

ENVIRONMENTAL CHEMISTRY

Degradable pollutants → Discarded vegetables
Slowly degradable → DDT, plastic materials,
heavy metals, nuclear wastes etc.

Troposphere → The lowest region of atmosphere in which the human beings along with other organisms live is called troposphere.

→ It extends upto the height of 10 km from sea level.

→ cloud formation, turbulent.

Stratosphere → Above the troposphere between 10 and 50 km above sea level.

→ contains dinitrogen, dioxygen, ozone

→ The presence of ozone in stratosphere prevents about 99.5% UV radiation.

Tropospheric pollution

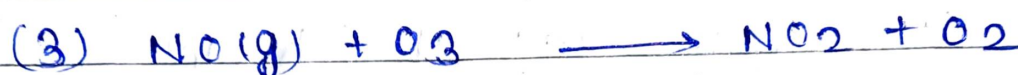
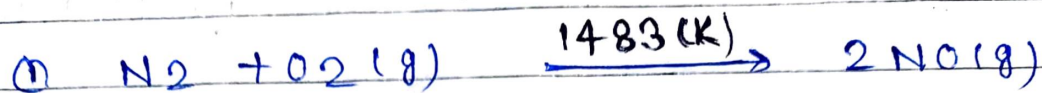
oxide of sulphur - SO_2 is a gas that is poisonous to both animals and plants.

→ Low concentration of sulphur dioxide causes → Asthma, bronchitis, emphysema, irritation to eyes

→ High concentration of SO_2 leads - stiffness of flowers bud



⇒ **Oxides of Nitrogen** → NO_2 is oxidised to nitrate ion NO_3^- (it serves as a fertilizer)



→ Higher concentration of NO_2 damage the leaves of plants

→ NO_2 is a lung irritant. It is also harmful to various textiles fibres and metals.

⇒ **Hydrocarbons** → Formed by incomplete combustion of fuels.

(1) Hydrocarbons are carcinogenic → They cause cancer.

⇒ **Oxides of Carbon**

(a) Carbon monoxides → CO is the most serious air pollutants.

→ colourless, odourless gas.

→ It blocks the delivery of oxygen to the organs and tissues.

→ Source → combustion of carbon, coal, firewood, petrol.

→ It binds to haemoglobin to form carboxy-haemoglobin.

→ headache, weak eyesight, nervousness and cardiovascular disorder etc.

Carbon dioxide → CO_2 released by respiration, burning of fossil fuels for energy, decomposition of limestone, during volcanic eruption.

⇒ The increased amount of CO_2 in air is mainly responsible for Global warming.

Global warming and Greenhouse effects

→ About 75% of the solar energy reaching the earth is absorbed by the earth surface which increases its temperature.

→ Some of the heat is trapped by gases such as CO_2 , methane, ozone, CFCs and water vapour etc. This causes global warming.

→ If the amount of CO_2 crosses the delicate proportion of 0.03%, the natural greenhouse balance may get disturbed.

→ Greenhouse gases — CO_2 , methane, water vapour, NO_2 , CFCs and ozone etc.

→ CFCs → Damaging ozone layer.

Acid Rain

→ pH value of normal rain water — 5.6

→ When the pH of the rain water drops below 5.6, it is called acid rain.

SO_2 and NO_2 are responsible.



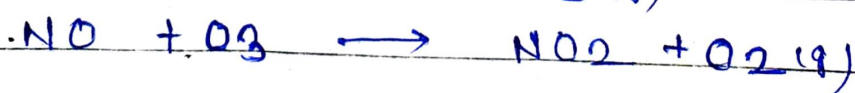
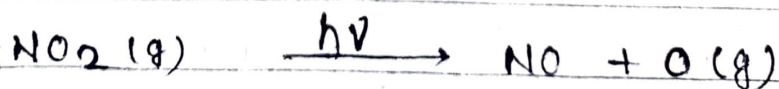
- $\Rightarrow$ Acid rain is harmful for agriculture, trees and plants.
- $\Rightarrow$ It corrodes water pipes resulting in the leaching of iron, lead, copper in drinking water.
- $\Rightarrow$ Acid rains damage buildings made of stone or metals.
- $\Rightarrow$ The Taj Mahal has been affected by acid rain.



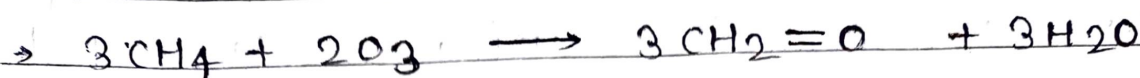
$\Rightarrow$ **Smog** $\rightarrow$ The word smog is derived from smoke and fog.

- (1) classical smog $\rightarrow$ occurs in cool humid climate
 - $\rightarrow$ mixture of smoke, fog and SO_2
 - $\rightarrow$ it is also called as reducing smog.

- SEE (2) photochemical smog $\rightarrow$ occurs in warm, dry and sunny climate.
- $\rightarrow$ sunlight, unsaturated hydrocarbon, NO_2
 - $\rightarrow$ oxidising smog.



⇒ Ozone is a toxic gas and both NO_2 and O_3 are strong oxidising agents.



↘ formaldehyde.

PAN → peroxyacetyl nitrate.

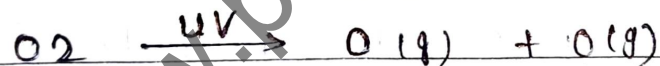
Common components → ozone, Nitric oxide, acrolein, formaldehyde and PAN

Harm → cause headache, chest pains, dryness of throats, corrosion of metals, cracking of rubber.

Stratospheric pollution

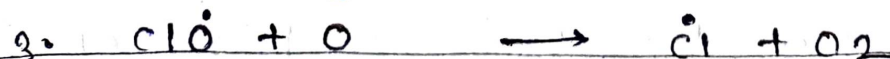
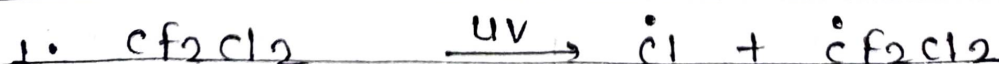
Ozone protects us from harmful ultraviolet radiation ($\lambda = 255\text{nm}$)

→ UV cause skin cancer (melanoma)



→ Ozone is thermodynamically unstable.

→ CFCs (Freons) is the main reason of ozone layer depletion. Used in refrigerators, AC



⇒ Effects → skin cancer, cataract, Sunburn,

Causes of water pollution

⇒ pathogens → The most serious water pollutants are the disease causing agents called pathogens.

- pathogens include bacteria and other organism.
- human excreta contain bacteria such as *Escherichia coli* and *Streptococcus faecalis*.

⇒ organic wastes → such as leaves, grass, trash etc.

→ In cold water dissolved oxygen (DO) can reach a concentration up to 10 ppm.

→ DO in water is very important for aquatic life.

→ If concentration of DO of water is below 6 ppm, the growth of fish get inhibited.

SEE

Biochemical oxygen demand (BOD) → The amount of oxygen required by bacteria to break down the organic matter present in a certain volume of a sample of water.

1. clean water would have BOD value less than 5 ppm.
2. Highly polluted water could have BOD value 17 ppm or more.

International standards for drinking water

① **Fluoride** → Its deficiency in drinking water is harmful to man and cause tooth decay.
→ concentration of fluoride in water should be 1 ppm.

→ The F^- ions make the enamel on teeth much harder (Fluorapatite: $[3(Ca_3(PO_4)_2 \cdot CaF_2)]$)

→ F^- ion concentration above 2 ppm causes brown mottling of teeth.

→ Excess fluoride (10 ppm) causes harmful effects of bones and teeth.

Lead → The prescribed upper limit concentration of Lead in drinking water is about 50 ppb.

→ Lead can damage (i) kidney

(ii) liver (iii) reproductive system.

Sulphate → Excessive sulphate i.e more than 500 ppm in drinking water causes laxative effect.

Nitrate → The maximum limit of nitrate in drinking water is 50 ppm.

Fe → 0.2

Mn → 0.05

Al → 0.2

** Cu → 3.0

Zn → 5.0

Cd → 0.005

Q.) The presence of soluble fluoride ion upto 1 ppm concentration in drinking water is :

- (A) safe for teeth ✓
- (B) harmful to skin
- (C) harmful for teeth
- (D) harmful to bones

Q. The condition that indicates a polluted environment

- (A) BOD value of 5 ppm
- (B) Eutrophication ✓
- (C) 0.03% of CO_2 in the atmosphere
- (D) pH of rain water to be 5.6

* Eutrophication → In Eutrophication nutrient enriched water bodies support a dense plant population, which kills animal life by depriving it of oxygen and results in subsequent loss of biodiversity.

(Q) The process of calcination and roasting in metallurgical industries respectively can lead to

- (A) Global warming and photochemical smog
- (B) photochemical smog and ozone layer depletion
- (C) photochemical smog and global warming
- (D) global warming and acid Rain ✓

calcination → CO_2 → global warming.
Roasting releases → SO_2 → acid rain

Match the following

- | | |
|---------------|----------------|
| (i) foam | (a) smoke |
| (ii) Gel | (b) cell fluid |
| (iii) Aerosol | (c) jellies |
| (iv) Emulsion | (d) rubber |
| | (e) froth |
| | (f) milk |

Ans: (i) - e (ii) - c (iii) - a (iv) - f

foam → froth, whipped cream, soap lather

Gel → cheese, butter, jellies

Aerosol → smoke, dust

Emulsion → milk

- (Q) The incorrect statements regarding acid rain is -
- (a) it can corrode water pipes
 - (b) it can damage structures made up of stone
 - (c) it cannot cause respiratory ailments in animals
 - (d) it is not harmful for trees

Ans → c and d

- (Q) Thermal power plants can lead to
- (A) ozone layer depletion
 - (B) Blue baby syndrome
 - (c) Eutrophication
 - (d) Acid rain ✓

(Q) The statement that is not true about ozone is:

- (A) In the stratosphere, CFCs release chlorine free radicals (Cl) which reacts with O_3 to give chlorine dioxide radicals. ✓
- (B) It is a toxic gas and its reaction with NO gives NO_2 .
- (C) In the atmosphere, it is depleted by CFCs.
- (D) In the stratosphere, it forms a protective shield against UV radiation.

(Q) Among the gases a) - (e) the gases that cause greenhouse effect are:

- (a) CO_2 (b) H_2O (c) CFCs (d) O_2 (e) O_3

Ans → a, b, c, e

(Q) The primary pollutant that leads to photochemical smog is:

- (a) acrolein
- (b) ozone
- (c) sulphur dioxide
- (d) nitrogen oxide. ✓

(Q) The correct set of species responsible for the photochemical smog is:

- (A) NO , NO_2 , O_3 and hydrocarbons ✓
- (B) N_2 , NO , and hydrocarbons
- (C) CO_2 , NO_2 , SO_2 and hydrocarbons
- (D) N_2 , O_2 , O_3 and hydrocarbons.