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GS Advanced Program 2023

Generic Booklet

Test Name/Code/No. :35....

Name

Email ID.

Roll No.

Mobile No.

Date

Allotted Time : 60 Minutes

Instructions to Candidates -

- There are 7 Questions in this Question paper.
- All Questions are Compulsory.
- For all updates, please visit the noticeboard -
<https://noticeboard.forumias.com/gsap-2023/>

Important -

- Answers must be attempted in the QCA Booklet only.
- To upload the Answer Copies please visit to "My Course" section on -
<https://academy.forumias.com/>
- Only those copies will be evaluated which will be submitted before the next class.

Q. No.	Grade/Score
1	
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Overall Grade/Score	

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Q.1)

Discuss the concept of air mass and explain its role in macro-climatic changes.

Air mass is a homogenous body of air in which upward gradients of temperature, humidity are uniform over an area of millions of km^2 with little horizontal variation of temperature & humidity.

$10,000 \text{ km}^2$ / No gradient
wrt height

Pic: Air mass

→ It acquires characteristics of an area
Features of source region

→ Stable atmospheric conditions

→ Divergence of air.

Ex: Maritime Tropical (mT)
Continental Arctic (cA)

Ex: Tropical air mass is warm,
Polar air mass is cold.

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Role of air mass in macroclimatic changes.

→ Summer Monsoon: Weather of South Asia is by maritime Tropical (mt) air mass which give rise to Summer Monsoon.

→ Drought of great Plains of USA is due to air mass from Mexico causing aridity.

→ Western disturbances bring rain to North India for beneficial to Rabi crops.

→ Temperate cyclones: Frontogenesis and later instability are due to meeting of contrasting (warm, cold) air masses and hence British type of climate for temperate cyclones.

Thus air masses help in understanding macroclimatic changes with rising climate change phenomenon

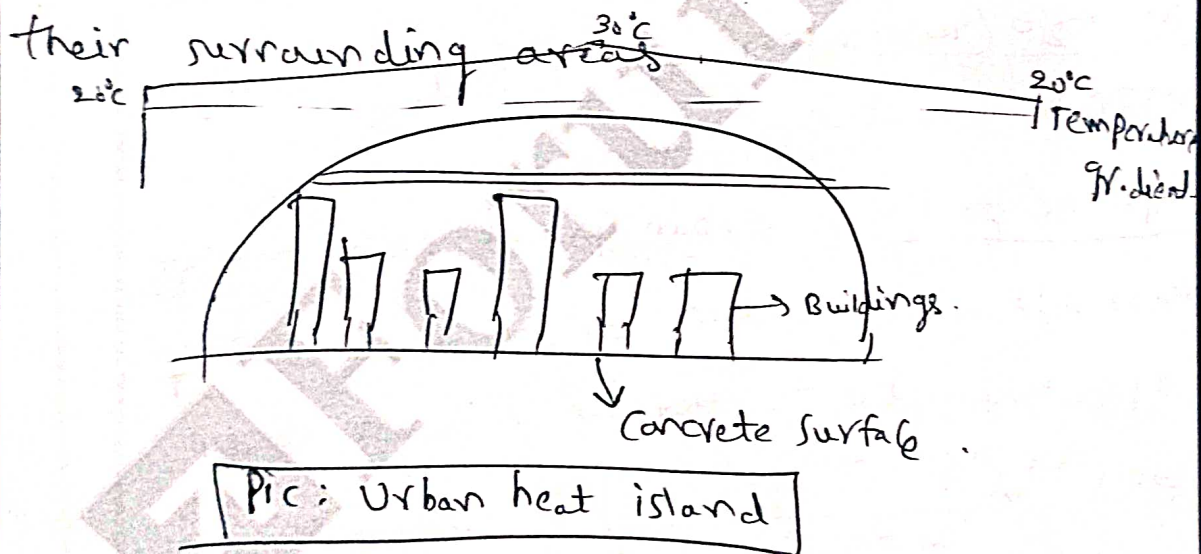
Overall Grading (✓)

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Q.2) Bring out the Causes for the formation of heat islands in the urban habitat of the world.

Heat islands in the urban habitats is a regional phenomenon in which urban habitat poses distinct weather & climatic features (abnormal heat) distinguishable from their surrounding areas.



Causes for the formation of heat islands in the urban habitats of the world :

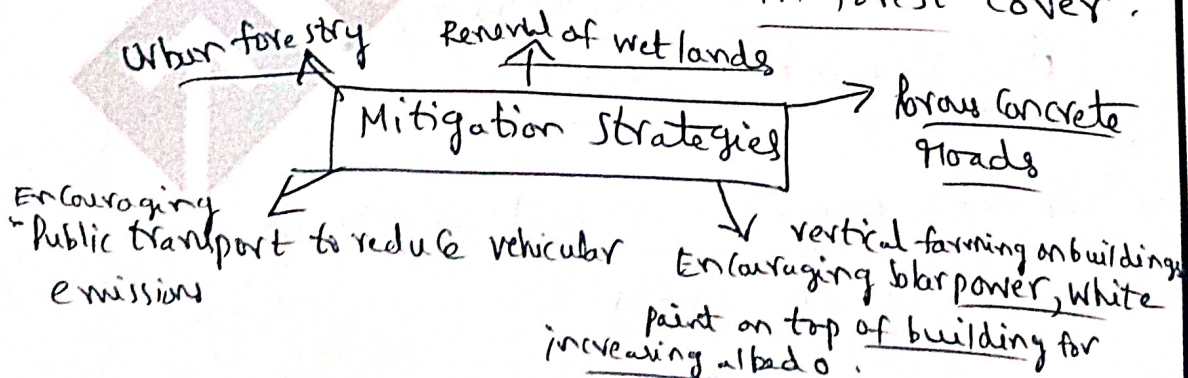
- ① Lithospheric factors: Black asphalt surfaces, Buildings construction - decreases albedo & absorb

more heat.

② Atmospheric factors : vehicular emissions, industries Thermal power plants release NO_x , CO_2 , SO_x emission create a layer less transparent to outgoing terrestrial long wave radiation.

③ Hydrospheric factors : Destruction of wetlands etc. decreases moderation of temperature rise. So, due to rise in temperature evaporation increases $\Rightarrow$ More H_2O (water vapour) $\Rightarrow$ Less transparent to outgoing terrestrial radiation.

④ Biospheric factors : Urban sprawl, destruction of green belts, deforestation $\Rightarrow$ Less moderation of Temperature due to decrease in forest cover.



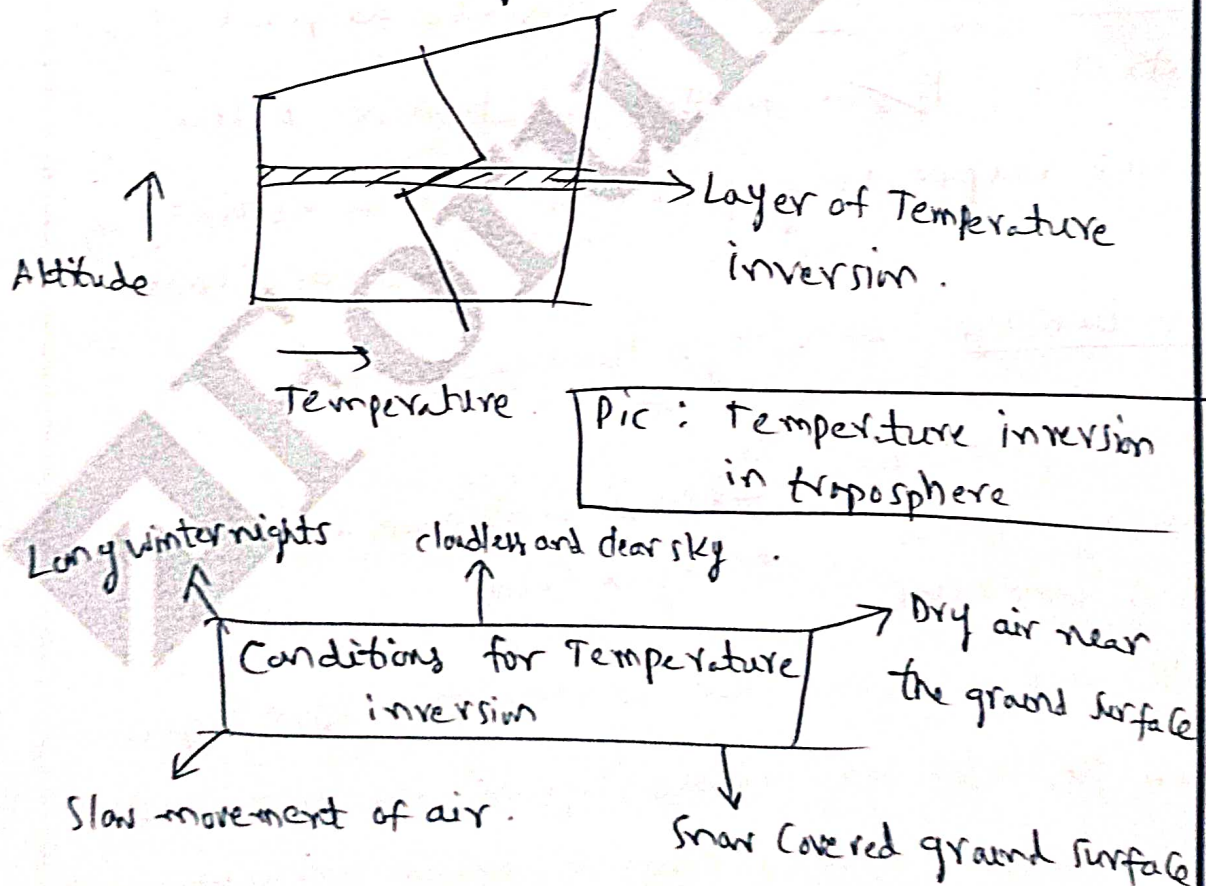
Overall Grading (✓) Urban heat island is recurring phenomenon in event of climate change. Norms as per UN Habitat is required

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Q.3) What do you understand by the phenomenon of temperature inversion in meteorology? How does it affect the weather and the habitants of the place?

Temperature inversion in meteorology is a phenomenon of reversal of air temperature with an increase in height i.e. increase in temperature as height increases.



Effect of Temperature Inversion: On weather and habitants:

→ Precipitation: Prevents convective clouds to rise high

So it restricts winter rainfall $\Rightarrow$ Decreases productivity of Rabi crops, also it causes atmospheric stability in western margins of continents $\Rightarrow$ Arid desert conditions $\Rightarrow$ Sahara desert.

$\rightarrow$ Fog formation: Surface inversion leads to dense fog in morning $\Rightarrow$ Fog forms protective layer from intense Solar radiation in Yemeni coffee plantation (increases productivity)
 $\Rightarrow$ Smog formation in urban areas below inversion layer

$\rightarrow$ Increase in air pollution: Prevents dispersal of air pollutants $\Rightarrow$ Winter pollution in Delhi.
 $\Rightarrow$ Causes respiratory problems, Reduces visibility, So, cause accidents.

$\rightarrow$ Frost Damage: At valley bottom locations.

$\Rightarrow$ Apple growers in Himalayan states avoid lower slopes.



air parcel travels down as it is dense, heavy & cold.

$\rightarrow$ tele communication: Due to refraction from layers above the cold air, radio signals are disturbed.

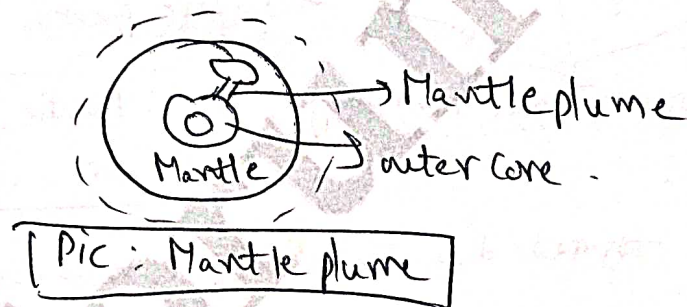
So, better understanding of inversion is required as it

Overall Grading (✓) effects agriculture, transport, communication, pollution

Poor			Average			Good		
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Q.4) Define Mantle plume and explain its role in plate tectonics.

Mantle plume is a point in the interior of the Earth (Core-Mantle boundary) from where Basaltic lava erupts through a plume. caused due to residual heat from earth's formation, radio active disintegration.
(Pipe like conduit)



Role of Mantle plume in plate tectonics :

It created isolated volcanoes / Hot spot volcanoes at places where, exceptionally hot areas are located at core-Mantle boundary by basaltic lava which comes to earth's surface through Mantle plume.

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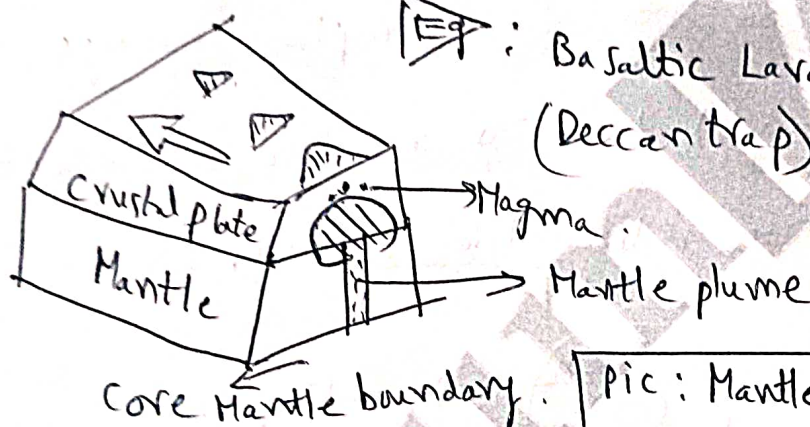
Various plates moves over these fixed Mantle plume locations.

⇒ If oceanic plate moves ⇒ Creation of

Eq: Hawaii islands Volcanic island

⇒ If Continental plate moves ⇒ Lava plateaus are created.

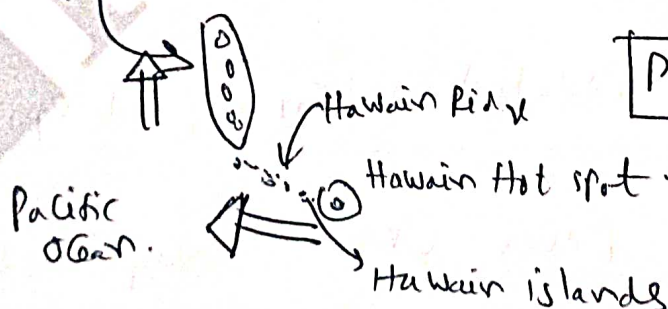
Eq: Basaltic Lava in India (Deccan trap)



Pic: Mantle plume action on crustal plate

→ Landforms formed due to hot spot volcanoes show the direction of movement of plates

Eq: Emperor Seamount chain



Pic: Directional change of plate
Initially: North
Now: North-West

Individual volcanism phenomenon is explained by Mantle (isolated)

Overall Grading (✓)

plumes which help in better management of

disasters and understanding interior of earth

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Q.5) Distinguish between weathering and erosion along with suitable illustrations. Also, discuss various types of weathering and significance of weathering.

Weathering and erosion are exogenic geomorphic processes, which modify the relief features by wearing them down.

Weathering

- In situ degradation (or) break down of rocks into smaller sediments.
- 1st stage in exogenic geomorphic process.
- Caused by climatic,

Erosion

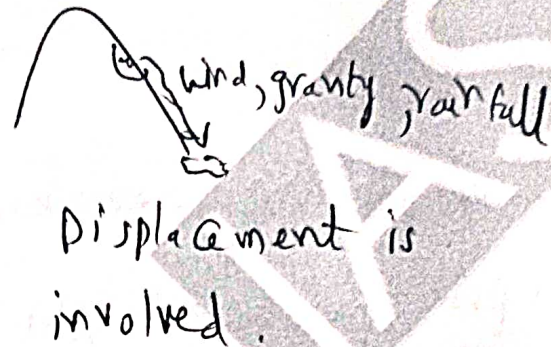
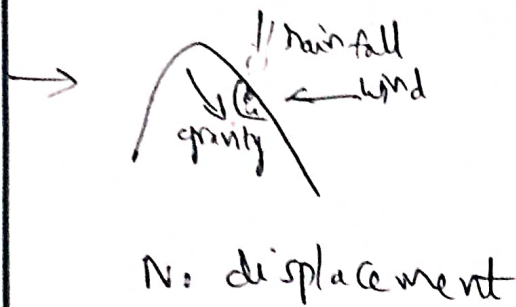
- short distance removal travel of eroded sediments
- 2nd stage in exogenic geomorphic process
- Caused by geomorphic

geological, topographical

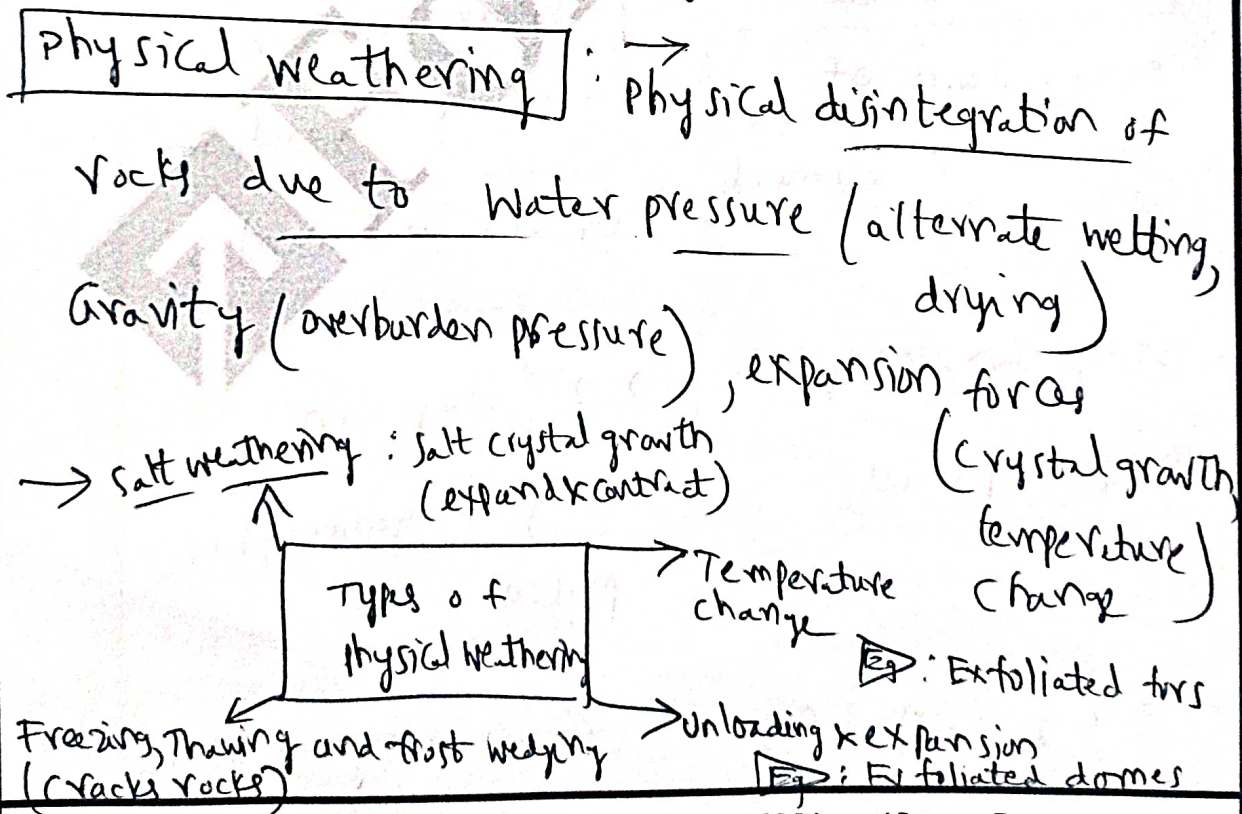
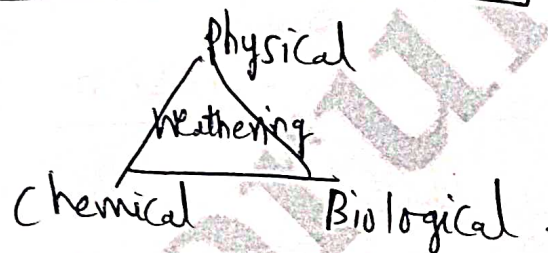
Vegetative factors.

agents like wind, ice,

running water, waves, currents etc.



Various types of weathering



chemical weathering

Types

Carbonation

Reaction of carbonate, bicarbonate with minerals

oxidation, Reduction

$Fe^{2+} \rightarrow Fe^{3+}$

Red $\rightarrow$ Yellow

Rock break down

Due to water, Air (O_2 , CO_2), Heat, by chemical reactions acids

Solution:

Complete dissolution of minerals in acid, solution of water

Hydration: Addition of

water to minerals

fatigue $\rightarrow$ repeated disintegration

Biological weathering

Human by Mining, cultivation

Due to ants, termites, burrowing animals, expose rocks to weather, vegetation breaks rocks

Significance of weathering

Helps in mass

Wasting, erosion

$\Rightarrow$ change in relief of land forms

Ecological succession

Formation of soils
Enrichment & concentration of ores like Iron, Copper, Aluminium (De silication)

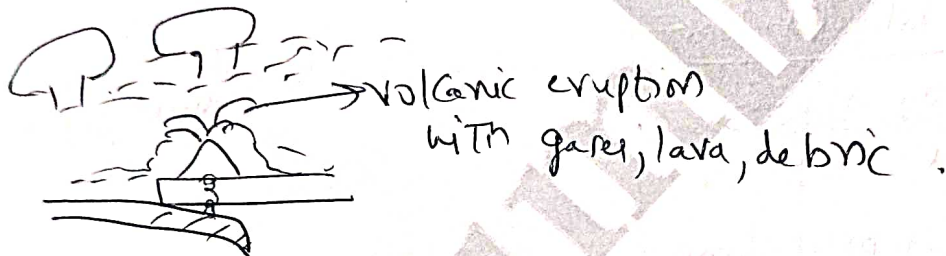
weathering is a ^{anthro} natural phenomenon in ecological succession and in rock cycle

Overall Grading (✓)

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Q.6) Mention the global occurrences of volcanic eruptions in recent times and their impact on the local environment.

Volcanic eruption is that lava and gases are released from an active volcano.



Pic : volcanic eruption

Global occurrences of volcanic eruptions in recent times :

→ Hunga Tonga - Hunga Ha'apai : (Hot spot volcanism)
This submarine volcano erupted in 2021

→ Taal volcano erupted in 2021 near Manila, Philippines.

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→ Volcanic area of Iceland eruption in 2021

→ Mt. Etna, Mt. Stromboli eruption in 2022 in Italy

→ La-hlma eruption in 2021

→ Mt. Nyiragongo of Democratic Republic of Congo erupted in 2021

Impact of eruption of volcanoes on the local environment :

Negative :

→ They stimulate earthquake in the region.

→ creates loss of property, human lives.

→ They are accompanied by volcanic

lightning

→ Recent Hunga-tunga eruption

→ They spread plumes of volcanic ash thus reducing visibility.

→ CO_2 , fluorine gases of volcanic ash can pollute environment → breathing difficulty for humans, animals, effect plants' photosynthesis

Positive : → The volcanic ash increases soil productivity in the region.

→ Volcanic ash, clouds reflect incoming solar radiation & has localized cooling effect.

→ Mt. Krakatau brought mini ice age.

They are natural phenomenon, so, efforts to be taken to minimise/mitigate their effects

Overall Grading (✓)

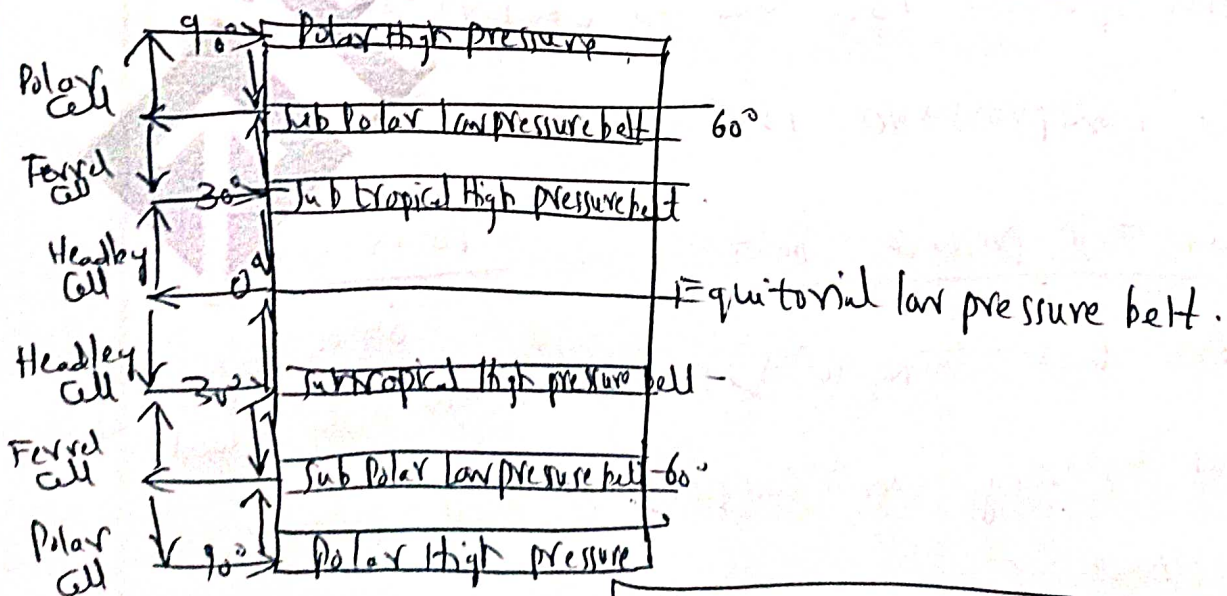
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Q.7) 181721_691047_1910077088 (2023-01-15 13:26:38)

Describe the tri-cellular model of global atmospheric circulation. Explain its significance in explaining the world's climatic patterns.

Air moves from high pressure to low pressure. So, on this basis there is tri-cellular model of global atmospheric distribution divided into 7 pressure belts across the globe.

Tri-cellular model of atmospheric circulation.



Pic: Tri-cellular model of air circulation

Equatorial Low pressure belt $5^{\circ}N$ to $5^{\circ}S$

Doldrums region

shifts according to apparent movement of sun.

Hadley cellSub tropical High Pressure Belt $10^{\circ}N$ - $30^{\circ}N$,
 $10^{\circ}S$ - $30^{\circ}S$ $25^{\circ}N$ to $35^{\circ}N$, $25^{\circ}S$ to $35^{\circ}S$ Thermally inducedsubsidence of air. $\Rightarrow$ High pressure.Anticyclonic condition; these latitude region.Sub Polar Low pressure BeltFerrel cell $60^{\circ}N$ - $65^{\circ}N$, $60^{\circ}S$ - $65^{\circ}S$, $35^{\circ}N$ - $60^{\circ}N$,
 $35^{\circ}S$ - $60^{\circ}S$ dynamic eddy induced

Air spreads here due to rotation of earth

so, Low pressure is caused.

Polar High Pressure BeltPolar cellAt Poles ($90^{\circ}N$, $90^{\circ}S$) $65^{\circ}N$ - $90^{\circ}N$,
 $65^{\circ}S$ - $90^{\circ}S$ Thermally induced

Due to very low temperature, High pressure is there.

Significance in world climatic patterns

→ In subtropical high pressure belt,

due to anticyclonic conditions, there is atmospheric stability & aridity, so, there are hot deserts in western part of

continents ($25^{\circ}\text{N}-35^{\circ}\text{N}$
 $25^{\circ}\text{S}-35^{\circ}\text{S}$) $\Rightarrow$ Kalahari,
Namib deserts

$\Rightarrow$ Maintaining heat budget of earth.

Due to shift of pressure belt cells according to apparent movement of sun, there are

Monsoon climate in South Asia,

Mediterranean climate (wet winters,
dry summers)

in ^{western} Europe

→ Hadley cell $\Rightarrow$ convective cell, heavy rainfall @ equator
changes in world climatic pattern due to

extreme events caused by climate change by

anthropogenic factors and its mitigation is required for

SDG-13 (Climate Action)

Overall Grading (✓)			Average			Good		
Poor			4	5	6	7	8	9
1	2	3	4	5	6	7	8	9