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91414



914140



NEW ZEALAND QUALIFICATIONS AUTHORITY
MANA TOHU MĀTAURANGA O AOTEAROA

QUALIFY FOR THE FUTURE WORLD
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SUPERVISOR'S USE ONLY

Level 3 Earth and Space Science, 2019

91414 Demonstrate understanding of processes in the atmosphere system

2.00 p.m. Thursday 28 November 2019
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.

Achievement

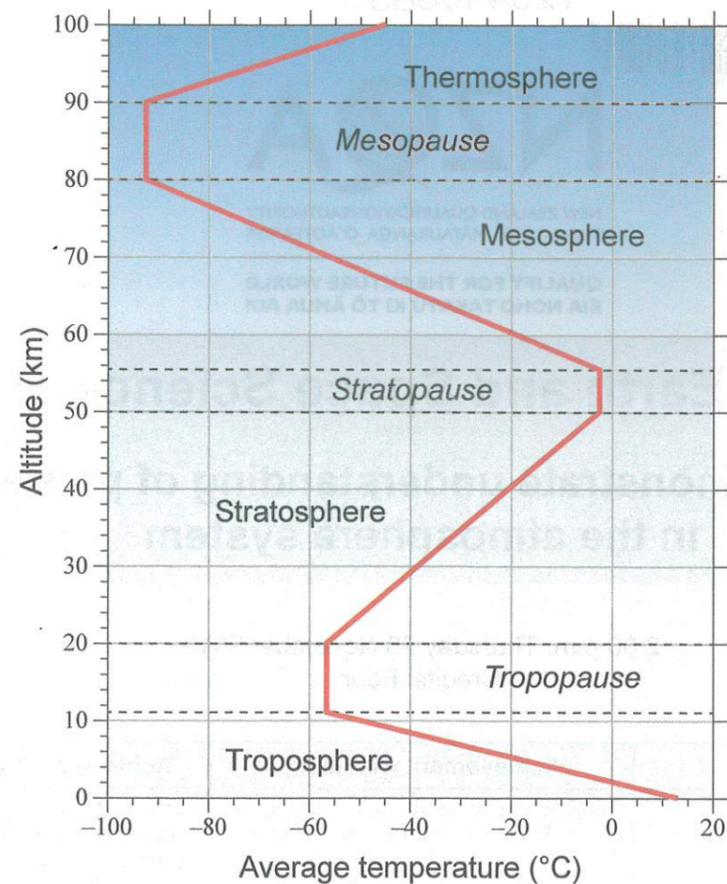
TOTAL

10

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QUESTION ONE: TEMPERATURE WITHIN THE ATMOSPHERE

The graph below shows the **average** temperature gradient for the Earth's atmosphere.



Adapted from: www.physicalgeography.net/fundamentals/images/atmslayers.gif

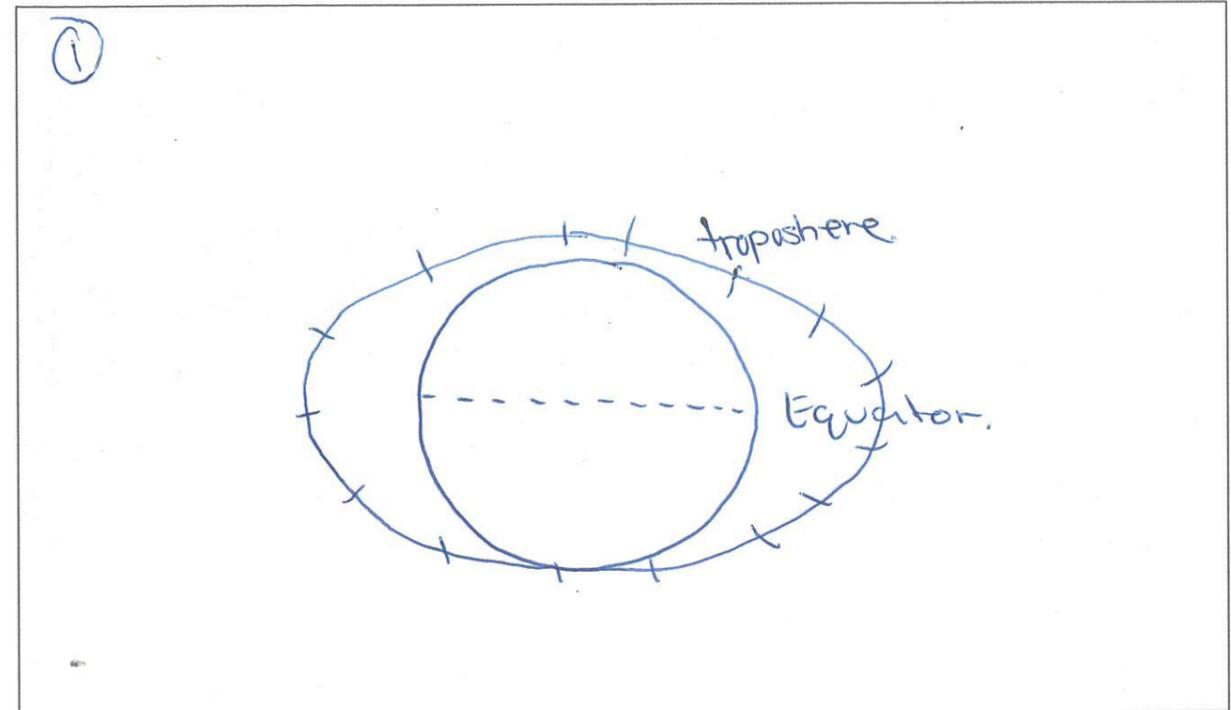
Explain the temperature gradient graph.

In your answer, you should consider:

- the heat source of each layer, and the type of radiation involved
- reasons for the temperature changes shown
- the effect of changes in latitude and seasons on the height of the troposphere.

You may use a diagram to help support your answer.

The troposphere is closest to the earth's surface, it is heated by the emission of stored radiation out of the ground. The earth absorbs lots of radiation during the day and then slowly releases it during the night and following day, the cycle



then continues. The temperature becomes colder and colder as altitude rises because it is further and further away from the heat source, the emitted radiation from the ground. The temperature rises back up in the stratosphere due to the o-zone being located there. Many chemical reactions take place lots of energy is created, causing the temperature to increase. The mesosphere is the coldest, calmest layer of the atmosphere. It reaches temperatures of -90° Celsius. Nothing happens here except for floating remnants of meteors and other space debris, that come from the thermosphere. It is the largest

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

layer of our atmosphere, many meteors and space rocks blow up and collide with others here. It creates high levels of energy and therefore heat. Increasing in temperature like the stratosphere. The troposphere is the most important, interesting and variable layer of our atmosphere. Its height ranges from 10km above sea level to 20km above sea level. The range is so extreme due to the change of latitudes and seasonality. The troposphere is filled with 79% oxygen, 20% carbon and 1% trace gases such as water vapor. It also has 90% of earth's weather with the other 10% occurring in the tropopause and low altitudes of the stratosphere. This means energy levels can change drastically. During summer months more radiation enters our atmosphere, this causes particles to gain more energy, heat up, expand and spread out. This then causes the troposphere's altitude to increase due to the space needed to hold the same particles. This is opposite in winter months, less radiation means less energy. This causes the particles to sink and become more dense,

which lowers the altitude of the troposphere. Difference in latitudes have the same effect, low latitudes cause effects the same as summer does, summer in low latitudes has the highest latitude possible for the troposphere. High latitudes (60°-90°) cause effects the same as winter does, winter in high latitudes has the lowest latitude possible for the troposphere due to the extremely low levels of heat and energy.



QUESTION TWO: THE ROARING FORTIES AND THE WEST COAST OF NEW ZEALAND

Sailors call the latitudes between 40° and 50° south the 'Roaring Forties'. New Zealand lies in the 'Roaring Forties', represented by the green band on the map below.



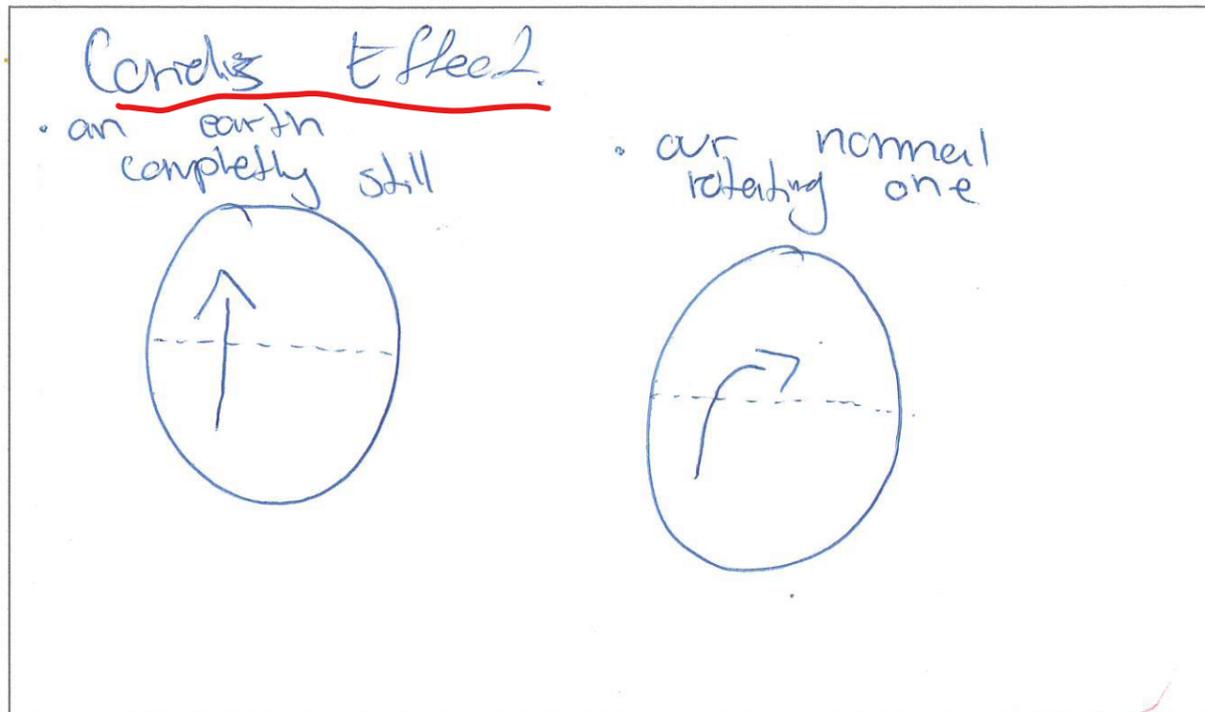
Source: http://www.thesuperfins.com/wp-content/uploads/2017/02/001-the-Roaring-Forties-TheSuperFins.com_.jpg

Explain how the westerly winds of the 'roaring forties' are formed, AND how these contribute to the high annual precipitation rates found on the west coast of the South Island of New Zealand.

In your answer, you should consider:

- the role of solar heating and air pressure on wind formation
- the role of the Coriolis effect on the westerly wind belt
- the role of the Southern Alps in the South Island on precipitation rates.

You may use a diagram to help support your answer.



Wind is formed from differences in densities of air, cold air flows to where hot air is. Solar heating increases the temperature of particles so colder particles take place. This creates movement of air, which is called wind. The Coriolis effect is the backbone of all established wind belts and paths. The Coriolis effect is the displacement of wind travelling north or south due to the rotation of the earth. The wind doesn't account for the rotation of the earth. The earth rotates to the right causing the extremely strong westerly trade winds to exist. The southern alps act as a barrier for precipitation on the south island. The Tasman sea has high energy levels which causes lots of wind. A main wind band flows to the East, over New Zealand when clouds take the wind band they are mostly blocked by the Southern Alps. This causes a lot of precipitation to occur on the west coast. The clouds that don't get blocked normally freeze as they are travelling through the mountains due to the

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high latitudes. This causes the precipitation rates on the East Coast of the South Island to be extremely low compared to the west.

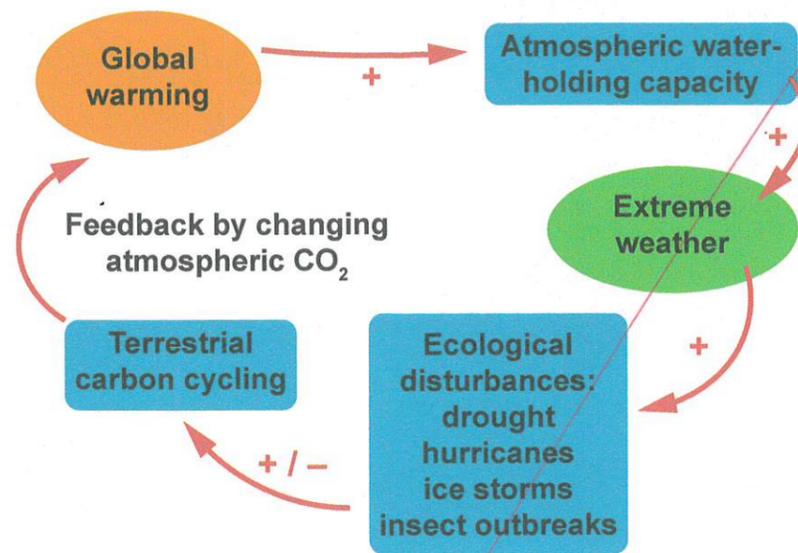
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N2

QUESTION THREE: THE CARBON AND WATER CYCLES

The carbon and water cycles are closely linked, and help to regulate the Earth's temperature. One example of this is shown in the diagram below.



Adapted from: <https://iopscience.iop.org/article/10.1088/1748-9326/10/7/070201/pdf>

Explain how changes to the carbon AND water cycles can **influence** climate change.

In your answer, you should consider:

- how the Earth's temperature affects the water cycle
- the role of the carbon cycle in the Earth's temperature regulation
- how human activities have changed the carbon and water cycles.

You may use a diagram to help support your answer.

At face value the water cycle is easy; evaporation, clouds then it rains. Instead there is runoff, dry spells, wet spells, absorption, along with evaporation, cloud formation and precipitation. There are multiple external factors that can negatively affect the water cycle, one of these variables is earth's temperature. Firstly earth's increasing temperature is melting polar ice caps, this is causing more water to be in our oceans. The sun, along with highly energetic particles floating above the ocean evaporate water and convert it to water vapor. Increased temperature is causing more water to be evaporated. This creates larger clouds and more water vapor in the air (a particle contributing to earth's increased temperature by storing heat energy). More water in the air causes more unexpected weather patterns and extreme weather events like tsunamis and hurricanes. Which hold and collate masses of energy. Events and larger rain patterns cause an infinite loop of increased energy, increased temperature, which increases the earth's

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

temperature, therefore the water cycle.
 The carbon cycle regulates the
 increasing global temperature to an
 extent. After extreme weather
 terrestrial carbon cycling begins where
 needed to mitigate the increased temperature
 increase. Fossil fuels has increased
 the severity of the carbon and water
 cycles. There is more carbon and more
 water which is slowly becoming a
 problem //

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A4

ESS 91414 Annotated exemplars 2019

Subject	ESS	Standard	91414	Total score	10
Q	Grade score	Annotation			
1	A4	Has linked decrease in temperature in troposphere to the distance from its heat source for one Achievement point; Links ozone to stratosphere's increase in temperature and has explained the height of the troposphere at different latitudes for one Merit point.			
2	N2	Has explained the Coriolis effect on wind in the paragraph and diagram.			
3	A4	Has linked an increase in temperature to an effect on the water cycle – melting polar ice caps. Has linked the concentration of water in the atmosphere to global temperatures by stating 'more water vapour' in the explanation. Has linked the two points for a Merit explanation (point 5).			

Confirmation of check	Y / N
This exemplar has been checked for similarities with current online exemplars.	Y