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NZQA | Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Earth & Space Science 2023

91193 Demonstrate understanding of physical principles related to the Earth System

Credits: Four

Achievement	Achievement with Merit	Achievement with Excellence
Demonstrate understanding of physical principles related to the Earth System.	Demonstrate in-depth understanding of physical principles related to the Earth System.	Demonstrate comprehensive understanding of physical principles related to the Earth 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.

Check that this booklet has pages 2–16 in the correct order and that none of these pages is blank.

Do not write in any cross-hatched area (DO NOT WRITE IN THIS AREA DO NOT WRITE). This area will be cut off when the booklet is marked.

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

QUESTION ONE: HEAT DISTRIBUTION AROUND EARTH

Global Surface Currents

Source: https://serc.carleton.edu/eslabs/climate/4a.html

(a) Describe the role of the wind in the formation of surface ocean currents.

(b) Explain, in detail, why ocean and land temperatures at the Equator are significantly higher than at the poles.

In your answer you should consider:

- the angle of the incoming radiation
- the curvature of the Earth.

Fully annotate the diagram below in support of your answer.

Sources: https://a-z-animals.com/blog/how-does-the-sun-produce-energy/
https://solarsystem.nasa.gov/planets/earth/overview/

(c) Explain, in detail, how heat is transferred from the ocean to the atmosphere, as the ocean currents move away from the Equator towards the poles.

In your answer you should consider:

- methods of heat transfer
- the heat capacity of water.

An annotated diagram may assist your answer.

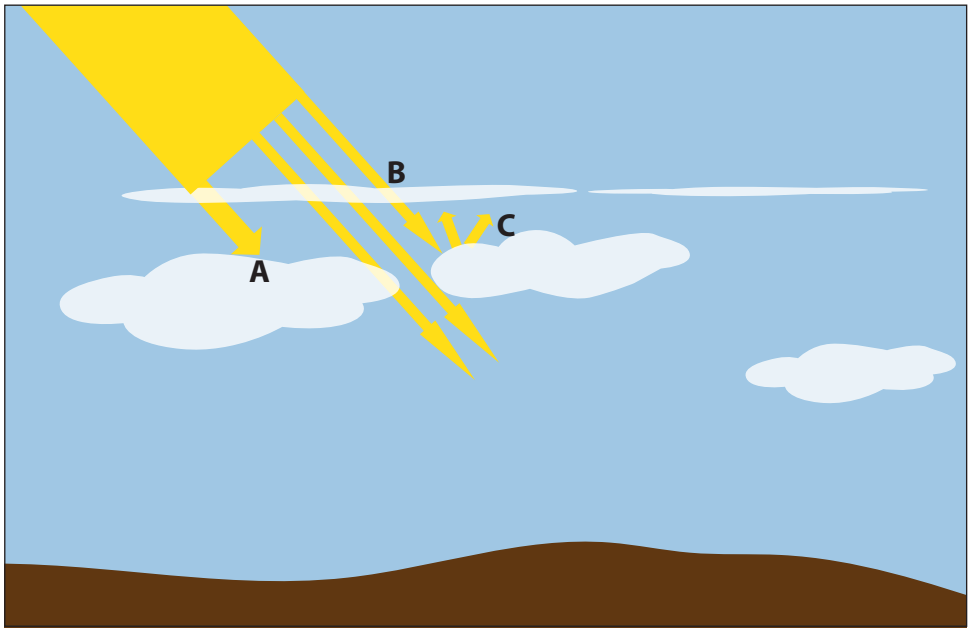
QUESTION TWO: CLOUDS

Cumulus clouds

Source: https://commons.wikimedia.org/wiki/File:Cumulus_humilis_Sch%C3%B6nwald_im_Schwarzwald_20180810.jpg

Clouds affect the amount of light that reaches the Earth's surface. Many clouds appear white in colour and can reach from the Earth's surface to heights of up to 20 km.

(a) As light travels through the atmosphere, different interactions can take place between the light waves and clouds. The letters A, B, and C represent three of those processes.



Complete the table below, labelling the processes that are taking place as light travels through the atmosphere.

A	
B	
C	

(b) Explain, in detail, why cumulus clouds appear white from below.

In your answer you should consider:

- the visible light spectrum
- what clouds are made up of
- what happens to light as it travels through clouds.

An annotated diagram may assist your answer.

(c) Rain is often associated with dark grey cumulonimbus clouds. These clouds can contain six times more water than cumulus clouds.

Cumulonimbus clouds
Source: https://www.weatherwatch.co.nz/content/how-to-spot-a-thunderstorm-in-the-making

Explain, in detail, why cumulonimbus clouds usually appear dark.

In your answer you should consider:

- what happens to light as it travels through the cloud
- why the clouds appear dark grey or black when viewed from the Earth's surface.

An annotated diagram may assist your answer.

QUESTION THREE: VOLCANIC ERUPTIONS AND GREENHOUSE GASES

Source: www.climate.gov/news-features/feed/eruption-provides-rare-opportunity-study-volcanic-gas-and-ash-injected-0

Volcanoes release greenhouse gases, such as carbon dioxide and water vapour, into the atmosphere when they erupt.

(a) Describe what is meant by a greenhouse gas.

(b) Explain, in detail, the role of greenhouse gases in regulating the Earth's temperature.

In your answer you should consider:

- the wavelength of incoming radiation
- what happens to incoming radiation once it reaches the Earth's surface
- the natural greenhouse effect.

An annotated diagram may assist your answer.

Question Three continues on the next page.

(c) The 2022 volcanic eruption in Tonga released approximately 45 million tonnes of water vapour into the atmosphere, and increased atmospheric carbon dioxide concentrations near the volcano by the equivalent amount of a whole year's carbon dioxide emissions on Earth.

Compare the likely effects of increased water vapour and carbon dioxide emissions on atmospheric temperatures.

In your answer you should consider:

- the greenhouse effect
- the differences between the two greenhouse gases involved
- whether the effects on temperature will be long- or short-term for each greenhouse gas.

An annotated diagram may assist your answer.

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

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