Environmental Chemistry..

(4 marks)

- Environmental pollution — Undesirable changes in surroundings, which affect living beings
- Pollutant — Substance which cause pollut.n (Solid/liq/gas)

primary pollutant	Secondary pollutant
natural form. NO, SO_2, NO_2...	PAN (Peroxy acetyl nitrate) ⊛

Biodegradable pollutant	non-biodegradable pollutant
discarded Vegetables, plant leaves	DDT, plastic waste, ⊛ Heavy metal, Hg, Ag, nuclear waste, Pb.

Atmospheric pollution.

Trophospheric, stratospheric.

Water pollution, Soil pollution.

Green house effect

Environment

Atmosphere, Hydrosphere, Lithosphere

Biosphere

Atmospheric pollution →

Troposphere (0-10 km)

Stratosphere (10-50 km) Ozonosphere

Tropospheric pollution →

Trophospheric pollutants → SO_x, NO_x, CO_x, H_2S, C_xH_y → gaseous pollutants

↳ dust, mist, fume, smoke, smog (particulate pollutant)

SO_x → produced when sulphur containing fossil is burnt in thermal plants.

produced by Volcanic eruption.

→ Causes asthma, bronchitis, irritation to eyes. (low conc.).

→ High conc. → stiffness of flower buds

→ acid rain

$SO_2 + O_2 \rightarrow SO_3$ ↑ (H_2O_2, Ozone) help in this rx.n

$SO_3 + H_2O \rightarrow H_2SO_4$ (acid rain)

NO_x (N_2 gas) $N \equiv N$ (requires high temp. to break)

When lightening occurs —

$N_2 + O_3 \rightarrow NO\,(g)$

$NO + O_2 \rightarrow NO_2\,(g)$

$NO_2 + H_2O \rightarrow HNO_3 + NO\uparrow$

→ Combustion of fuel in motor Vehicle (spark plug - 1473K)

$N_2 \rightarrow NO \rightarrow NO_2 \xrightarrow{H_2O} HNO_3$

effects → damage plant leaves.

decreases photosynthesis.

Respiratory illness (children)

C_xH_y → Incomplete combustion of fuel in automobile

Lanaerobic bacterial decomposition of organic matter

↳ These are Carcinogens (Cancer-producing).

↳ ageing of plants, leaves shedding, flower die.

CO_x CO → automobile exhaust, incomplete combustion of coal, fossil fuel.

O_2 + haemoglobin — Oxyhaemoglobin

CO + hamoglobin — Carboxyhaemoglobin (more stable)

'CO' reduces Oxygen carrying capacity of blood.

Global Warming and Green house effect →

↑↑ conc. of green house gases
↓
↑↑se global temperature
↓
polar ice caps melting, flooding in low areas.

green house gases →
CO_2, CH_4, O_3, CFC's, nitrous oxide, water vapour.

Green house effect →
Trapping of infrared radiation of green house gas ↓
Heat earth's atmosphere

Acid Rain → normal rain pH → 5.6

pH < 5.6 → acid rain.

due to HNO_3, H_2SO_4 — SO_x
NO_x

effect — Harmful for agriculture washes away useful nutrients for growth
- Damages aquatic ecosystem. (↑↑ acid pH)
- Respiratory illness
- damage building made up of stone, marble, metal

Tajmahal Corrosion $CaCO_3$ + H_2SO_4 → Yellowness

$$CaCO_3 + CaSO_4 + CO_2 + H_2O$$

particulate pollutant

Viable	non-viable
small size living organism	smoke, dust, mist, fumes
Bacteria, fungi, moulds, algae etc.	

Smoke — cigarette, oil smoke.
Dust — crushing of stone, saw dust of wood, cement factory.
Mist — particles of spray liquid and by condensation of vapour in liquid
Fumes — Condensation of vapours during sublimation, distillation, boiling etc.

Note →
particle size → > 10 micron - lodge in nasal cavity.
→ < 1 micron - effect lungs

Smog → major air pollutant.
Smoke + Fog → Harmful gases

Smog

Classical smog	Photochemical smog
London smog	Los angeles smog.
Cool and Humid. climate.	Warm and dry climate.
1° pollutant	2° pollutant
Reducing smog	Oxidizing smog

Photochemical Smog →

$$NO_{2(g)} \xrightarrow{h\nu} NO_{(g)} + O_{(g)}$$
$$O + O_2 \longrightarrow O_{3(g)}$$
$$O_3 + NO \longrightarrow NO_{2(g)} + O_{2(g)}$$

Both NO_2 and O_3 are strong oxidising agents and react with unburnt hydrocarbon to produce formaldehyde, acrolein, PAN

$$CH_3-\overset{O}{\overset{\|}{C}}-O-O-\underset{O}{N}=O \rightarrow PAN$$

effects → Irritation in eyes, respiratory illness.
cracking of rubber
extensive damage to plant life.

Ozonosphere / Stratospheric pollution →

Stratosphere → Ozone protect us from harmful UV rays → carcinogens.

Formation of Ozone →

$O_2 \xrightarrow{h\nu} O + O$

$O + O_2 \rightleftharpoons O_3$ → Thermodynamically unstable. So, breaks down to O and O_2 and eq^m exist.

Depletion of Ozone →

due to CFC's (AC, fridge) →

$CF_2Cl_2 \xrightarrow{h\nu} \dot{C}F_2Cl + Cl^\cdot$

$CFCl_3 \xrightarrow{h\nu} \dot{C}FCl_2 + Cl^\cdot$

$Cl^\cdot + O_3 \longrightarrow ClO + O_2$

1 molecule of CFC ↓ destroy 1000 ozone molecules

$Cl^\cdot$ → regenerated

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

Ozone hole in Antarctica →

Sept. and Oct (spring) → Ozone hole develops each year

Summers → $ClO + NO_2 \rightarrow ClONO_2$

$Cl^\cdot + CH_4 \rightarrow \dot{C}H_3 + HCl$ → chlorine sinks

prevents depletion. # termination rx.^{n}

Winters → special polar stratospheric clouds. which contain ($HNO_3 \cdot 3H_2O$) or ice.

$ClO + NO_2 \rightarrow ClONO_2$

$ClONO_2 + H_2O \rightarrow HOCl + HNO_3$

$ClONO_2 \xrightarrow{HCl} Cl_2 + HNO_3$

Spring → $Cl_2 \rightarrow Cl^\cdot + Cl^\cdot$

$HOCl \rightarrow OH^\cdot + Cl^\cdot$

$Cl^\cdot O \rightarrow Cl^\cdot + O$ ***

Effect of Ozone layer depletion →

Skin Cancer

Eye damage – Snowblindness, Cataract.

Harmful for agriculture.

Water pollution →

Water pollutant →

(1) pathogen → disease causing agents (from domestic sewage, human excreta).

(2) Organic Waste → leaves, grass trash, phytoplanktons.

(3) BOD → pure water = BOD = < 5ppm

↑↑gh polluted water = ≥ 17ppm

(4) Chemical pollutant → major oil spill, acin from mining

International Standard for pure drinking water → Vimp

Fluoride → 1ppm ✓

above 2ppm – brown molting of teeth

over 10ppm – bones and teeth damage.

Lead → 50ppb ✓

damages Kidney, liver, reproductive system.

Nitrate → 50ppm ✓

blue baby syndrome (methemoglobinemia)

Sulphate → 500ppm ✓

Causes laxative effect.

Fe – 0.2 Cu – 3

Al – 0.2 Zn – 5

Mn – 0.05 Cd – 0.005

Soil pollution →

Causes → pesticide.

Chemical used to kill / stop growth of unwanted organism.

Insecticide –

DDT, BHC, Aldrin – stays in soil for long period of time, and contaminate root crops. potato, carrot, raddish.

Herbicide –

$NaClO_3$, Na_3AsO_3 – earlier used

Triazines – These days.

Fungicide — organo mercury compound
↓
leaves mercury in soil
↓
Heavy metal = toxic

Strategy for Controlling environmental pollution →

① Waste water management from household ↓
Swachh Bharat Mission → Urban
→ Gramin
↳ aim - free from open defacation
↳ clean, hygiene.

not imp

② Recycling.

③ Sewage treatment

Incineration
↓
Combustion of organic matter
↓
energy produce
↓
deficits generation

Digestion
↓
anaerobic bacteria

Dumping
↓
dump sewage in land
↓
fertilizer

Green Chemistry →

① dry cleaning of cloths
$Cl_2C=CCl_2$ ↓ Carcinogen
H_2O_2 / $liq\,O_2$ → used.

② paper bleaching.
Cl gas ↓ pehle
H_2O_2 → used.

not imp

③ ethanol preparation —

$$H_2C=CH_2 \xrightarrow[Pd/Cu/H_2O]{\text{Catalyst}} CH_3CHO$$