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GS Advanced Program 2023

Generic Booklet

Test Name/Code/No. : #35 B2

Name			
Email ID			
Roll No.			
Mobile No.		Date	16/01/23

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	
2	
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Overall Grade/Score	

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Start Writing Here

Q.1) Discuss the concept of air mass and explain its role in macro-climatic changes.

Air masses are large bodies of air having uniform temperature, humidity and pressure; which adapts to the surface below it.

(*) It is a distinctive and homogenous air mass having little horizontal variation.

Classification

1. Temperature → cold, warm
2. Region → Equatorial, tropical, polar.
3. Humidity → Continental (dry), Monsoon (moist).

Role in Macro climatic change.

1. air mass diverging in coastal areas are moist with more humidity → cause heavy precipitation

② air mass formed between warm and cool air masses may result in cyclonic storms; formation of fronts - ; (frontal collision)

③ latent heat transfers can cause heat imbalance.

④ change local temperature of large regions
eg: temperature inversion in valleys.

⑤ reason behind heat bursts in post rainfall situations.

⑥ by virtue of motion effect region
eg: bowling wind in mid west USA or gulf stream

⑦ hot air masses are generally the reason behind forest fires / wildfire or drought.

Thus, air mass and their development have an inevitable impact on climate.

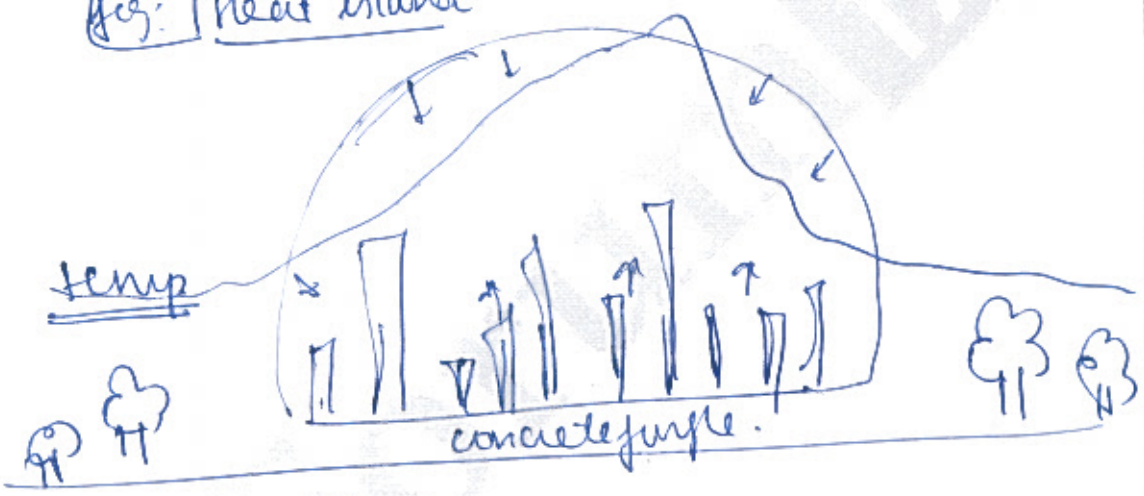
Overall Grading (√)

Poor			Average			Good		
1	2	3	4	5	6	7	8	9

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

Heat islands are urbanized areas which experience higher temperature than outlying areas.

Fig: Heat island.



Causes

(1) Urban sprawl - changing settlement pattern leading to destruction of green belts.

(2) encroachment on wetlands and river domains; eliminating the natural counter weights

(3) Industrial contribution

→ especially in tier 1 mehos.

→ eg: use of asphalt in building / road construction lowers albedo.

(4) Transport fallens - vehicular emissions, thermal power plants.

⇒ release of SO_x, NO_x, CO_2 in atmosphere.

These are less transparent to outgoing long wave terrestrial radiation

Yet several steps like enforcing green code for buildings, green / carbon tax for vehicles, and promoting sustainable transport practices can be explored.

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Poor			Average			Good		
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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 habitants of the place?

While under normal conditions, temperature decreases with height, during temperature inversion - there is a reversal and cool air at surface is overlaid by warmer air

eg: Hilly areas

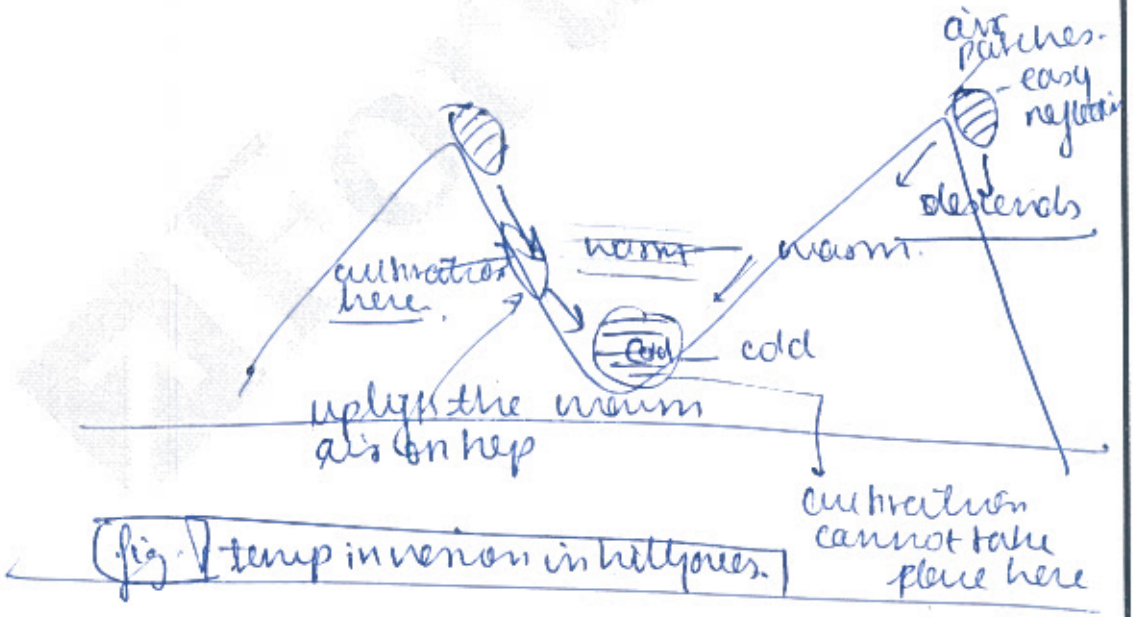


fig: temp inversion in hilltopes.

Various types of temperature inversions take place:

(1) valley - along sloping surface.

→ cold air condensed and heavy → downward movement

↓

settles down and upper layers are warmer.

Ideal condition

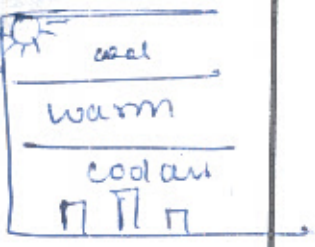
① long nights so outgoing radiation > incoming radiation

② clear skies - unobstructed escape of radiation

③ calm + stable air → no vertical mixing

(2) ground inversion - in high latitudes.

contact with cold surface - air parcel cooler than overlying warm air



(3) frontal inversion along warm or cold front

Affect local inhabitants

(1) impact agriculture in valley - prone to frosting: esp apple cultivation happens along slopes.

(2) fog reduces visibility.

(3) less rainfall because of stable conditions.

(4) impact settlement pattern: houses located on upper slopes - not cold valleys.

Thus temperature inversion has lasting impacts on socio-economic aspects of life.

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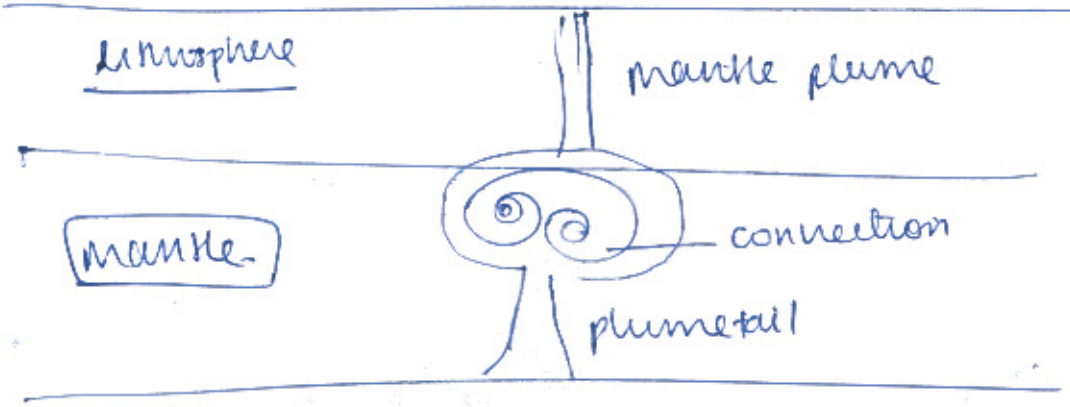
Q.4) Define mantle plume and explain its role in plate tectonics.

Mantle plume is the upwelling of abnormally hot rock within Earth's mantle. Here the magma is hotter than the surrounding magma - causing melting and thinning of crust.



* The rising hot rocks reaches base of lithosphere and mushrooms into a cap.
↓
heat transferred raises temperature in lithosphere and forms magma chambers
↓
these help feed volcanoes at the surface.

* mantle plume is another way Earth loses heat.

Role in plate tectonics

1) understood as cause of hotspots

2) transports primordial mantle material leading to development of volcanic chains
↓
this can break up continents; affect plate tectonics.

3) plume stays in core-mantle boundary so as lithospheric plates shift - volcanoes or eruptions are formed [eg:] Deccan traps.

4) [eg:] Hawaiian Island was created due to a mantle plume.

5) affect lithosphere as it swells, and increases in temperature.

6) hypothesized that mantle plume affect continental rifting and formation of ocean.

Mantle plumes are an indispensable part to explain volcanoes and plate tectonics.

Overall Grading (√)

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

Both erosion and weathering are processes which break down rocks into fine particles.

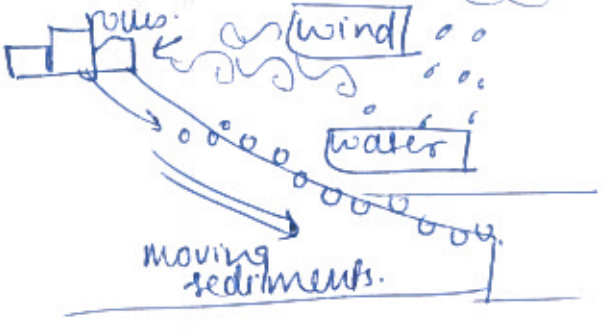
* **Weathering** → degrades the rock without displacing them.

* **Erosion** → rock particles are carried away by external agents like wind and water.

Difference between Erosion & Weathering

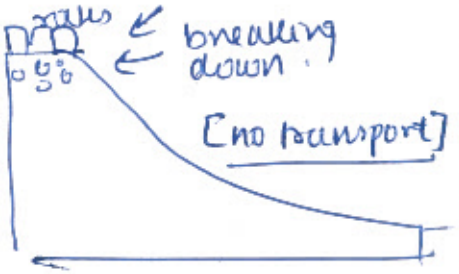
Erosion

1) displacement by wind, water, air



Weathering

1) ~~displacement of solids~~ decomposition of rocks by direct contact with atmosphere



2) eroded materials are displaced.

3) human activities, ice, water etc. can also cause erosion

1) weathered solids are not displaced.

3) primarily atmospheric agents like air pressure cause weathering

4) Insitu degradation

Types of weathering

Chemical | Physical | Biological

(1) Chemical weathering

(*) disintegration due to chemical reaction of water, acids, O_2 etc.

(*) chemical weathering types: oxidation, carbonation, hydration, solution

(2) Physical weathering

(*) physical disintegration of rocks due to → water pressure (wet/dry cycles)

→ expansion because of temperature change

→ gravitational forces.

Eg: Thawing, salt weathering.

③ Biological weathering

- due to movement of organisms eg: earthworms etc.
- by human beings through agriculture
- expose new chemicals to soil; help escalate moisture etc.

significance

1) enrichment of soils and concentration of magnesium, copper, aluminum - important for development of industry.
2) renew soil - support life
3) escalate mass wasting and erosion - change relief and landforms.

As natural process, erosion and weathering help maintain Earth's equilibrium.

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

Volcanic eruptions are caused due to a rupture in Earth's surface, allowing magma, volcanic ash, and gases to escape.

* As per Smithsonian Institute, at any given day there are approximately 50 volcanoes in various stages of eruption

Volcanic eruptions in recent times

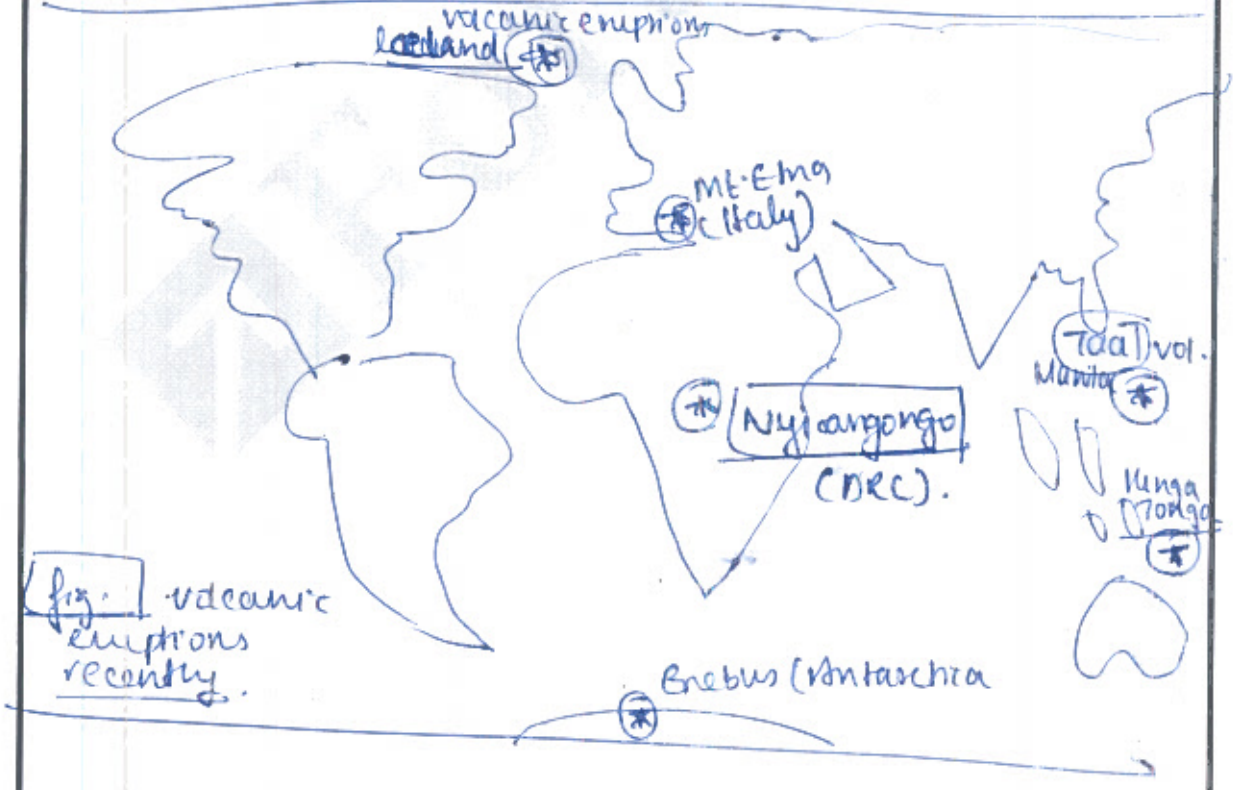

fig. volcanic eruptions recently.

Impact on local Environment

Air

1) reduce visibility; impact transport and everyday life.

2) gaseous clouds are created - can impact albedo and form unusually cold atmosphere

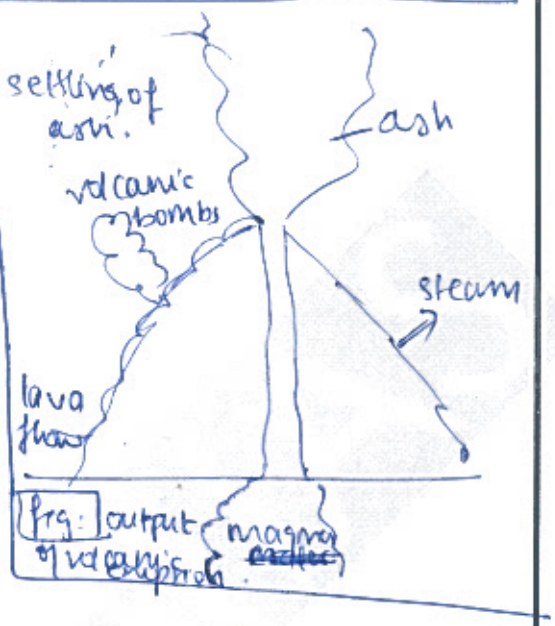

Fig: output of volcanic eruption

3) eruptions at tropics (especially Ring of Fire) can impact both hemispheres

4) releases - greenhouse gases - escalate global warming

5) reflects insolation → cooling → localised cooling effect. eg. Mt. Krakatau brought mini ice age.

Soil

6) positively impact soil productivity

Flora & Fauna

7) settle on plants and impact photosynthesis.

8) CO_2 and fluorine gas can make it difficult for animals to breathe.

Local population

9) health complications for elderly and children

10) Lava flow can distress the settlement pattern [eg:] pompei blast.

11) cause migration and turbulence in local economic system

12) frequent earthquakes and tsunamis increase vulnerability.

While majority of the disasters occur in the Ocean Pacific Belt; they are a natural occurrence which cannot be predicted.

(+) Robust disaster resilience methods and satellite mapping are crucial steps.

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Q.7) Describe the tri-cellular model of global atmospheric circulation. Examine its significance in explaining the world's climatic patterns.

The distribution of insolation is not equal on earth due to spherical shape of Earth; rotation of Earth in inclined axis; and revolution.

(B) This resulted in pressure gradients giving rise to the tri-cellular model (i.e.):

→ Hadley cell
→ Ferel cell
→ Polar cell

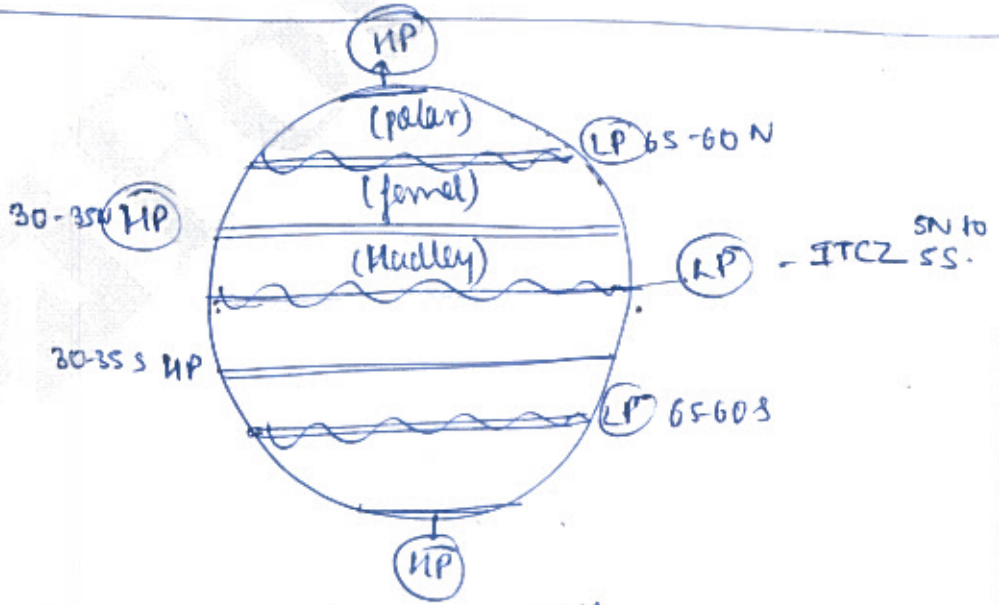


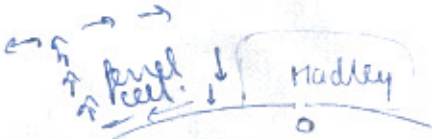
fig: World's pressure belts.

1) Hadley Cell

- between ~10 - 30° latitudes.
- low pressure created at Inter tropical convergence Zone (ITCZ) and air rises because of convection from high insolation
- Thermally induced cell -

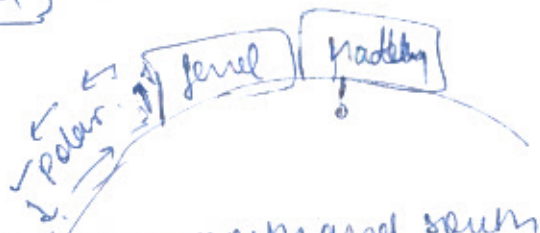
2) Ferel cell

- between ~35 - 60° latitudes.
- dynamically induced - not because of insolation

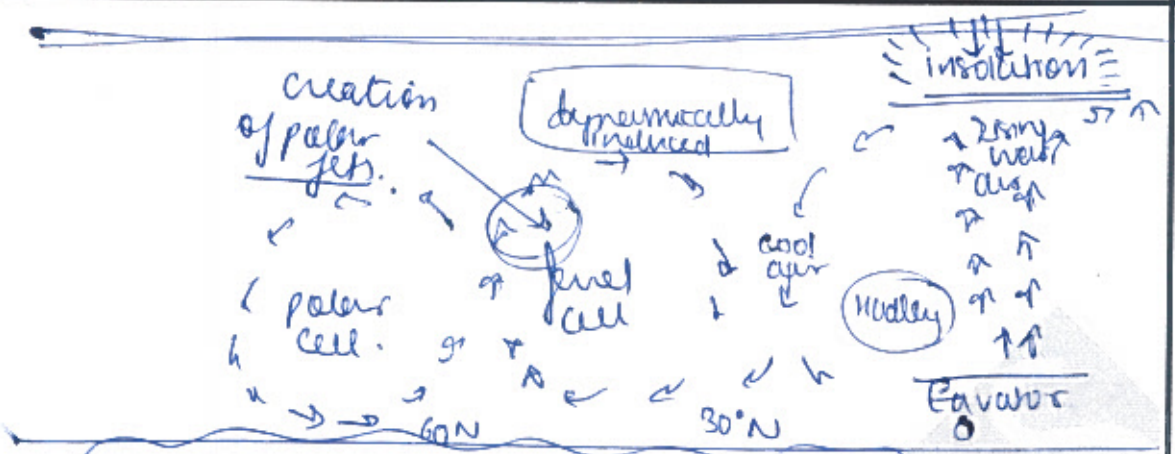


- part of the air moves towards equator and cools down, on the other hand it moves to polar latitudes.

3) Polar Cell



- ~65 to 90 degrees north and south.
- Thermally induced cell which feeds dry winds



significance in world climate

1) responsible for the creation of variation in wind system → trade winds, westerlies, polar easterlies

2) these in turn influence the ocean currents and impact phenomenon like ENSO

3) explains the location of deserts (western margins of continents).

4) explain cyclones and anti-cyclonic activities.

5) Hadley cell crucial for rain in equatorial region

6) balance heat budget; impact monsoon (Eg: Indian monsoon).

While it does not account for topographical variations, tricellular model is elemental to Earth's study.

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Poor			Average			Good		
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