Environmental Issues

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Environmental Issues

Pollution

Any undesirable change in natural resources is termed as pollution.

Though pollution at times, occurs naturally due to volcanic eruptions, forest fibres, etc., it is mainly man-made (anthropogenic), due to the enormous growth in the human population size.

Environment (Protection) Act, 1986

To control environmental pollution and to protect and improve the quality of environment the Government of India, has passed the Environment (Protection) Act, 1986.

Types of Pollution:

(i) Air Pollution
(ii) Water Pollution
(iii) Soil Pollution

POLLUTANTS

- Substances that reduce the physical and chemical qualities of natural resources are pollutants.

Types of Pollutants

Whether microbes can decompose any pollutant or not, pollutants are of two types: **Biodegradable** and **non-biodegradable pollutants.**

Definition

Pollution: Any undesirable change in the physical, chemical and biological characteristics of air, water and soil that adversely affect the living organisms.

Biodegradable Pollutants	Non-biodegradable Pollutants
Pollutants which can be broken into simpler and harmless substances by the action of decomposers or microbes.	Pollutants which cannot be broken into simpler and harmless substances by the action of decomposers or microbes.
For example, sewage, paper, leather goods, animal refuse, dead plants and animals, etc.	For example, pesticides, polythene bags, plastics, aluminium cans, e-wastes, etc.

ON THE BASIS OF FORMATION AIR POLLUTANTS ARE OF TWO TYPES

Primary and secondary air pollutants

Primary Air Pollutants	Secondary Air Pollutants
Emitted directly from a source.	These are not directly emitted from a source but is formed in the atmosphere by the reaction with ultraviolet rays, rainwater. etc.
Examples are SO_2, CO, NO_x, particulate matter, etc.	Examples are photochemical oxidants like ozone, nitrogen dioxide, sulphur trioxide, etc.

Note

Smog

It is formed when smoke and fog mix with each other.

Classical Smog

Typical form of smog which occurs in the areas that have humid climate. It is formed in reducing conditions.

It is a mixture of smoke, fog and sulphur gases (SO_2 and H_2S), water vapour, dust and smoke particles.

Photochemical Smog

It is greyish or yellowish-brown smog, also called as brown air and is composed mainly of ozone, peroxyacetyl nitrate (PAN) and oxides of nitrogen along with dust and smoke particles. It is formed in warm climate caused due to intense solar conditions. It is an example of secondary pollutant.

It causes respiratory problems like asthma and bronchitis in human beings. In plants, it causes silvering, glazing and necrosis of leaves.

AIR POLLUTION

- Any undesirable change in the physical, chemical and biological characteristics of air, which adversely affects the living organisms.

Previous Year's Question

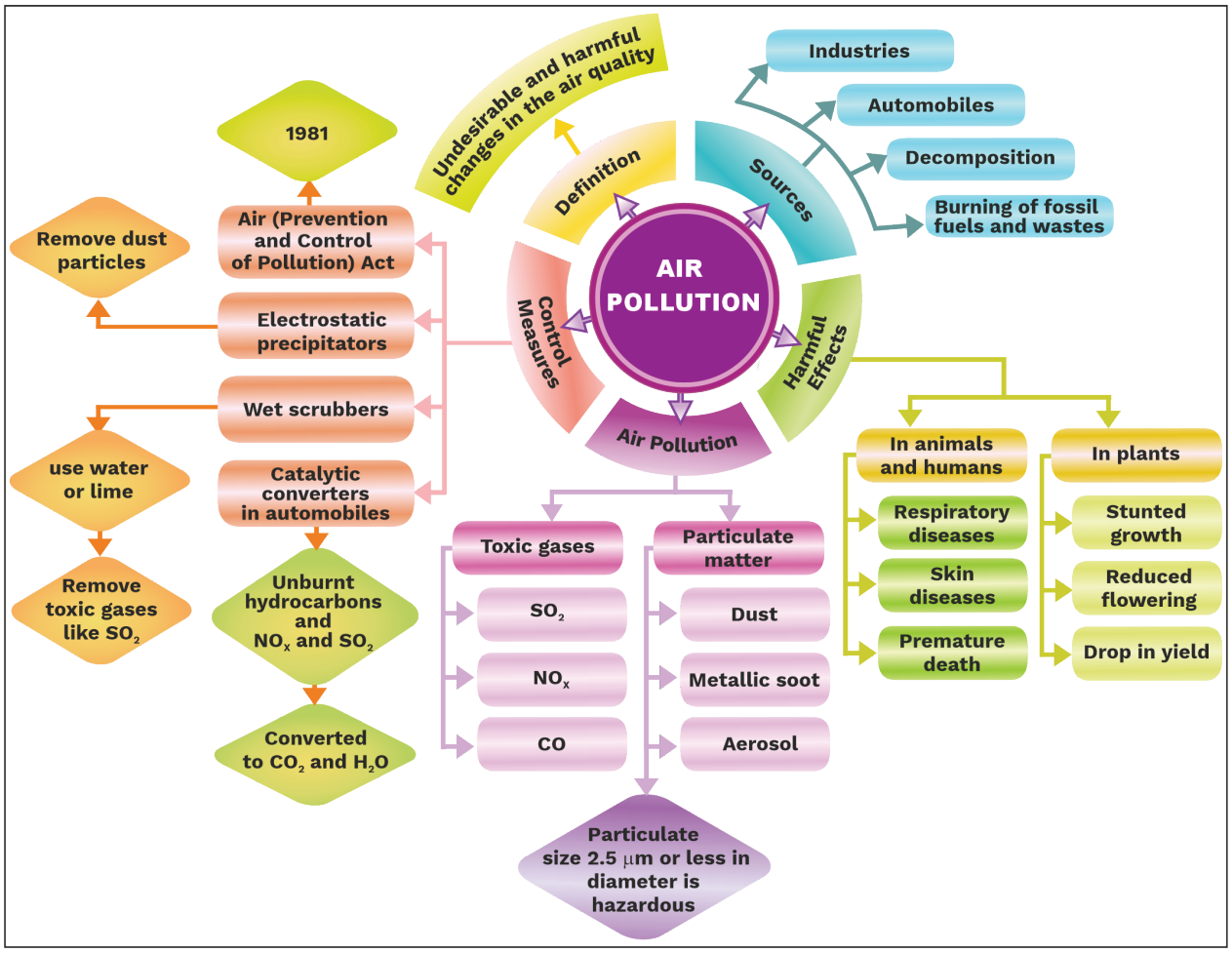
In India, metropolitan cities like Delhi, major air pollutant is

(1) SPM
(2) SO_x
(3) NO_x
(4) CO and CO_2

Previous Year's Question

SO_2 pollution is indicated by excessive growth of:

(1) *Cynodon dactylon*
(2) *Sphagnum*
(3) *Usnea*
(4) Cucurbits



Causes of Air Pollution

- Smokestacks of thermal power plants, smelters and other industries.
- Burning of fossil fuels in automobiles, industries and households.
- Smoke from forest fires, volcanic eruptions, etc.
- Release of unwanted gases into the atmosphere due to the decompositiobn of garbage.

Air Pollutants

- Thermal power plants, smelters, oil refineries automobiles, etc., release:
  - Particulate pollutants, e.g., metallic particles, dust particles, soot, aerosol, etc.

Definition

Pollutants: These are those substances or agents which bring about undesirable changes in the properties of air, water and soil, that adversely affect the living organisms.

- Gaseous pollutants like carbon monoxide (CO), sulphur dioxide (SO_2) and nitrogen oxides (NO_x).

CONDITIONS THAT CAUSE HARMFUL EFFECTS OF AIR POLLUTION

- Concentration of pollutants.
- Duration of exposure to the pollutants.

HARMFUL EFFECTS OF AIR POLLUTION IN ANIMALS

- Respiratory problems in humans and other animals.
- Skin problems like rashes, acne, skin ageing, etc.

HARMFUL EFFECTS OF AIR POLLUTION IN PLANTS

- Injury to plants
- Premature death of plants
- Reduced growth
- Delayed flowering and reduced yield.

FINDINGS OF CENTRAL POLLUTION CONTROL BOARD (CPCB)

- As per Central Pollution Control Board (CPCB), **particulate size 2.5 micrometres** or less in diameter **(PM 2.5μm)** cause greatest damage to human health.
- These particles cannot be exhaled as they settle down deep inside the lungs.
- These particles cause inflammation and damage of lungs, severe respiratory problems, irritation in respiratory tract and premature deaths.

Note: Air (Prevention and Control of Pollution) Act came into force in 1981.

CONTROL METHODS

To reduce harmful gases and particulate matter from the exhausted air of automobiles and industries following are the control methods:

Previous Year's Question

Automobile exhaust gas that causes major respiratory problem is
(1) CO
(2) CH4
(3) NO_2
(4) Chlorine

Suspended Particulate Matter (SPM)
It includes solid but small sized pollutants which remain suspended in the air. It is formed of dust particles which may be silica, cement, coal, etc. It is known to cause respiratory diseases like bronchitis, asthma, pneumoconiosis, asbestosis, silicosis, etc.

Previous Year's Question

Acid rain is secondary effect of
(1) sound pollution
(2) water pollution
(3) air pollution
(4) soil pollution

- **Electrostatic Precipitator**
  - Most widely used method for removal of particular matter from exhausted air of thermal power plants, i.e., about 99% of particular pollutants are removed.
  - Stage of collecting plates and electrode wires are present in the precipitator.
  - The electrode wires are maintained at several thousand volts which produce a corona that release electrons.
  - These electrons get attached to the (dust) particles and give them a net negative charge within a very small fraction of second.
  - The collecting plates are grounded and hence, attract the charged particles.

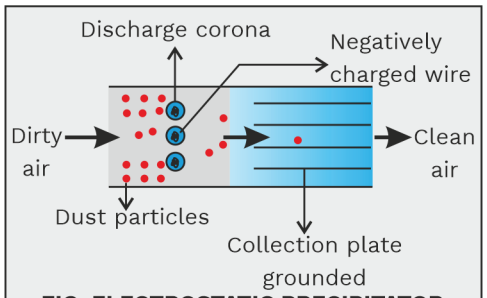


FIG. ELECTROSTATIC PRECIPITATOR

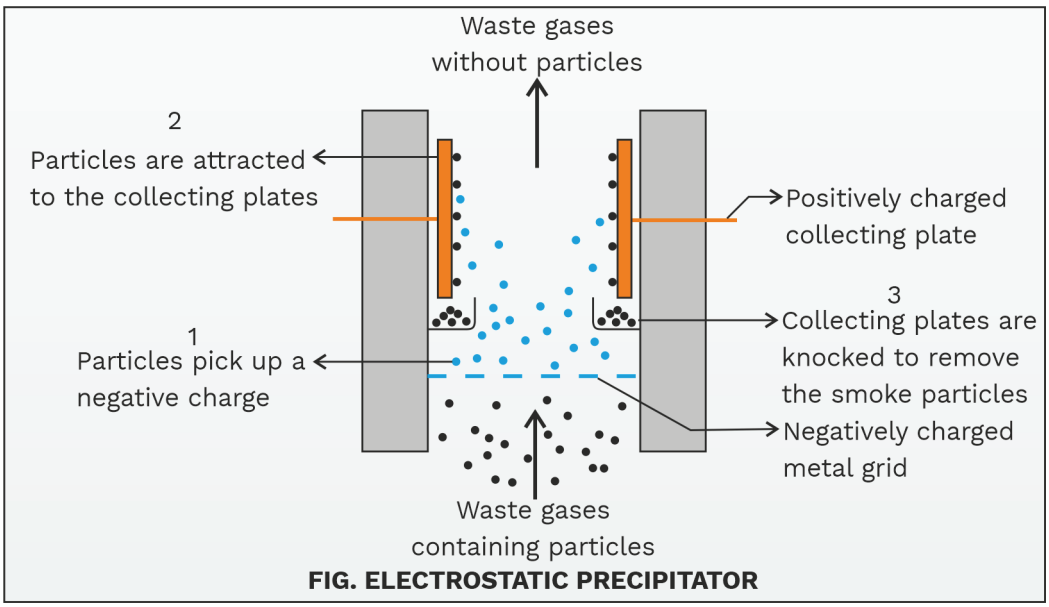


FIG. ELECTROSTATIC PRECIPITATOR

Caution

The velocity of air between the plates of an electrostatic precipitator must be low enough to allow the particles to fall on them.

Previous Year's Question

Most hazardous metal pollutant of automobile exhausts is:
(1) Mercury
(2) Cadmium
(3) Lead
(4) Copper

- **Scrubber**
  - It is used to remove gases like **sulphur dioxide** (SO_2) from the industrial exhaust.
  - The exhaust is passed through a spray of **lime water .**
  - Water dissolves the gases while lime reacts with sulphur dioxide to form precipitate of **calcium sulphate** or **sulphite.**

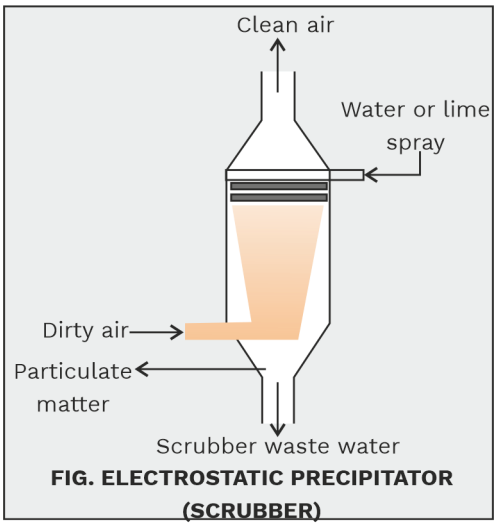


FIG. ELECTROSTATIC PRECIPITATOR (SCRUBBER)

Note: Wet scrubbing

Wet scrubbing primarily uses magnesium-enhanced lime (containing 3-8% magnesium oxide) because it provides high alkalinity to increase SO_2 removal capacity from industrial exhaust.

- **Catalytic Converters**
  - Used in vehicles for reducing emission of harmful and poisonous gases.
  - **Platinum-palladium** and **rhodium** as catalysts.
  - Through chemical reactions catalytic converters convert:
    - **Unburnt hydrocarbons** into carbon dioxide (CO_2) and water vapour (H_2O).
    - **Carbon monoxide** and **nitric oxide (NO)**, **nitrogen dioxide (NO_2)** get changed into carbon dioxide (CO_2) and nitrogen gas (N_2).

Previous Year's Question

Carbon monoxide is a pollutant because it
(1) inactivates nerves
(2) inhibits glycolysis
(3) combines with oxygen
(4) combines with haemoglobin

Caution: Unleaded petrol to be used in vehicles

Unleaded petrol should be used in vehicles with catalytic converters as lead in the petrol inactivates the catalyst

AUTO FUEL POLICY

- The Government of India has laid down a road map to cut down the vehicular air pollution in many cities of India through the auto fuel policy.
- The goal of this policy is to reduce **sulphur at 50 ppm in petrol** and diesel, and reduce it further to 35 per cent.
- According to Euro II norms, **sulphur** is to be controlled at **350 ppm** in diesel and **150 ppm** in petrol; aromatic hydrocarbons are to be contained at 42 per cent.
- Upgradation of vehicle engines.

Rack Your Brain

Leaded gasoline contains lead
(1) peroxide (2) tetramethyl
(3) tetraethyl (4) oxide

Types of Vehicles	Norms	Cities of Implementation
4 Wheelers	Bharat Stage III	Throughout the country since October 2010
4 Wheelers	Bharat Stage IV	13 Mega cities (Delhi and NCR, Mumbai, Kolkata, Chennai, Bengaluru, Surat, Kanpur, Agra, Lucknow and Sholapur) since April 2010
3 Wheelers	Bharat Stage III	Throughout the country since October 2010
2 Wheelers	Bharat Stage III	Throughout the country since October 2010

Table: Mass Emission Standards in India

Note:

In 13 megacities (Delhi and NCR, Mumbai, Kolkata, Chennai, Bengaluru, Surat, Kanpur, Agra, Lucknow and Solapur) Bharat Stage IV emission norms have been in place since April 2010 and it has been enforced for entire country since April 2017

CONTROL OF VEHICULAR AIR POLLUTION IN DELHI

- The switching over of public transport from diesel to **Compressed Natural Gas (CNG)** from the end of 2002.

- Phasing out of old vehicles.
- Use of unleaded petrol.Useof low sulphur petrol and diesel.
- Use of catalytic converters in vehicles.
- Application of Euro-II norms for vehicles.

Final Observation: Substantial fall in the level of sulphur dioxide and carbon dioxide in the air in Delhi.

NOISE

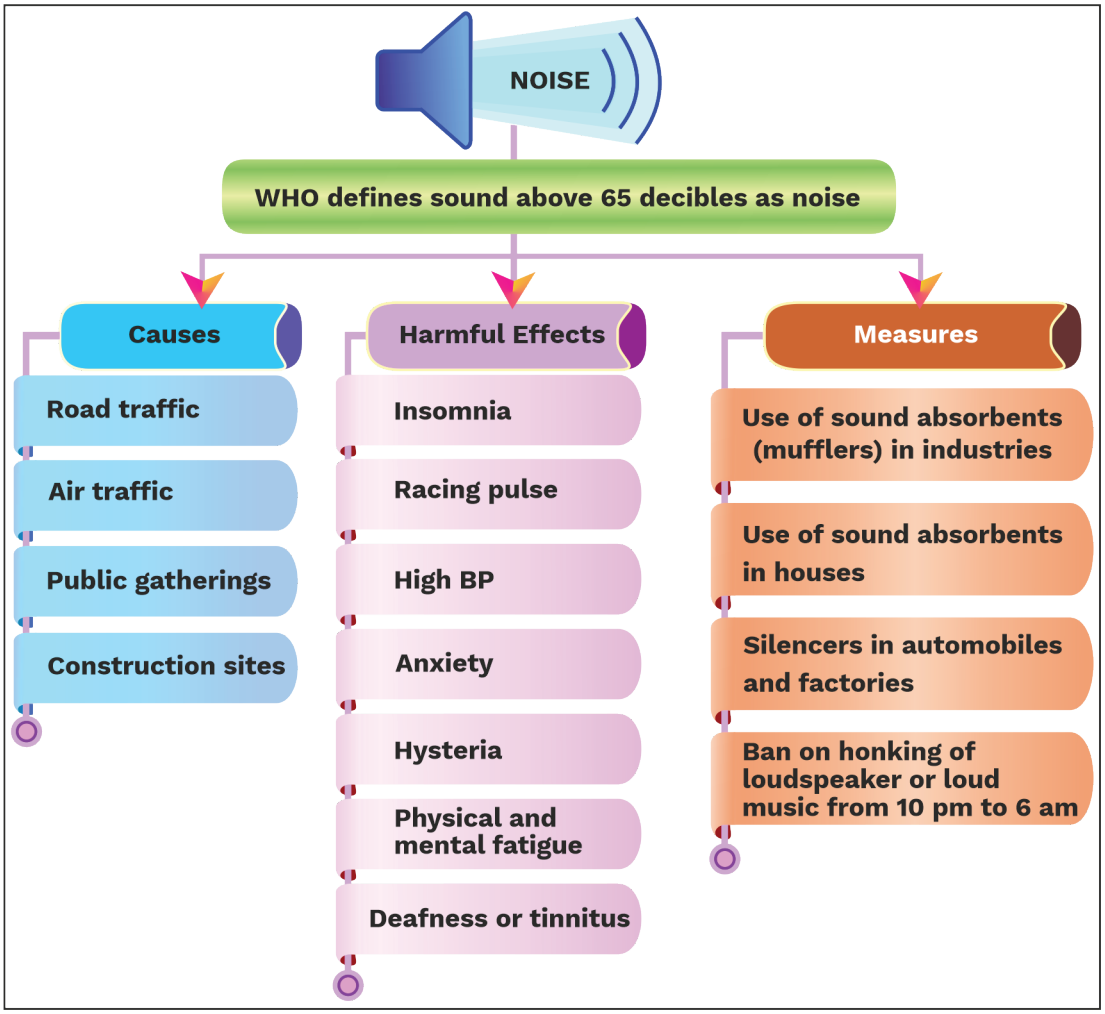
- Noise is unpleasant and undesirable high level of sound.
- According to World Health Organisation (WHO) sound (noise) **above 65 decibels is termed as noise pollution.**

Rack Your Brain

Which is not an atmospheric pollutant?
(1) CO_2 (2) CO (3) O_3 (4) NO_2

Gray Matter Alert!!!

Sound level meter. The most common instruments used for measuring noise are the sound level meter (SLM), the integrating sound level meter (ISLM), and the noise dosimeter.

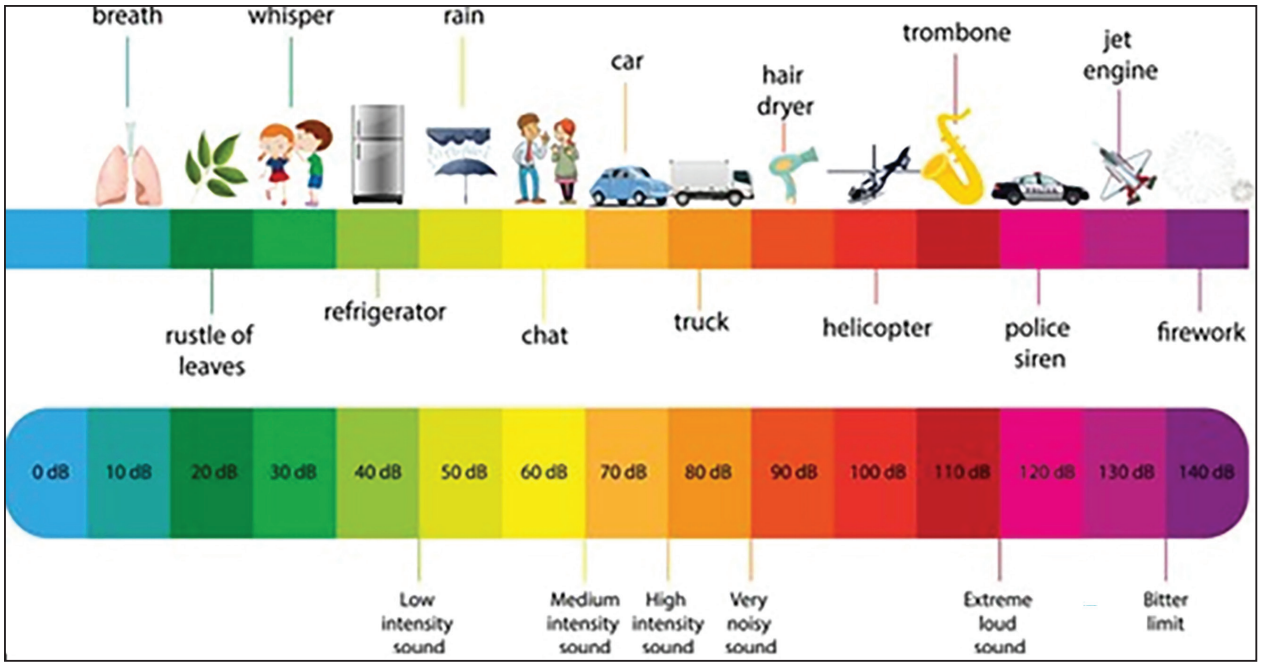


HEARING FREQUENCY RANGE OF HUMAN BEINGS

- Human beings can hear sound in a frequency range of **20 hertz** to **20 kilohertz** (1kHz = 1000 Hz).
- In decibels (dB) the hearing range is **0 dB (threshold) to 120–130 dB.**
- All sounds above 90 dB harm the inner ear and do **irreversible damage above 120 dB.**
- Extremely high sound level of 150 dB or more generated by take-off of a jet plane or rocket and can cause damage to the eardrum and permanent loss of hearing.
- Chronic exposure to low level noise (**80 dB**) can also cause permanent damage to hearing abilities.

Previous Year's Question

Pollution is controlled by:
(1) Banning atomic blasts
(2) Use of electrically operated automobile
(3) Sewage treatment
(4) All the above



NOISE AS AIR POLLUTANT

- **The Air (Prevention and Control of Pollution) Act** was amended in **1987** to include noise as an air pollutant.

Harmful Effects of Noise on Human Beings:

- Sleeplessness (insomnia)
- Increased rate of heartbeat or racing pulse.

Previous Year's Question

Noise pollution is measured in:
(1) Hertz
(2) Fathoms
(3) Nanometres
(4) Decibles

- Altered breathing pattern.
- Stress (Physical and mental)
- High blood pressure
- Anxiety
- Hearing impairment
- Tinnitus

Control of Noise:

- Establishment of horn-free zones **(silent zones)** around schools and hospitals.
- Use of sound absorbent materials or mufflers in industries.
- Use of acoustic material in the wall of homes located in high sound zones.
- Machines with low noise emission should be used.
- Silencers are fitted in automobiles and industrial gadgets.
- Use of crackers and loudspeakers with permissible sound levels.
- Laws are framed to enforce timings like loudspeakers, etc., cannot be used after 10 pm till 6 am.

Previous Year's Question

Maximum permissible noise as per Noise Pollution Rules 2000 is
(1) 75 dB
(2) 65 dB
(3) 55 dB
(4) 45 dB

Previous Year's Question

Noise becomes uncomfortable above
(1) 180 dB
(2) 140 dB
(3) 100 dB
(4) 80 dB

PERMISSIBLE NOISE LEVEL

- **Central Pollution Control Board (CPCB)** has laid down the permissible noise level for different areas or zones in India:

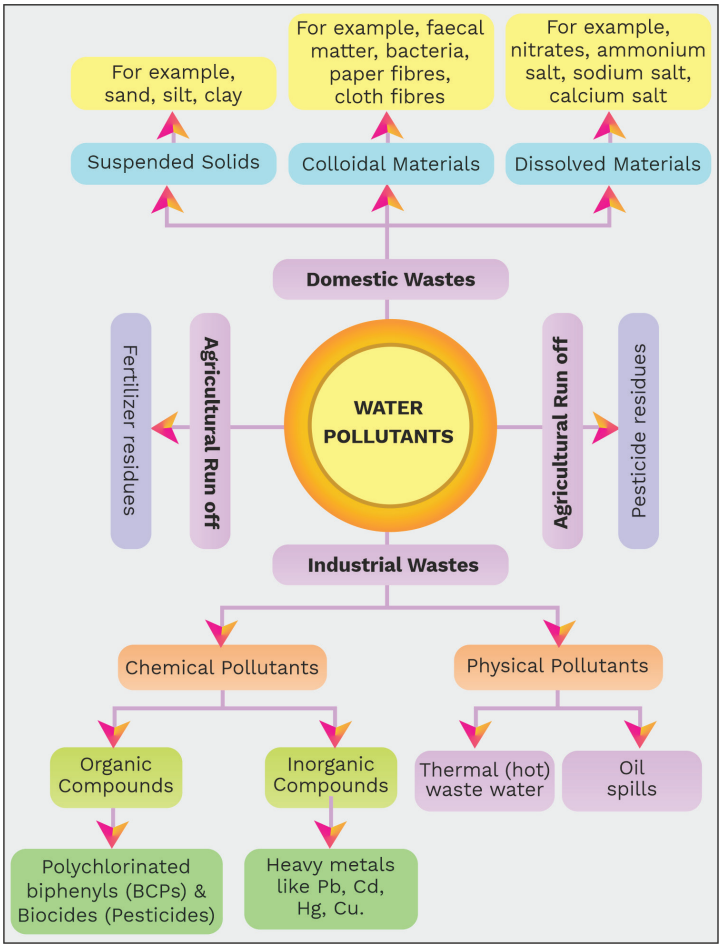
Zone	Permissible Noise Level Standards	
	Day (dB)	Night (dB)
Silent Zone	50 dB	40 dB
Residential Zone	55 dB	45 dB
Industrial Zone	75 dB	70 dB

WATER POLLUTION

- Water pollution refers to any undesirable change in the physical, chemical and biological properties of water that adversely affects the living beings.
- The Government of India has passed the **Water (Prevention and Control of Pollution) Act, 1974** to safeguard our water resources.

Water Pollutants

- Water pollutants can be classified as follows:



Gray Matter Alert!!!

Gambusia fish was introduced in the water bodies in India. This carnivorous fish feed on larvae of *Anopheles* mosquito.

Previous Year's Question

A water body has high BOD indicating water is
(1) being contaminated with sewage
(2) being aerated
(3) receiving minerals
(4) atrophic

Previous Year's Question

Water pollution is caused due to
(1) agricultural discharges
(2) sewage and other wastes
(3) industrial effluents
(4) all of these

EFFECTS OF WATER POLLUTION ON LIVING ORGANISMS

Domestic Sewage

- Domestic sewage mainly contains biodegradable wastes, they are decomposed by microorganisms; the decomposers use oxygen of the water body and hence many aquatic organisms die due to lack of oxygen.
- **Biochemical Oxygen Demand (BOD)** is used to measure the amount of biodegradable organic matter in sewage water.
- Higher BOD reflects more is the presence of biodegradable wastes in sewage water.
- Domestic sewage contains nutrients like nitrogen add phosphorus, which trigger excessive growth of algae and aquatic plants; this may result in **algal bloom** which in turn causes the following:
  - Deterioration in water quality
  - Fish mortality
  - Secretion of chemicals that are highly toxic to human and other animals.

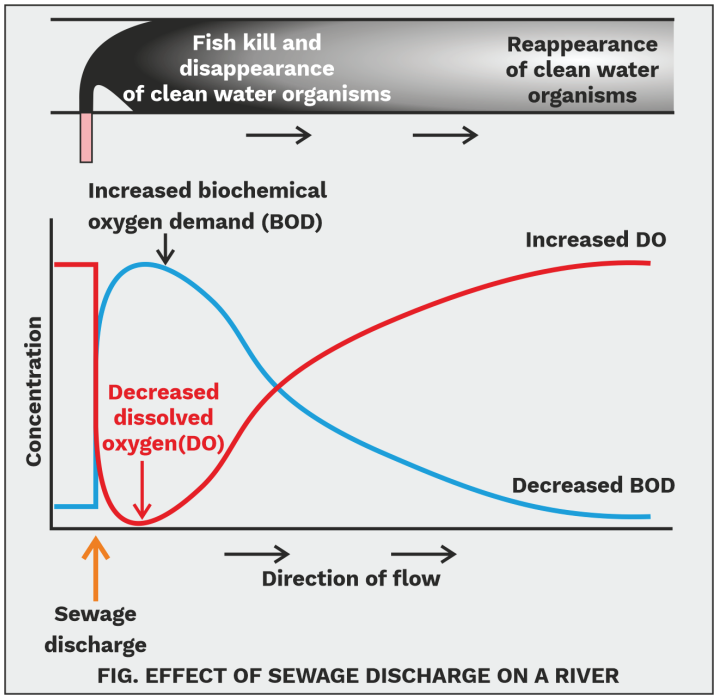


FIG. EFFECT OF SEWAGE DISCHARGE ON A RIVER

Definition

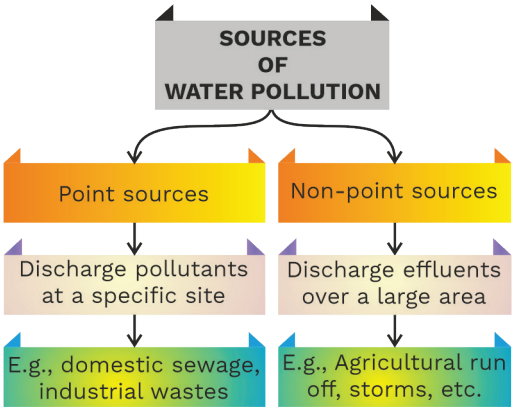
Biochemical Oxygen Demand (BOD): It is a measure of oxygen required by aerobic decomposers for the biochemical degradation of biodegradable organic wastes.

Previous Year's Question

Treatment of polluted water is carried with the help of
(1) Lichens
(2) Fungi
(3) Ferns
(4) Phytoplanktons

Definition

Algal Bloom: The excess or profuse proliferation of planktonic algae imparting distinct colour to the water, is called algal bloom.



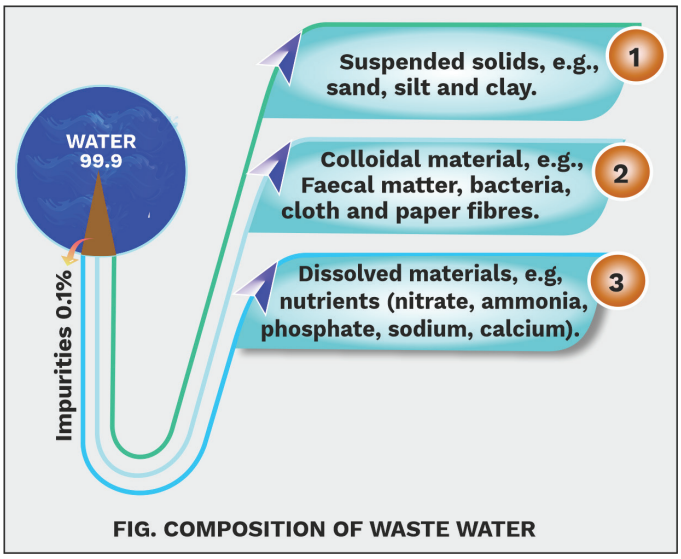


FIG. COMPOSITION OF WASTE WATER

- Domestic sewage may also contain pathogens and cause diseases like typhoid, jaundice, dysentery, etc.

Industrial Chemical Wastes

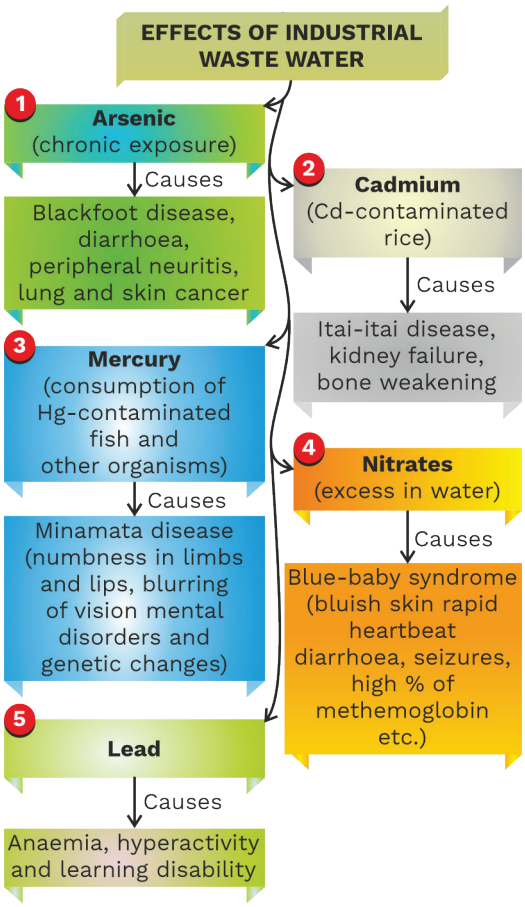
- Industrial wastes often contain heavy metals like cadmium, mercury, lead, copper, etc., and a variety of organic compounds; many industrial chemicals are toxic to humans and other animals.
- Mercury and DDT (**Dichloro Diphenyl Trichloroethane**) cause biological magnification.
- For example, the concentration of DDT increases from 0.003 ppb (parts per billion) in water to 5 ppm (part per million) in fish-eating birds.
- The concentration of DDT increases at successive trophic levels because it is neither metabolised nor excreted; instead, it accumulates in the tissues of the organisms.

Note:

Maize is the sensitive indicator of fluoride pollution.

FACT!!!

A mere 0.1 percent impurities make domestic sewage unfit for human consumption.



Definition

Biological Magnification: The phenomenon in which harmful chemicals get accumulated in the tissues of organisms in increasing concentrations at successive trophic levels, as they travel along the food chain.

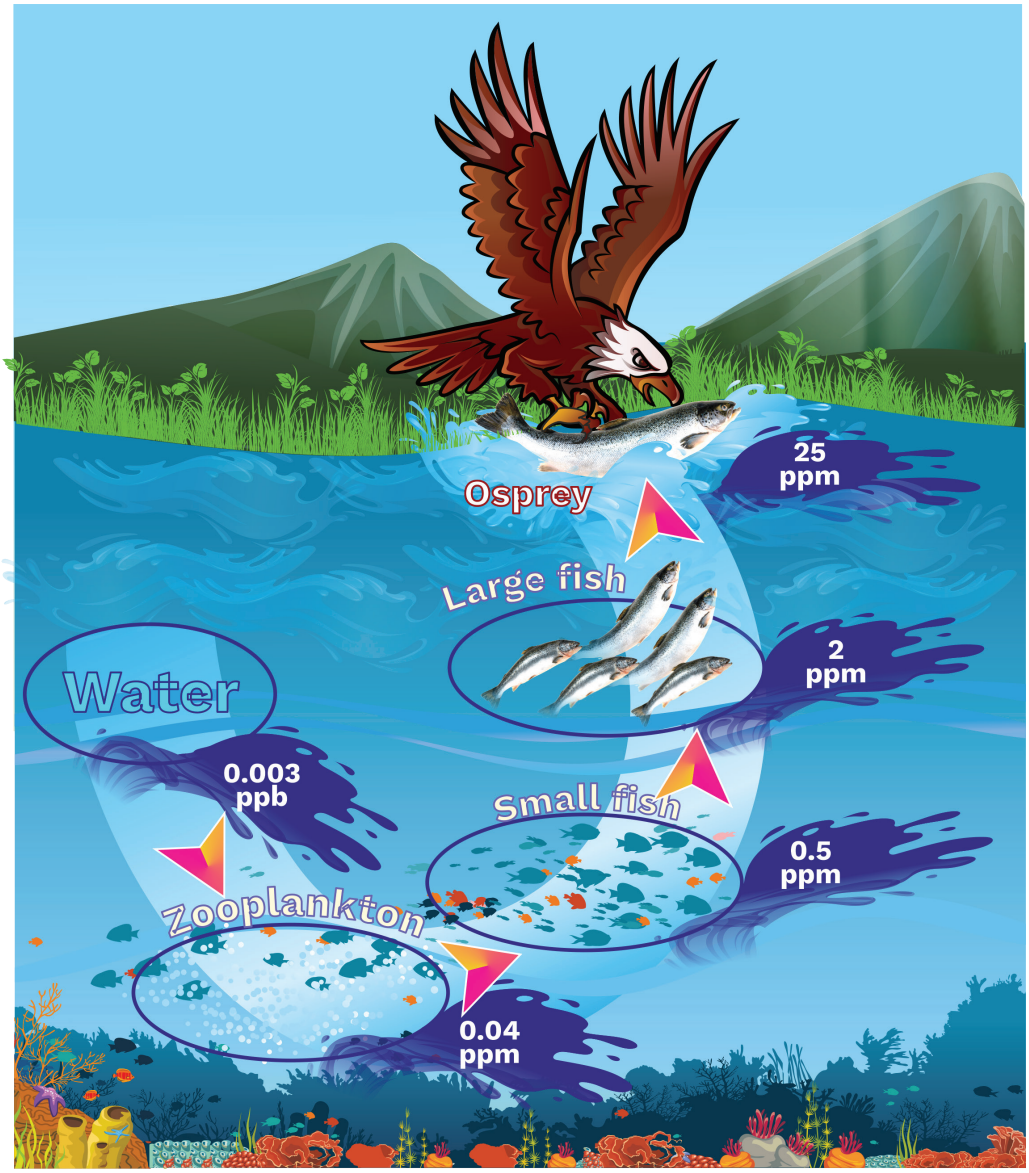


FIG. BIOMAGNIFICATION OF DDT IN AN AQUATIC FOOD CHAIN

Note:

High concentration of DDT interferes with calcium metabolism in birds and cause thinning of eggshells and their premature breaking; this leads to a decline in bird population.

Definition

Bioaccumulation: Increase in the percentage of a toxic pollutant in an organism.

EUTROPHICATION

- Natural ageing of a lake by **nutrient enrichment** such as **nitrogen** and **phosphorus** of its water.
- Nutrients of lake's water promote growth of aquatic organisms.
- Over the time bottom of the lake is piled up with debris that makes it shallower and warmer which promotes marsh like plants.
- Thus, aquatic succession continues for thousands of years.

Definition

Eutrophication: It refers to the nutrient enrichment in the water bodies leading to lack of oxygen and deadening of life-supporting conditions.

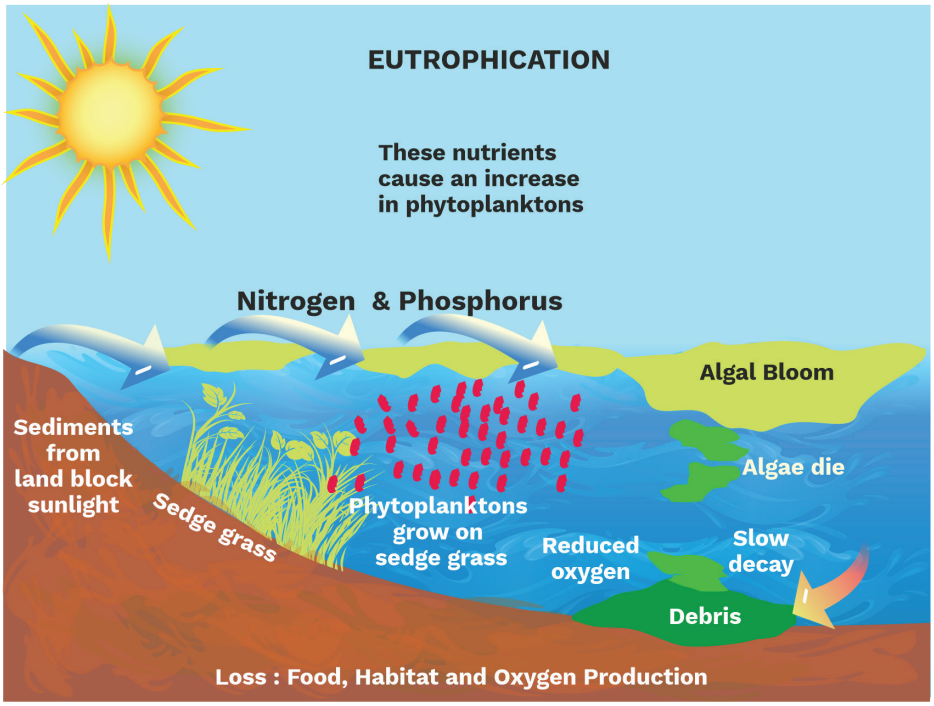


FIG. EUTROPHICATION

ACCELERATED OR CULTURAL EUTROPHICATION

- Overloading of a lake with domestic, agricultural and industrial wastes speeds up the eutrophication termed as accelerated or cultural eutrophication.
- The prime contaminants are **nitrates** and **phosphates** which act as plant nutrients.
- Growth of algae is over stimulated.

Definition

Cultural or Accelerated Eutrophication: It is man-induced nutrient enrichment of water bodies which accelerate algal growth and dissolved oxygen is reduced.

- Unpleasant odours are generated, dissolved oxygen (DO) is used up by the algae resulting in suffocation and eventually death of other aquatic organisms.
- Reduced dissolved oxygen slows down the decomposition of debris and further addition of sewage, etc., chokes the lake to death.

Note: *Eichhornia crassipes* grows very fast in eutrophicated lakes and other such water bodies causing imbalance in the ecosystem dynamics. It is world's most problematic aquatic weed and in India it is called '**Terror of Bengal**'.

Thermal Wastewater

- Thermal (heated) wastewater flowering out from thermal power plants (electricity-generating units), eliminates or reduces many organisms that are sensitive to high temperature (indigenous flora and fauna) and it may enhance the growth of plants and fish in extremely cold areas.

SOLID WASTES

- Solid wastes refer to all that goes out in trash.
- **Types of solid wastes:**

Municipal solid wastes

- These are wastes from homes,schools,offices, etc., that are collected and disposed by the municipality and generally consists of paper, glass,waste food materials, leather, textile, rubber, etc.
- When they are dumped in the open, they provide breeding ground for flies and other insects which may be vectors.

Fly ash

- Thermal power plants generate fly ash. It is composed of oxides of silica, iron and

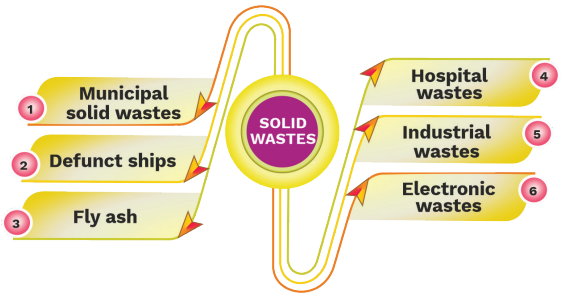
Gray Matter Alert!!!

Consumption of large amount fish and shellfish contaminated with mercury can cause a disease of central nervous system known as Minamata disease or Chisso-Minamata disease.

FIG. WATER HYACINTH
(*Eichhornia crassipes*)

Rack Your Brain

Why is *Eichhornia crassipes* known as the world's most problematic aquatic weed?



aluminium and low concentrations of toxic heavy metals.

Defunct ships

- Defunct ships are broken down in developing countries for scrap metal.They contain toxic substances like asbestos, polychlorinated biphenyls, tributyltin, lead, mercury, etc.
- The workers are not suitably protected and are exposed to toxic chemicals.
- The coastal area in the vicinity of the ship breaking yard becomes polluted.

Hospital wastes

- Hospitals produce and dump many hazardous wastes that contain pathogenic microbes, disinfectants and other harmful chemicals.
- The use of incinerators is crucial for the disposal of hospital wastes.

Industrial Wastes

- Industries involved in manufacturing of paper, rubber, pesticides, dye, etc., produce large amounts of corrosive and highly inflammable chemicals.

Electronic Wastes (e-wastes)

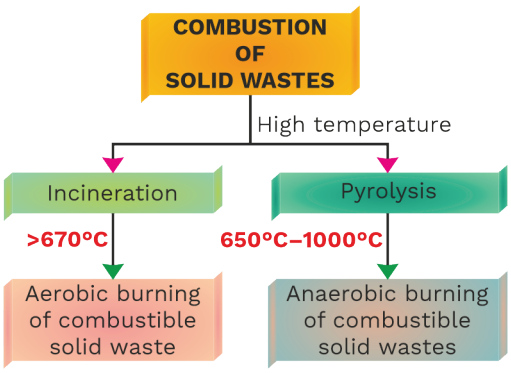
- Irreparable computers and other electronic goods, are known as electronic wastes.
- e-wastes are generated in the developed countries and are sent to developing countries where certain metals like gold, nickel, silicon, copper, iron, etc., are recovered from them.
- Then recycling is done manually and so, the workers are exposed to the toxic substances.

DISPOSAL OF SOLID WASTES

- Municipal solid wastes are burnt to reduce the volume; but they are not burnt completely, and

Previous Year's Question

Domestic wastes constitute:
(1) Non-biodegradable pollution
(2) Biodegradable pollution
(3) Effluents
(4) Air pollution



Gray Matter Alert!!!

Biomethanation is a process by which biodegradable organic wastes are microbiologically converted under anaerobic conditions to produce biogas.

the open dumps serve as the breeding ground for flies and rats.

- Sanitary landfills have been adopted as an alternative to open-burning dumps.
- 'EcoSan' toilets recycle human excreta into a natural fertiliser. EcoSan are found in Kerala, Gujarat, Karnataka, Maharashtra, Andhra Pradesh, Orissa, Bihar, Ladakh and Sri Lanka.
  - Municipal wastes are incinerated.The heat released is used to generate electricity.
  - They are also recycled for various components.
  - Fly ash is used in construction industry or buried as landfills.It is also used to alterthe soil as it increases aeration and water retention of soil.
  - e-wastes are buried as landfills or incinerated; they are also cycled.
  - From e-wastes metals like copper, iron, silicon, nickel and gold are recovered during recycling process.

Rack Your Brain

Fly ash improves soil quality. Justify.

Gray Matter Alert!!!

Most dangerous radioactive air pollutant is strontium-90.

Previous Year's Question

Degradable pollutant is
(1) Domestic waste
(2) DDT
(3) Mercury salt
(4) Aluminium foil

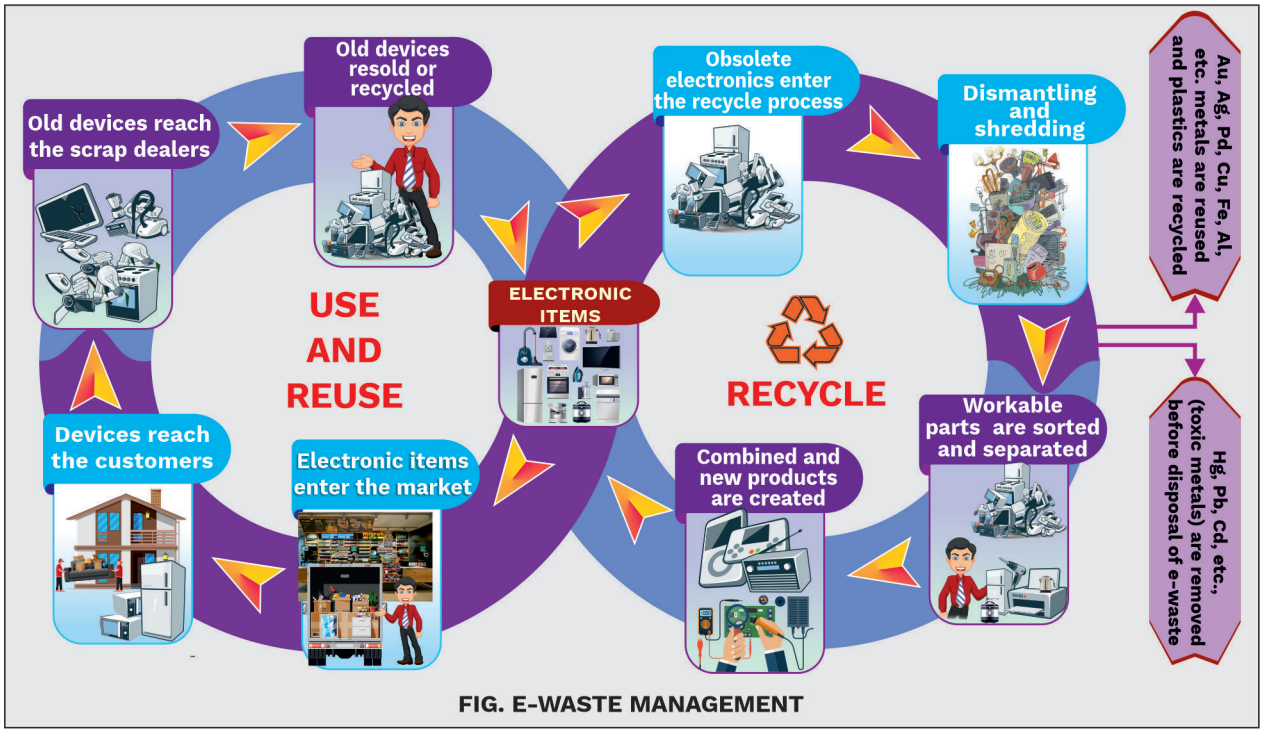


FIG. E-WASTE MANAGEMENT

SOIL POLLUTION

- Any undesirable change in the physical, chemical and biological properties of soil that reduces productivity of plants is termed as soil pollution.

Sources of soil pollution

- Fertilisers and pesticides from croplands. Pesticides are complex organic compounds that degrade very slowly and many are toxic to living organisms that are components of the ecosystem.
- Solid wastes from industries and household.
- Rains may wash-down heavy metals and other toxic chemicals which seep into the soils and pollute it.

Harmful effects

- Pesticides may cause biomagnification.
- Acids form in the soil when rainwater reacts with the chemical pollutants present in the soil like calcium, magnesium, sodium and potassium held by **soil** colloids. In acidic soils, the crop growth is much reduced.
- Change in the chemical nature of soil affects many living organisms (microorganisms and macroorganisms) of the soil.

ORGANIC FARMING

- It is a solution to reduce dependence on chemical fertilizers and thus it helpful in reducing soil pollution.
  - Crop wastes, animal dung and human excreta is used to prepare **manure** and **compost.**
  - **Biofertilisers:** Several microorganisms are commonly used as biofertilisers including nitrogen-fixing soil bacteria (*Azotobacter, Rhizobium*), nitrogen-fixing cyanobacteria (*Anabaena*), phosphate-solubilising bacteria (*Pseudomonas* sp.), and AM fungi.

Previous Year's Question

Soil fertility is reduced by
(1) Crop rotation
(2) Nitrogen fixing bacteria
(3) Decaying organic matter
(4) Intensive agriculture

Previous Year's Question

Lead is associated with
(1) Water pollution
(2) Air pollution
(3) Soil pollution
(4) Noise pollution

Previous Year's Question

Effect of pollution is marked first in
(1) Micro-organisms
(2) Vegetation
(3) Food crops
(4) None of these

RADIOACTIVE WASTES

- Radioactive wastes are of three types depending on the amount of radioactivity:
  - **Low level radioactive wastes.**
  - **Intermediate level radioactive wastes.**
  - **High level radioactive wastes.**
- The high-level radioactive wastes consist of spent fuel and generate a lot of heat and require cooling.
- Such wastes are first concentrated to reduce the volume and then kept for 50–100 years in small ponds within the premises of nuclear power plants to decay the radioactivity and lessening of heat.
- After sufficient treatment high level radioactive wastes are stored in suitably shielded containers and buried within the rocks about **500 m deep** inside the earth.
- Nuclear energy has two most serious problems:
  - **The accidental leakage of radioactivity**
  - **The safe disposal of radioactive wastes.**

GREENHOUSE EFFECT

- The term 'Greenhouse Effect' has been derived from a phenomenon that occurs in a greenhouse.
- Greenhouse effect is naturally occurring and is responsible for heating earth's surface and atmosphere.
- In the absence of greenhouse effect the average temperature of the surface of earth would have been -18°C rather than the present average temperature (15°C).

GREENHOUSE GASES

- **Carbon dioxide (60%)** and **methane (20%)** are commonly known as greenhouse gases as these are responsible for greenhouse effect.
- **Nitrogen dioxide (6%)** and **chlorofluorocarbons (14%)** are the other greenhouse gases.

Previous Year's Question

Which is regional pollution?
(1) Smog
(2) Acid rain
(3) Ozone layer depletion
(4) Both (1) and (2)

Previous Year's Question

What is B.O.D.?
(1) Amount of O_2 utilized by organisms in water
(2) Total amount of O_2 present in water
(3) Amount of O_2 utilized by micro-organisms for decomposition
(4) All of these

Definition

Greenhouse Effect: It is a naturally occurring phenomenon in which the shortwave radiations are absorbed and the long wave radiations are reflected by the earth responsible for heating of earth's surface and atmosphere.

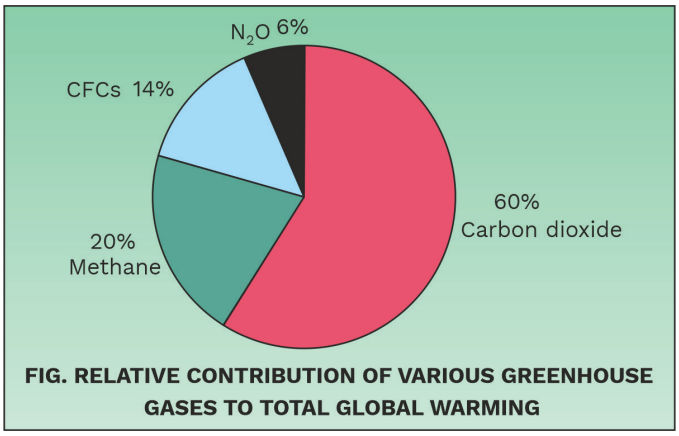


FIG. RELATIVE CONTRIBUTION OF VARIOUS GREENHOUSE GASES TO TOTAL GLOBAL WARMING

Mechanism of Greenhouse Effect

- Out of the total incoming solar radiation one-fourth is reflected by the clouds and atmospheric gases.
- Half of the incoming solar radiation falls on the earth and heats it and a small portion is reflected back.
- Earth's surface emits heat in the form of infrared radiation to the space. But most of this heat is absorbed by gases like carbon dioxide, methane, nitrous oxide and chlorofluorocarbons, which fails to escape the earth's atmosphere.
- The molecules of these gases radiate heat energy that comes back to earth's surface and heats it up.
- The cycle is repeated till the long-wave radiation becomes unavailable for absorption.

Note:

Ramsar Convention (Convention of Wetlands)
The Ramsar Convention on Wetlands of International Importance Especially as Waterfowl Habitat, is an international treaty for the conservation and sustainable use of wetlands. It is named after the city of Ramsar in Iran, where the convention was signed in 1971.

Previous Year's Question

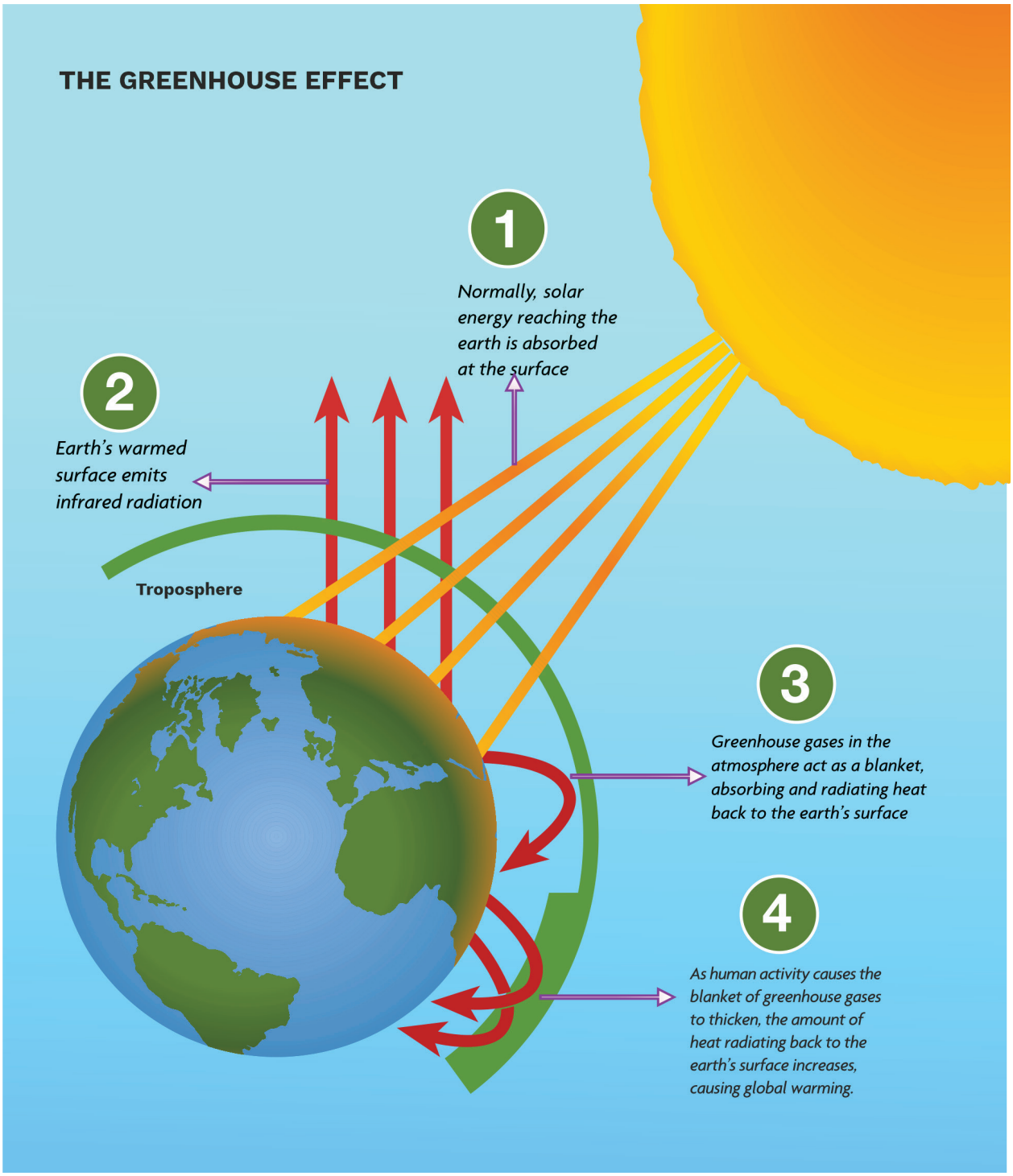
A gas that contributes most to greenhouse effect is
(1) CH_4
(2) NO_2
(3) CO_2
(4) CO

Previous Year's Question

Greenhouse effect refers to
(1) plants grown in green houses
(2) global warming caused by increasing CO_2
(3) ozone hole
(4) increased chlorofluorocarbons

Note:

Basel Convention
An international treaty that was designed to reduce the movements of hazardous waste between nations, and specifically to prevent transfer of hazardous waste from developed to less developed countries (LDCs). It entered into force on 5 May 1992.
It does not, address the movement of radioactive waste between the nations.


THE GREENHOUSE EFFECT
1
Normally, solar energy reaching the earth is absorbed at the surface
2
Earth's warmed surface emits infrared radiation
Troposphere
3
Greenhouse gases in the atmosphere act as a blanket, absorbing and radiating heat back to the earth's surface
4
As human activity causes the blanket of greenhouse gases to thicken, the amount of heat radiating back to the earth's surface increases, causing global warming.

GLOBAL WARMING

- Increase in the level of greenhouse gases is mainly responsible for global warming.
- During the past century, the temperature of the earth has increased by 0.6°C and the average global temperature may increase by 1.4°C – 5.8°C by the year 2100.

Definition

Global Warming: The increase in the global mean temperature is known as global warming.

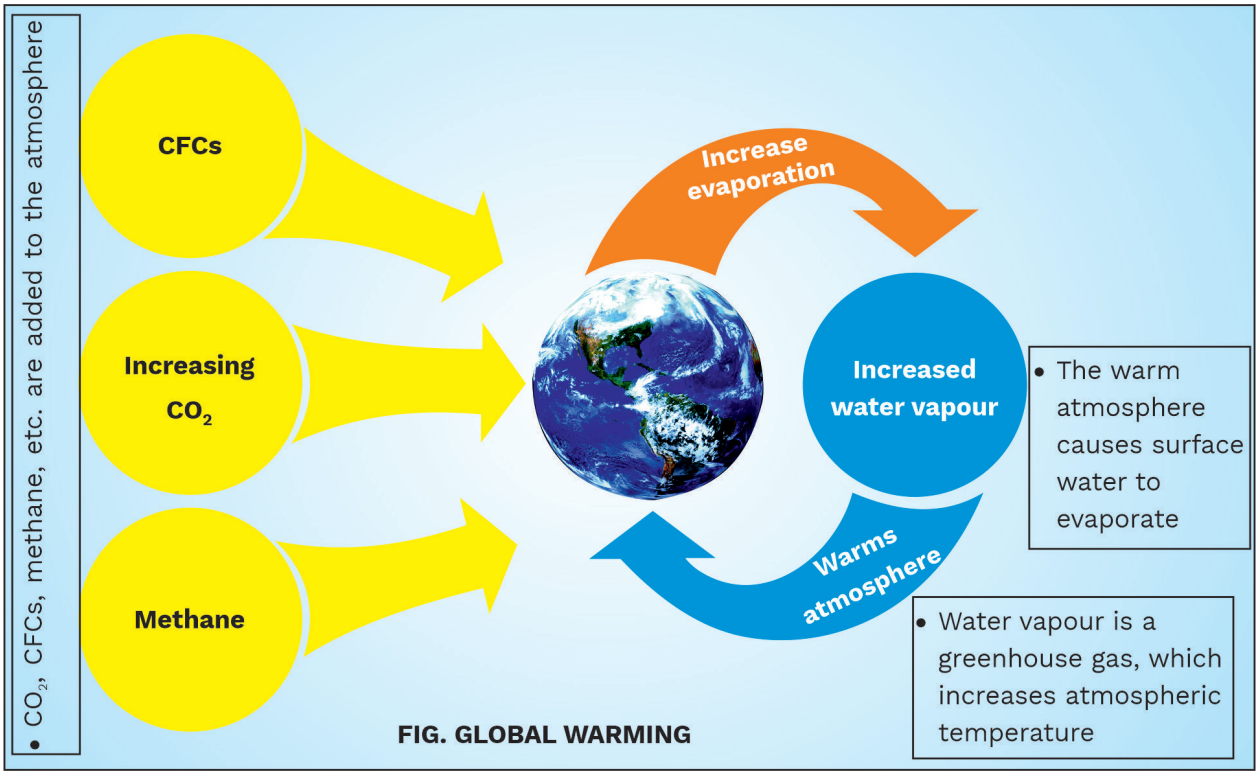


FIG. GLOBAL WARMING

Measures to Control Global Warming

- Reduce the use of fossil fuels.
- Improving efficiency of energy usage.
- Reducing deforestation and planting more trees.
- Reducing the use of nitrogen fertilisers.
- Reduce the emission of greenhouse gases.
- Using birth control methods to reduce population growth.

Previous Year's Question

Ultraviolet radiations from sunlight cause a reaction that produces
(1) fluorides
(2) carbon monoxide
(3) sulphur dioxide
(4) ozone

OZONE

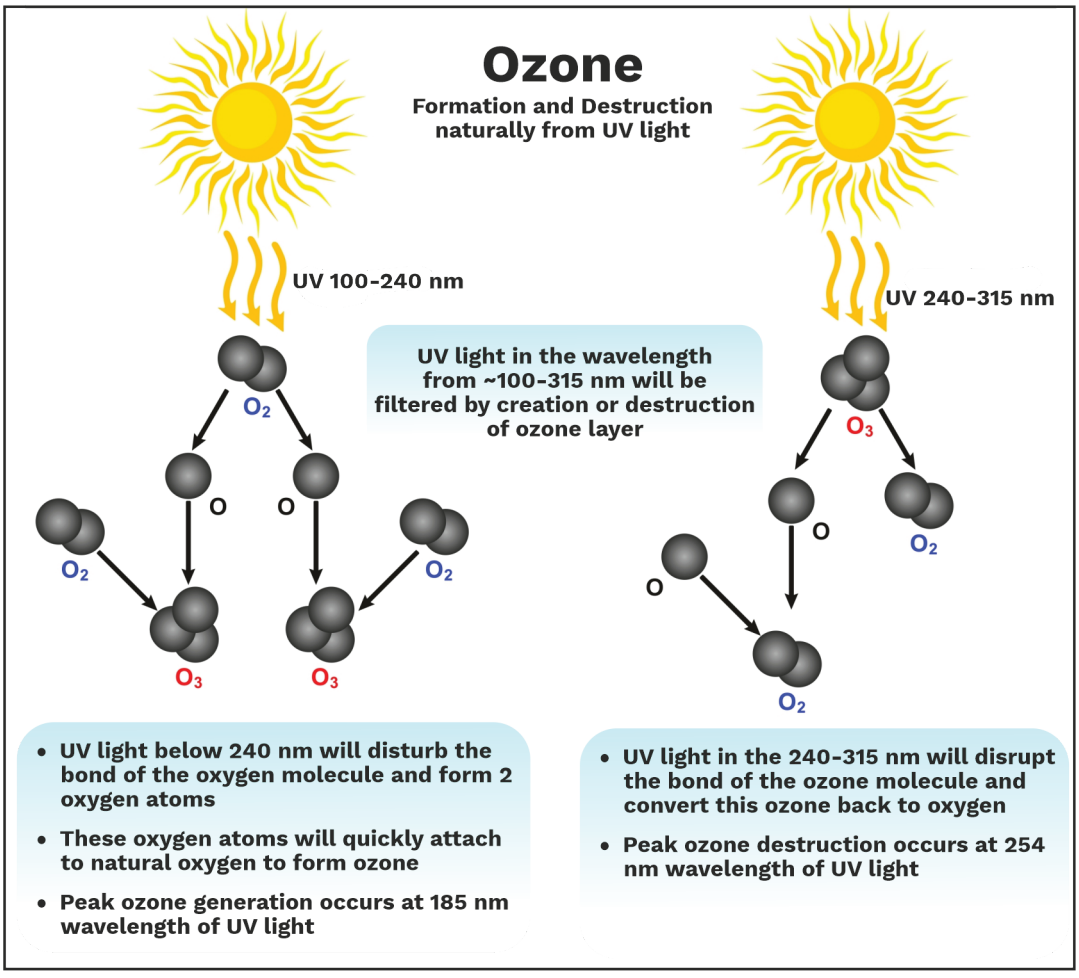
- The ozone (O_3) formed in the stratosphere is called **'good' ozone**, as it acts as a shield and absorbs the ultraviolet radiation from the sun and protects living organisms from its ill-effects.
- The ozone formed in the troposphere is called **'bad' ozone**, as it harms plants and animals.

Formation of Ozone

- Ozone gas is formed by the action of UV rays on molecular oxygen.
- Ozone is also degraded by UV rays into molecular oxygen; so that there is a balance between the formation and degradation of ozone in the stratosphere.

Definition

Ozone Hole: The decline in the thickness of ozone layer is called ozone hole.



Measurement of Thickness of Ozone Layer

- The thickness of ozone is measured in terms of **Dobson Units (DU)**.
- The thickness of ozone layer is measured in a column of air from ground to the top of the atmosphere.

Ozone Depletion

- The balance in the formation and degradation of ozone is disrupted by **chlorofluorocarbons (CFCs),** which break into active chlorine in the presence of UV; the Cl atoms degrade ozone into molecular oxygen.
- Since Cl atoms act only as catalyst, the CFCs have a permanent and continuing effects on ozone levels; the large area of thinned ozone, layer, is called ozone hole.
- **This depletion of ozone is marked over Antarctica and ozone hole develops here every year between late August and early October.**

Previous Year's Question

Ozone is spread in the swimming pool because

(1) it acts as disinfectant
(2) it absorbs UV-radiations
(3) ozone is easily available from O_2
(4) all of the above

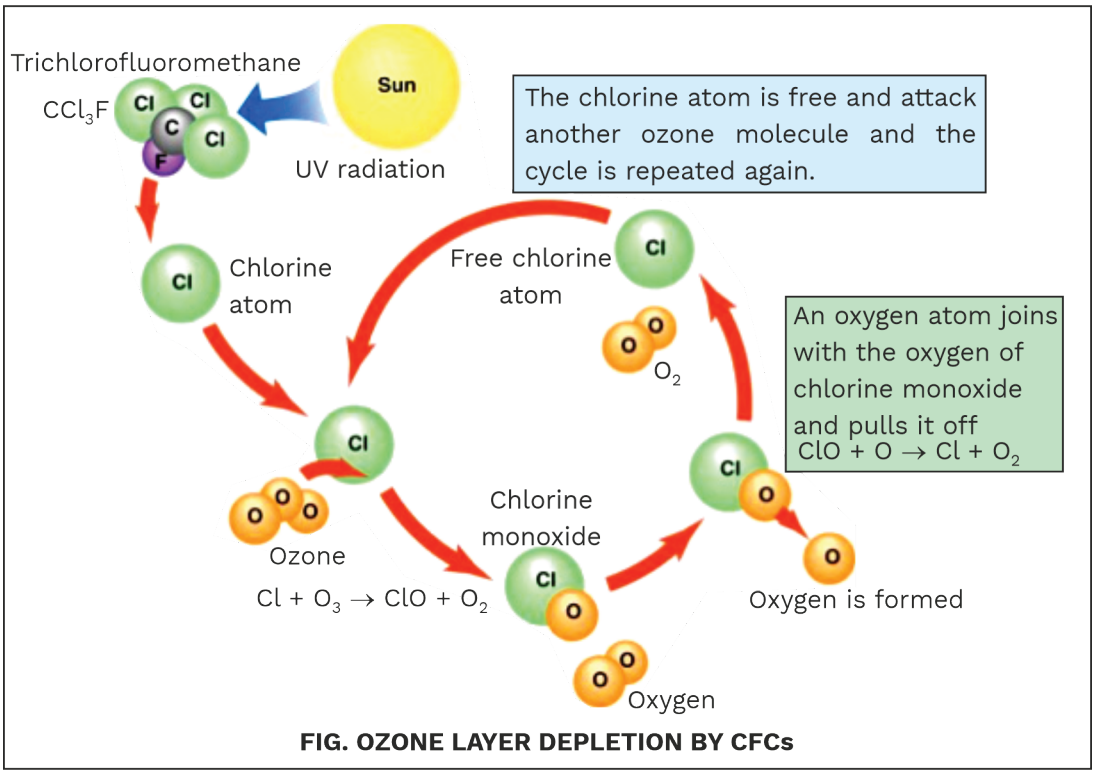


FIG. OZONE LAYER DEPLETION BY CFCs

Note: Chloroflurocarbons

Chlorofluorocarbon (CFC), any of several organic compounds composed of carbon, fluorine, and chlorine. These are also called freons.
When CFCs also contain hydrogen in place of one or more chlorines, they are called hydrochlorofluorocarbons or HCFCs.

- In the thinning of ozone layer, the UV-B radiations reach the earth, and the following consequences occur:
  - It damages DNA and mutations arise.
  - It causes ageing of skin, damage to skin cells and skin cancer.
  - High dose of UV-B radiations causes inflammation of cornea (**snow-blindness**) and cataract, as cornea absorbs the UV-B radiation.
  - It is lethal to microorganisms.
- **Efforts to Restore the Ozone Level**
  - An international treaty, called **Montreal Protocol,** was signed at Montreal (Canada) in 1987 and it became effective in 1989.
  - It was subsequently amended and modified in Beijing in 1999. It has undergone total 9 revisions till date. Its objective is to control the emission of CFCs and other ozone-depleting substances.

Definition

Polar Vortex: It refers to the natural circulation of wind that completely isolates the Antarctic air from the rest of the world.

Previous Year's Question

Peeling of ozone umbrella which protects us from UV-rays is caused by
(1) Coal burning
(2) CO_2
(3) CFCs
(4) PAN

DEGRADATION OF NATURAL RESOURCES BY IMPROPER UTILISATION AND MAINTENANCE

- Natural resources get degraded not only by pollutants, but also by improper practices of their utilisation and maintenance.
- Soil erosion, is caused by human activities like:
  - Over-cultivation and monoculture
  - Over grazing
  - Poor irrigation practices
  - Deforestation, etc.
- When the large arid/barren patches of land meet over a period of time, desertification results.
- Irrigation without proper drainage, leads to waterlogging of soil.

Definition

Jhum Cultivation: Clearing the forest land by cutting and burning of forests trees. The plant's ash is used as fertilizer.

- Waterlogging affects the crop productivity and causes deposits of salts on the land surface or near to the roots; saline soil becomes uncultivable.
- Desertification is a major problem nowadays, mainly due to increased urbanisation.

DEFORESTATION

- Deforestation is the clearing of forested areas into non-forested ones by the humans.
- According to an estimate, almost 40 per cent forests have been lost in the tropics and 1 per cent forests in the temperate region.
- In India, at the beginning of twentieth century, forests covered about 30 per cent of land whereas by the end of the century it reduced to 19.4 per cent.
- **The National Forest Policy (1988) has recommended 33 per cent forest cover for plains and 67 per cent for hills.**

Causes for Deforestation

- Forests are converted into agricultural land to feed the growing human population.
- Forests are cleared for making homes and establishing industries.
- Tree are felled for timber, firewood, etc.
- Slash and burn agriculture or jhum cultivation in the north-eastern states has contributed to deforestation.

Consequences of Deforestation

- Carbon dioxide concentration of the atmosphere has increased.
- There is loss of biodiversity due to habitat destruction.
- Deforestation has disturbed hydrological cycle.
- There is soil erosion and it may lead to desertification in extreme cases.

Previous Year's Question

Chlorofluoro carbons are responsible for
(1) acid rain
(2) ozone layer depletion
(3) global warming
(4) thermal inversion

Definition

Reforestation: It is the process of restoring a forest that once existed, but was removed at some point of time in the past.

Previous Year's Question

Pollution of SO_2 destroys
(1) lichen
(2) fungi
(3) algae
(4) fishes

PEOPLE'S PARTICIPATION TO PROTECT FORESTS

- The Government of India has instituted **Amrita Devi Bishnoi Wildlife Protection Award**; it is given to individuals or communities that show extraordinary courage and dedication to protect wildlife. Amrita Devi along with her three daughters and hundreds of Bishnois lost their lives saving trees in 1731.
- The **Chipko Movement** that started in Garhwal, Himalayas in 1973, by local women. It aimed primarily at saving trees and forests.
- The Government of India has introduced the concept of **Joint Forest Management** (JFM) to work closely with the local communities for protecting and managing forests; the communities get benefits of various forest products.

Gray Matter Alert!!!

Polyblend is a fine powder of recycled modified plastic which is mixed with bitumen to lay roads.

Previous Year's Question

Act formulated in 1986 was
(1) Insecticide Act
(2) Environment (Protection) Act
(3) Water (Prevention and Control of Pollution) Act
(4) Air (Prevention and Control of Pollution) Act

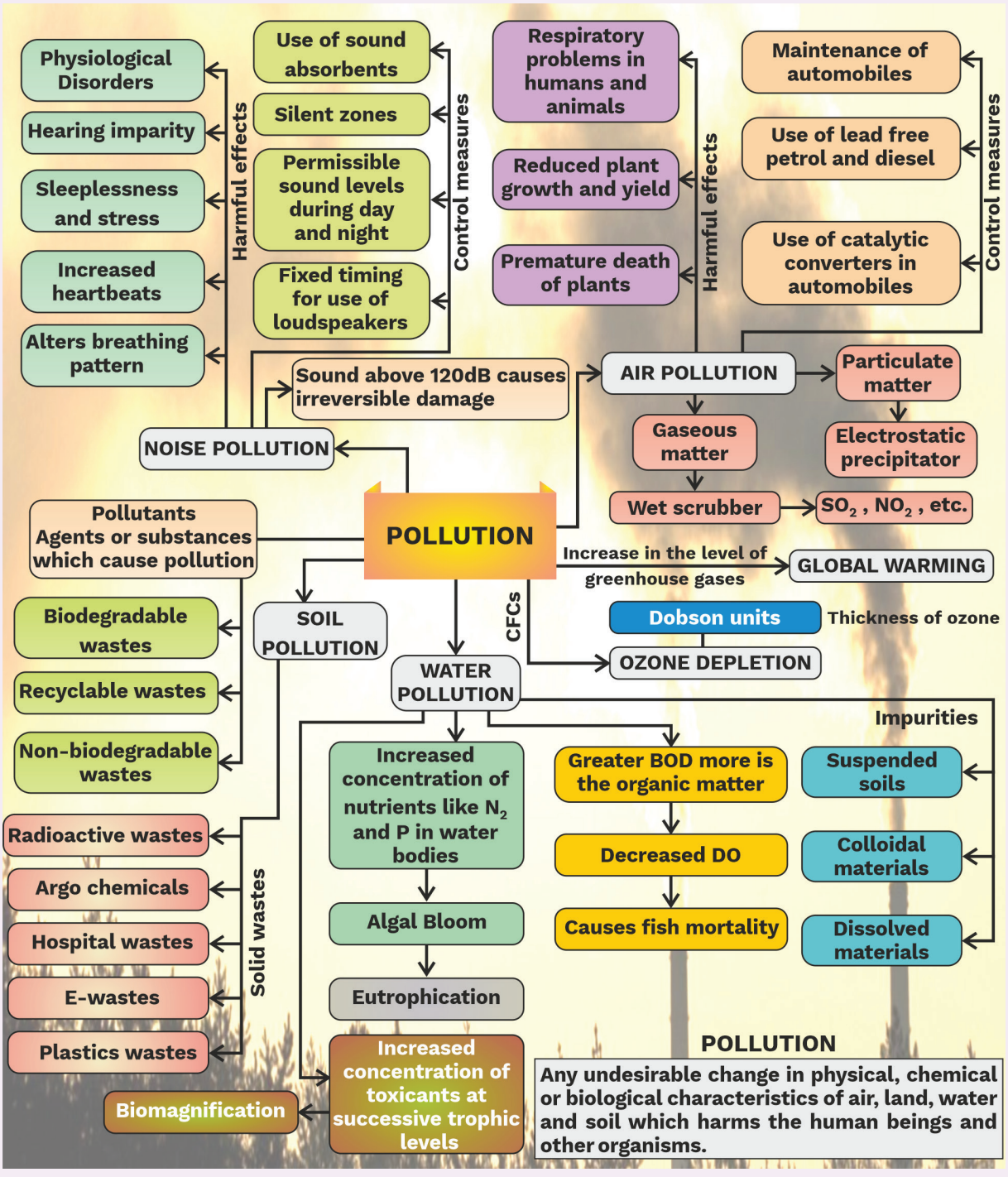
Note: Acid Rain

Any form of precipitation that contains high levels of nitric and sulfuric acids. It can also occur in the form of snow, fog, and tiny bits of dry material that settle to Earth. Normal rain is slightly acidic, with a pH of 5.6, while acid rain generally has a pH between 4.2 and 4.4. Mostly acid rain is a product of human activities. The biggest sources are coal-burning power plants, factories, and automobiles.
Burning of fossil fuels , release sulphur dioxide (SO_2) and nitrogen oxides (NO_x) into the atmosphere. These air pollutants react with water, oxygen, and other substances to form airborne sulfuric and nitric acid. Winds may spread these acidic compounds through the atmosphere and over hundreds of miles. When acid rain reaches Earth, it flows across the surface in runoff water, enters water systems, and sinks into the soil.
It has killing effect on vegetation, insects, aquatic life-forms and other organisms. It causes peeling of paint, corrosion of steel structures such as bridges, and weathering of stone buildings and statues.

Note: The CSIR-National Environmental Engineering Research Institute (CSIR-NEERI)

The CSIR-National Environmental Engineering Research Institute (CSIR-NEERI) is a research institute created and funded by Government of India. It was established in Nagpur in 1958.It focuses on water supply, communicable diseases,sewage disposal, and to some extent on industrial pollution and occupational diseases found common in India. NEERI is a pioneer laboratory in the field of environmental science and engineering and part of Council of Scientific and Industrial Research (CSIR).

Summary


POLLUTION
Pollutants
Agents or substances which cause pollution
NOISE POLLUTION
Harmful effects
Physiological Disorders
Hearing imparity
Sleeplessness and stress
Increased heartbeats
Alters breathing pattern
Control measures
Use of sound absorbents
Silent zones
Permissible sound levels during day and night
Fixed timing for use of loudspeakers
Sound above 120dB causes irreversible damage
AIR POLLUTION
Harmful effects
Respiratory problems in humans and animals
Reduced plant growth and yield
Premature death of plants
Control measures
Maintenance of automobiles
Use of lead free petrol and diesel
Use of catalytic converters in automobiles
Particulate matter
Electrostatic precipitator
Gaseous matter
Wet scrubber
SO_2 , NO_2 , etc.
GLOBAL WARMING
Increase in the level of greenhouse gases
CFCs
Dobson units
Thickness of ozone
OZONE DEPLETION
SOIL POLLUTION
Biodegradable wastes
Recyclable wastes
Non-biodegradable wastes
Solid wastes
Radioactive wastes
Argo chemicals
Hospital wastes
E-wastes
Plastics wastes
WATER POLLUTION
Impurities
Suspended soils
Colloidal materials
Dissolved materials
Greater BOD more is the organic matter
Decreased DO
Causes fish mortality
Increased concentration of nutrients like N_2 and P in water bodies
Algal Bloom
Eutrophication
Increased concentration of toxicants at successive trophic levels
Biomagnification
POLLUTION
Any undesirable change in physical, chemical or biological characteristics of air, land, water and soil which harms the human beings and other organisms.

Solved Exercise

Q.1 **All of the following will increase pollution except**
(1) Using lead gasoline
(2) Using products that contain Fluro-hydrocarbons
(3) Driving at 55 miles per hour
(4) Using biodegradable products

Ans. (4)
Leftovers of biodegradable products can be decomposed by microbes, thus will help in decreasing the pollution.

Q.2 **Use of mufflers in industries will help in reducing**
(1) Particulate matter from the exhausted air
(2) Pollutants in wastewater
(3) Noise pollution
(4) Harmful gases from the exhausted air

Ans. (3)
Industrial silencers and mufflers absorb and attenuate noise levels from machinery thus help in reducing noise pollution.

Q.3 **Sewage containing nitrates and sulphates may cause a lake to die by**
(1) Biomagnification
(2) Eutrophication
(3) Depletion
(4) Exploitation

Ans. (2)
Sewage containing nitrates and sulphates may cause a lake to die by accelerated eutrophication. Nitrates and sulphates promote algal growth which sucks maximum oxygen from the water resulting in decreased population of aquatic fauna due to reduced dissolved oxygen and eventually the lake choke to death.

Q.4 **Normally which one is not a pollutant?**
(1) Carbon dioxide
(2) Hydrocarbons
(3) Sulphur dioxide
(4) Carbon monoxide

Ans. (1)
Carbon dioxide is not a pollutant, as it is important for greenhouse effect to maintain warm atmosphere on earth essential for sustaining life. The only concern is too much of CO_2 is the reason for global warming along with other factors like deforestation and extensive industrialisation.

Q.5 **The eggshell of a golden eagle gets fragile by the presence of ..... in the environment.**
(1) CO_2
(2) DDT
(3) Mercury
(4) Nitrates and phosphates

Ans. (2)
If the environment is contaminated with DDT, then eagle will have more bioaccumulation of this pesticide being the top carnivore. DDT is neither metabolised nor excreted from the body of organisms. The effect of DDT is that birds lay eggs with thin shells that breakdown easily reducing their population.

Q.6 **Sound becomes hazardous noise pollution at level**
(1) Above 30 dB
(2) Above 80 dB
(3) Above 100 dB
(4) Above 120 dB

Ans. (2)
Sound from 0 dB to 65 dB is tolerable for human beings. So, sound above 80 dB is hazardous and prolonged exposure to such sound can cause various health issues like insomnia, heart problems, anxiety, hearing impairment, etc.

Q.7 **Formation of ozone hole is maximum over**
(1) Africa
(2) India
(3) America
(4) Antarctica

Ans. (4)
This depletion of ozone is marked over Antarctica and ozone hole develops here every year between late August and early October.

Q.8 **Natural sink of stratospheric ozone layer is**
(1) Sulphur flux of oceans
(2) Sulphur dioxide
(3) Freons
(4) Nitrogen dioxide

Ans. (3)
Chlorofluorocarbons are also called as freons and are the primary cause of damaging the ozone layer.

Q.9 **Phosphate pollution is caused by**
(1) Sewage and phosphate rock
(2) Phosphate rock only
(3) Agricultural fertilizers only
(4) Sewage and agricultural fertilizers

Ans. (4)
Phosphates are present in the detergents and in phosphate fertilizers, so the sewage and agricultural runoff adds phosphates in the water bodies.

Q.10 **Greenhouse effect refers to**

(1) Trapping of heat reflected from the earth's surface.

(2) Global warming caused by increasing CO_2

(3) Ozone hole

(4) Increased CFCs in the atmosphere

Ans. (1)

Greenhouse effect is a naturally occurring phenomenon that is responsible for heating earth's surface and atmosphere. The radiated heat from the earth's surface is trapped primarily by CO_2 and methane gas.