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Level 3 Earth and Space Science 2020

91414 Demonstrate understanding of processes in the atmosphere system

2.00 p.m. Wednesday 18 November 2020
Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of processes in the atmosphere system.	Demonstrate in-depth understanding of processes in the atmosphere system.	Demonstrate comprehensive understanding of processes in the atmosphere system.

Check that the National Student Number (NSN) on your admission slip is the same as the number at the top of this page.

You should attempt ALL the questions in this booklet.

If you need more room for any answer, use the extra space provided at the back of this booklet and clearly number the question.

Check that this booklet has pages 2–15 in the correct order and that none of these pages is blank.

YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

TOTAL

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QUESTION ONE: EQUATORIAL AND POLAR PRECIPITATION

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Both the Hadley and polar convection cells share many similarities. However, precipitation rates at the Equator are very high, while at the extreme latitudes of the poles, they are very low.

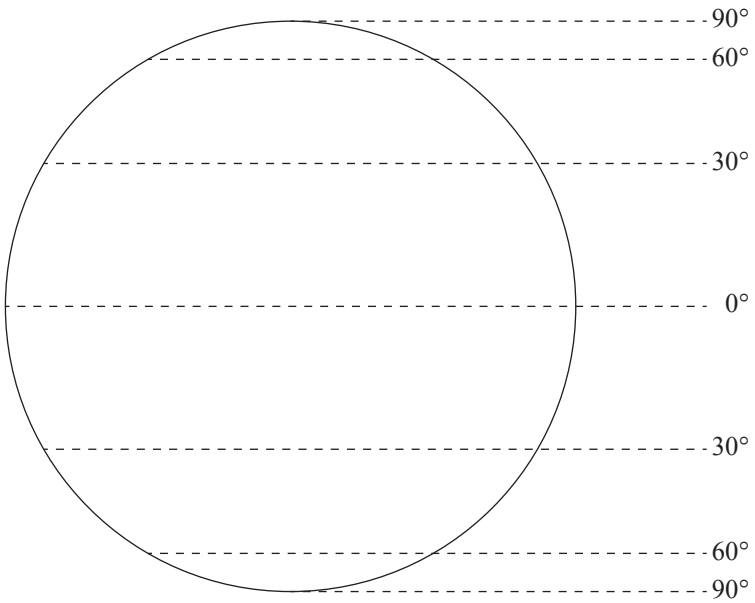
Adapted from: https://climatedataguide.ucar.edu/climate-data/gpcp-monthly-global-precipitation-climatology-project

Explain, with reference to the convection cells, why precipitation rates are so different at the Equator and the poles.

In your answer you should consider:

- what a convection cell is
- the role of solar radiation in the formation of the Hadley and polar convection cells
- the conditions required for precipitation
- reasons for the different precipitation rates at the Equator and the poles.

You should fully annotate the diagram below to support your answer.



You may use annotated diagrams to support your answer.

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There is more space for your answer to this question on the following pages.

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QUESTION TWO: THE TROPOSPHERE AND CLOUDS

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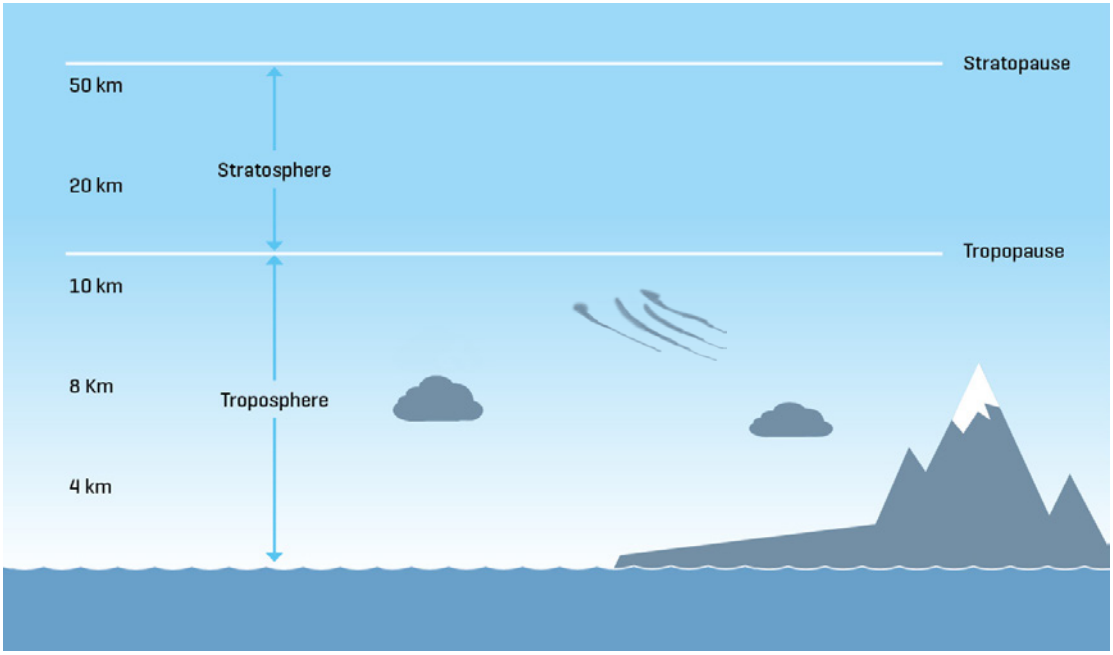
The troposphere extends from the Earth's surface to between 7 to 20 kilometres above sea level. The characteristics of the troposphere vary with altitude.



Adapted from: https://phys.org/news/2016-07-middle-atmosphere-sync-ocean.html

With reference to the composition of the troposphere and the formation and impact of clouds, explain the reasons for the different characteristics observed in the troposphere with increasing altitude, and how global warming may impact this layer.

In your answer you should consider:

- changes due to altitude in air temperature, air pressure, and air density in the troposphere, AND the reasons for these changes
- how clouds are formed
- the role of high-level and low-level clouds on the Earth's surface temperature
- possible consequences of global warming on the troposphere.

You may use annotated diagrams to support your answer.

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There is more space for your answer to this question on the following pages.

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QUESTION THREE: SAHARAN DUST

Recent NASA data of the lower troposphere shows that wind picks up on average 182 million tonnes of dust each year from the Sahara Desert in Africa, and carries it 2500 kilometres across the Atlantic Ocean towards the eastern coast of South America. Here, on average, 27.7 million tonnes of dust fall to the surface over the Amazon rainforest.

Satellite photo showing dust being blown from the Sahara Desert to the Amazon rainforest.

Source: https://svs.gsfc.nasa.gov/11751

Distribution of rainforest and desert in North and South America, and Africa.

Adapted from: https://www.dkfindout.com/us/earth/deserts/where-are-deserts-found/

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Explain how this dust stays suspended in the atmosphere for such a long time, AND why so much ends up in the Amazon rainforest.

In your answer you should consider:

- what an aerosol is
- the convection cell (you do not need to explain its formation) and wind belt associated with this region of the world
- the role of air pressure and the Coriolis effect on wind direction in the circulation cell
- how the dust leaves the atmosphere to land on the surface.

You may use annotated diagrams to support your answer.

There is more space for your answer to this question on the following page.

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Extra paper if required.
Write the question number(s) if applicable.

QUESTION NUMBER

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