S20210010027 Batch-1
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Q1 $H = 7.13$ km

a) $\rho = 1.02 \text{ kg/m}^3$, $\rho_0 = 1.25 \times$ ~~10~~ kg/m^3

$$Z = H \ln\left(\frac{\rho_0}{\rho}\right) = 7.13 \times \ln\left(\frac{1.25}{1.02}\right)$$

$$= 7.13 \times 0.203$$

$$= \text{~~14.49 km~~ } 1.45 \text{ km}$$

b) $P = 1.15$ hPa , $P_0 = 1000$ hPa

$$Z = H \ln\left(\frac{P_0}{P}\right) = 7.13 \times \ln\left(\frac{1000}{1.15}\right)$$

$$= \text{~~46.36k~~ } 7.13 \times 6.5$$

$$= 47.45 \text{ km}$$

Q2 Ar covered by Arctic ice = 3.01% of A_{Earth}

Ar of Land = 28.5% of A_{Earth}

$\Rightarrow$ Ar covered by Sea = 71.5% of A_{Earth}

$r_{Earth} = 6371$ km, mass of sheet/Ar $= 0.04 \times 10^3$ kg/m²

Mass of ice melted $\equiv$ Mass of water increment

$$\Rightarrow (0.04\times10^3) \times \left(\frac{3.01}{100} \times A_{Earth}\right) = \left(\frac{71.5}{100} \times A_{Earth} \times x\right) \times 1000$$

(x: water level rise; $\frac{71.5}{100} \times A_{Earth}$: Vol. of increment of water; 1000: density of water)

$$x = \frac{0.1204}{71.5} \text{ km} = 1.68 \times 10^{-3} \text{ km}$$

$$= 1.68 \times 10^{-1} \text{ cm}$$

$$= 0.168 \text{ cm}$$

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Q3 Key components of Earth System are:

1) Atmosphere
2) Oceans
3) Cryosphere
4) Biosphere
5) Lithosphere

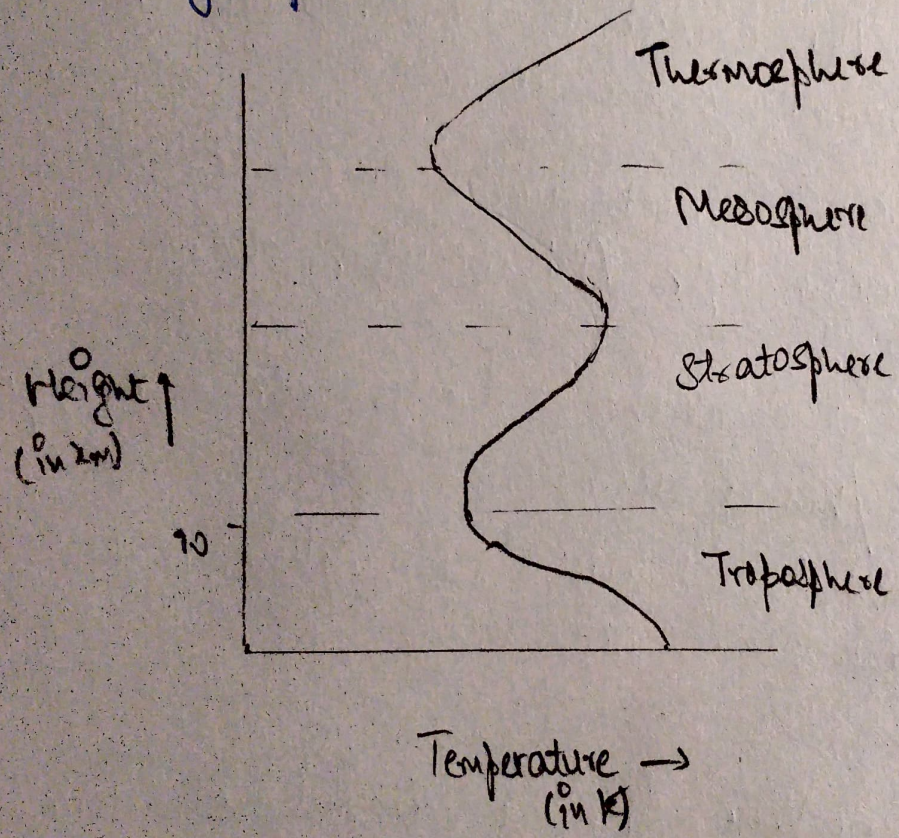
1) Atmosphere :- The blanket of air surrounding the Earth is categorised by these devisions:

a) Troposphere: Lowermost layer of atmosphere. It is also called mixing layer. All weather changes occur in this region.
It shows a decrement in temperature of nearly:
$-6.5^{\circ}C$ /km of ascension.
Around 80% of total mass of atmosphere makes it the ~~dense~~ most dense region.

b) ~~Meso~~ Stratosphere: Has a layered structure, there is little to no mixing here.
Ozone rich area, ozone formation takes place in this region. Due to UV absorption, this layer shows an increment in temperature with increment in height.

c) Mesosphere: Also called the middle layer.
Shows a decrement in temperature with increasing height.

d) Thermosphere: This layer has the least density of air, and the molecules undergo ionization on a large scale. This makes the temperature go up with increment in height.

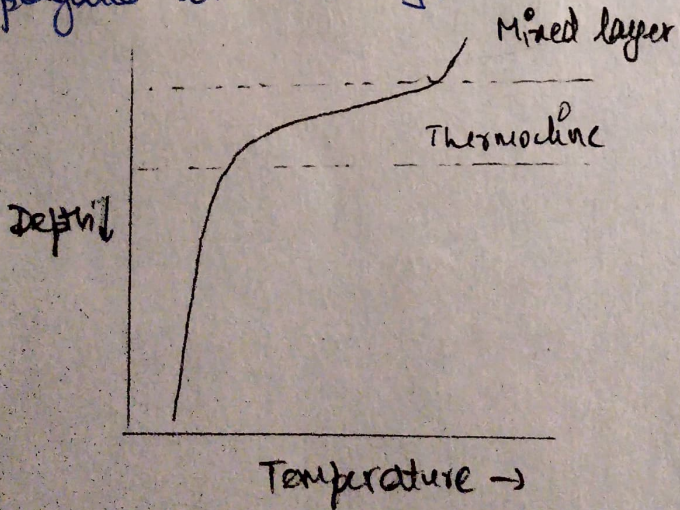


2) Oceans - Nearly 72% of Earth's surface is covered with water, with mass being around 250 times that of atmosphere. It can be categorised into:

a) Mixed layer: The topmost layer of the ocean is well mixed, propagates with air currents and extends only upto a few meters.
It is very slightly less dense, maybe less than a tenth of a percent than the lower layers.
Although the temperature decreases with depth, there is no significant change in this layer.

b) Pycnocline: Transitionary middle layer.

c) Thermocline: Lower layer showing a significant temperature gradient, it is not mixed and propagates with density.



→ Usually, ocean water has a density 2.4% greater than fresh water, with 34-36 g/kg salt in the water.

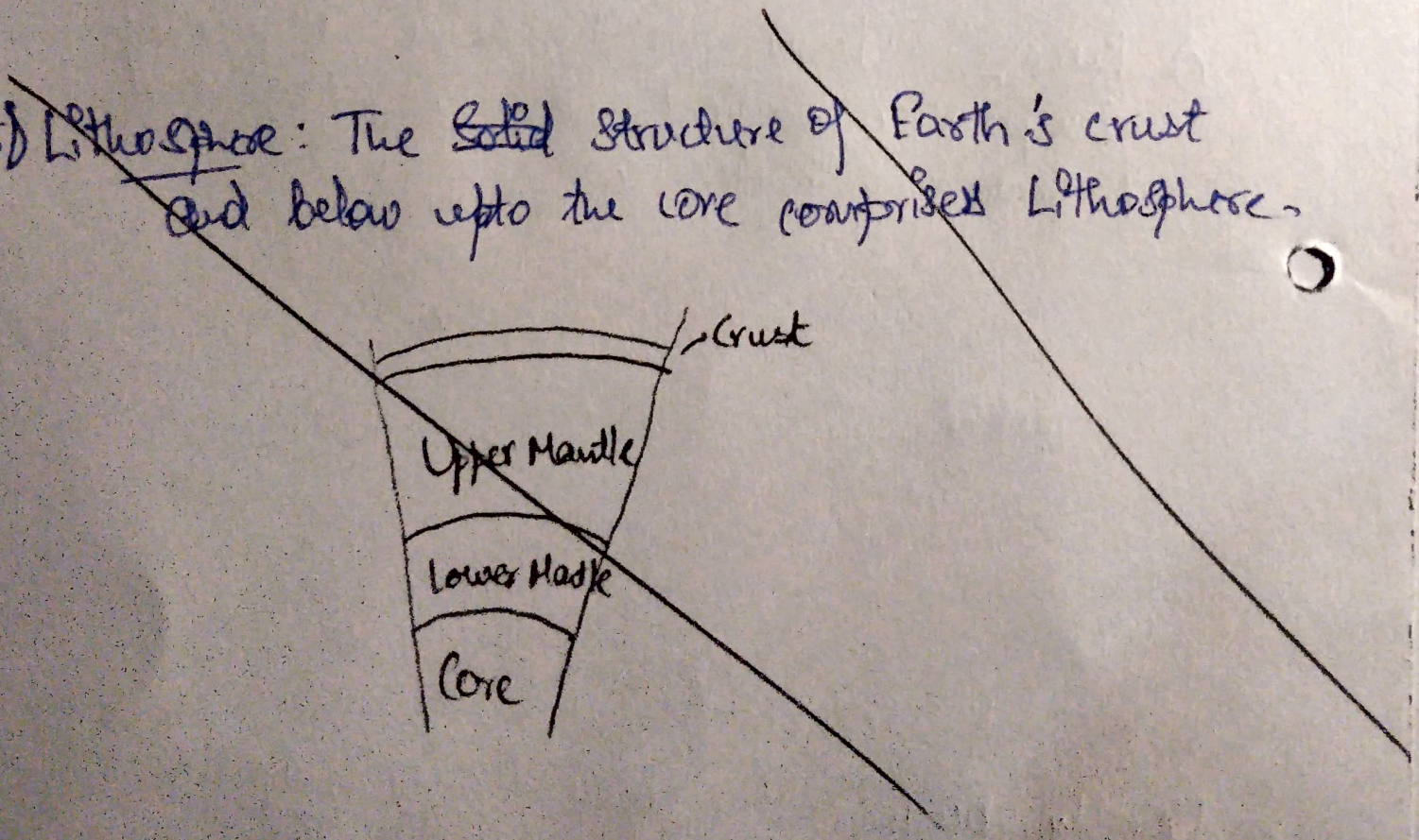
3) Cryosphere: Includes all the waters present in its solid state, from polar ice caps to glaciers.

Arctic ice sheet is the largest component of this system, covering nearly 3% of Earth's surface.

Permafrost is also a component of this system, which is ground frozen for at least two years.

4) Biosphere: System comprising all the living organisms (biota) and the abiotic components.

5) Lithosphere: The solid structure of Earth's crust and below upto the core comprises Lithosphere.



S20240010027 Batch-1 E

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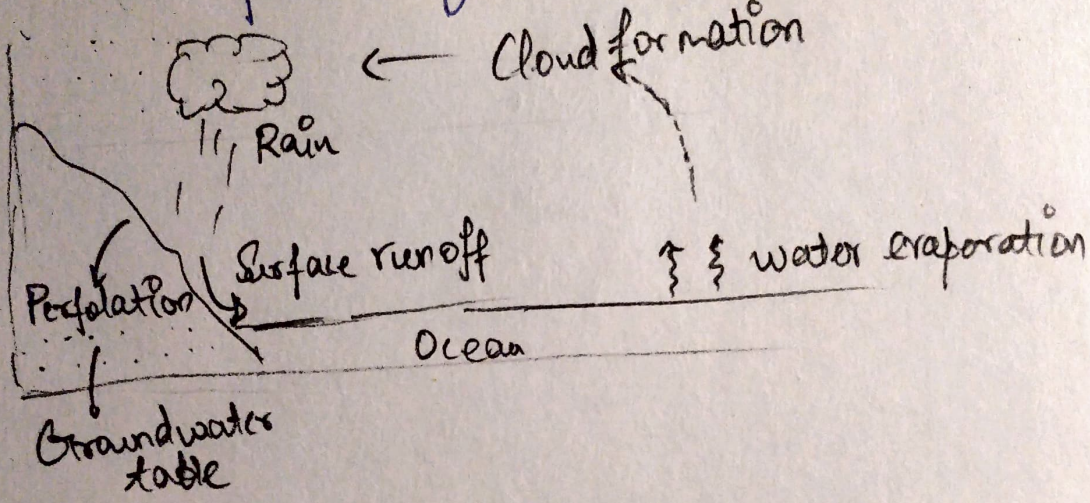
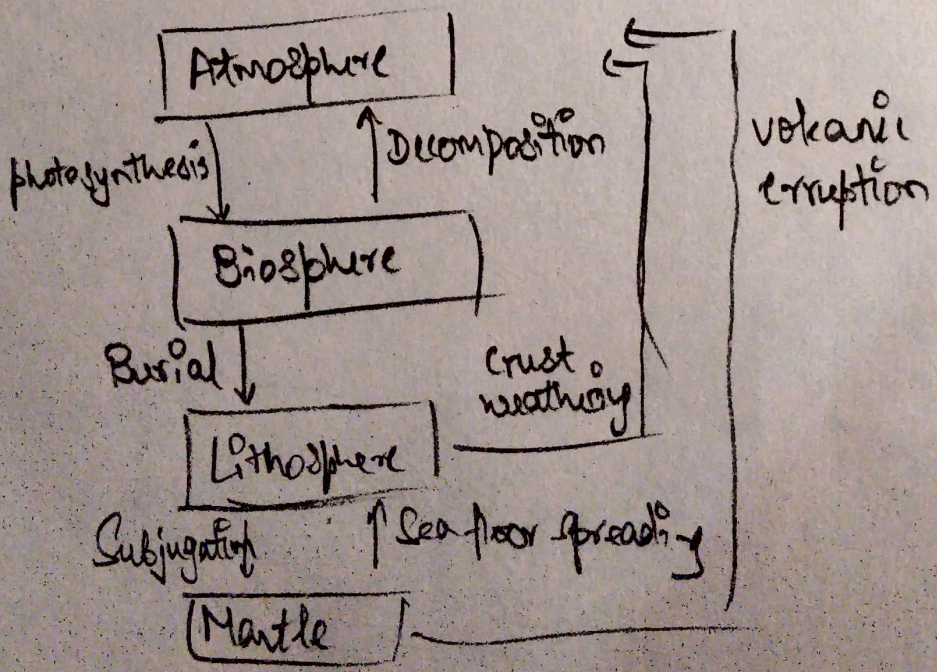
Water and carbon cycles come under the Biosphere.

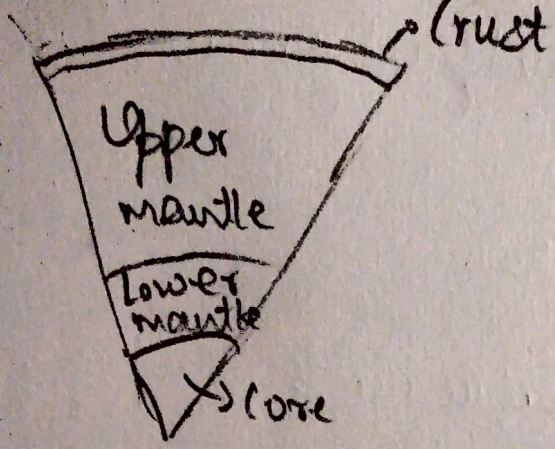
Hydrological (water) cycle: is a key regulatory component of the ecosystem, depicting the flow/cycle of water in its liquid and gaseous state.



Carbon cycle: Movement of carbon through the ecosystem



5) Lithosphere: Solid structure of Earth's crust and everything below it.



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Qu-) Climate variability is the deviation of a particular trend from its long term average (difference between maximum or minimum and long term mean).

Climate change is the trend described by long term average of weather parameters.

Some natural reasons for climate change are:

1) Volcanic Eruptions -

Erupting volcanoes spew out a large quantity of dust and ash in the atmosphere. Ash contains black carbon aerosol to some extent, which makes a shade, absorbs radiation. While the ash and dust may settle down in some weeks, other components might take a bit longer.

Apart from ash, large quantities of H_2O vapours, CO_2 and SO_2 are released.

SO_2 forms sulphate aerosols, which are excellent at reflecting incoming radiation.

These decrease the overall temperature of the system.

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2) Ice age - Over a large cycle-like period, Earth's temperature continues to decline, freezing solid the water. Such "ice age" conditions have happened 5-6 times in Earth's history, last one happening 12000 years ago.

3) Aerosol emissions :- Aerosol is the colloidal solution of solid (sometimes liquid) particles suspended in a gaseous medium.
This impacts climate over a region either directly through disruption of Earth-radiation budget or indirectly through changes in cloud formation.

Eg- a) Biomass burning : Releases large quantity of black carbon aerosol (soot) which creates a shade of impurity over a region.
It also increases the local albedo.

b) Biotic emissions : Pollens ~~fr~~ released by flowers ~~are a major aerosol~~ categorises as aerosol.
It has the perfect size for a good condensation nuclei for cloud formation, and it is generally observed that region with pollen emissions tend to get more rainfall.

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eg - c) Volcanic eruption releases a large quantity of SO_2, with little quantities of nitrogen oxides. Aerosols of sulphates and nitrates are perfect for reflection of incoming radiation, and is generally observed that the global temperature drops a bit after some volcanic eruption.