CCI Mid Exam

Group 1

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UG4

Q-1 $H = 6.9\,km$, Earth's Radius = 6371 Km

Density of air @ sea level = $1.25\,kg/m^3$

(a) Find height of atmosphere at air density $1\,kg/m^3$

Sol→ $Z = H \ln(\rho_0/\rho)$

ρ_0 = density of air @ sea level

ρ = density of air @ point of interest

do, $Z = 6.9 \ln(1.25/1)$

$= 6.9 \ln(1.25) = 1.539\,Km$

(b) # Find height at which pressure = 1.2 hPa

Sol ⇒ $Z = H \ln(P_0/P)$

P_0 = Pressure at sea level

P = Pressure at point of interest

So, $Z = 6.9 \ln(101325/120)$

$= 46.49\,Km$

Q-2 Area of Antartica ice sheet
= 2.7 % of area of surface of Earth

Land area = 30% of surface of Earth

Earth Radius = 6371 km

Mass of Antartica ice sheet = 53000 kg/m^2

Sol Mass of Antartica ice sheet = 2.7% Earth's area x (mass in/m^2)

$= 2.7 \times 4 \times 3.14 \times (6.3 \times 10^6)^2 \times 53000$

$= 2.7 \times 4 \times 3.14 \times (6.37)^2 \times 5.3 \times 10^{16}$

$= 7.29 \times 10^{19}$ kg

Let rise in sea level = x

Mass of Antartica ice sheet = Area of ocean x density of H_2O x (x)

$7.29 \times 10^{19} = (5.1 - 1.45) \times 10^{14} \times 997 \times (x)$

$\frac{7.29 \times 10^5}{997 \times 3.65} = X$

$X = 200.3$ meters

So, level in sea rise = 200.3 meters.

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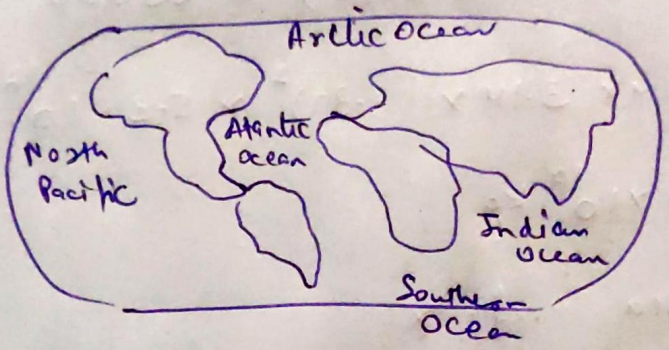
Sol: The various components of Earth system include-

① Oceans → Oceans are large water bodies covering around 70% of total area of Earth. It reaches to an extreme depth of 11 km. Their density of ocean H_2O changes over time.

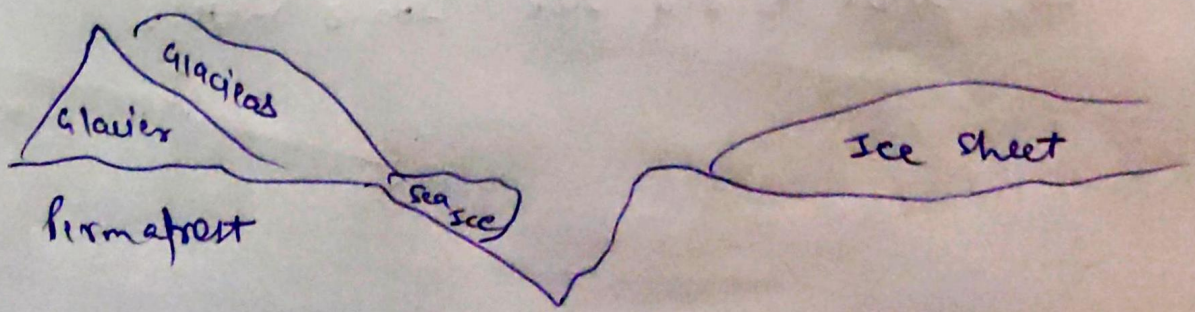


Thermocline is a layer with strong temperature gradient with depth.

② Cryosphere

→ It is Earth's component comprising of water in solid state

→ It has huge water to enormously increase Global sea levels



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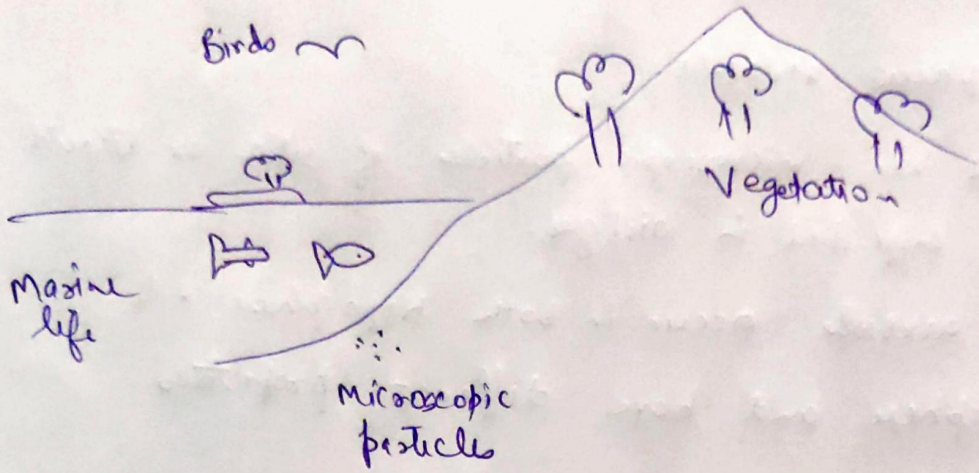
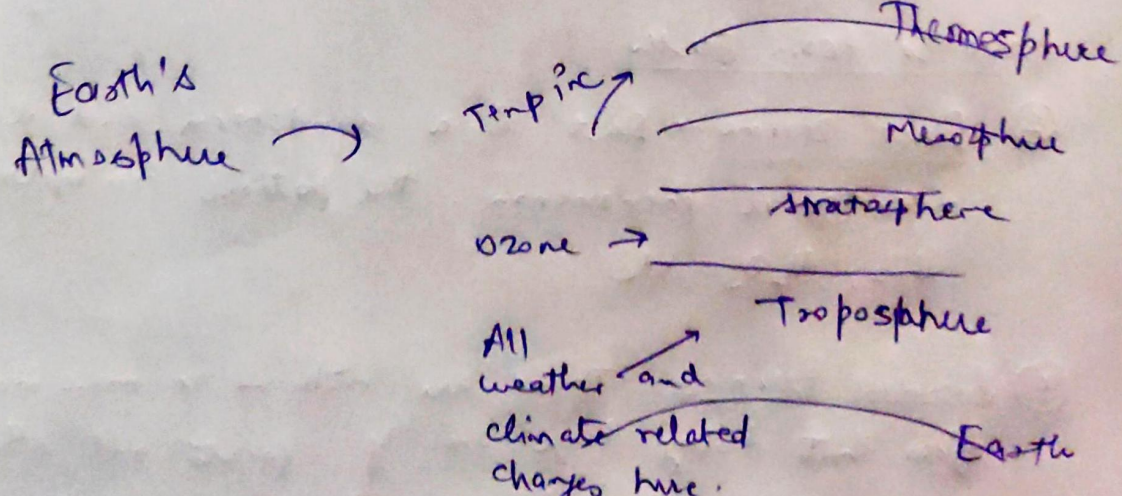
(3) **Biosphere** → It is a global ecosystem composed of living organism (biotic) and abiotic (non living) factors.



(4) **Atmosphere** – It is an envelope of air surrounding Earth. It receives solar radiations and ~~re-emit~~ re-emit them back.



(5) Geosphere → It is composed of rocks/ minerals. The area of geosphere is subject to erosion, volcanic activity and tectonic forces etc. Earth's crust/ core/ mantle are included here

Q-5 Atmospheric aerosols.

Ans aerosols are microscopic particles of solid or liquid matter suspended in air/ gas.

→ These aerosols occur in both troposphere and stratosphere and have different properties

Types of aerosols based on source →

Primary → They directly reaches to the atmosphere via (wind action, burning)

Secondary → These are forms present in atmosphere itself. Eg → GPC and DPC

Sources from Earth

(1) Dust storms → Dust is a sandstorm and it is a meteorological phenomenon. The particles here include SiO_2, Al_2O_3 etc

(2) Biomass Burning → These are natural or man-made fires that destroy large area of forests and other vested surfaces. They increase levels of CO_2 in air.

(3) Volcanic activity → They inject aersols directly into atmosphere.
Gases from volcanic eruption include SO_2 and CO_2.

(4) Ocean surface process - Aerosols particles are produced on ocean surface majorly ~~in fact~~ include NaCl and tiny amounts of Potassium and Magnesium ions.

Aerosol removal from atmosphere

(1) Dry Removal → When the updraft that lifts aerosols weakens, aerosols go down due to gravitational setting
→ They can also get attached to obstacles by their own motion and settle down
→ Small particles collide and stick together to form larger blocks. This is called particle coagulation

(2) Wet Removal → Cloud and precipitation processes are most efficient way to remove them.
This process is also called precipitation scavenging.

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Q3 Climate models

These are the models that capture and predict the behaviour of climate using behavioural and mathematical equations.
These models come handy when doing analysis on climate data

Spatial resolution → These models make use of grid cells to map the surface. Spatial resolutions refers to multiple sizes of these grid cells. More cells in finer area of resolution and cells are of small sizes.

Eg: FAR 500km Resolution and AR4 (~110km Resolution)

Temporal resolution → These refers to number of timesteps a particular grid is observed over certain duration. This includes adding history of how climate behaved over years and help in better understanding of dynamic semantics

Representative Const
Concentration Pathways (RCP) - It is
a greenhouse gas concentration (not
emission) adopted by IPCC
(International Panel of Climate Change)

They help in describing different climate features,
depending on the forecast of green-house gas
emissions in the years to come.

The RCP are labelled after a possible range of
radioactive forcing values.

In IPCC 6th Assessment Report

SSP 1-1.9 to control temperature b/w 1-1.8°C | 1.6°C
1-2.6 " 1.3 - 2.4°C | 1.7°C
2-4.5 2.1 - 3.5°C | 2.0°C
3-7 2.8 - 4.6°C | 4.4°C

↑
Estimated
global
warming