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Write a comprehensive

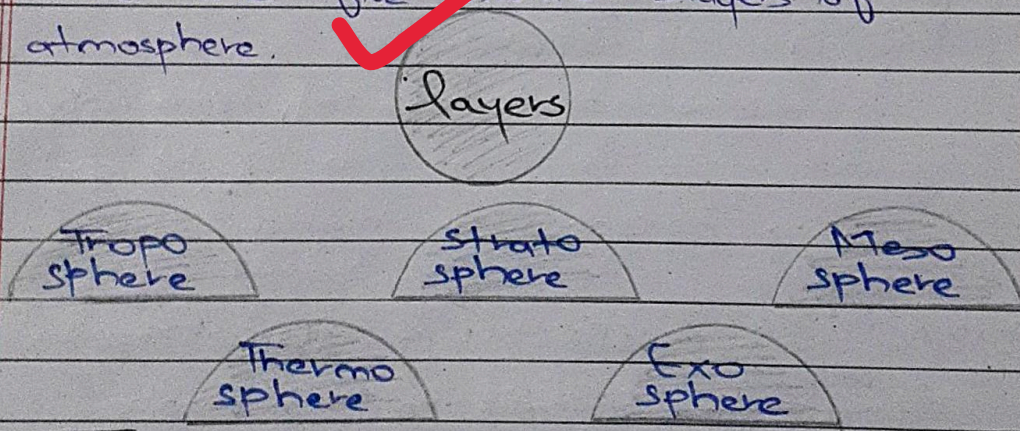
Q.1 What are the different layers of atmosphere? On what basis these layers are classified? In which layer 'Auroras' are formed and where do satellites orbit?

## Definition of Atmosphere

Atmosphere is a mixture of gases that surrounds the planet earth which exist naturally. The gases are suspended in atmosphere under the action of gravity.

## Layers of Atmosphere

There are five distinct layers of atmosphere.



### a Troposphere

It starts at earth's surface and goes up about 12 km. We live in this layer, and this is where weather happens. The most commercial aircraft fly here. The temperature and air pressure both decrease as you go higher in troposphere. The temperature decreases upto  $-53^{\circ}\text{C}$ .



## b Stratosphere

It starts at about 12 km and goes to about 50 km. This layer contains ozone layer. Temperature increases as you higher into the stratosphere, it increases to  $-0.3^{\circ}\text{C}$ .

## c Mesosphere

This is the middle layer. It starts at about 50 km and goes up to about 80 km high. It is the coldest layer and most meteors burn up here. The temperature decreases as you go up/higher, it decreases up to  $-93^{\circ}\text{C}$ .

## d Thermosphere

This is the hottest layer of atmosphere. The temperature increases with height and rises up to  $2000^{\circ}\text{C}$  or higher.

## Formation of Auroras

Auroras are formed in thermosphere of atmosphere. The formation of auroras is because of the ionosphere's charged particles. Auroras form in region known as auroral zone, typically ~~above~~ between 100 and 400 km above the Earth's surface.

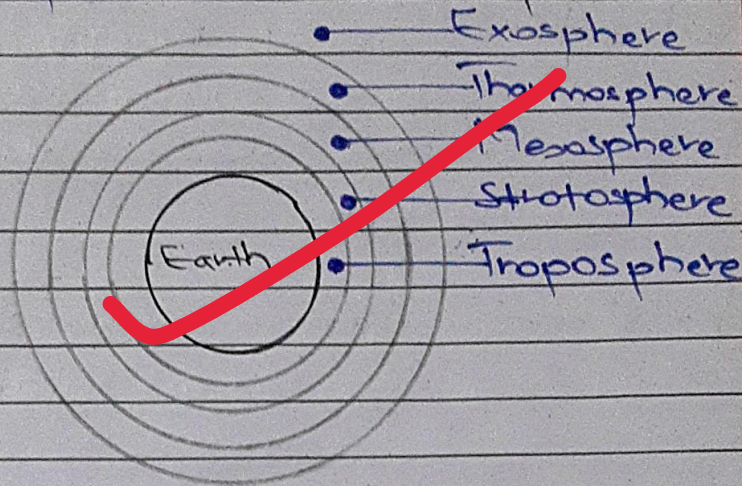
## e Exosphere

This is the outermost part of atmosphere. Temperatures are very high, but can change depending on location. This layer blends into outer space.



## Where do Satellites Orbit

Satellites orbit in the outermost part of atmosphere known as exosphere.



Question  $\frac{1}{b}$  What is 'water pollution', Discuss its causes and measurement methods. Name the countries with the highest and lowest percentage of it.

## Definition of Water Pollution

Any change in the physical, chemical and biological properties of water that will have a detrimental consequence on living things is water pollution. It is the contamination of water bodies, very often by human activities.

## Causes of Water Pollution

a Organic matter: Industrial waste water and domestic sewage depletes oxygen from the water column.



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## Causes of Water Pollution

Physical  
Pollutants

Physical change in water occurs due to harmful secretion of the products from industries and domestic waste.

Agricultural  
Pollutants

The products use in agriculture sector like fertilizers and pesticides release many harmful chemicals. These chemicals pollute the water consumed by human and aquatic life.

Hospital  
Pollutants

Waste released by hospitals like syringes, bottles, wrapper etc.

## Measurement of Water Pollution

Water pollution is particularly measured by:

1. Measuring 'physical' factors oxygen, pH-level, temperature, salinity and nutrients (nitrogen and phosphorus) can help indicate the quality of water.
2. Measuring toxicants such as insecticides, herbicides and metals also provide information on what is impacting the system.
3. Biological indicators - measure of macro-invertebrate or fish diversity, benthic algal growth, and benthic oxygen demand are direct measures for fauna and flora health in waterway.



## Countries with Highest and Lowest percentage of Water Pollution

Highest Water Pollution **INDIA**

Lowest Water Pollution **FINLAND**

Question What are the factors responsible for environmental pollution?

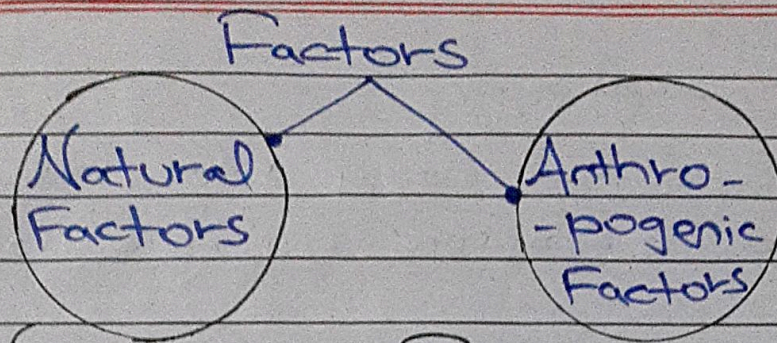
### Defining Environmental Pollution

The word pollution has its origin in the Latin word "Pollure" which means 'to contaminate'. So, environmental pollution can be defined as the contamination of any feature of the environment or any discharge of pollutants into water, land, or air that may cause acute or chronic detriment to the Earth's ecological balance.

### Factors Affecting Environment

The factors responsible for environmental pollution can be classified into two main categories:





## 1 Natural Factors

### a Eruption of Wild Fires

The frequency of wild fires has increased with time. These wild fires are adding large amounts of <sup>CO<sub>2</sub>, Ash, dust, haze, heat</sup> gases and other pollutants to the environment.

Example: Canadian wildfires (2023)

Brazilian wildfires (2022)

Turkish wildfires (2021)

Australian wildfires (2019)

### b Volcanic Eruption

It emits a series of toxic gases into the atmosphere including SO<sub>2</sub>, HCL, Ash, as well as heat and particulate matter. It also impacts the water quality. Moreover, it causes land pollution as it damages crops and destructs vegetation.

### c Bacterial and Microbial activity

Their decaying process can release a variety of gases into the atmosphere especially methane gas which at the end causes environmental pollution.



## d Radioactivity

The radioactive decay releases radon into the atmosphere causing environmental pollution.

## a Anthropogenic Factors

### a Combustion of Fossil Fuels

When non-renewable energy resources such as coal, oil, diesel, natural gas are burnt, they produce  $\text{CO}_2$ , CO and  $\text{SO}_2$ . These resultant <sup>released</sup> gases play a vital role in causing global warming.

As per IPCC: Non-renewable energy utilization by different segments:

Energy = 35% (domestic + industrial + institutional)

Agriculture = 25%

Industrial = 21%

Transport = 15%

Global Emissions

## b Population Explosion

There is exponential population growth worldwide which itself is a threat to environment.

1960 → 3 Billion

2000 → 6 Billion

As of Nov 25 2022 → 8 Billion

As of today

Prediction, the world population will cross

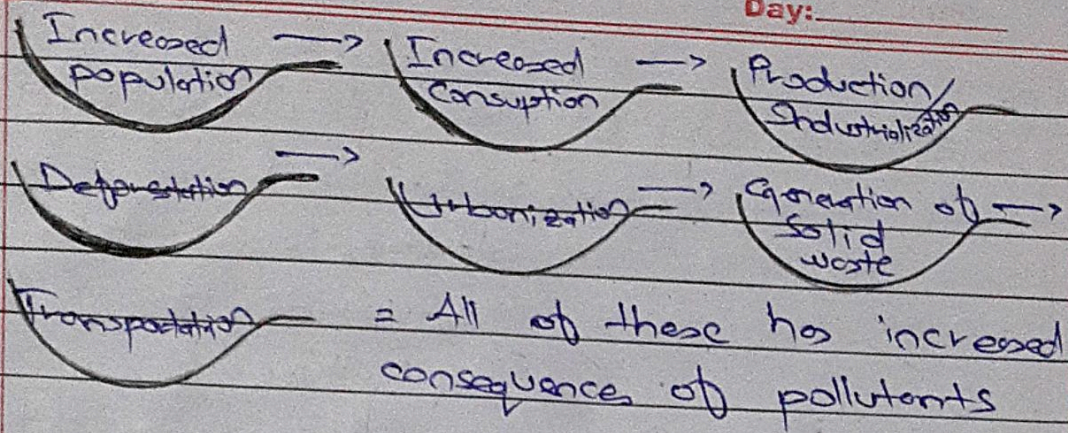
9 Billion in 8-10 years

Ref  
US  
Census  
Bureau



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## c Massive Deforestation

Forests are considered as carbon sinks because they absorb  $\text{CO}_2$ , the carbon sinks are decreased because of deforestation.

As per Global Forest Watch, more than 10 million Hectars have been deforested in the world over the past 4 years only.

As per NOAA,  $\text{CO}_2$  has reached 424PPM

## d Rapid Urbanization and Industrialization

The increased urbanization need more construction of roads, bridges, flyovers, housing expansion, under passes, and over all expansion of infrastructure. To meet the needs of growing population, more industries were developed. These industries generate hazardous wastes, such as

Textile industry emit =  $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{NO}_x$

Steel Industry =  $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{NO}_x$

Cement Industry =  $\text{CO}_2$ ,  $\text{CO}$ ,  $\text{SO}_2$

Fertilizers, pesticide, → Methane,  $\text{N}_2\text{O}$ ,  $\text{CO}_2$



## e Generation of Solid Waste

Solid waste sources: Municipal

Domestic

Industries

Agriculture

Organic <sup>solid</sup> waste from above resources contributes methane, Nitrous Oxide  $N_2O$ , and  $CO_2$  to environment causing pollution.

"More than 350 million tons of plastic are produced on annual basis globally. And Pakistan produces 15 million tons annually." (source: UNEP)

## d Use of Electric Appliances

The use of electric appliances such as Air conditioners and refrigerators produce chlorofluorocarbons (CFCs). They disrupt the whole process of natural greenhouse effect as they have a very high global warming potential. CFCs also cause depletion of ozone layer.

## g Weapons of Massive Destruction

The production of these weapons and their <sup>practical</sup> use in warfare emit  $CO$ ,  $CO_2$  and solid particles. These chemicals and gases are released into the atmosphere causing environmental pollution.



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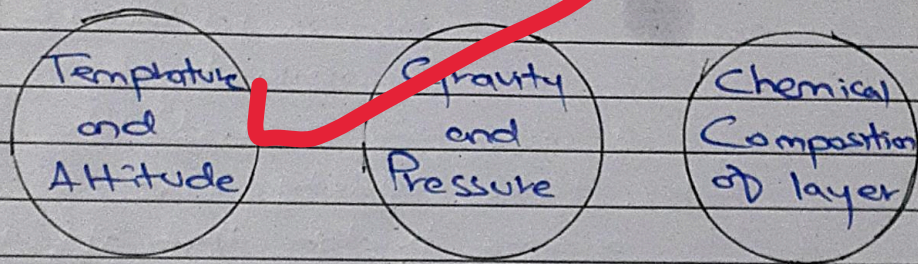
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Question <sup>On factors</sup> What is the sequence of strata of the atmosphere depends?

a

## Factors affecting the Composition of Atmosphere

The atmosphere is divided into troposphere, stratosphere, mesosphere, thermosphere and exosphere based on following 3 factors:



### a Temperature and Altitude of the layer

Troposphere: The temperature starts dropping as one goes higher. It drops by  $6.5^\circ\text{C}$ .

Stratosphere: Since the ozone layer comes under it, the ozone molecules absorb ultraviolet (UV) rays from the sun and convert them into heat; consequently, the temperature of the layer increases.

Mesosphere: The temperature again decreases with increasing height. This is the coldest part of atmosphere. It can reach about  $-93^\circ\text{C}$ .



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Thermosphere: The presence of UV rays and ions increases the temperature of the layer. Temperature in the upper part of the thermosphere ranges from  $500^{\circ}\text{C}$  to  $2000^{\circ}\text{C}$  or even higher.

### b) Gravity and Pressure in layer

Gravity pulls the molecules in the air towards the earth exerting pressure on molecules. The pressure causes molecules to behave in a specific way. When a parcel of air moves upwards, it expands, and when air expands, it gets colder. Hence, gravity and pressure is another factor that affects the sequence of strata.

### c) Chemical Composition of the layer

The chemical composition of the layer is another major factor, which in some ways is affected by the gravity, temperature, and pressure in the respective ways.

Add more arguments



Question

(a)

What is the role of oxygen-demanding wastes in water pollution? How it can be preventing?

## Defining Oxygen Demanding Wastes

Oxygen demanding wastes (ODW) also known as organic wastes are water wastes that are decomposed by oxygen-requiring bacteria. These organic wastes can be solids, liquids or gases coming from the sources like sewage, animal manure, and agricultural runoff, either directly or through leaching.

## The Role of Oxygen Demanding Wastes in Water Pollution

Organic wastes have a significant impact on water quality. When these materials decompose in water, they consume oxygen which can lead to the formation of hypoxic-low oxygen or anoxic-no-oxygen conditions. As a result, the biological oxygen demand to decompose the wastes increases, and the Dissolved Oxygen (DO) level of water reduces drastically. This can be harmful to aquatic organisms and can lead to the release of harmful compounds such as ammonia and hydrogen sulphide. In the long term, oxygen demanding wastes can contribute to eutrophication or over-enrichment of



water bodies with nutrients, which can lead to algal blooms and other water quality issues.

## Ways to Prevent Oxygen Demanding Wastes from Water Bodies

There are a number of ways to prevent

ODW from polluting water:

- Municipal and industrial waste water should be treated to remove ODW before it is discharged into waterways.

- Agricultural runoff can be managed by using conservation practices, such as cover crops and buffer strips. These practices can help to keep pollutants from washing into waterways.

- Businesses should use more sustainable practices, such as composting food wastes instead of sending it to landfills.

- Sewage treatment plants should use aeration to add oxygen to the water, which helps to break down ODW <sup>more</sup> quickly.

- Industries should use on-site wastewater treatment systems to reduce the amount of waste that is discharged into waterways.

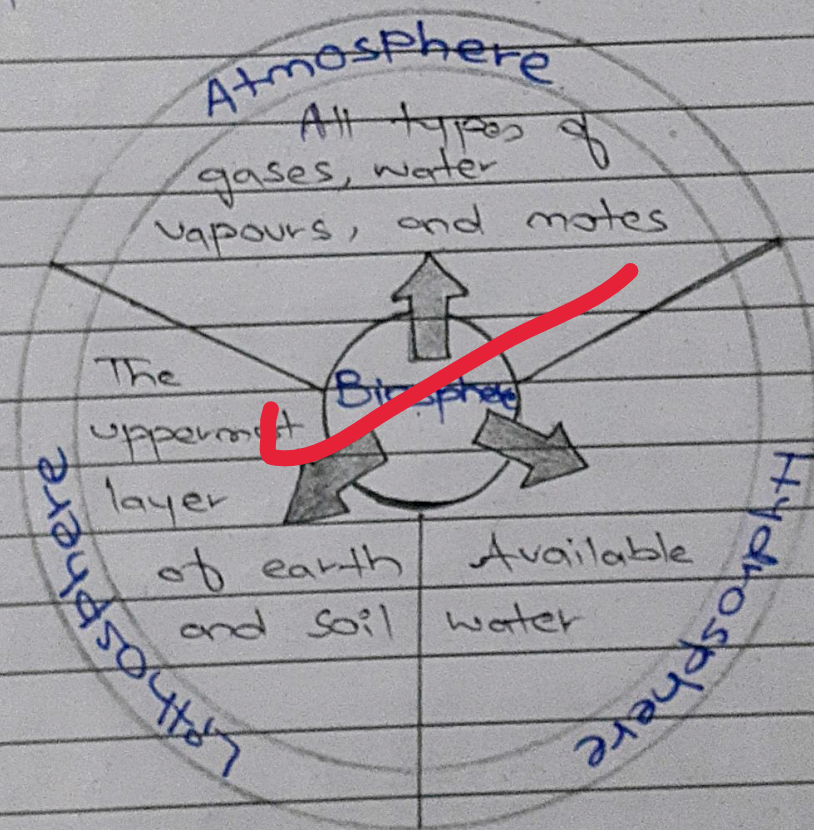
- Individuals must also reduce their own contribution to ODW by composting food wastes, using less fertilizer, and disposing of household hazardous waste properly.



Question What is biosphere? Write a note on the 'Energy Resources' available in the biosphere.

## Definition of Biosphere

Biosphere is the part of earth that supports life. It also involves the abiotic factors that provide living organisms with nutrients and energy, including sunlight, water, soil, and the environment. The biosphere is considered to be formed by the interaction of the atmosphere, lithosphere and hydrosphere.



## "Energy resources" available in the Biosphere

The energy resources available in the biosphere can be divided into two main types: Renewable resources and non-renewable energy resources.



## Energy Resources in Biosphere

### Renewable Energy Resources

- Wind power
- Sun/Solar energy
- Water/Hydro power
- Biomass
- Geo Thermal

### Non-Renewable Energy Resources

- Fossil fuels
- Hot Reservoirs
- Nuclear atoms

## Renewable Energy Resources

An energy that is collected from resources which are naturally replenished on a human timescale.

Renewable energy resources include:

### - Wind Power

Wind power generated by harnessing the kinetic energy of moving air to run turbines for the generation of electricity.

### - Solar Energy

Solar energy applies energy from the sun in the form of solar radiations for heat or to generate electricity. Sunlight

- is utilized through solar panels for electricity generation

### - Hydropower

Hydropower utilizes the energy of flowing water to generate electricity because water is about 800 times denser than air.



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It involves the use of dams or water turbines to convert the potential energy of water into mechanical and electrical energy.

## - Biomass and Biofuels

Biomass - the organic matter derived from plants, animals, and microorganism. serves as a renewable energy resource through processes such as combustion, fermentation or anaerobic digestion to produce heat, electricity or biofuels like biodiesel and bioethanol.

## - Geothermal Energy

Hot water and steam from deep underground can be used to drive turbines: this is called thermal energy

## Non-Renewable Energy Resources

The sources of energy which, on usage last forever and can't be recycled and replenished are called non-renewable energy resources. They include:

## - Fossil Fuels

Fossil fuels including coal, oil, and natural gas are formed from the remains of ancient plants and animals. They release energy when combusted, which is then used for electricity generation, transportation, and heating.



# Fossil Fuels

Coal

Almost all the different kinds of coal such as peat, lignite, bituminous and anthracite coal are used for burning of furnaces or electricity generation.

Petroleum

Petroleum or crude oil is a liquid fluid fuel that is used from generation of electricity to the manufacture of medicines, plastics, and other commercial items.

Natural Gas

Natural gas is almost always found in deposits of petroleum. Wells with only natural gas also exist. Compared to petroleum and coal, natural gas is relatively clean-burning.

## - Nuclear Energy

Nuclear energy is obtained through the process of nuclear fission, where the nucleus of an atom is split, releasing a significant amount of energy.

Question Differentiate between the renewable and non-renewable source of energy giving examples of each one of them.



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Characteristics	Renewable Energy Source	Non-Renewable Energy Sources
Definition	The resources that are continuously replenished and do not run out.	The resources that cannot be recycled or replenished and deplete over time.
Examples	Water, sunlight, wind, geothermal	Fossil fuels, coal, Natural gas, petroleum
Environment	They are friendly to environment	They are not env-friendly
Implications	as they are produced naturally, and do not emit any harmful gases or pollutants that can cause damage to environment	since some of them emit carbon monoxide and CO <sub>2</sub> , thus causing pollution and ozone depletion respectively.
Maintenance Cost	They require less maintenance cost as compared to NRS.	They require more maintenance cost as a lot of time is consumed and takes considerable effort.
Example	Turbines in hydro power stations or in wind farms do not require any external system for their functioning or rotating their parts	The process included in searching for coal mines like installation of complex machines, refining, drilling and transporting etc is very time consuming
Efficiency	RS and technology have low efficiency	NRS and technology have high efficiency.

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