The atmosphere is the field above ground level.

The raw materials we can get are N2, 02, New, Ar, Kr and Xe.

Q13: Which raw materials we can get from hydrosphere?

Answer

Sea water is a good source of sodium chloride, magnesium and bromine.

Q14: Which raw materials are obtained from lithosphere?

Answer

Coal, natural gas, crude petroleum and other chemicals.

Q15: Which raw material can be derived from biosphere?

Answer

Oils, fats, waxes, resins, sugar, natural fibers and leather etc.

Q16: What are dyes? Give examples.

Answer

Dye are the coloured compounds used in solution and are capable of fixing with a fabric.

Examples: Methylene blue, naphthol yellow.

Q17: How dyes owes their colour?

Answer

Dyes owes their colour due to the presence of a chromphone and its

Q18: What are pesticides? Give examples.

Answer

The chemicals which are used b man to kill or control pests are called pesticides.

Q19: What are Nematicides? Give examples.

Answer

Nematicides are chemicals used to control nematodes. Examples: soil fumigants

Answer

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Q25: Enlist some chemicals produced from ethylene.

Answer

i) Polyethylene ii) Ethanol iii) Ethylene oxide

iv) Polyesters v) Glycol ethers vi) Vinyl chloride and many more.

Q26: Name chemicals produced from propylene.

Answer

i) Isopropyl alcohol ii) Acrylonitrile

iii) Polypropylene iv) Propylene oxide

v) Glycol ethers vi) Allyl chloride

Q27: Give the names of some chemicals produced from benzene.

Answer

i) Cumene Ii) Ethylbenzene

iii) Cyclohexane iv) Nitrobenzene

v) Alkyl benzene vi) Chlorobenzene

Q28: Give the names of chemicals produced from Toluene

Answer

i) Benzene ii) Toluene disocyanate iii) Polyurethanes iv) Benzoic acid

Q29: Give the names of chemicals produced from tollene.

Answer

i) Phthalic anhydride ii) Dimethyl terephthalate

iii) Isopthalic acid iv) Ortho xylene

v) Polyamide Resins vi) Alkyd resins

Q30: What are polymers? Give example.

Answer

Polymers are high molecular weight compounds whose structures are made up of a large number of simple repeating units.

Example: polyethylene

Q31: What are addition polymers?

Answer

Addition polymers are formed by combination of alkenes monomers to produce a single huge molecule only.

Example

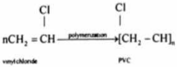
$nCH_2 = CH_2 \rightarrow CH_2\text{-}CH_2n$

ethylene polyahylene

Q32: How PVC is formed? Give its uses. [redacted]

Answer

PVC i.e polyvinyl chloride is obtained by the polymerization of vinyl chloride.



$$\underset{\text{vinylchloride}}{nCH_2=\overset{\overset{Cl}{|}}{C}H} \xrightarrow{\text{polymerization}} \underset{\text{PVC}}{[CH_2-\overset{\overset{Cl}{|}}{C}H]_n}$$

Uses

PVC is used in the manufacturing of limitation leather, floor covering and gramophone records etc.

Q33: What are condensation polymers? Give example.

Answer

Condensation polymers are formed with the elimination of simple molecules such as H20 or CH20H

Example: Nylon — 6, 6

Q34: What are thermoplastic and thermosetting polymers?

Answer

A thermoplastic polymers icon which softens on heating and becomes hard on cooling. A thermosetting polymers is one which becomes hard on heating and cannot be soften by heating.

Q35: What is heat spinning process?

Answer

Heat spinning process is the process in which involves the heating of fiber until it begins to melt, then drawing out (þ the molten fiber with tweezers as quickly as possible. Then draw the molecules by aligning them in a parallel arrangement. This brings the fibers close together and allows them to crystallize and orient. Lastly, is heat setting. This utilizes heat to permeate the shape and dimensions of fabrics made from heat sensitive fibers.

Q36: Give uses of fibers.

Answer

Fibers are used for making clothes, ropes, fish nets, tents, carpets etc.

Q37: For which purpose glass fiber is used?

Answer

It is used in home insulation reinforcement of composite materials.

Q38: What is the use of synthetics in horticulture industry?

Answer

Synthetics are used to help plant growth better, to expanded polystyrene flakes, to phenolic resin foam and in urea-formaldehyde foam resins etc.

Q39: Which chemical is used as a nail polish remover?

Answer

Acetone and ethyl acetate are commonly used as nail polish remover.

Q40: Which raw materials are used in hair dyes?

Answer

The raw materials include:

i) Dyes e.g. 4-amino-2-hyroxylolyene

ii) Modifiers e.g. resorcinol

iii) Antioxidant e.g. sodium sulphate

iv) Alkalizers e.g. ammonium hydroxide