Ecology and Environment → (5 Marks)

Ecology :- Study of relationship between living organism (plants and animals) and their environment.

→ Derived from Greek word: oikos
→ Father of ecology: Reiter
→ Termed by: Earnest Haeckel

Warming classified plants into hydro, meso and xerophytes. [Plant ecology]

* Branches of Ecology

① Autoecology: species / population with environment (population ecology) / species ecology. (1st priority)

② Synecology: Community with environment (community ecology).

③ Genecology: genetic makeup with environment.

④ Paleoecology: (fossils) Past organism with environment.

⑤ Applied ecology: Agricultural ecology.

⑥ System ecology: use of maths in ecological data enterpretation.

* Ecological Hierarchy

- Individual (organism): for continuity of generat
- Population: combination of same species.
- Community: combination of different species in
- Ecosystem:
- Biome: largest ecosystem, large landescope (majority of Biome → aquatic)
- Biosphere: Total area occupied by living beings includes atmosphere, lithosphere and hydrosphere.

Biota: Living beings (Flora and Fauna) of particular area/region.

♥ Ecology ☺
Father → Reiter
Term → Earnest Haecked
Warming → classified plants into hydro, xero & meso.

Ecosystem →
Father → E.P odum
Term → A.G. Tansley

Q. Northern treeless biome is:-

(a) Tagia (Northern coniferous forest)
(b) Tundra (minimum biodiversity) (layering)
(c) Savanah (grassland with scattered trees)
(d) Tropical rain forest

max. stratification, max. productivity among terrestrial, maxm anual rainfall, max competition for light → Maximum tree, max. biodiversity

Q. Biosphere refers to:-

(a) Area occupied by plants only
(b) Area occupied by animals only
(c) Both (a) & (b)
(d) Area occupied by microorganisms

* Carrying capacity: Maximum no. of individual of species that can be feeded by ecosystem for healthy life.

* Biotic potentials: Natural capacity to reproduce in optimum condition.
  ↳ Real potential is less than biotic potential.

* Keystone species: Most influential species of ecosystem. e.g. Bengal Tiger

* Endemic species: species restricted to particular area.

• Ecotypes

→ Genetically distinct geographical variety, race within species adapted to specific environmental condition.
→ capable of interbreeding
→ e.g. Beach ecotypes:- prostate habitat with pubescent leaves
Mountain ecotype:- Erect shrubs with hairless leaves

• Ecads / Ecophene

→ Genetically similar.
→ Morphologically differences are induced by environment

	Ecotype	Ecophene
Definition	Ecotype is a best-adapted phenotype of an organisms when it lives in a new environment for a longertime.	Ecophene is the first phenotype of an organism or immediate morphological response of an organism when it arrives in a new environment.
Adaptation	Permanent	Temporary
changes in genes	yes	No
Reversibility of adaptation or changes	No	yes

• Ecotone: Transition zone between 2 different ecosystem.

• Eusturine :- place where river (freshwater) meets ocean (marine)

• Speciation :- process of formation of new species.

* Allopatric / geographical :- Due to physical or geographical barrier.
  • commonly seen in birds and mammals.

* Sympatric / reproductive :- Sexual or reproductive isolated.
  • No physical or geographically barrier.
  • Commonly seen in plants, fishes.

Study of Fresh water (Limnology)
- lotic → Floating
- lentic → stagnant

Habitat and Ecological Niche

• E.P. odum → defined, adress of species is habitat and profession of species is Niche of species.

• Habitat :- physical and functional area of ecosystem occupied by specific organism.
(part) → place where the organism finds Food, shelter and mates.

• Microhabitat :- Part of habitat which has specific property of its own due to change in one or few environmental factors.
e.g. canopy tree

different habitat, Similar Niche → ecological equivalent

* Ecological Niche: term coined by Grinell (Habitat + function / ~~Niche~~)

→ Role of an organism in its environment (physical space & functional role)
→ Total interaction of species in the community : range of condition it can tolerate, resource it utilize and Function.
→ No two species can occupy exact same ecological niche.

• Ecological equivalent: different habitat but similar niche.

Q. Competition is severe (max) in :-
(a) Niches (b) Habitat (c) biome (d) Food range

Ecosystem: → dynamic interaction between biotic & abiotic factors.
[Homeostasis: self limiting & self regulating]
→ Term given by A.G. Tansley.
→ E.P Odum defined as: ecosystem is structural (biotic & abiotic) and functional (Food chain, Food web, pyramid, productivity, etc) unit or study of nat
→ father of ecosystem: E.P. odum
→ structural components: boitic and abiotic factors

- Functional components: food chain, food web, pyramid, productivity, interactions.

Q. Ecosystem is mainly concerned with:-
(a) flow of energy (b) recycling materials
(c) both a & b (d) stratification

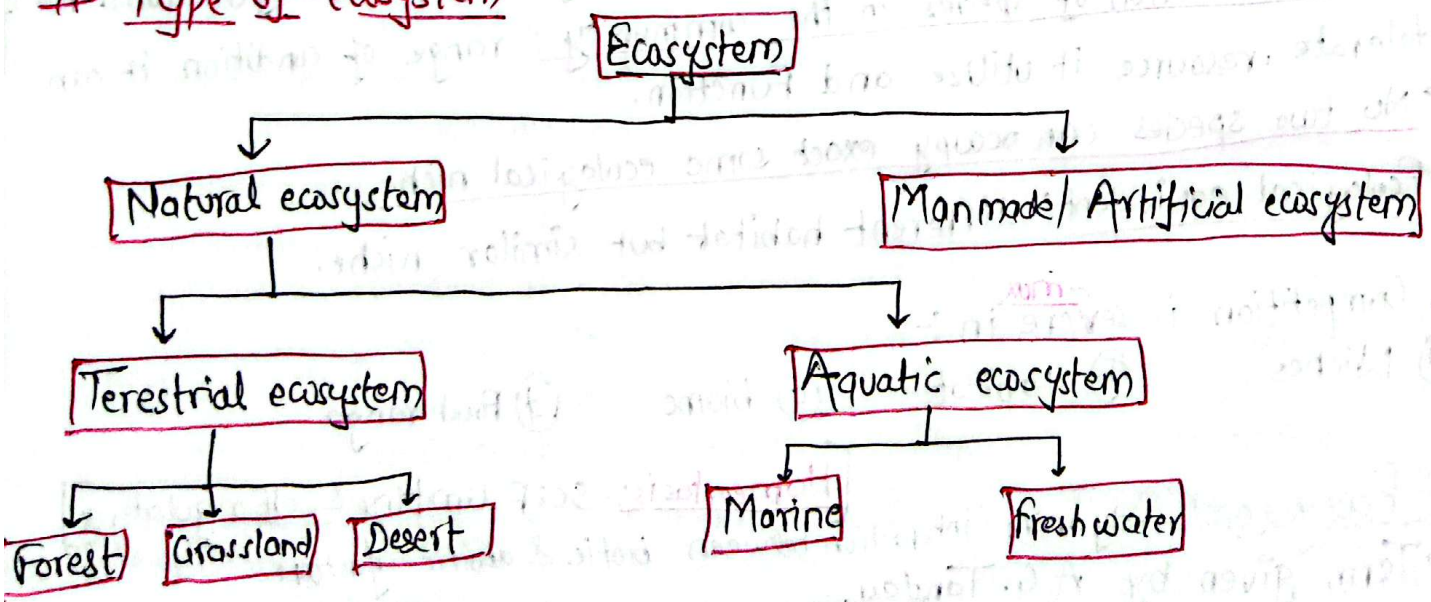
Q. Most stable ecosystem is:-
(a) mountain (b) desert (c) Ocean ↳2nd priority
(d) forest (e) Tropical rain forest (5 moxes → biodiversity, anual rainfall, stability, productivity, stratification). ↳(among terrestrial)

Q. Flow of energy in our ecosystem is:- ↳phloem conduction
(a) Unidirectional ↳xylem conduction (b) bidirectional ↳DNA replication (c) both a & b (d) Multidirectional ↳Biogeochemical cycle

Q. Which of the following is examples of micro ecosystem?
(a) Water droplet ↳nano ecosystem (b) pond ecosystem (c) forest ↳macro (d) Ocean, TRF ↳ mega.

Note:

Type of ecosystem



Climatic Factors

* Temperature → (0-40°c) / thermal factors
  ← optimum tempr

- Megatherms:- Vegetation grow in high temperature throughout the year.
  e.g. Tropical rain forest.
- Mesotherms:- Vegetation grow in alternate high and low tempr.
  e.g. Sub tropical forest.
- Microtherms:- grow in lower tempr throughout the year.
  e.g. Temperate Forest
- Hekistotherms: Very low tempr throughout the year (alpine region).
- Stenotherms: species tolerate narrow range of temperature.
- Eurytherms: species tolerate wide range of temperature.
- Stenohaline: Species tolerate narrow range of salinity.
- Euryhaline: Species tolerate wide range of salinity.

Temperature stratification of lake

- epilimnion → uppermost layer
- Metalimnion → Transition zone
- hypolimnion → lowermost layer

Sunlight / solar energy

→ Ultimate source of energy.
→ Driving force of our ecosystem.
→ Major source of energy: carbohydrate
→ Immediate source of energy: ATP. → also known as currency of cell.
→ Photoactive stomata: open at day
→ Scotoactive stomata: open at night.
→ PAR (Photosynthetically active radiation) → 400-700 nm

PAR (photosynthetically active radiation) → 400-700nm

* Vegetation types according to light

- Heliophytes: Plants which grow well in bright sunlight.
- Sciophytes: Plants which grow well in shady conditions.

Zoology Botany Physics
class of animals cell biology

Light stratification in lake
→ Littoral zone → uppermost
→ Limnetic zone →
→ Profundal zone → 2nd last
→ Benthic zone → lowermost

* Rainfall → major source of precipitation

* Mainly determines the nature of plant community
- Rainfall throughout the year = Tropical rain forests (>250cm usually)
- Rainfall 6-7 month per year = deciduous forest
- Rainfall in winter only → scrubs forest
- Rainfall < 10cm annually = desert

Q. Moderate rainfall in summer leads to formation of :-
(a) deciduous forest (2nd priority) (b) Deserts
(c) grassland (d) Scrubs forests

Humidity ∝ 1/transpiration
measured by Hygrometer

* Edaphic factors (related to soil)
- Pedogenesis / edaphogenesis : formation of soils.
- Pedology / edaphology: study of soils.
- Weathering :- process of breaking down bigger rocks into sand particles. (1st step of soil formation / pedogenesis.)
- Mulching: moisture conservation of soils.
- Leaching: Washing of minerals and nutrients from soil.

Soil Horizons
(1) Organic materials → Litter (O_1) & duff (O_2) O - horizons
(2) Top soil → Rich in humous. → elluvial soil A "
(3) Sub soil → Rich in minerals → illuvial soil. B "
(4) Weathered or decomposed rock → C horizons
(5) Solid rock R "

- Hydroponics : Soil less cultivation
- Phytotron : cultivation in controlled environment.

Botany
cell biology
cell division

Physics
... dimension

Chemistry
→ chemical bonding

Q. Which soil is best for plant growth? neutral or slightly acidic

(a) Clay soil ↳ smallest size (b) Silt soil (c) sandy soil (d) loam soil

- Clay soil: least porous soil, smallest particle size.
- Sandy soil: porous soil, minimum water holding capacity. (85% sand + 15% clay or silt)
- Increasing size of particle: clay soil < silt soil < fine sand < coarse sand < Gravel → min porous, min water holding
- Physically dry soil:- actual scarcity of water. eg. sandy soil
- Physiologically dry soil:- water is abundant but not reached to plant.
  eg Water logging soil, saline soil.

loamy soil → 50% sand + 50% clay/silt

* Types of soil water - main source - rainfall

Holard = chesard + echard
(total water) (available) (unavaible)

high Holard → hydrophytes
high chesard → mesophytes
high echard → Xerophytes

Q. Which water is utilized by plants?

(a) Hygroscopic water (b) Gravitational water
(c) Combined water (d) Capillary water

- Field capacity:- Holard - gravitational water
- Water Holding capacity: field capacity - hygroscopic water

Q. Soil transported by air or wind is:-

(a) alluvial → water (b) colluvial → gravity
(c) glacial - glacier (d) eolian

Plant community based on habitats

- Psammophytes: plant growing on sandy soil.
- Psychrophytes: plants growing on cold soil.
- Cryophytes: plants growing very cold soil.
- Oxylophytes: plants growing on acidic soil.
- Halophytes: plants growing on saline soil.
- Helophytes:- Plants growing on marshy areas.
- Xerophytes: Plants growing on dry habitat.
- Lithophytes: plants growing on rocks.
- Chasmophytes: plants growing on cervices of rocks.
- Psilophytes: Plants growing in savanah grasslands.
- Eremophytes: Plants growing in deserts.

Biotic factors

- producer / transducer / autotrophs :-
  - → First link of food chain → producer
  - → connects biotic to abiotic factors. 5
  - → Food chain starts with → photosynthesis
    - ↳ respiration is just opposite

Q. Insectivorous plants / carnivorous plants (like Nepenthes (pitcherplant)) are:-

(a) Autotrophs (b) Heterotrophs (c) Both a & b (d) decomposer

Digestive gland ↳ proteolytic enzyme present.

- Consumers / heterotrophs (Macroconsumer)
  - Primary / first order consumer / herbivores → depends upon producer.
    e.g. plant parasite like cuscuta, zooplankton, rabbit, deer.
  - Secondary / second order consumer / 1st order carnivores - depends upon 1° consumer.
    e.g. animal parasite, wolf
  - Tertiary consumer / top order consumer / second order carnivores
    - → All the predators are carnivores but all carnivores are not predators.
    - e.g. → Hawk, Lion, etc.
- Decomposer / reducer / saprotrophs (Fungi, Bacteria) / osmotrophs / mineralizer / scavenger
  - → Helps in recycling of materials.
  - → Bacteria and Fungi are main decomposer.
  - → restore environmental equilibrium.

Q. Vulture is best defined as:-

(a) tertiary consumer (b) scavenger

(c) Predators (d) All of above

Food chain :- transfer of energy from one level to another by process of eating and being eaten. / unidirectional.

→ Grazing / predatory food chain:

- → Starts from smaller organism ends with larger organism.
- → most stable, common and independent food chain.

→ Parasitic food chain

→ Starts from host i.e, larger organism to smaller organism.

→ Dependent food chain.

→ Parasitic over parasites are known as hyperparasites.

→ Detritus food chain | Saprophytic food chain

→ starts from dead and decay.

- Dead org. matter → Bacteria & fungi (Decomposer) → earthworm (Detritivores) → Sparrow (Predators)

Food web: complex and ~~Food~~ interlinked Food chain.

→ Food web is more stable than food chain.

→ multidirectional.

Trophic level | Energy level: [decomposer को Trophic level मा पर्दैन]

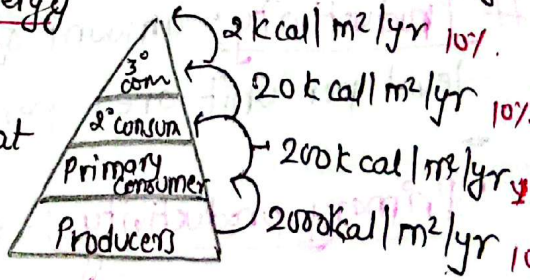
→ Each and every feeding level.

→ Lindlemann gave the law of 10% transfer of energy. Only 10% of energy is transfer in succesive trophic level. / 90% energy lost.

→ Plants utilize (1-2)% of solar energy

Q. If carbon enter two times already in Food chain. What coill be next trophic level?

→ 2° consumer



Ecological pyramids | Eltonian Pyramids

→ Graphical representation of relationship between different trophic levels.

→ Environmental relationship can be best depicted by ecological pyramid.

→ Concept of ecological pyramid was given by → Charles Elton

① Pyramid of no: represents no of individual organism in each tropic lev

- Erect or upright: grassland and ~~tan~~ pond ecosystem
- Spindle shaped: forest ecosystem
- Inverted: Tree and parasitic food chain.

② Pyramid of biomass / fixed energy / dry weight

→ It shows the amount of energy stored in an ecosystem.

- Erect or upright : Terrestrial system
- Inverted : Pond ecosystem

Q. Which pyramid shows the amount of living matter in an ecosystem?

(a) Pyramid of no (b) Pyramid of biomass ✓
(c) Pyramid of energy (d) All

③ Pyramid of energy

→ represents the amount of transfer of energy at different trophic level.

→ Pyramid of energy is always erect. except tundra, desert.

→ Represents the ecological efficiency, stability of ecosystem.

→ follows the second law of heat and thermodynamics.

Productivity: amount of energy / biomass produced by particular trophic level per unit area per unit time.

- Primary productivity :- energy stored at the level of producer.
- Gross primary productivity (G.P.P) : Total photosynthesis.
- Net primary productivity (N.P.P) : G.P.P - respiration loss
- Secondary productivity :- rate of storage at the level of consumer.
- Tertiary productivity (T.P):- energy not utilized by heterotrophs.

T.P = N.P.P - consumption by heterotrophs.

Q. Which of the following has least primary productivity?

(a) Cave ✓ (b) Island (c) Pond (d) Grassland

Q. Productivity is maximum in:-

(a) Tropical rain forest (2nd position) (b) Coral reefs ✓ more among terrestrial
(c) Sugarcane field ← can use upto 10-12% solar energy (d) Tundra ← most productive agriculture fields

Note:

- Most productive ecosystem: Coral reef
- Most productive terrestrial ecosystem: tropical rain forest
- Most productive agronomic plant: Sugarcane field
- Least productive ecosystem: Tundra, desert
- Most productive ecosystem in Nepal: Tropical forests.

Interaction among biotic community:-

① Positive interaction:

→ Symbiosis / mutualism (+, +):- both species get benefited & it is obligatory. e.g. Lichen ~~and~~ (algae & fungi)
Mycorrhiza (Fungus & roots of higher plants)
Rhizobium (with root nodules of legumes

→ Commensalism (+, 0):- One species is benefited and another is neither harmed nor benefited.
e.g. Sucking fish with shark, epiphytism

→ Protocooperation :- both species (+, +) get benefited but it is not obligatory.
e.g. Predatory birds with cattle, rhinoceros.
· Hermit crab and sea anemone

(2) ⇒ Negative interactions / Antibiosis / ammensalism / allelopathy (-, 0)
→ One species inhibit the growth of another species with production of toxins which are known as allochemicals or allomons.
→ Juglans regia produce juglone which is toxic to apples.
→ Penicillum notatum produce penicillin that inhibit growth of staphylococcus bacteria.

→ Competition (-, -):- Rivalary relationship in which involved individuals are adversely affected.
→ Intraspecies competition is severe than interspecies competition.

→ Paracitism (-,+):-

→ One get benefited (parasite) and another get harmed (host). Host is usually not killed.

→ May be ectoparasites and endoparasites.

→ Predation (+,-):-

→ strong (predator) attacking weak (prey) one.

→ It is natural controlling factor of ecosystem.

• Cannabilism:- It is intraspecific relationship in which stronger feeds its own individual.

Ecological succession

→ Gradual replacement of one community by another community.

→ Unidirectional change.

• Pioneer community:- First community
• Seral community: विचरा
• Climax community:- last and stable community.

• Complete stage of succession is:- Sere

* Types of succession

① Primary succession: The succession which occurs in originally barren site or area such as a pond or on rocks or on sand dunes, volcanic island, etc.

② Sec. succession:- If succession occurs in an area which was previously well colonized but the vegetation has been completely destroyed either by any natural calamity (such as land sliding, flood or forest fire) or by mans interferences.

• Autogenic succession:- occuring naturally
• Allogenic succession:- by human interferences.

- Hydrosere :- succession in aquatic habitat.
- Lithosere :- Succession in rocks.
- Xerosere :- succession in dry habitat.
- Halosere :- Succession in saline habitat.
- Psammosere :- Succession in sandy habitat.

Q. Which grows 1st in forest burnt with fire?

(a) Crustose Lichen (b) Mosses
(c) Liverworts (d) Fern

- Poineer community in Lithosere: Crustose lichen
- Poineer community in hydrosere: Phytoplanktons
- Climax community is characterized by having tree.

* Stages of succession

(1) Nudation :- formation of barren land. First step
(2) Invasion :- establishment of species in new area, includes:-
   (a) Migration
   (b) ecesis: successful establishment of species.
   (c) Aggregation: ~~mutat~~ mutual association among same species for short time.

- Competition :-
- Reaction:

- Climax stable stage monoclimax theory (given by Clements):- climax community is due to climatic factors.
- Poly climax (accepted) theory (given by Tansley): climax community is due to factors like edaphic, topographic, biotic, etc

Plant adaptation

(1) Hydrophytes

→ free Floating hydrophytes. e.g. Eichornia, Pistia., lemna, azolla, wolfia (smallest rootless angiosperm)

- Sub merged hydrophytes: e.g. Hydrilla, vallisneria, ceratophyllum, etc
- Rooted Floating hydrophytes:- e.g. Nelumbo, Nymphea.
- Amphibian or Helophytes/ emergents:- e.g. Tussaea typha

* Adaptive features

- Root system:- poorly developed. / Root hairs are also absent.
- root cap is absent instead roots pockets are present.
- spongy petiole is present helps in Floating.
- Aerenchyma tissue i.e. well developed
- Heterophylly: presence of different types of leaves.

* Gaseous exchange in Hydrophytes

- In free Floating hydrophytes: by epistomata
- In sub merged hydrophytes: stomata are absent so by General body surface or epidermis: — body surface is coated with wax. — gas exchange.

Q. Finely dissected leaves are adaptive features of:-

(a) Xerophytes (b) Halophytes
(c) Mesophytes (d) Hydrophytes.

(2) Xerophytes:

- Drought escaper / evadors / ephimerals (short lived):- they escape the drought by reducing their life span.

e.g. Argemone Mexicana

- Succulents | Malacophilus Xerophytes, drought avoiders :- CAM plants.
  - → Water storing in leaves: Aloe Vera, Bryophyllum.
  - → Water storing in stem: Opuntia
  - → Water storing in roots: Asparagus.

- Non succulents | drought enduring | true Xerophytes:-
  e.g. ~~Tanni~~ Acacia catechu (Khair), Nerium, Calotropis, etc.
  → A tannin is extracted from acacia catechu known as Kutch or Kattha (use in pan).

* Adaptational Features
  - → Root system well developed. High root to shoot ratio.
  - → Vascular strands are well developed.
  - → Thick cuticle (to reduce the transpiration loss)
  - → Sunken stomata.
  - → Leaves modified to spines or needles. Stem modified to phylocladode, Cladode, etc.

Bio-geochemical cycle | Nutrient cycles | Mineral cycle (Multidirectionals)
→ uptake, retention and release from various trophic plants.
→ Hydrological cycle: Water cycle driven by sunlight.
→ Gaseous cycle: Nitrogen cycle, carbon cycle.
→ Sedimentary cycle:- calcium, phosphorus cycle, affected by weathering.

* Nitrogen cycle:- plants utilize nitrogen in the form of nitrite and nitrates.

(a) Nitrogen fixation
- Abiological or physical fixation: during lightening and thundering # nitrogen combine with oxygen to form oxide.
- Biological fixation: 70% Fixation by micro organisms. e.g. Azotobacter → free living
- Symbiotic bacteria: e.g. Rhizobium in root nodules.
- Free living nitrogen fixer: like azotobacter, clostridium, cyanobacteria, like nostoc anabena, etc.

Nitrogen cycle

① Nitrifaction (ammonia to nitrite to nitrates)

- Nitrasomonas group: NH_3 ⟶ Nitrite (NO_2)
- Nitrobacter group: Nitrite ⟶ Nitrate (NO_3)

② Nitrogen Assimilation

→ Utilization of nitrogenous compounds like nitrates, nitrite and ammonia by living organism.

③ Ammonifaction (Dead ⟶ NH_3)

→ The conversion of dead and decaying organism into ammonia.
→ It involves two steps: proteolysis and deamination.
→ Proteolysis :- proteins breakdown into aminoacids, bacteria like proteus helps.
→ Deamination :- removal of amino group from amino acids. Bacteria like bacillus ramosus helps.

④ Denitrification :-

→ conversion of nitrates, nitrites and ammonia into atmospheric nitrogen pseudomonas, micrococus denitrificans helps in denitrification.
→ This step reduces fertility of soil.

- Sedimentation or fossilization :- fossilization of nitrogenous compounds into soil particle.

Environmental Pollution:

Q. Which of the following is normally not considered as pollutant?

(a) Carbon monoxide
(b) Carbon dioxide
(c) Lead
(d) Sulphur dioxide.

Water pollution → Minamata disease
air → TEL → respiratory problem
→ most dangerous air pollutant.

ysics chemistry
t & dimension → chemical bonding

Q. Which of the following is considered as secondary pollutant?

(a) Smog (fog + smoke)
(b) PAN
(c) both a & b
(d) SO_2

PAN: peroxy acetyl nitrate:- photochemical smog → also known as Los angeles smog.

Green House effect:

- Main cause: Carbondioxide
- Main environment issue: climate change/ global warming
- Earth is threatened by CO_2
- Layers of CO_2 allow enter of short wavelength and high energy radiation. and doesnot allow to go back reflected low energy and long wavelength, ultimately tempr increases.

Ozone layer depletion

→ Protective layers present in stratosphere, prevents entry of ultravoilent rays into earth.
→ Main cause of ozone layer depletion is: Chlorofloro carbon (CFCs)
→ Ozone hole: massive thinning of ozone layer.

Acid rain

→ Main cause: SO_2 and NO_2
→ Old monuments like Krishna mandir, taj Mahal is degraded by: acid rain (or air pollutant or SO_2 and NO_2)
→ Stone leprasy is due to acid rain.

Biomagnification :- increasing concentration / effect of non biodegradable pollutant (like DDT) in successive trophic level.

BOD (Biological oxygen demand) and DO (Dissolved oxygen):-

→ Amount of oxygen required to breakdown the organic matter by microbial action.
→ BOD and DO are inversely related.
→ BOD is the indicator of degree of water pollution. High BOD means high pollution.

Indicator of fecal water pollution : Escheria coli (E. coli)

→ Indicator of water pollution → Daphnia, cyclops, etc.

Q. Insecticide & pesticide mainly causes!-
(a) Noise pollution (b) Soil pollution (2nd priority)
(c) Water pollution (d) Air pollution

Eutrophication

→ Excessive growth of microorganism / microvegetation due to high accumulation of nutrients.
→ Mainly due to: phosphate and nitrate.
→ Massive killing of fishes is due to: eutrophication.
→ Eutrophic lake: high BOD, less oxygen, shallow lake rich in nutrients.

Q. Minamata disease is due to poisoning of!-
(a) Merury (b) lead (c) Cadmium (d) SO_2

Q. Main cause of ~~deforestation~~ desertification in Nepal?
(a) Deforestation (b) overgrazing (c) Tourism (d) Urbanization

Q. Indicator of air pollution is!-
(a) Lichens (specially SO_2 pollution) (b) Moss (indicator of soil pollution)
(c) Ferns (d) None

Q. The main cause of wildlife extinction is!-
(a) Forest fire (b) Poaching (c) deforestation (d) destruction of habitat
↳ illegal hunting

• Gas leaked in Bhopal gas tragedy is!- Methyl isocyanate (MIC)

Q. Green mufflers are used to reduce!-
(a) air pollution (b) Soil pollution
(c) Water pollution (d) Noise pollution

Note!- Green Mufflers are trees on roadside highway.

Abishek singh