38. Environmental Issues

1. Pollution

Any change in physical, chemical or biological characteristics of environment that has ability to harm human life, life of desirable species, natural resources, cultural assets & industries.

World Environment Day : World Environment Day (WED) occurs on 5 June every year, and is the United Nations' principal vehicle for encouraging worldwide awareness and action for the protection of our environment. First held in 1973, it has been a flagship campaign for raising awareness on emerging environmental issues from marine pollution, human overpopulation, and global warming, to sustainable consumption and wildlife crime. WED has grown to become a global platform for public outreach, with participation from over 143 countries annually. Each year, WED has a new theme that major corporations, NGOs, communities, governments and celebrities worldwide adopt to advocate environmental causes.

1.1 Natural Pollution

Pollution caused by natural sources, e.g., volcano, release of methane by paddy fields and cattle, release of carbon monoxide by plants and animals, emission of natural gas, ozone, nitrogen oxides, soil erosion, dust storms, cosmic rays, ultra-violet rays.

1.2 Man-made or Anthropogenic Pollution:

Resulting from human activities like burning of fossil fuels, deforestation, mining, sewage, industrial effluents, pesticides, fertilizers, etc. It is hardly 0.05% of total but is more dangerous because of its concentration in some localities.

On the basis of emission of pollution, it can be

(1) **Point Source Pollution :** From a single point, e.g., chimney, municipal sewer.
(2) **Line Source Pollution :** Pollution is passed along a narrow belt, e.g. automobile exhausts.
(3) **Area Source Pollution :** In a definite area. E.g. mining area, industrial estate.
(4) **Diffuse Source Pollution :** Over a large area, e.g., sprayed pesticides or fertilizers.

1.3 Pollutant

Substance, which has potentiality to adversely affect natural characteristics of environment. Pollution may be a substance in wrong place, e.g., fertilizer causes water pollution.

(1) **Primary Pollutant :** Pollutant persisting in environment in the form it is produced e.g., CO
(2) **Secondary Pollutant :** Pollutant formed from a primary one through change or reaction. Nitrogen oxides and hydrocarbons react photochemically to produce peroxyacyl nitrates & O_3. The secondary pollutants may be more toxic than primary, called **synerigism.**
(3) **Qualitative Pollutant :** Causes harm due to its nature. e.g., insecticides.
(4) **Quantitative Pollutant :** Become pollutant only beyond a threshold value, e.g., CO_2, CO.
(5) **Degradable Pollutant:** Degrades after some time either automatically (e.g. heat) or by microorganisms (e.g., sewage).
(6) **Nondegradable Pollutant :** Does not get degraded harmless material, e.g., DDT, plastics.

1.4 Forms of Pollution

The major forms of pollution are listed below

(1) **Air Pollution :** the release of chemicals and particulates into the atmosphere. Common gaseous pollutants include carbon monoxide, sulphur dioxide, chlorofluorocarbons (CFCs) and nitrogen oxides produced by industry and motor vehicles. Photochemical ozone and smog are created as nitrogen oxides and hydrocarbons react to sunlight. Particulate matter, or fine dust is characterized by their micrometre size PM to PM
(2) **Light Pollution :** includes light trespass, over-illumination and astronomical interference.
(3) **Littering :** the criminal throwing of inappropriate man-made objects, unremoved, onto public and private properties.
(4) **Noise Pollution:** which encompasses roadway noise, aircraft noise, industrial noise as well as high-intensity sonar.
(5) **Soil Contamination** occurs when chemicals are released by spill or underground leakage. Among the most significant soil contaminants are hydrocarbons, heavy metals, MTBE, herbicides, pesticides and chlorinated hydrocarbons.
(6) **Radioactive Contamination,** resulting from 20th century activities in atomic physics, such as nuclear power generation and nuclear weapons research, manufacture and deployment. (See alpha emitters and actinides in the environment.)
(7) **Thermal Pollution,** is a temperature change in natural water bodies caused by human influence, such as use of water as coolant in a power plant.
(8) **Visual pollution,** which can refer to the presence of overhead power lines, motorway billboards, scarred landforms (as from strip mining), open storage of trash, municipal solid waste or space debris.
(9) **Water Pollution,** by the discharge of wastewater from commercial and industrial waste (intentionally or through spills) into surface waters; discharges of untreated domestic sewage, and chemical contaminants, such as chlorine, from treated sewage; release of waste and contaminants into surface runoff flowing to surface waters (including urban runoff and agricultural runoff, which may contain chemical fertilizers and pesticides); waste disposal and leaching into groundwater; eutrophication and littering.
(10) **Plastic Pollution:** involves the accumulation of plastic products in the environment that adversely affects wildlife, wildlife habitat, or humans. We will discuss some pollutions and their cause in detail:

2. Atmospheric Pollution

Air pollution occurs when harmful substances including particulates and biological molecules are introduced into Earth's atmosphere. It may cause diseases, allergies or death of humans; it may also cause harm to other living organisms such as animals and food crops, and may damage the natural or built environment. Human activity and natural processes can both generate air pollution.

It is the addition of particulate matter, gases and other ingredients into air.

It is total about 1×10^{12} tonnes. Man-made only 5×10^8 tonnes or 0.05% of the total.

Major sources of atmospheric pollution are
  (i)   Combustion of fossil fuels
  (ii) Mining and processing
  (iii) Chemical industries.
  (iv) Processing industries. 52% by CO, 18% by SO_2, 12% by hydrocarbons, 10% by particulates, 6% by NO_x.

2.1 Particulate Matter

Solid particles. It is differentiated into-
(1) Settleable: Larger than $10 \mu m$ and settle down from after some time.

(2) Suspended: Less than $10 \mu m$.

SPM (suspended particulate matter) is maximum in Calcutta (Tokyo is most polluted city of world).
It can aerosol (less than $11 \mu m$) dust (more than $1\mu m$) and mist (liquid, more than 1$\square$m).

Particles of 2-4 μm size are mostly deposited in the respiratory tract.

Soot (incomplete burning of carbohydrates), smoke, flyash (fine particulate matter passed out alongwith gases during of coal).
Grey Snow : Occurred in Norway due to soot from industrial Ruhr area of Germany.

2.2 Carbon Monoxide CO

Produced due to incomplete combustion and naturally by plant, animal.
70% from automobiles. CO combines with haemoglobin, produces carboxyhaemoglobin.
At 50 ppm, CO converts 7.5% of haemoglobin into carboxy-haemoglobin within 8 hours.
It impairs O_2 transport resulting in, headache, cardiovascular malfunction and asphyxia.

2.3 Carbon Dioxide CO$_2$

It is a green house gas, concentration of which is constantly rising (0.033 from 0.029 and   expected to be doubled by 2020). In excess it causes headache and nausea.
CO_2 Concentration : 316 ppm in 1960 and 539 ppm in 1994.

2.4 Hydrogen Sulphide H$_2$S

It is a product of putrefaction, treatment of sulphur containing ores, refineries.
It causes chlorosis and defoliation in plants, produces eye and throat irritation.

2.5 Hydrocarbons

Produced naturally as well as due to incomplete combustion.
Hydrocarbons, especially polynuclear aromatic (with 2 or more fused benzene rings) or PAH, are carcinogenic, cause irritation of eyes and mucous membrane and bronchial constriction.
Methane (marsh gas) is produced naturally during decomposition of organic matter, paddy fields, cattle and incomplete combustion. It is a green house gas.

2.6 Sulphur Dioxide SO$_2$

Produced by combustion of fossil fuels.
Sulphur dioxide produces smog. Maximum SO_2 pollution is found in Calcutta.
It damage membrane, destruct chlorophyll (changed to phaeophytin).
Lichens are most sensitive to SO_2 pollution. Mossess and Garden Pea are also destroyed.
SO_2 corrodes metals, equipment, damages buildings, marble, paper and textiles.
SO_2 (alongwith NOx) produces acid rain that destroys vegetation and degrades various articles.
Threat to Taj from Mathura refinery is due to SO_2, H_2S and NO, convert $CaCO_3$ (marble) into $CaSO_4$ & $Ca(NO_3)_2$

2.7 Nitrogen Dioxide NO$_2$

Formed electro-photo-chemically, burning of fossil fuel, denitrifying bacteria.
Maximum NO_2 pollution is recorded from Baroda.
Cause necrosis, defoliation, dieback , Like SO_2, they corrode metals and deteriorate paints.

2.8 Fluorides

Formed during refining of minerals (e.g., aluminium, also from ground water).
13 states of India possess high fluoride content in drinking water (more than 1.5ppm).
Fluorides cause **florosis.** In plants there is chlorosis and necrosis of leaf tips and leaf margins,.
Causes abnormal calcification of bones and teeth (making weak), and swelling of knee bones.
Causes mottling of teeth, weak bone, knocking knee, neuromuscular disorders.

2.9 Chlorofluorocarbons/Chlorofluoromethane / Freon / Aerosols

Used as refrigerants, propellants and plastic foams. They are released as aerosol by jets flying at high altitudes.

Along with NO_2, chlorofluorocarbons react with ozone of ozonosphere and deplete the same.

Hole in O_3 shield over Antarctic region has widened from 129 to 133 dobson units in 1994 alone.

This can increase the amount of ultraviolet radiations reaching the earth.

2.10 Photochemical Oxidants

Secondary pollutants (O_3, peroxy-acyl nitrates, aldehyde, and phenols) produced due to photochemical reactions between NO_2 and unsaturated hydrocarbons.

(i) **O_3:** Destroys chlorenchyma, hardens rubber, damages textile, injure mucous membranes.

(ii) **Proxy-Acyl Nitrates (PAN, also PPN):** Parenchyma destroyed, Silvering, glazing, bronzing.

(iii) **Aldehydes :** Irritation in gastro-intestinal and respiratory tracts.

(iv) **Phenols :** Damage to kidneys, liver spleen and lungs.

Bhopal gas tragedy (Dec, 1984) was due to release of phosgene and methyl isocyanate. Dec. 3, 1984. Methyl isocyanat (MIC) leaked out from pesticide unit of Union Carbide.

It actually causes the water pollution. It killed over 2000 and injured over 250,000 persons.

National Pollution Prevention Day : 2, December

2.11 Automobile Exhausts

Causes 80% of air pollution, 75% of noise pollution in urban area.

They release hydrocarbons (13.7%), CO_2 (77.2%), NO_2 (7.7%), SO_2 , and lead (90% of total lead).

Polonium-210: Radioactive carcinogen probably as companion of antiknock lead added to gasoline in automobile.

2.12 Smog (Des Voeux)

Dark fog having condensed vapour, dust, smoke, gases (SO_2, H_2S, NO_2)

Causes silvering/glazing and necrosis in plants, allergies and asthma/bronchitis in humans.

Smog is of two types :

(i) **Classical (London)/Sulphurous Smog :** Occurs at low temp., has sulphur gases (H_2S, SO_2) smoke and dust particles.

It has reducing atmosphere, contains SO_2 , smoke, moisture and requires low temperature.

(ii) **Photochemical (Los Angleles) Smog :** Occurs at high temperature over cities and towns due to emission of nitrogen oxides and carbohydrates from automobile exhausts and solar energy.

It has oxidizing atmosphere, no or little smoke, and requires photochemical reaction for producing secondary pollutants NO_2 splits into nitric oxide and nascent O_2 . Nascent O_2 combines with molecular O_2 to from O_3 .

O_3 reacts with carbohydrates to form aldehydes and ketones. NOx, O_2 and ketones combine to form peroxy-acyl- nitrates (PAN).

2.13 Pollen/Spores

Causes allergy in some persons. e.g. parthinium, castor, convolvulus.

2.14 Control of Air Pollution

(1) Automobiles :

(i) Two-stroke engines fitted in two wheelers (waste fuel 20-30%) be changed to either four-stroke engines of fitted with catalytic converters specially designed for them.

(ii) Leaded petrol should be replaced with unleaded one and diesel with low sulphur diesel.

(iii)Tune-ups (for high air-fuel ratio) and catalytic converters (for oxidizing $CO \rightarrow CO_2$ and reducing $NO \square \square N_2$) be fitted in automobiles.

(2) Fly Ash : About 38% fly ash is produced by coal based thermal plats.

(3) Industrial Pollution :

(i) **Tall Chimneys :** They disperse smoke more thoroughly.

(ii) **Gravity Settling Chambers :** Particles larger than 50$\square$m settle down.

(iii) **Wet Scrubbers:** A fine spray of water or alkali is used to remove soluble gases and particles.

(iv) **Bag Filters :** Porous bags of teflon or polyester filter out particulate matter.

(v) **Cyclone Collectors:** They cause setting down of particulate matter through centrifugation.

(vi) **Electrostatic Precipitators (ESPs):** Charged plates or electrodes, which remove most of particles present in exhausts.

(4) Vegetation: Vegetation along road and around industrial areas reduces particulate pollution.

CO metabolized by Ficus, Phaseolus and NO_2 etabolise by Vitis, Pyrus, and Robinia .

NOTE: I.A.P.: Indices of atmospheric pollution. Prepared with help of lichens (sensitive to SO_2).

3. Controlling Vehicular Air Pollution – A Case Study of Delhi

Delhi leads the country in its levels of air-pollution – it has more cars than the states of Gujarat and West Bengal put together. In the 1990s, Delhi ranked fourth among the 41 most polluted cities of the world. Air pollution problems in Delhi became so serious that a public interest litigation (PIL) was filed in the Supreme Court of India. After being censured, the government was asked to take, within a specified time period, appropriate measures, including switching over the entire fleet of public transport, i.e., buses, from diesel to compressed natural gas (CNG). All the buses of Delhi were converted to run on CNG by the end of 2002.

Advantages of CNG

(1) CNG burns most efficiently.
(2) CNG is cheaper than petrol or diesel.
(3) Cannot be siphoned off by thieves and adulterated like petrol or diesel.
(4) The main problem that government has faced is the difficulty of laying down pipelines to deliver CNG through distribution points/pumps and ensuring uninterrupted supply.

- Use of unleaded petrol, use of low-sulphur petrol and diesel, use of catalytic converters in vehicles, application of stringent pollution-level norms for vehicles, etc. are other steps taken to reduce pollution in Delhi.
- Stringent norms for fuels were given in new auto fuel policy for steadily reducing the sulphur and aromatic contents in petrol and diesel fuels. Euro-II norms, for example, stipulates that sulphur be controlled at 350 parts-per million (ppm) in diesel and 150 ppm in petrol. Aromatic hydrocarbons are to be contained at 42 per cent of the concerned fuel. The goal, according to the roadmap prepared by Indian Government, is to reduce sulphur to 50 ppm in petrol and diesel and bring down the level to 35 per cent. Vehicle engines will also need to be upgraded.
- **The Bharat State II** (equivalent to Euro-II norms), which is currently in place in Delhi, Mumbai, Kolkata, Chennai, Bangalore, Hyderabad, Ahmedabad, Pune, Surat, Kanpur and Agra, will be applicable to all automobiles throughout the country from April 1, 2005. All automobiles and fuel-petrol and diesel – were to have met the Euro-III emission specifications in these 11 cities from April 1, 2005 and have to meet the Euro-IV norms by April 1, 2010. The rest of the country will have Euro-III emission norm compliant automobiles and fuels by 2010.
- A substantial fall in CO_2 and SO_2 level has been found in Delhi between 1997 and 2005.
- **Emission Norms :** Emission norms for petrol driven cars have been designated as euro-1 (June 1999) and euro – 2 (April 2000). They are related to mainly three parameters-hydrocarbons, CO and particulate matter.

	Present	**Euro 1**	**Euro 2**
Hydrocarbons and NO_2	3-4.6 ppm	0.97	0.5
CO	6.68 – 12.00	2.72	0.2
Particulate Matter	Not Enforced	0.14	Nil

(i) **N.E.E.R.I.** National Environmental Engineering Research Institute.

(ii) **C.P.C.B.** Central Pollution Control Board.

(iii) **U.N.E.P.** United Nations Environment Programme.

4. Acid Rain

Acid rain is a result of air pollution. When any type of fuel is burnt, lots of different chemicals are produced. The smoke that comes from a fire or the fumes that come out of a car exhaust don't just contain the sooty grey particles that you can see - they also contains lots of invisible gases that can be even more harmful to our environment.

Power stations, factories and cars all burn fuels and therefore they all produce polluting gases. Some of these gases (especially nitrogen oxides and sulphur dioxide) react with the tiny droplets of water in clouds to form sulphuric and nitric acids. The rain from these clouds then falls as very weak acid is known as "acid rain".

Term was coined by R. Augus. Acid rain is rainfall with a pH of less than 5. The most acidic rain has occurred over West Virginia (U.S.A.) with a pH of 1.5. Acid rain corrodes metals, marble, stone, etc. Phenomenon is called stone leprosy.

4.1 Effects of Acid Rain

Acid rain has significant effects on the world environment and public health.

(1) **Effect on Aquatic Environment :** Acid rain either falls directly on aquatic bodies or gets run off the forests, roads and fields to flow into streams, rivers and lakes. Over a period of time, acids get accumulated in the water and lower the overall pH of the water body. The aquatic plants and animals need a particular pH level of about 4.8 to survive. If the pH level falls below that the conditions become hostile for the survival of aquatic life.

(2) **Effect on Forests :** It makes trees vulnerable to disease, extreme weather, and insects by destroying their leaves, damaging the bark and arresting their growth. Forest damage due to acid rain is most evident in Eastern Europe – especially Germany, Poland and Switzerland.

(3) **Effect on Soil :** Acid rain highly impacts on soil chemistry and biology. It means, soil microbes and biological activity as well as soil chemical compositions such as soil pH are damaged or reversed due to the effects of acid rain. The soil needs to maintain an optimum pH level for the continuity of biological activity. When acid rains seep into the soil, it means higher soil pH, which damages or reverses soil biological and chemical activities. Hence, sensitive soil microorganisms that cannot adapt to changes in pH are killed. High soil acidity also denatures enzymes for the soil microbes.

(4) **Vegetation Cover and Plantations :** The damaging effects of acid rain on soil and high levels of dry depositions have endlessly damaged high altitude forests and vegetation cover since they are mostly encircled by acidic fogs and clouds. Besides, the widespread effects of acid rain on ecological harmony have lead to stunted growth and even death of some forests and vegetation cover.

(5) **Effect on Architecture and Buildings :** Acid rain on buildings, especially those constructed with limestone, react with the minerals and corrode them away. This leaves the building weak and susceptible to decay. Modern buildings, cars, airplanes, steel bridges and pipes are all affected by acid rain. Irreplaceable damage can be caused to the old heritage buildings.

(6) **Effect on Public Health** : When in atmosphere, sulphur dioxide and nitrogen oxide gases and their particulate matter derivatives like sulfates and nitrates, degrades visibility and can cause accidents, leading to injuries and deaths. Human health is not directly affected by acid rain because acid rain water is too dilute to cause serious health problems. However, the dry depositions also known as gaseous particulates in the air which in this case are nitrogen oxides and sulphur dioxide can cause serious health problems when inhaled. Intensified levels of acid depositions in dry form in the air can cause lung and heart problems such as bronchitis and asthma.

(7) **Other Effects** : Acid rain leads to weathering of buildings, corrosion of metals, and peeling of paints on surfaces. Buildings and structures made of marble and limestone are the ones especially damaged by acid rain due to the reactivity of the acids in the rain and the calcium compounds in the structures. The effects are commonly seen on statues, old grave stones, historic monuments, and damaged buildings. Acid rain also corrodes metals like steel, bronze, copper, and iron.

5.   Ozone Depletion

O_3 layer is present in tropopause or stratosphere at 25 km. It protects earth from short-wave UV rays (below 300 nm) by changing them into infra-red rays. A large hole has appeared in O_3 layer over Antarctica (detected by Farman) & small over North Pole. Size of the holes varies with seasons. Thinning of ozone shield has also been reported elsewhere (e.g., 8% between 30° – 50° N).

Depletion of ozone layer allows harmful ultra-violet radiations to reach earth. It is the major cause of skin cancer, cataract, dimming of eye sight, decrease in immune system and increased susceptibility to herpes. Thinning of ozone shield is being caused by a number of pollutants like chlorofluorocarbons (14% of total depletion), NO_2 (3.5% depletion), SO_2, halon, CCl_4, methyl chloroform, chlorine. Max. O_3 depleting potential or ODP is of chlorofluorocarbon due to release of chlorine by it. A single chlorine atom converts 1 lakh molecules of ozone into oxygen. Now a days chlorofluorocarbons (CFCs) are being replaced by hydrofluorocarbons. Carbon tetrachloride, halon and methyl chloroform also deplete ozone by a similar method. Nitric oxide (NO) and other gases released by jets directly react with ozone to form oxygen. $NO + O_3 \rightarrow NO_2 + O_2$

- **Ozone Day :** September 16.

5.1   Stratospheric ozone depletion Stratospheric O_3 layer:

In the stratospher. UV-radiation causes photodissociation of ozone into O_2 and O. But O_2 and O quickly recombine to form O_3.

- This ozone dynamics dissipates the energy of UV as heat. An equilibrium is established between generation and destruction of O_3, leading to a steady state concentrating of ozone layer in the stratospher between 20 and 26 km above the sea level.
- The thickness of the vertical column of stratospheric O_3 layer, condensed to standard temperature and pressure, averages 0.29 cm above the equator and may exceed 0.40 cm above the poles at the end of the winter season.
- This layer acts as ozone shield protecting earth biota from harmful effects of UV-radiation. Absorption of UV-radiation by ozone layer increases exponentially with its thickness.
- Therefore, maximum amount of UV-radiation passing through atmosphere reaches the earth surface of the tropics (i.e., near the equator), and this amount decreases towards the poles.
- Concentration of O_3 in stratosphere changes with season, concentration being highest during February-April (spring season) and lowest during July-October (fall season).

5.2   Ozone Hole

During the period 1956-1970 the spring – time O_3 layer thickness above Antarctica varied from 280 to 325 Dobson Unit (1 DU = 1 ppb). The thickness was sharply reduced to 225 DU in 1979 and to 136 DU in 1985. Later, the O_3 layer thickness continued to decline to about 94 DU in 1994. The decline in spring-time ozone layer thickness is termed Ozone hole. The ozone hole was first discovered in 1985 over Antarctica. The existence of ozone hole was also confirmed above Arctic in 1990. The global-average total column ozone amount for the period 1997-2001 was about 3 per cent below the per-1980 average values.

6.   Water Pollution

It is the degradation of quality of water due to addition of substances (inorganic, organic, biological), factors (e.g., heat) that makes it health hazard, unfit for human use and growth of aquatic biota. Water pollution affects the entire biosphere of plants and organisms living in these water bodies, as well as organisms and plants that might be exposed to the water. In almost all cases the effect is damaging not only to individual species and populations, but also to the natural biological communities. It is of two types :

6.1   Natural sources of Water Pollution

Clay & silt from soil erosion, leaching of mineral, mixing of organic matter from banks

6.2   Anthropogenic or Man-Made Source of Water pollution

Domestic waste, sewage, soaps, & detergents, run-off from agricultural fields having fertilizers and pesticides, industrial wastes, heat, waste from animal sheds and slaughter houses, oil pollution, etc.

(1) **Organic Wastes/Sewage :** Food residue, animal & human excreta, detergent, discharge from commercial and industrial establishment. It has:

(i)   Raw sewage contains a number of pathogens.

(ii) It stimulates activity of several decomposer organisms collectively called sewage fungus.

The property of becoming decomposed through microbial activity is known as putrescibility.

Oxygen in milligrams required for five days in one litre of water at 20°C for the microorganisms to metabolise/ decompose organic waste called B.O.D. (Biochemical oxygen demand).

Degree of impurity of water due to organic matter is measured in terms of B.O.D.

Low pollution – below 1500 mg/1, medium pollution – 1500 – 4000 mg/l and high organic pollution – above 4000 mg/l.

(iii) Water has a brown colouration and an unpleasant odour due to formation of secondary pollutants like CH_4, NH_3, H_2S.
(iv) Scum and sludge (H_2S + metallic ions).
(v) There may be algal blooms and eutrophication. Due to phosphates present in detergents.
(vi) Animals may die due to depletion of oxygen by sewage fungus.

(2) Fertilizers : Part of fertilizers added to crop fields are passed down to water bodies during rains through surface run-off.
Presence of extra nutrients brings about growth of plant and animal, called eutrophication.
Eutrophication leads to organic loading, depletion of oxygen, death of animals.

(3) Pesticides : Pesticides sprayed over crops also pass into water bodies due to surface run-off.
Persistent pesticides (e.g., organochlorine or chlorinated hydrocarbons like DDT) pass into food chain and increase in amount per unit weight of organisms with rise in trophic level due to their accumulation, called biomagnification / biological amplification, e.g. 0.01-0.05 parts per billion in water, 10 parts per billion or 0.001 ppm in water birds like Sea Gulls.
Silent Spring : Novel written by Rachel Carson (1962) mentioning effect of DDT on birds. DDT use has been banned in U.S.A. since then. But in India banned since 1985.

(4) Silt : Slit from soil erosion makes water muddy and unfit for plant growth.

(5) Thermal Pollution : Hot effluents and hot water (e.g. thermal plants/atomic reactors) increases water temperature. Many animals fail to reproduce e.g., Trout, Salmon Warm water has less O_2, lower putrescibility resulting in increased organic loading, replacement of green algae by BGA.
El Nino is warm **Peru current** that recurs after 5-8 years, kills animal and plant in Peru.

(6) Oil Pollution: Refinery discharges cause oil pollution, reduces oxygenation, and kills animals.

(7) Industrial Effluents :
(a) **Mercury :** It is changed to water soluble dimethyl mercury which causes biomagnification.
Eating poisoned animals causes deformity known as minamata (minimata) disease which is characterized by diarrhoea, hemolysis, impairment of various senses, meningitis.
(b) **Copper :** Hypertension, uremia, occasional fever and coma.
(c) **Lead (also from automobile exhausts):** Checks haem synthesis and glucose metabolism.
Harmful effects include anaemia, vomiting , loss of appetite, damage to liver, kidneys and brain.
(d) **Zinc :** Vomiting, cramps, renal damage.
(e) **Cobalt :** Diarrhoea, hypotension, bone defects and paralysis.
(f) **Chromium :** Gastro-intestinal ulcers, nephritis and nervous system disorders.
(g) **Cadmium :** Anaemia, hypertension, testicular atrophy, damage to liver and kidneys, diarrhoea and skeletal deformities called **itai- itai** (ouch-ouch).

6.3 Control of Water Pollution

Sewage pollution can be prevented by treating sewage before passing into water course.
(1) Primary Treatment: This consists of shredding, churning, floatation, screening, sedimentation.
(2) Secondary Treatment : Organic matter is decomposed through sewage fungus by either trickling filter method (passing through thick bed of gravel) or activated sludge method (aeration/oxidation tanks). The cleared water is now chlorinated to kill pathogens. The water can be passed into fields, where it may cause eutrophication.
(3) Tertiary Treatment : Water is to be recycled, chlorinated waste is mixed alum, ferric chloride for precipitation of slat.
Zirconium is also a good precipitant. Another technique is reverse osmosis. **I.W.P. :** Indices of Water pollution. Daphnia and trout are sensitive to water pollution.
Faecal Pollution: Indicated by Escherichia coli. **MPN** in most probable number of E. coli. (indicator of water pollution.)

7. A Case Study of Integrated Waste Water Treatment

Waste water including sewage can be treated in an integrated manner. An example of such an initiative is the town of Arcata (California). The towns people created an integrated waste water treatment process within a natural system in collaboration with Humboldt State University. The cleaning occurs in two stages :
i. The conventional sedimentation, filtering and chlorine treatments are given. After this stage, but dissolved heavy metals still remain.
ii. The biologists developed a series of six connected marshes over 60 hectares of marshland. Appropriate organisms were seeded into this area, which neutralize, absorb and assimilate the pollutants. Hence, as the water flows through the marshes, It gets purified naturally, marshes also constitute a sanctuary.

Friends of the Arcata Marsh (FOAM) are responsible for the upkeep and safeguarding of this wonderful project. Ecological sanitation is a sustainable system for handling human excreta, using by compositing toilets. This is a practical, hygienic, efficient and cost-effective solution by which human excreta can be recycled into a resource (as natural fertilizer), which reduces need for chemical fertilizers. There are working 'EcoSan' toilets in many areas of Kerala and Sri Lanka.

7.1 Ganga Action Plan

For controlling pollution in Ganga, started 1985.
National Environment Policy Act : 1969.

7.2 Effects of Water Pollution

(1) Groundwater contamination from pesticides causes reproductive damage within wildlife in ecosystems.
(2) Sewage, fertilizer, and agricultural run-off contain organic materials that when discharged into waters, increase the growth of algae, which causes the depletion of oxygen. The low oxygen levels are not able to support most indigenous organisms in the area and therefore upset the natural ecological balance in rivers and lakes.

(3) Swimming in and drinking contaminated water causes skin rashes and health problems like cancer, reproductive problems, typhoid fever and stomach sickness in humans.

(4) Industrial chemicals and agricultural pesticides that end up in aquatic environments can accumulate in fish that are later eaten by humans. Fish are easily poisoned with metals that are also later consumed by humans. Mercury is particularly poisonous to small children and women. Mercury has been found to interfere with the development of the nervous system in foetuses and young children.

(5) Ecosystems are destroyed by the rising temperature in the water, as coral reefs are affected by the bleaching effect due to warmer temperatures. Additionally, the warm water forces indigenous water species to seek cooler water in other areas, causing an ecological damaging shift of the affected area.

(6) Human-produced litter of items such as plastic bags and 6-pack rings can get aquatic animals caught and killed from suffocation.

(7) Water pollution causes flooding due to the accumulation of solid waste and soil erosion in streams and rivers.

(8) Oil spills in the water causes animal to die when they ingest it or encounter it. Oil does not dissolve in water so it causes suffocation in fish and birds.

8. Soil Pollution

Soil pollution is defined as the presence of toxic chemicals (pollutants or contaminants) in soil, in high enough concentrations to pose a risk to human health and/or the ecosystem. In the case of contaminants which occur naturally in soil, even when their levels are not high enough to pose a risk, soil pollution is still said to occur if the levels of the contaminants in soil exceed the levels that should naturally be present. Change in soil caused by removal or addition of substance, which decrease productivity.

8.1 Negative soil pollution

is reduction in soil productivity due to erosion and over-use.

8.2 Positive soil pollution

is reduction in soil productivity due to addition of undesirable substances (e.g., pesticides, fertilizers, industrial wastes).

8.3 Landscape/third pollution

is converting fertile land into barren one by dumping wastes (e.g. ash, sludge, garbage, rubbish, industrial wastes, broken cans, bottles, etc.) over it. **Third poison :** Ground water pollution due to seepage of minerals, toxins and sewage.

(1) Pesticides : They include insecticides, fungicides, algicides, rodenticides and weedicides.

(2) Fertilizer : Excessive use causes soil deterioration through decrease of natural microflora. Leaching down causes pollution of underground water (third poison). Salts entering crop plants in excess may prove harmful. e.g., nitrate rich leaves, fruits and water produce nitrite in alimentary canal that centers blood, combines with haemoglobin forming **met-haemoglobin** and reducing oxygen transport. It may fatal in infants.

(3) Mine Dust : Destroys vegetation and produces many deformities in animals and humans.

8.4 Soil Salination

It is increase in salt concentration of soil making the latter halomorphic. It makes the soil barren. Only halophytes can grow over it. Soil salination is caused by-

(i) Parent rock
(ii) Poor drainage and elevated water table
(iii) Salt rich ground/canal water
(iv) Excessive fertilizers
(v) Salts blow from rocks/sea.
(vi) Plants that absorb acidic ions.
(vii) Formation from rocks having excess of Sodium, Calcium, Magnesium, etc.
(viii) Nearness to sea shore, salt lake or salt mine.
(ix) Irrigation water rich in basic salts

It is the presence of excess salts especially those of Sodium, Potassium and Magnesium. India has 6 million hectares of saline soils. Soil salinity measured by Conductivity Meter. Depending upon colour, saline soils can be – white solonchak and blackish solonetz.

Saline soils support only a few plants called halophytes, e.g., Tamarix, salvadera, salsola.

Saline soils are called usar, reh, thur, rakkar, chopan, etc.

They can be reclaimed or converted into fertile nearly neutral soils by –

(i) Removal of surface incrustation
(ii) Digging of trenches and flooding
(iii) Addition of gypsum or calcium sulphate, sulphur, press mud. Sugar factory waste, etc.
(iv) By N_2 fixing blue-green algae, manuring, Rice cultivation etc.

8.5 Land Degradation

Land becomes slowly unfit for plant growth due to

(1) **Jhuming/Shifting/Swidden Cultivation:** It is the practice of cutting down forest trees, burning of remains, raising crops on cleared area for a few years and then abandoning it.

(2) **Soil Erosion :** Removal of top soil by agency of water (water erosion) and wind (wind erosion). Soil erosion denudes additional 40,000 hec. of land annually in India.

(a) **Sheet Erosion :** Removal of extremely thin layer or sheet from soil surface.

(b) **Rill Erosion :** Development of finger like or groove-like narrow depressions.

(c) **Gully Erosion:** Deeper, wider channels formed by cutting of running water. 15-30 m deep gullies are called ravines.

(d) **Landslide/Slip Erosion :** Rock masses become loosened due to repeated rainfall and percolation. Hence slip erosion along the slope.

(e) **Riparian Erosion :** Caused by siltation of river beds and overflowing in rainy season.
Wind erosion is caused by carrying of dust, saltation & surface creep of larger particles.

8.6 Control of Soil Erosion/Soil Conservation

(i) **Crop Rotation :** It is the practice of sowing different crops, usually legume and nonlegume, in successive seasons on the same piece of land for maintaining soil fertility.

(ii) **Mixed Cropping :** Two or more crops simultaneously on the same land.

(iii) **Mulching :** Covering of harvested filed with plant litter or polyethene (LDPE or low densitypolyethylene) in order to decrease run off and retention of water.

(iv) **Strip Cropping :** Sowing of perennial crops alternating with annulas.

(v) **Terracing :** Slope is divided into a number of flat fields for slowing down the flow of water.

(vi) **Contour Bunding :** Raising small bunds on edges of fields to prevent loss of top soil.

(vii) **Wind Breaks :** Growth of several alternate rows of trees and shrubs at right angles to prevalent direction of wind for reducing its speed and preventing carrying of soil particles.

(viii) **Afforestation & Reforestation :** Plantation of forest in new area is afforestation and refrestation in deforested area.

8.7 Restoration of Soil Fertility

It is carried out by

(i) Stoppage of overuse or over-cropping.

(ii) Rotation of crops

(iii) Green manuring

(iv) Addition of manure & fertilizers

(v) Proper irrigation

(vi) Maintenance of soil pH and porocity.

8.8 Desertification

It is conversion of fertile land into barren sandy tract. It is due to

(i) Overgrazing

(ii) Drying of rivers/irrigation canals

(iii) Felling of trees.

(iv) Nearness to sandy beach

(v) Activities like mining, human settlements, industry, canals, roads, rail tracks, etc.

9. Land and Water Management

India has a

(a) **Total land mass** – 305 million ha

(b) **Urban/Industrial area** – 18 million ha

(c) **Rocky/Snow Bound** – 21 million ha

(d) **Forests/Pastures** – 83 million ha of

(e) **Agricultural** – 143 million ha

(f) **Culturable Wasteland** – 17 million ha

(g) **Fallow** – 23 million ha. 87 million ha of land is erosion prone.

9.1 Wasteland Development

Land not put to economic/ecologic use is wasteland. A lot of wasteland occurs even in India. Two types- culturable & nonculturable.

Case Study of Organic Farming

Integrated organic farming is a cyclical, zero-waste procedure, where waste products from one process are cycled as nutrients for other processes.

This allows the maximum utilization of resources and increase the efficiency of production.

Ramesh Dagar, a farmer in Sonipat, Haryana, is doing just this. He includes bee-keeping, dairy management, water harvesting, composting and agriculture in a chain of processes, which support each other and allow an extremely economical and sustainable venture.

There is no need to use chemical fertilizers for crops, as cattle excreta (dung) are used as manure. Crop waste is used to create compost, which can be used as a natural fertilizer or can be used to generate natural gas for satisfying the energy needs of the farm. Enthusiastic about spreading information and help on the practiceof integrated organic farming, Dagar has created the Haryana Kisan Welfare Club, with a current membership of 5000 farmers.

10. Solid Waste Management

Solid wastes refer of everything that goes out in trash. Sanitary landfills were adopted as the substitute for open-burning dumps where in a sanitary landfill, wastes are dumped in a depression or trench after compaction, and covered with dirt everyday. But these sites are getting filled too and seepage of chemicals. etc, from these landfills pollutes underground water resources.

* Anthropogenic solid waste is categorized into three types –

* (a) bio-degradable, (b) recyclable and (c) the non-biodegradable.

(i) Polyblend, a fine powder of recycled modified plastic, was developed by the company owned by Ahmed Khan in Bangalore. This mixture with the bitumen that is used to lay roads. Blends of Polyblend and bitumen, when used to lay roads

(ii) enhanced the bitumen's water repellent properties, and helped to increase road life by a factor of three.

(iii) The use of incinerators (burning in presence of O_2 at 900–1200°C) other is pyrolysis (anaerobic burning at 1650°C) is crucial for disposal of hospital waste.

(iv) Irreparable computers and other electronic goods are known as electronic wastes (e-wastes). E-wastes are buried in landfills or incinerated. Over half of the e-wastes generated in the developed world are exported. Recycling is the only solution for the treatment of e-wastes, provided it is carried out in an environment-friendly manner.

(v) Developing countries like China, India and Pakistan imports over half of the e-waste generated by developed countries for recovery of metals like Cu, iron, silicon, nickel & gold.

Sources and Types of Solid Wastes

Source	Typical Waste Generators	Types of Solid Wastes
Residential	Single and multifamily dwellings	Food wastes, paper, cardboard, plastics, textiles, leather, yard wastes, wood, glass, metals, ashes, special wastes (e.g., bulky items, consumer electronics, white goods, batteries, oil, tires), and household hazardous wastes.).
Industrial	Light and heavy manufacturing, fabrication, construction sites, power and chemical plants.	Housekeeping wastes, packaging, food wastes, construction and demolition materials, hazardous wastes, ashes, special wastes.
Commercial	Stores, hotels, restaurants, markets, office buildings, etc.	Paper, cardboard, plastics, wood, food wastes, glass, metals, special wastes, hazardous wastes.
Institutional	Schools, hospitals, prisons, government centers.	Same as commercial.
Construction and demolition	New construction sites, road repair, renovation sites, demolition of buildings	Wood, steel, concrete, dirt, etc.
Municipal services	Street cleaning, landscaping, parks, beaches, other recreational areas, water and wastewater treatment plants.	Street sweepings; landscape and tree trimmings; general wastes from parks, beaches, and other recreational areas; sludge.
Process (manufacturing, etc.)	Heavy and light manufacturing, refineries, chemical plants, power plants, mineral extraction and processing.	Industrial process wastes, scrap materials, off-specification products, slay, tailings.
Agriculture	Crops, orchards, vineyards, dairies, feedlots, farms.	Spoiled food wastes, agricultural wastes, hazardous wastes (e.g., pesticides).

10.1 Methods of Solid Waste Disposal and Management:

(1) **Sea Dumping Process :** This sea dumping process can be carried out only in coastal cities. This is very costly procedure and not environment friendly.

(2) **Fermentation/Biological Digestion :** Biodegradable wastes are converted to compost and recycling can be done whenever possible. Hazardous wastes can be disposed using suitable methods.

(3) **Solid Wastes Sanitary Landfills :** Solid wastes sanitary landfills process is simple, clean and effective. In this procedure, layers are compressed with some mechanical equipment and covered with earth, levelled, and compacted. A deep trench of 3 to 5 m is excavated and micro-organisms act on the organic matter and degrade them.

(4) **Incineration Method :** Incineration method is suitable for combustible refuse. High operation costs and construction are involved in this procedure. This method would be suited in crowded cities where sites for land filling are not available.

It can be used to reduce the volume of solid wastes for land filling.

(5) **Composting Process :** Composting process is similar to sanitary land-filling and it is popular in developing countries. Decomposable organic matter is separated and composted in this procedure. Yields are stable end products and good soil conditioners. They can be used as a base for fertilizers.

Two methods have been used in this process:
- Open Window Composting
- Mechanical Composting

(6) **Disposal by Ploughing into the Fields :** Disposal by ploughing into the fields are not commonly used. These disposals are not environment friendly in general.

(7) **Disposal by Hog Feeding :** Disposal by hog feeding is not general procedure in India. Garbage disposal into sewers including BOD and TSS increases by 20-30%. Refuse is ground well in grinders and then fed into sewers.

(8) **Salvaging Procedure :** Materials such as metal, paper, glass, rags, certain types of plastic and so on can be salvaged, recycled, and reused.

11. Radioactive Pollution

Degradation of environment due to release of radioactivity (α, β, γ rays) by change in nuclides of radioactive elements. Radioactive pollutant causes short – range and long range harmful effects on livings. Radioactivity is measured in units called roentgens or r.

11.1 Background Radiation

Found naturally in biosphere due to cosmic rays reaching earth & radio-nuclides found in earth's crust. e.g.Ur-238, Ur-235. Th – 232, Radium – 224, Radon – 222, Potassium – 40 and C – 14. Max. background radiation is found in Kerala beach where 75% of thorium of world is found.

11.2 Mining and Refining

Due to mining and refining of radioactive elements like Plutonium, Uranium and Thorium, nuclear power plants and fuels, preparation of radio-active isotopes, production and explosion of nuclear weapons.

11.3 Nuclear Weapons

They use Ur – 235 Plutonium – 239 for fission and hydrogen. A nuclear explosion produces (i) Uncontrolled chain reactions (ii) Tremendous heat (iii) Neutron flux that changes other elements to radioactive state, e.g., Ba– 142, Cs – 137, I– 131, Kr – 91, Sr – 90, Cobalt – 60, Phosphorus-32. (iv) Unused explosive and activation products (v) A lot of radioactive and other gases forming mushroom type cloud. The radioactive particles are carried to all places polluting air, water, soil and food chains.

Nuclear bombing of Nagasaki and Hiroshima (1945), not only destroyed the two cities, killed thousands of humans and animals but have left a chain of genetic deformitites. (Hiroshima Day: August 6. Nagasaki Day : August 9.) Iodine–131 damages spleen, lymph nodes, leucocytes, bone marrow, produces lung tomour, skin cancer, sterility. Strontium-90 causes bone cancer and tissue degeneration. Cesium-137 brings about nervous, muscular and genetic changes. Cattle, milk, drinking water, vegetables, fruits and grains all pass on radioactivity to humans. Animals can store radioactive elements. Oysters-Zn-65, Fish-Fe-55, Marine Animals – Sr- 90. **Radon** causes leukemia, brain tumours and kidney cancers.

11.4 Atomic Reactors

They employ controlled radioactive fission/fusion for liberation of energy.

(i) Coolant water causes thermal pollution
(ii) Small amount of radioactivity enters coolant water which undergoes biomagnifications to some 75000 times in birds.
(iii) They release.
(iv) A mistake can be dangerous as an atomic explosion, e.g., Chernobyl in Ukraine in April 1986. Reactor burst due to overheating causing leakage of radioactive substances. (v) Radioactive waste is highly pollutant and its dumping requires several precautions.

Radio-Isotopes : They are used in research (e.g., metabolic pathways), induction of mutations in plants and microorganisms, radiotherapy, etc. e.g., Co-60, P-32, C –14, I –125.

11.5 Harmful Effects

They were first recorded in uranium miners as skin burns and cancers.
Many plants are killed. Young and recently divided cells are more easily damaged.

11.6 Short Range Effects

Loss of nails and hair, subcutaneous bleeding, changed proportion of blood cells, changed metabolism, damage to all organs, death in high dose.

11.7 Long Range/Delayed Effects

Cancers, mutations, genetic deformities, shorter life span.

11.8 Nonionising Radiations

They are ultra-violet rays (100-300 nm) which have low penetration.
Damage eye sight by damage of cornea, rupture of subcutaneous capillaries.
They causes reddening of skin (sunburn), mutations, skin and other cancers due to inactivation of organic molecules and formation of pyrimidine dimmers in DNA.
Thick cuticle, sporopollenin and carotenoids protect plants from UV radiations.
Human can be protected by wearing sun glasses Absence of this protective system produces a deficiency called xeroderma pigmentosum.

12. Noise Pollution

Physical pollution that affects receiver directly, due to release of unwanted sound generally of 80dB and above.
Frequency of sound is measured in Hz (Hertz) while unit of sound is dB (deciBel).
Range of human hearing is 50 Hz to 15000 Hz.
Moderate conversation produces 60 dB sounds, loud conversation 70dB.
Scooter 80 dB, plying of truck/bus 90dB, jet aeroplane 150 dB, rocket 180 dB.
A regular exposure to sound of 80dB (day time noise level in metropolitan cities) reduces hearing by 15dB in 10 years.
Noise becomes uncomfortable above 100 dB.

12.1 Sound Limits

(i) **Silence Zone** (Hospitals, Schools)- 50 dB during day and 40 dB at night.
(ii) **Residential Zone :** 75 dB during day and 45 dB at night
(iii) **Commercial Zone :** 65 dB in day and 55 dB at night
(iv) **Industrial Zone** – 75 dB during day and 70 dB at night. 30 dB is considered calm. Breathing has a sound level of 10 dB.

12.2 Effect

(i) Damage to ear drum & impairment of hearing (a ten year exposure to 80 dB impairs hearing by 15 dB).
(ii) Interference in conversation and hearing.
(iii) Emotional disturbance, development of anxiety and stress (first effect).
(iv) Damage to eye sight, colour perception, night vision etc.
(v) Hypertension, decreased heart output and gastric problems
(vi) Startle Reaction.

12.3 Control

(i) Delimitation of acoustic zoning
(ii) Use of cotton plugs or ear muffs in occupational exposure.
(iii) Development of quieter machines.
(iv) Restricted use of loud speakers
(v) Acoustic furnishing and low voice radio/TV.
(vi) Regulation of noise on road
(vii) **Green Muffler :** Green plants along road to reduce noise pollution.

12.4 Range of Tolerance

According to Shelford's law of tolerance (Shelford, 1913), the abundance, fitness, growth and distribution of organisms are controlled by a number of ecological factors below their critical maximum and above their critical minimum.

(1) Critical minimum and critical maximum of a factor are called limits of tolerance The factors which limit various aspects of life of organisms by their deficiency (two little) or excess (too much) are known as limiting factors.
(2) For example, low temperature limits plant growth in arctic and alpine regions, water availability limits plant growth in deserts and phosphorus availability limits phytoplankton growth in deep lakes. Similarly, high temperature is responsible for little biota in hot springs. Excess of water in water-logged soils does not allow plant growth in many parts.
(3) Range of tolerance of an organism for an ecological factor (e.g., temperature, sunlight, nutrient concentration) is the ragne between critical minimum and critical maximum values of the factor. It appears as a bell-shaped curve.
(4) It has two zones of tolerance, optimum and stress.
(5) The optimum range or zone of tolerance is the central part of the curve where the organism shows maximum growth, survival, fitness and abundance.
(6) Zone of stress or stress range is that regime of ecological factor where it begins to function as limiting factor. Only a few individuals survive in this zone. They are mostly unable to reproduce in the zone of stress.
(7) Zone of intolerance are values of the ecological factor below the critical minimum and above the critical maximum. Organisms do not occur in zone of intolerance.
(8) A number of ecological factors are simultaneously acting on an organism. For an organism to occur at one place it must receive optimum range of all the factors influencing it. The range of ecological factors within which a species displays its maximum potentiality is called ecological amplitude.
(9) An organism will have a wide range of distribution if it has a wide range of tolerance to different ecological factors. Such an organism is called eurytopic, e.g., euryphagic, eurythermal, euryhaline.
(10) An organism will have a restricted range of geographical distribution if it has a narrow range of tolerance. It is called stenotopic, e.g., stenohaline, stenophagic and stenothermal.

13. Greenhouse Effect

The **greenhouse effect** is the process by which radiation from a planet's atmosphere warms the planet's surface to a temperature above what it would be without its atmosphere.

If a planet's atmosphere contains radiatively active gases (i.e., greenhouse gases) they will radiate energy in all directions. Part of this radiation is directed towards the surface, warming it. The intensity of the downward radiation – that is, the strength of the greenhouse effect – will depend on the atmosphere's temperature and on the amount of greenhouse gases that the atmosphere contains.

Earth's natural greenhouse effect is critical to supporting life. Human activities, mainly the burning of fossil fuels and clearing of forests, have strengthened the greenhouse effect and caused global warming.

13.1 Greenhouse Gases

Many GHGs, including water vapour (the most important), ozone, carbon dioxide, methane, and nitrous oxide, are naturally present in the atmosphere. Other GHGs are synthetic chemicals that are emitted only as a result of human activity. Human activities are significantly increasing atmospheric concentrations of many GHGs.

(1) **Carbon dioxide (CO2)**, the most significant GHG directly affected by anthropogenic activity, is the product of the oxidation of carbon in organic matter, either through combustion of carbon-based fuels or the decay of biomass. Natural CO_2 sources include volcanic eruptions, respiration of organic matter in natural ecosystems, natural fires, and exchange of dissolved CO_2 with the oceans. The main anthropogenic sources are (a) fossil fuel combustion and (b) deforestation and land use changes (such as converting agricultural land or forests to urban development), which release stored organic matter and reduce the ability of natural ecosystems to store carbon.
(2) **Methane (CH_4)** is produced by anaerobic decay of organic material in landfills, wetlands, and rice fields; enteric fermentation in the digestive tracts of ruminant animals such as cattle, goats, and sheep; manure management; wastewater treatment; fossil fuel combustion; and leaks from natural gas transportation and distribution systems and abandoned coal mines.
(3) **Nitrous oxide (N_2O)** is produced by fertilizer use, animal waste management, fossil fuel combustion, and industrial activities.

(4) Hydrofluorocarbons (HFCs) and perfluorocarbons (PFCs) are synthetic chemicals that are used in a variety of industrial production processes such as semiconductor manufacturing. PFCs are also produced as a by-product of aluminium smelting. Both groups of chemicals are finding increasing use as substitutes for ozone-depleting chlorofluorocarbons (CFCs), which are being phased out under the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer. HFCs and PFCs are replacing CFCs in applications such as refrigeration and foam-blowing for insulation. When atmospheric GHG concentrations increase, Earth temporarily traps infrared radiation more efficiently, so the natural radiative balance is disturbed until its surface temperature rises to restore equilibrium between incoming and outgoing radiation. It takes many decades for the full effect of greenhouse gases to be realized in higher surface temperatures, because the oceans have a huge capacity to store heat. They must be gradually warmed by excess infrared radiation from the atmosphere.

13.2 Effects of Greenhouse Gases on Climate Change

Greenhouse gases have had a huge affect on climate change.

(1) Global Warming- Although the Earth has natural cycles of extreme heat and extreme cold, we are causing an unnaturally quick global warming with our constant burning of fossil fuels. More and more of the thermal radiation that comes to us from the sun millions of miles aware is getting trapped on Earth because of the dense layer of many different greenhouse gases, which means that the average temperature of the Earth is on the rise and not set to stop any time soon. This means that many places are suffering from droughts more often throughout the year and some places are becoming completely inhospitable.

(2) The Melting of the Polar Ice Caps- As a direct result of the greenhouse gases keeping the heat from the sun close to Earth, the polar ice caps are starting to melt at an alarming rate. Not only is this problematic for the animals that rely on those ice caps for their survival – for instance, seals and polar bears that use them as shelter, places to hunt from and places to raise their young – but it could also mean that the average level of the sea will start to rise alarmingly quickly. When the sea rises too high, it will start to cause some of the lower lying land around the world to start disappearing, meaning that many thousands if not millions of people will be forced to move, or may even die.

(3) Changing of Climates and Seasons- Global warming is not all about the Earth slowly but surely getting hotter and hotter. In fact, it is a lot more complicated than that. Unfortunately, the accumulation of greenhouse gases in our atmosphere means that the average temperatures are gradually rising and that rain is becoming more and more scarce in some areas of the world, but it does also mean that seasons and climates are becoming more and more sporadic and difficult to predict.

13.3 Degradation by improper resource utilisation and maintenance

The lowering of quality, fertility and productivity of land by various factors such as salination of soil, erosion, desertification, shifting cultivation and development activities etc. is called land degradation. It is caused by five main factors:

(1) Development Activities : Many development activities such as rapid urbanization, human settlement, mining, construction of roads, dams, canals, railways, airports, playgrounds, industries cause loss of large areas of fertile and productive land.

(2) Soil Erosion : It is the removal of top, fertile, mineral rich soil layer by water, floods, wind, ocean waves, glaciers, felling of trees, overgrazing on slopes or some arid soils, over cropping and improper farming techniques etc. It occurs in both wet and arid regions. Roots of grasses are excellent binding material and keep the soil intact and free from soil erosion.

(3) Desertification : It is the change of fertile soil into a non productive desert soil. It is due to the shifting of sand dunes by strong winds, or by deforestation, soil erosion or overgrazing in lands sparsely covered by grasses. Many deserts in the world are man-made. Afforestation is the only solution to prevent desertification.

(4) Shifting cultivation: In many tribal communities of tropical and subtropical regions of Africa and Asia, it is a practice of slashing, cutting down trees, burning the felled trees and raising crops on the ash formed. This practice is called 'Jhum Cultivation' in north east India. This destroys forests and causes soil erosion.

(5) Salination of Soil : Increase in the concentration of soluble salts in the soil is called salination. Origin or development of saline soil depends upon following factors:

    (a) Poor Drainage of Soil : Salts dissolved in irrigation water accumulate on the soil surface due to inadequate drainage especially during flood.

    (b) Quality of Irrigation Water : The ground water of arid (dry, barren having not enough rainfall to support vegetation) regions are generally saline in nature. The irrigation water may be itself rich in soluble salts and add to salinity of soils.

    (c) Excessive Use of Basic Fertilizers : Excessive use of alkaline fertilizers like sodium nitrate, basic slag, etc may develop alkalinity in soil.

    (d) Saline Nature of Parent Rock Materials: If soil develops from saline nature of parent rock materials, soil would be saline.

14. Deforestation

(1) It is the conversion of forested areas to non-forested ones. It is estimated that almost 40 per cent forests have been lost in the tropics, compared to only 1 per cent in the temperate region.

(2) At the beginning of the twentieth century, forests covered about 30 per cent of the land of India. By the end of the century, it shrunk to 19.4 per cent, whereas the National Forest Policy (1988) of India has recommended 33 per cent forest cover for the plains and 67 per cent for the hills.

(3) Trees are axed for timber, firewood, cattle ranching and for several other purposes. Slash and burn agriculture, has also contributed to deforestation.

(4) One of the major effects of deforestation is increased carbon dioxide concentration in the atmosphere. It also causes loss of biodiversity due to habitat destruction, disturbs hydrologic cycle, causes soil erosion, and may lead to desertification in extreme cases.

(5) Reforestation is process of restoring a forest it may also occur naturally in a deforested area.

15. Case Study of People's Participation in Conservation of Forests

A Bishnoi woman of Khejarli village, Jodhpur, Rajasthan named Amrita Devi showed exemplary courage by hugging a tree. Amrita Devi **Bishnoi Wildlife Protection Award :** for individuals or communities from rural areas that have shown extraordinary courage and dedication in protecting wildlife.

15.1 Chipko Movement.

It is movement which was initially meant for protecting trees but not meant for preservation of environment habitat and wildlife. **Chipko movement was born** in March 1974 in Gopeshwar in Chamoli district. The movement has two leaders, Chandi Prasad Bhatt of Gopeshwar and Sunder Lal Bahugana of Silyara in Tehri region. A similar movement was undertaken by Paudurang Hedge in the South. It is known as appiko movement.

- Government of India in 1980s has introduced the concept of Joint Forest Management (JFM) so as to work closely with the local communities for protecting and managing forests.

15.2 Environment Laws for Controlling Pollution

Important legislations directed at the protection of environment in India are listed below:
(1) The Environment (Protection) Act, 1986
(2) The Insecticide Act, 1968
(3) The Water (Prevention and Control of Pollution) Act, 1974
(4) The Air (Prevention and Control of Pollution) Act, 1981 (Amended in 1987 to include noise as an air pollutant).

15.3 International Initiatives for MITIGATING Global Change

The long-term challenge of stabilizing the atmospheric concentrations of greenhouse gases requires that global emissions be significantly lowered than what they are today. In 1987, many countries signed the Montreal Protocol (effective in 1989) at Montreal (Canada), a landmark international agreement to protect the stratospheric ozone by agreeing to limit the production and use of ozone-depleting substances, phasing out of ozone-depleting substances and helping the developing countries to implement use of alternatives to CFCs. The United Nations Conference on Environment and Development (UNCED, Earth Summit), held to Rio de Janeiro, Brazil in 1992, established the principles for reducing greenhouse gas emission, The Kyoto Protocol, approved by a follow-up conference held in Kyoto, Japan, during December 1997, has specified the commitments of different countries to mitigate climate change. This protocol requires countries to take appropriate measures to reduce their overall greenhouse gas emissions to a level at least 5% below the 1990 level by the commitment period 2008-2012.

15.4 Initiatives for mitigating global change

(1) **Earth Summit (1992)** - The United Nations Conference on Environment and Development (UNCED, Earth Summit), held to Rio de Janeiro, Brazil in 1992, established the principles for reducing greenhouse gas emission,

(2) **Montreal Protocol (16 September 1987)** : A landmark international agreement to protect the stratospheric ozone by agreeing to limit the production and use of ozone depleting substances to half the level of 1986 and helping the developing countries to implement use of alternatives to CFCs.

(3) **Helsinki Declaration (May, 1989)** : Montreal protocol was ratified by 82 nations at Helsinki. They pledged to phase out CFCs by 2000.

(4) **Kyoto Protocol (December, 1997)** : International conference held in Kyoto, Japan obtained commitments from different countries for developing alternatives to ODS and reducing overall greenhouse gas emissions at a level 5% below 1990 level by 2008-2012.

(5) **Beijing Protocol (1999)** : The protocol lays down steps to reduce emission of CFSc and other ozone depleting substances. It separates the efforts to be made by developing and developed countries.

38. Environmental Issues – Multiple Choice Questions

1. Pollution

1. Green house effect means
   (a) Increase in the temperature of earth due to high conc. of NO_2
   (b) Increase in the temperature of earth due to high conc. SO_2
   (c) Increase in the temperature of earth due to high conc. O_2
   (d) Increase in temperature of earth due to high conc. of CO_2

2. Which of the following is not a green-house gas
   (a) Water vapor   (b) Carbon monoxide
   (c) Methane   (d) Oxygen

3. Which of the following is not a greenhouse gas
   (a) N_2O (b) CFC
   (c) O_3 (d) SO_2

4. It is said, the Taj Mahal may be destroyed due to
   (a) Flood in Yamuna River
   (b) Decomposition of marble as a result of high temperature
   (c) Air pollutants released from oil refinery of Mathura
   (d) All the above

5. Some effects of sulphur dioxide and its transformation products on plants include
   (a) Chlorophyll destruction   (b) Plasmolysis
   (c) Golgi body destruction   (d) None of the above

6. BOD stands for
   (a) Biological organism death
   (b) Biochemical organic matter decay
   (c) Biotic oxidation demand
   (d) Biochemical oxygen demand

7. Pollution can be controlled by
   (a) Sewage treatment
   (b) Manufacturing electrically operated vehicles
   (c) By checking atomic blasts
   (d) All of the above

8. Photochemical smog always contains
   (a) O_3 (b) CH_4
   (c) CO (d) None of these

9. Which among the following is likely to have the highest levels of D.D.T. depositions in its body
   (a) Eel   (b) Crab
   (c) Sea gull   (d) Phytoplankton

10. Which is a green house gas
    (a) CO (b) CO_2
    (c) H_2 (d) N_2

11. Acid rain is the secondary effect of
    (a) Water pollution   (b) Air pollution
    (c) Soil pollution   (d) Sound pollution

12. Gases referred to as "green house gases" are
    (a) CO_2, O_2, NO_2, NH_3
    (b) Chlorofluoro carbon, CO_2, NH_3, N_2
    (c) CH_4, N_2, CO_2, NH_3
    (d) Chlorofluoro carbon, CO_2, CH_4, NO_2

13. Frequent occurrence of water blooms in a lake indicates
    (a) Nutrient deficiency
    (b) Oxygen deficiency
    (c) Excessive nutrient availability
    (d) Absence of herbivores in the lake

14. Checking of reradiating heat by atmospheric dust O_3, CO_2 and water vapors is
    (a) Green house effect   (b) Solar effect
    (c) Ozone layer effect   (d) Radioactive effect

15. Non-biodegradable pollutants are created by
    (a) Nature
    (b) Excessive use of resources
    (c) Humans
    (d) Natural disasters

16. The material generally used for sound proofing of rooms like a recoding studio and auditorium is
    (a) Cotton   (b) Coir
    (c) Wood   (d) Styrofoam

17. Compressed Natural Gas (CNG) is
    (a) Propane   (b) Methane
    (c) Ethane   (d) Butane

18. Which of the following material takes the longest time for biodegradation
    (a) Cotton   (b) Paper
    (c) Bone   (d) Jute

19. Among the following which one cause maximum indoor chemical pollution
    (a) Burning coal   (b) Burning cooking gas
    (c) Burning mosquito coil   (d) Room spray

20. Which one of the following impurities is easiest to remove from wastewater
    (a) Bacteria   (b) Colloids
    (c) Dissolved solids (d) Suspended solids

21. Nuisance growth of aquatic plants and bloom-forming algae in natural waters is generally due to high concentration of
    (a) Carbon   (b) Sulphur
    (c) Calcium   (d) Phosphorus

22. Which of the following does not cause pollution
    (a) Hydroelectric schemes
    (b) Automobiles
    (c) Nuclear energy project
    (d) Thermal power project

23. Most important causative pollutant of soil may be
    (a) Plastics   (b) Iron junks
    (c) Detergents   (d) Glass junks

24. Metal generally present in polluted air is
    (a) Cadmium   (b) Lead
    (c) Mercury   (d) Zinc

25. Why is the concentration of ozone less over the north and south poles
    (a) CFCs accumulate only in area where the air is cold
    (b) CFC use is highest in these areas
    (c) CFCs stick to frozen water vapor and are able to act as catalysts
    (d) UV rays are stronger in the atmosphere

26. The amount of freshwater of the earth frozen as polar or glacial ice is
    (a) 0.5 %   (b) 0.02 %
    (c) 0.01%   (d) 1.97 %
    (e) 2.5 %

27. Which of the following are true
    (i) Benzene hexachloride is a non biodegradable pollutant
    (ii) Anthropogenic air pollutants are natural in origin
    (iii) Carbon monoxide is a primary air pollutant
    (iv) Sulphur dioxide causes brown air effect during traffic congestion in cities
    (a) (i) and (iii) only   (b) (i) and (ii) only
    (c) (ii) and (iii) only   (d) (ii) and (iv) only
    (e) (i) and (iv) only

28. Which one of the following is not an air pollutant
    (a) Pollen from plants   (b) Phosphates
    (c) Carbon monoxide   (d) Hydrocarbons
    (e) Sulphur dioxide

29. Marsh gas mainly contains
    (a) SO_2 (b) CO_2
    (c) CH_4 (d) H_2O

30. The Environment (Protection) Act to protect and improve the quality of environment (air, water and soil) was passed by the Government of India in the year
    (a) 1971   (b) 1974
    (c) 1981   (d) 1986

31. Biomagnification of DDT in a aquatic food chain starting from water having a concentration of 0.003 ppb may go, in fish eating birds, up to
    (a) 2 ppm   (b) 25 ppm
    (c) 50 ppm   (d) 100 ppm

32. The Air (prevention and Control of Pollution) Act was amended in 1987 to include one of the following as pollutant
    (a) Water   (b) Noise
    (c) Dust   (d) None of these

33. The purpose of biological treatment of waste-water is to
    (a) Reduce BOD   (b) Increase BOD
    (c) Reduce sedimentation   (d) Increase Sedimentation

34. In a polluted environment, the maximum pollutant will occur in
    (a) Primary producers   (b) Tertiary consumers
    (c) Secondary Consumers   (d) Primary consumers

35. Biological treatment of water pollution is done with the help of
    (a) Phytoplankton   (b) Lichens
    (c) Fungi   (d) None of the above

36. Ozone layer in upper atmosphere (stratosphere) is destroyed by or which one of the chemicals is responsible for the reduction of ozone content of atmosphere

    Or

    What are the chief pollutants of the atmosphere which are most likely to deplete the ozone layer
    (a) Hydrochloric acid
    (b) Photochemical smog
    (c) Chlorofluoro carbon (CFC) and Nitrogen Oxide
    (d) Sulphur dioxide

37. 'Heat islands' are produced due to
    (a) Air pollution   (b) Water pollution
    (c) Land pollution   (d) All the above

38. Find the correct order of biomagnification of DDT in an aquatic food chain
    (a) Water (0.003 ppm), zooplankton (0.5 ppm), small fish (0.04 ppm), large fish (2 ppm), fish eating birds (25 ppm)
    (b) Water (0.003 ppm) zooplankton (0.04 ppm) small fish (0.5 ppm), large fish (2 ppm), fish eating birds (25 ppm)
    (c) Water (0.003 ppm), fish eating birds (25 ppm), zooplankton (0.5 ppm), small fish (0.04 ppm), large fish (25 ppm)
    (d) Water (0.003 ppm), small fish (0.04 ppm), zooplankton (0.5 ppm), large fish (2 ppm), fish eating birds (25 ppm)
    (e) Water (0.003 ppm), large fish (0.04 ppm), small fish (0.5 ppm), zooplankton (2 ppm), fish eating birds (25 ppm)

39. The river 'Sone' receives wastes from
    (a) Refinery   (b) Distillery
    (c) Textile mill   (d) Paper mill

40. In 1984, Bhopal gas tragedy was caused due to leakage of
    (a) Sodium monoxide   (b) Sodium thiocyanate
    (c) Potassium isocyanate   (d) Methyl isocyanate

41. Water pollution is caused due to
    (a) Sewage and other wastes (b) Industrial effluents
    (c) Agricultural discharges (d) All of these

42. Effect of pollution is first marked on
    (a) Micro-organisms
    (b) Green vegetation of an area
    (c) Food crop
    (d) None of these

43. A process that uses micro-organisms to convert harmful industrial wastes to less toxic or non-toxic compounds is
    (a) Complement fixation   (b) Precipitation
    (c) Bioremediation   (d) Bioconversion

44. Black-foot disease is caused due to groundwater contaminated with excess of
    (a) Nitrate   (b) Fluoride
    (c) Arsenic   (d) Sulphur
    (e) Mercury

45. Melanin pigment protects from which of the following radiations
    (a) UV rays   (b) X-rays
    (c) Infrared rays   (d) Gamma rays

46. The following shown device is best used to control which of the pollutants according to size of air pollutants, range and types of chemical
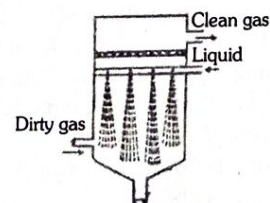
    (a) Fine particles   (b) Dissolved gases
    (c) Charged particulate matter (d) Large particulates

47. The given figure represents electrostatic precipitator. Select the right option in which A, B and C are correctly identified
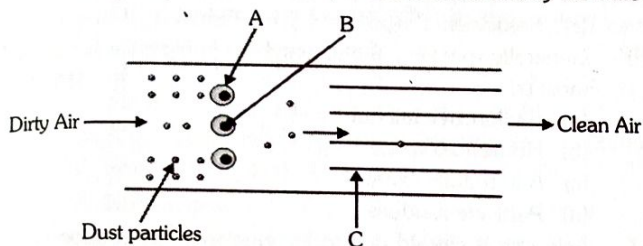
(a) A - Uncharged corona, B - Positively charged wire, C - Collection plate never ground
(b) A - Discharge corona, B - Negatively charged wire, C - Collection plate burnt
(c) A - Discharge corona, B - Positively charged wire, C - Collection plate grounded
(d) A - Discharge corona, B - Negatively charged wire, C - Collection plate grounded

48. Select the right option in which given figure is correctly identified

(a) Marsh meadow stage
(b) Ozone hole
(c) El Nino Effect
(d) Greenhouse effect

49. Which of the following would most likely help to slow down the greenhouse effect
(a) Converting tropical forests into grazing land for cattle
(b) Ensuring that all excess paper packaging is burned to ashes
(c) Redesigning land fill dumps to allow methane to be collected
(d) Promoting the use of private rather than public transport

50. Which of the following exhibits biomagnification
(a) SO_2
(b) Mercury
(c) DDT
(d) Both (b) and (c)

51. World's most problematic aquatic weed is
(a) *Azolla*
(b) *Wolffia*
(c) *Eichhornia*
(d) *Trapa*

52. Choose the incorrect statement
(a) The Montreal protocol is associated with the control of emission of ozone depleting substances
(b) Methane and carbon dioxide are green house gases
(c) Dobson units are used to measure oxygen content of Air
(d) Use of incinerators is crucial to disposal of hospital wastes

53. Catalytic converters are fitted into automobiles to reduce emission of harmful gases. Catalytic converters change unburnt hydrocarbons into
(a) Carbon dioxide and water
(b) Carbon monoxide
(c) Methane
(d) Carbon dioxide and methane

54. The green scum seen in the fresh water bodies is
(a) Blue green algae
(b) Red algae
(c) Green algae
(d) Both (a) and (c)

55. The major source of noise pollution world wide is due to
(a) Office equipment
(b) Transport system
(c) Sugar, textiles are paper industries
(d) Oil refineries and thermal power plants

56. The loudness of a sound that a person can withstand without discomfort is about
(a) 150 dB
(b) 215 dB
(c) 30 dB
(d) 80 dB

57. Match the following and choose the correct option

|	Column I		Column II
i.	Environment Protection Act	A.	1974
ii.	Air Prevention & Control of Pollution Act	B.	1987
iii.	Water Act	C.	1986
iv.	Amendment of Air Act to include noise as an air pollutant	D.	1981

The correct matches is
(a) i-C, ii-D, iii-A, iv-B
(b) i-A, ii-C, iii-B, iv-D
(c) i-D, ii-A, iii-B, iv-C
(d) i-C, ii-D, iii-B, iv-A

58. Why is it necessary to remove sulphur from petroleum products
(a) To reduce the emission of sulphur dioxide in exhaust fumes
(b) To increase efficiency of automobiles engines
(c) To use sulphur removed from petroleum for commercial purposes
(d) To increase the life span of engine silencers

59. Which one of the following disease is not cause due to contamination of water
(a) Hepatitis-B
(b) Jaundice
(c) Cholera
(d) Typhoid

60. Algal blooms impart a distinct color to water due to
(a) Their pigments
(b) Excretion of colored substances
(c) Formation of colored chemicals in water facilitated by physiological degradation of algae
(d) Absorption of light by algal cell wall

61. Match the items in column I and column II and choose the correct option

	Column I		Column II
A.	UV	i.	Biomagnification
B.	Biodegradable Organic matter	ii.	Eutrophication
C.	DDT	iii.	Snow blindness
D.	Phosphates	iv.	BOD

The correct match is
(a) A-ii, B-i, C-iv, D-iii
(b) A-iii, B-ii, C-iv, D-i
(c) A-iii, B-iv, C-i, D-ii
(d) A-iii, B-i, C-iv, D-ii

62. Which of the following is correct for the figure given below
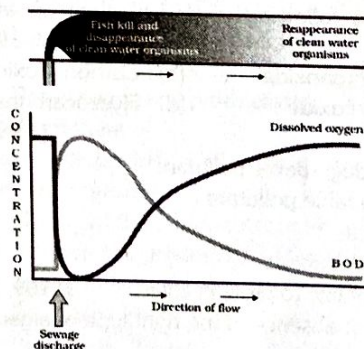
(a) (A) BOD, (B) Point of sewage discharge, (C) Dissolved oxygen
(b) (A) Dissolved oxygen (B) Point of treated water discharge (C) BOD
(c) (A) BOD (B) Point of treated water discharge (C) Dissolved oxygen
(d) (A) Dissolved oxygen (B) Point of sewage discharge (C) BOD.

63. Which one of the following is not a device used to control a particulate matter
(a) Arresters   (b) Scrubbers
(c) Filters   (d) Incinerator

64. The Minimata disease in Japan was caused through pollution of water by
(a) Lead   (b) Mercury
(c) Cyanide   (d) Methyl isocyanate

65. Ozone hole means
(a) Hole in the stratosphere
(b) Same concentration of ozone
(c) Decrease in concentration of ozone
(d) Increase in the concentration of ozone

2. NEET

1. Which of the following strategy is not a correct approach to reduce global warming   **[2006, 12; 2013]**
(a) Reducing the green house gas emission by limiting the use of fossil fuels
(b) Increase the vegetation covers particularly the forest for photosynthetic utilization of CO_2
(c) Minimizing the use of nitrogen fertilizers in agriculture for reducing N_2O emission
(d) Increasing the use of air conditioners, refrigeration unit and production of plastic foams and propellants in aerosol spray cans
(e) Developing substitutes for chlorofluorocarbons

2. DDT residues are rapidly passed through food chain causing biomagnifications because DDT is   **[2009]**
(a) Lipo soluble
(b) Moderately toxic
(c) Non-toxic to aquatic animals
(d) Water soluble

3. Protective layer of ozone in the atmosphere exists in which layer   **[2011; 2014]**
(a) Troposphere   (b) Ionosphere
(c) Stratosphere   (d) Atmosphere

4. Photochemical smog pollution does not contain   **[2006]**
(a) Carbon dioxide
(b) PAN (Peroxy acetyl nitrate)
(c) Ozone
(d) Nitrogen dioxide

5. Which of the following is normally not an atmospheric pollutant   **[1988, 92; 1992; 1993]**
(a) Carbon monoxide   (b) Carbon dioxide
(c) Sulphur dioxide   (d) Hydrocarbons

6. DDT is a   **[1999; 2004]**
(a) Non-biodegradable pollutant
(b) Biodegradable pollutant
(c) Antibiotics
(d) None of the above

7. Lichens do not like to grow in cities   **[1989, 93; 2002]**
(a) Because of absence of the right type of algae and fungi
(b) Because of lack of moisture
(c) Because of SO_2 pollution
(d) Because natural habitat is missing

8. Green house effect is due to the presence of   **[1989, 91; 1998, 99]**
(a) Ozone layer in the atmosphere
(b) Infrared light reaching the earth
(c) Moisture layer in the atmosphere
(d) CO_2 layer in the atmosphere

9. Polluted water can be purified by using   **[1990]**
(a) Micro-organisms   (b) Algae
(c) Pesticides   (d) Fishes

10. Generally speaking, the atmosphere in big cities is polluted most by   **[1991]**
(a) Radioactive fall out
(b) Household waste
(c) Automobile exhaust
(d) Pesticide residues

11. Acid rain is caused due to increase in concentration of (in atmosphere)   **[1991, 98; 1996, 2002, 10, 12; 2004; 2015]**
(a) SO_2 and NO_2 (b) CO and CO_2
(c) CO and SO_3 (d) O_3 and dust

12. Formation of ozone hole is maximum over   **[1997]**
(a) India   (b) Antarctica
(c) Europe   (d) Africa

13. *Taj Mahal* is threatened due to the effect of   **[1995; 2002; 2005]**
(a) Chlorine   (b) Sulphur dioxide
(c) Oxygen   (d) Hydrogen

14. A dental disease characterized by mottling of teeth is due to presence of a certain chemical element in drinking water. Which is that element   **[1995]**
(a) Boron   (b) Chlorine
(c) Fluorine   (d) Mercury

15. In the last decades, most serious nuclear reactor accident created MIC gas tragedy in   **[1996]**
(a) Russia (1990) and Bhopal (1996)
(b) Ucraine (1986) and Bhopal (1984)
(c) Bhopal (1994) and Russia (1990)
(d) Ucraine and USA (1984)

16. Which of the following country is responsible for releasing largest amount of green–house gases   **[1996, 2002]**
(a) Russia   (b) Germany
(c) Brazil   (d) America (USA)

17. Which important green-house gas, other than methane, is being produced from the agricultural fields   **[1998]**
(a) Arsine   (b) Sulphur dioxide
(c) Ammonia   (d) Nitrous oxide

18. PAN (Peroxy acetyl nitrate) is an important constituent of photochemical smog. It is a   **[1999]**
(a) Primary pollutant   (b) Secondary pollutant
(c) Natural pollutant   (d) Corollary pollutant

19. Secondary pollutant which stops Hill reaction is   **[1999; 2010]**
(a) Sulphuric acid
(b) Nitric acid
(c) Peroxyacetyl nitrate (PAN)
(d) Aldehydes

20. Which of the following is pollution related disorder   **[1999]**
(a) Hypertension   (b) Leprosis
(c) Silicosis   (d) Pneumoconisis

21. Increase in the concentration of pollutants (toxicant) in higher trophic levels is called   **[2010; 2015]**
(a) Recycling   (b) Eutrophication
(c) Biodegradation   (d) Biomagnification

22. In which one of the following the BOD (Biochemical Oxygen Demand) of sewage (S) distillery effluent (DE), paper mill effluent (PE) and sugar mill effluent (SE) have been arranged in ascending order **[2007]**
    (a) SE < S < PE < DE
    (b) SE < PE < S < DE
    (c) PE < S < SE < DE
    (d) S < DE < PE < SE

23. Which one of the following pairs is mismatched **[2005]**
    (a) Fossil fuel burning   -   release of CO_2
    (b) Nuclear power   -   radioactive wastes
    (c) Solar energy   -   greenhouse effect
    (d) Biomass burning   -   release of CO_2

24. In a coal fired power plant electrostatic precipitators are installed to control emission of **[2007]**
    (a) SO_2
    (b) NO_x
    (c) SPM
    (d) CO

25. Secondary sewage treatment is mainly a ____. **[2011]**
    (a) Biological process
    (b) Physical process
    (c) Mechanical process
    (d) Chemical process

26. In an area where DDT had been used extensively, the population of birds declined significantly because **[2012]**
    (a) Birds stopped laying eggs
    (b) Earthworms in the area got eradicated
    (c) Cobras were feeding exclusively on birds
    (d) Many of the birds eggs laid, did not hatch

27. The second commitment period for Kyoto Protocol was decided at **[2013]**

    Or

    The UN conference of parties on climate change in the year 2012 was held at **[2015]**
    (a) Durban
    (b) Bali
    (c) Doha
    (d) Cancun

28. A scrubber in the exhaust of a chemical industrial plant removes **[2014]**
    (a) Gases like ozone and methane
    (b) Particulate matter of the size 2.5 micrometer or less
    (c) Gases like sulphur dioxide
    (d) Particulate matter of the size 5 micrometer or above

29. Which of the following is not one of the prime health risks associated with greater UV radiation through the atmosphere due to depletion of stratospheric ozone **[2015]**
    (a) Reduced Immune System
    (b) Damage to eyes
    (c) Increased liver cancer
    (d) Increased skin cancer

30. Which one of the following is not correct as regards the harmful effects of particulate matter of the size 2.5 micro meters or less **[2013]**
    (a) It can cause respiratory problems
    (b) It can directly enter into our circulatory system
    (c) It can cause inflammation and damage to the lungs
    (d) It can be inhaled into the lungs

31. Steps taken by the Government of India to control air pollution include **[2009]**
    (a) Compulsory mixing of 20% ethyl alcohol with petrol and 20% biodiesel with diesel
    (b) Compulsory PUC (Pollution under Control) certification of petrol driven vehicles which tests for carbon monoxide and hydrocarbons
    (c) Permission to use only pure diesel with a maximum of 500 ppm sulphur as fuel for vehicles
    (d) Use of non-polluting compressed Natural Gas (CNG) only as fuel by all buses and trucks

32. Biochemical Oxygen Demand (BOD) in a river water **[2009]**
    (a) Remains unchanged when algal bloom occurs
    (b) Has no relationship with concentration of oxygen in the water
    (c) Gives a measure of salmonella in the water
    (d) Increases when sewage gets mixed with river water

33. A lake near a village suffered heavy mortally of fishes within a few days. Consider the following reasons for this
    (A) Lots of urea and phosphate fertilizer were used in the crops in the vicinity
    (B) The area was sprayed with DDT by an aircraft
    (C) The lake water turned green and stinky
    (D) Phytoplankton populations in the lake declined initials thereby greatly reducing photosynthesis
    Which two of the above were the main causes of fish mortality in the lake **[2008]**
    (a) (A), (C)
    (b) (A), (B)
    (c) (B), (C)
    (d) (C), (D)

34. Montreal Protocol which calls for appropriate action to protect the ozone layer from human activities was passed in the year **[2006]**
    (a) 1988
    (b) 1985
    (c) 1986
    (d) 1987

35. Limit of BOD prescribed by Central Pollution Control Board for the discharge of industrial and municipal waste waters into natural surface waters, is **[2006]**
    (a) < 100 ppm
    (b) < 30 ppm
    (c) < 3.0 ppm
    (d) < 10 ppm

36. One of the most dangerous radioactive pollutant to *Homo sapiens* is **[1990; 1990; 1995]**
    (a) Strontium – 90
    (b) Phosphorus – 32
    (c) Sulphur – 35
    (d) None of the above

37. The stratospheric ozone depletion leads to **[2016]**
    (a) Global warming
    (b) Increase in the incidence of skin cancers
    (c) Forest fires
    (d) All the above

38. What is the intensity of sound in normal conversation **[2001]**
    (a) 10-20 dB
    (b) 40-60 dB
    (c) 90-120 dB
    (d) 120-150 dB

39. Positive pollution of soil is due to **[2002]**
    (a) Excessive use of fertilizers
    (b) Addition of wastes on soil
    (c) Reduction in soil productivity
    (d) All of these

40. A lake with an inflow of domestic sewage rich in organic waste may result in **[2016]**
    (a) Drying of the lake very soon due to algal bloom
    (b) An increase production of fish due to lot of nutrients
    (c) Death of fish due to lack of oxygen
    (d) Increased population of aquatic food web organisms

41. In 1984, the Bhopal gas tragedy took place because methyl isocyanate **[2004]**
    (a) Reacted with CO_2
    (b) Reacted with water
    (c) Reacted with DDT
    (d) Reacted with ammonia

42. Kyoto Protocol was endorsed at **[2013]**
    (a) CoP - 4
    (b) CoP - 3
    (c) CoP - 5
    (d) CoP – 6

43. Eutrophication can be observed in **[2005; 2011]**
   (a) Saline soil   (b) Desert
   (c) Fresh water lakes   (d) Agricultural fields

44. Which one of the following is not used for disinfection of drinking water **[2005]**
   (a) Chlorine   (b) Ozone
   (c) Chloramine   (d) Phenyl

45. Which one of the following is not a bio indicator of water pollution **[2007]**
   (a) Sludge-worms   (b) Blood-worms
   (c) Stone flies   (d) Sewage fungus

46. dB is standard abbreviation used for the quantitative expression of **[2010]**
   (a) A certain pesticide
   (b) The density of bacteria in a medium
   (c) A particular pollutant
   (d) The dominant Bacillus in a culture

47. Which one of the following statements is wrong in case of Bhopal tragedy **[2011]**
   (a) It took place in the night of December 2/3/1984
   (b) Methyl Isocyanate gas leakage took place
   (c) Thousands of human beings died
   (d) Radioactive fallout engulfed Bhopal

48. Which one of the following is a wrong statement **[2012]**
   (a) Most of the forests have been lost in tropical areas
   (b) Ozone in upper part of atmosphere is harmful to animals
   (c) Greenhouse effect is a natural phenomenon
   (d) Eutrophication is a natural phenomenon in freshwater bodies

49. Select the correct statement
   Or
   According to Central Pollution Control Board (CPCB), which particulate size in diameter (in micrometers) of the air pollutants is responsible for greatest harm to human health **[2008]**
   (a) Particulate matter of size $10 \mu m$ can create severe damage to the lungs
   (b) Particulate matter of size greater than $2.5 \mu m$ can get trapped in lungs and cause problems
   (c) Particulate matter of size less than $2.5 \mu m$ penetrate deep into lungs
   (d) None of the above

50. The Air Prevention and Control of Pollution Act came into force in **[2013]**
   (a) 1990   (b) 1975
   (c) 1981   (d) 1985

51. The domestic sewage in large cities **[2012]**
   (a) Has a high BOD as it contains both aerobic and anaerobic bacteria
   (b) Is processed by aerobic and then anaerobic bacteria in the secondary treatment in Sewage Treatment Plants (STPs)
   (c) When treated in STPs does not really require the aeration step as the sewage contains adequate oxygen
   (d) Has very high amounts of suspended solids and dissolved salts

52. Climate of the world is threatened by **[2013]**
   (a) Decreasing amount of atmospheric oxygen
   (b) Increasing amount of atmospheric carbon dioxide
   (c) Decreasing amount of atmospheric carbon dioxide
   (d) Increasing concentration of atmospheric oxygen

53. The UN Conference of Parties on climate change in the year 2011 was held in **[2015]**
   (a) South Africa   (b) Peru
   (c) Qatar   (d) Poland

54. Rachel Carson's famous book "Silent Spring" is related to **[2015]**
   (a) Noise pollution   (b) Population explosion
   (c) Ecosystem management   (d) Pesticide pollution

55. In Minamata Bay, Japan, which of the following animals remained free from *Minamata disease* **[1995]**
   (a) Cats   (b) Rabbits
   (c) Dogs   (d) Pigs

56. Major aerosol pollutant present in the jet plane emission is **[1990]**
   (a) Sulphur dioxide   (b) Fluorocarbon
   (c) Carbon tetrachloride   (d) Carbon monoxide

57. One of them contributes maximum to air pollution **[2002]**
   (a) India   (b) USA
   (c) Russia   (d) Britain

58. Green house effect is caused by **[2002]**
   (a) Green plants   (b) Infra red rays
   (c) UV rays   (d) X rays

59. Ultraviolet radiation from sunlight cause the reaction that produce **[1988, 2012; 1990]**
   (a) Carbon monoxide   (b) Sulphur dioxide
   (c) Ozone   (d) Fluorides

60. Match the items given in Column I with those in Column II and select the correct option given below

	Column I		Column II
(1)	Eutrophication	(i)	UV-B radiation
(2)	Sanitary landfill	(ii)	Deforestation
(3)	Snow blindness	(iii)	Nutrient enrichment
(4)	Jhum cultivation	(iv)	Waste disposal

	(1)	(2)	(3)	(4)
(a)	(i)	(ii)	(iv)	(iii)
(b)	(iii)	(iv)	(i)	(ii)
(c)	(i)	(iii)	(iv)	(ii)
(d)	(ii)	(i)	(iii)	(iv)

61. Which of the following is a secondary pollutant **[2018]**
   (a) O_3 (b) SO_2
   (c) CO_2 (d) CO

62. In stratosphere, which of the following elements acts as a catalyst in degradation of ozone and release of molecular oxygen **[2018]**
   (a) Oxygen   (b) Fe
   (c) Cl   (d) Carbon

63. Use of bioresources by multinational companies and organizations without authorization from the concerned country and its people is called **[2018]**
   (a) Bioexploitation   (b) Biodegradation
   (c) Biopiracy   (d) Bio-infringement

3. AIIMS

1. Green muffler is used against which type of pollution **[2002]**
   (a) Air   (b) Water
   (c) Soil   (d) Noise

2. Minamata disease was caused due to the consumption of **[2004]**
   (a) Sea food containing lot of cadmium
   (b) Fish contaminated with mercury
   (c) Oysters with lot of pesticide
   (d) Sea food contaminated with selenium

3. Match the following items in column I with column II and choose the correct answer

Column I			Column II
A.	Arsenic	1.	Minamata disease
B.	Nitrate	2.	Itai–Itai
C.	Mercury	3.	Blue–baby syndrome
D.	Cadmium	4.	Skeletal fluorosis
E.	Fluoride	5.	Black–foot disease

[2007]
   (a) A – 2, B – 3, C – 5, D – 1, E – 4
   (b) A – 5, B – 3, C – 1, D – 2, E – 4
   (c) A – 3, B – 4, C – 5, D – 1, E – 2
   (d) A – 5, B – 4, C – 3, D – 2, E – 1
   (e) A – 2, B – 5, C – 4, D – 3, E – 1

4. A sewage treatment process, in which a part of decomposer bacteria present in the wastes is recycled into the starting of the process is called **[2007]**
   (a) Cyclic treatment
   (b) Activated sludge treatment
   (c) Primary treatment
   (d) Tertiary treatment

5. The excessive discharge of fertilizers into water bodies results in **[2002]**
   (a) Growth of fish
   (b) Death of hydrophytes
   (c) Eutrophication
   (d) Silt

6. Biological Oxygen Demand (BOD) is a measure of **[2003]**
   (a) Industrial wastes poured into water bodies
   (b) Extent to which water is polluted with organic compounds
   (c) Amount of carbon monoxide inseparably combined with haemoglobin
   (d) Amount of oxygen needed by green plants during night

7. In almost all Indian metropolitan cities like Delhi, the major atmospheric pollutant(s) is/ are **[2003, 08]**
   (a) Suspended particulate matter (SPM)
   (b) Oxides of sulphur
   (c) Carbon dioxide and carbon monoxide
   (d) Oxides of nitrogen

8. Nitrogen oxides produced from the emission of automobiles and power plants, are the source of line air borne particles which lead to **[2004]**
   (a) Photochemical smog
   (b) Dry acid deposition
   (c) Industrial smog
   (d) Wet acid deposition

9. The noise produced in office is normally at the level of **[2004]**
   (a) 20 db.
   (b) 30 db.
   (c) 40 db.
   (d) 60 db.

10. Photochemical smog formed in congested metropolitan cities mainly consists of **[2003, 08]**
    (a) Ozone, peroxyacetyl nitrate and NO_x
    (b) Smoke, peroxyacetyl nitrate and SO_2
    (c) Hydrocarbons, SO_2 and CO_2
    (d) Hydrocarbons, ozone and SO_x

11. The release of phosphates and nitrates in water bodies(i.e. rivers and lakes) lead to **[1987]**
    (a) Increased algae growth
    (b) Increased growth of decomposers
    (c) Nutrient enrichment
    (d) Reduced algae growth

4. Assertion and Reason

Read the assertion and reason carefully to mark the correct option out of the options given below :
(a) If both the assertion and the reason are true and the reason is a correct explanation of the assertion
(b) If both the assertion and reason are true but the reason is not a correct explanation of the assertion
(c) If the assertion is true but the reason is false
(d) If both the assertion and reason are false
(e) If the assertion is false but reason is true

1. **Assertion** : Suspended particulate matter (SPM) is an important pollutant released by diesel vehicles.
   Reason : Catalytic converters greatly reduce pollution caused by automobiles.

2. **Assertion** : Eutrophication shows increase in productivity in water.
   Reason : With increasing eutrophication, the diversity of the phytoplankton increases.

3. **Assertion** : Inhabitants close to very busy airports are likely to experience health hazards.
   Reason : Sound level of jet aeroplanes usually exceeds 160 dB.

4. **Assertion** : Presently, the global atmosphere is warming up.
   Reason : The depletion of stratospheric ozone layer has resulted in increase in ultraviolet radiations reaching the earth.

5. **Assertion** : Green-house effect is due to thick layer of carbon dioxide.
   Reason : The glass panels of a green-house allowing the sunlight to filter through but preventing the heat from being re-radiated in outer space.