SUPERVISOR'S USE ONLY

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Draw a cross through the box (☒) if you have NOT written in this booklet

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NZQA

Mana Tohu Mātauranga o Aotearoa
New Zealand Qualifications Authority

Level 2 Earth and Space Science 2025

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.

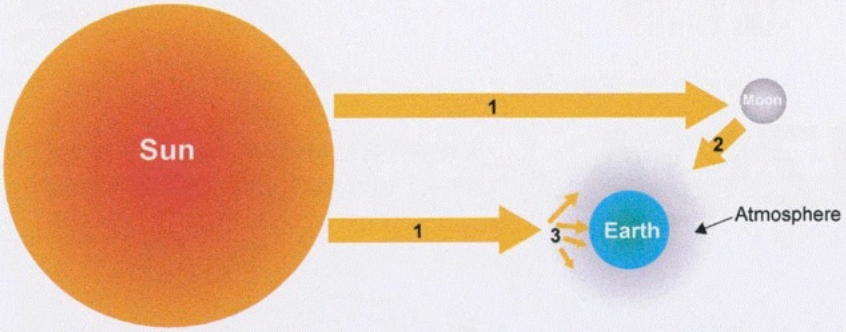
Do not write in any cross-hatched area (▨). This area will be cut off when the booklet is marked.

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

Achievement TOTAL 9

QUESTION ONE: LIGHT AND THE ATMOSPHERE

(a) Refer to the diagram below, which is not to scale, and complete the table below it by describing how visible light travels through space to the Earth's atmosphere and the Moon, for numbers 1 to 3.



Number	Physical Process
1	Heat transfer
2	Reflection
3	Light Scattering

(b) Explain, in detail, the properties of visible light, and why the Earth's atmosphere appears blue from the ground.

In your answer you should consider:

- how the colours of the visible spectrum differ from each other
- the relationship between wavelength and colour
- the relationship between wavelengths and the colour of the sky.

An annotated diagram may assist your answer.

Because of the light from the Sun, the Earths atmosphere appears blue. This is because of the light scattering when Sunlight hits the atmosphere. This is partly because of the relation ships with between wavelengths and the colour of the sky too. When the light rays hit the atmosphere it converts itself into visible light for us that we can see. Blue because of what the Atmosphere is made up of.

(c) In the summer of 2022, bushfires in Australia caused the Moon to appear a blood-red colour at moonrise in the early evening.

Normal moonrise
Source: www.boffamiskell.co.nz/news-insights/moonrise-over-mount-victoria

Blood-red moonrise
Source: https://inhabitat.com/how-to-watch-the-blood-moon-rising-across-north-america-tonight/

Explain, in detail, why the bushfires made the Moon appear a blood-red colour, compared to the colour of a normal moonrise. ~~fire~~

In your answer you should consider:

- why the Moon normally appears yellow/orange at moonrise Sun = yellow
- why the bushfires made the Moon appear blood-red. Fire = red

An annotated diagram may assist your answer.

A normal moon rise ~~when the moon is daft~~ at the beggining of the evening, the moon is yellow because of the Suns ~~Reflection~~ rays that the moon is reflecting. As the night goes on the moon turns less yellow and more white as the ~~Suns rays~~ light energy gets

more muted.

Because of the Australian bushfires, the moon turned blood red because of the light energy from the bush fires interfering with the suns light.

QUESTION TWO: COASTAL CLIMATES

(a) Describe how the Earth's surface is heated.

The Earths surface is heated by the Sun ~~heat transfer~~. and heat transfer

(b) During the day, the average land surface temperatures are higher than the average ocean surface temperatures. At night, these reverse.

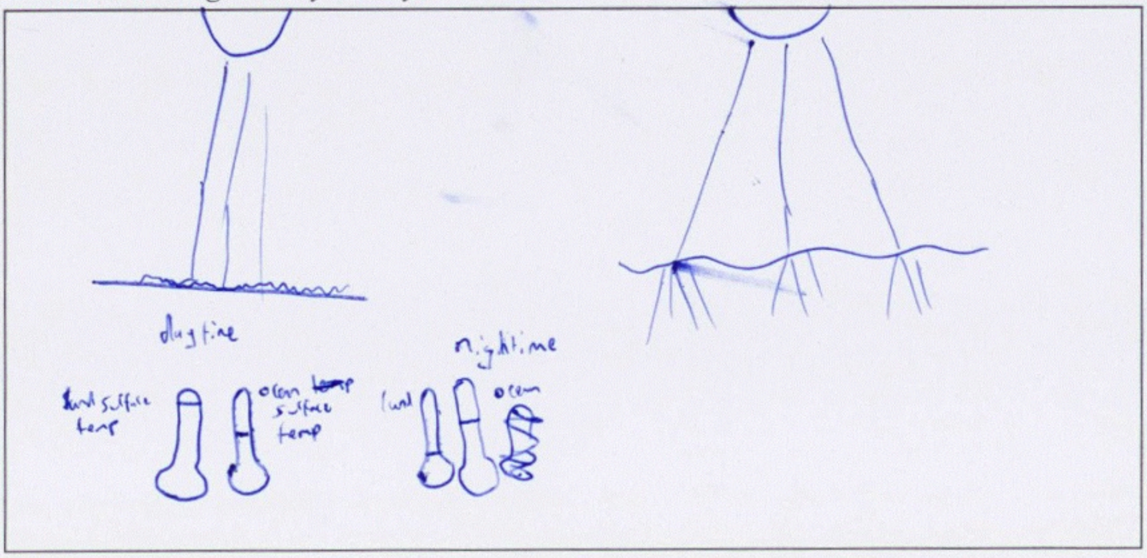
Explain, in detail, why there is a difference between the land surface temperatures and the ocean surface temperatures during the day and night.

In your answer you should consider:

- absorption and emission of radiation
- what heat capacity is.

An annotated diagram may assist your answer.

Ocean absorbs heat because it's a liquid while the surface as a solid doesn't absorb heat



The Surface has little to no Standard heat capacity as it is unable to absorb heat radiation, the heat radiation Simply radiates and scatters along the land Surface.

While the ocean surface temperatures absorb heat radiation from the Sun

With a high heat capacity, ~~and~~ meaning the ocean is able to store a lot more heat. The land surface ~~temperature~~ temperature compared to the ocean surface temperature is much ~~hot~~ higher in the daytime. While in the night, ocean surface temperature stays relatively the same while land ~~temperature~~ surface temperature gets lower and below the ocean surface temperature.

(c) Coastal cities, such as New Plymouth, generally experience a mild climate during the winter months.

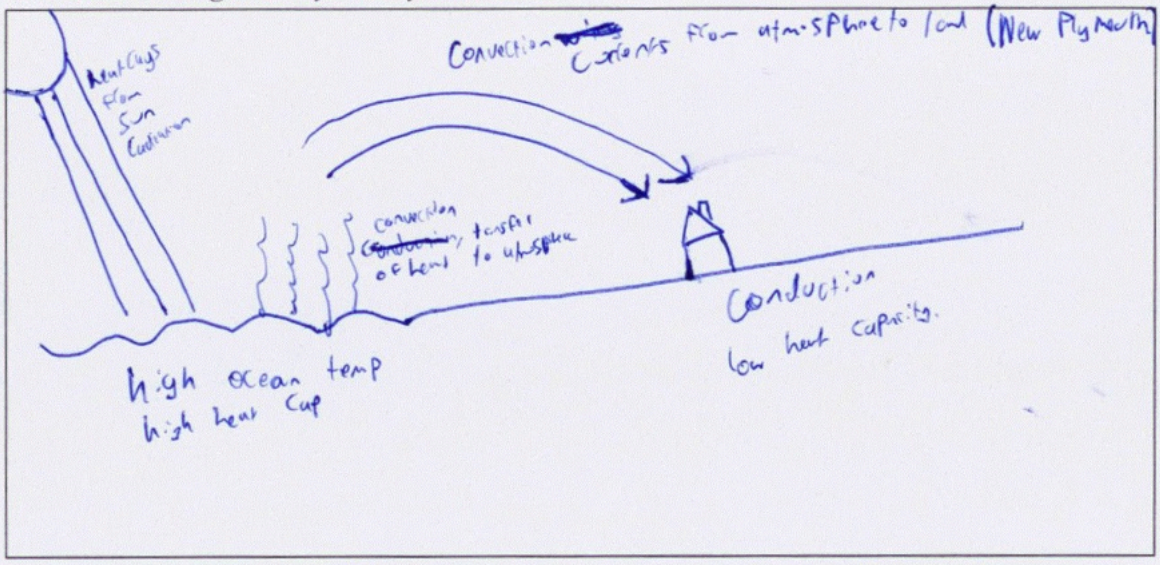
During the month of June, the average atmospheric temperature in New Plymouth is 12 °C, whilst the ocean temperature averages 15 °C.

Explain, in detail, how the ocean temperature can contribute to the mild June climate in New Plymouth.

In your answer you should consider:

- conduction, convection, and radiation
- the transfer of heat from the ocean to the atmosphere.

An annotated diagram may assist your answer.



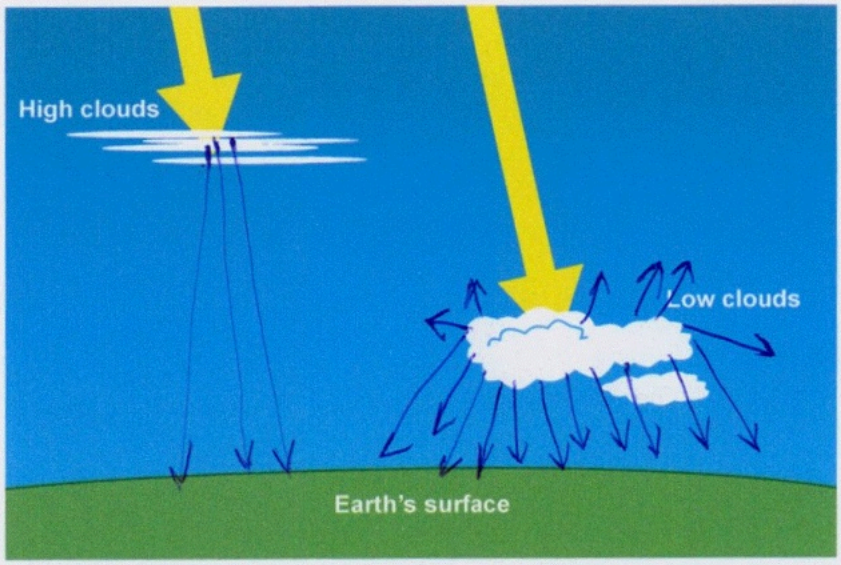
~~Because New Plymouth is close to the Sea~~

The heat rays from the Sun ~~Starts~~ is radiation involved with the heat transfer into the ocean. Then, with convection, the heat from the ocean is put into convection which is then transfered from the atmosphere to the land the conductor with low heat capacity compared to the oceans high heat capacity. The heat from the ocean radiates off from the ocean into the atmosphere using convection contributing to New Plymouths mild climate during winter, mostly because New Plymouth is close to the sea.

QUESTION THREE: CLOUDS

Clouds affect the Earth's surface temperature. Satellites and ground observations are used to measure the effect of cloud cover.

(a) Complete the diagram below by drawing arrows to show how incoming and outgoing radiation interacts with both high- and low-level clouds.



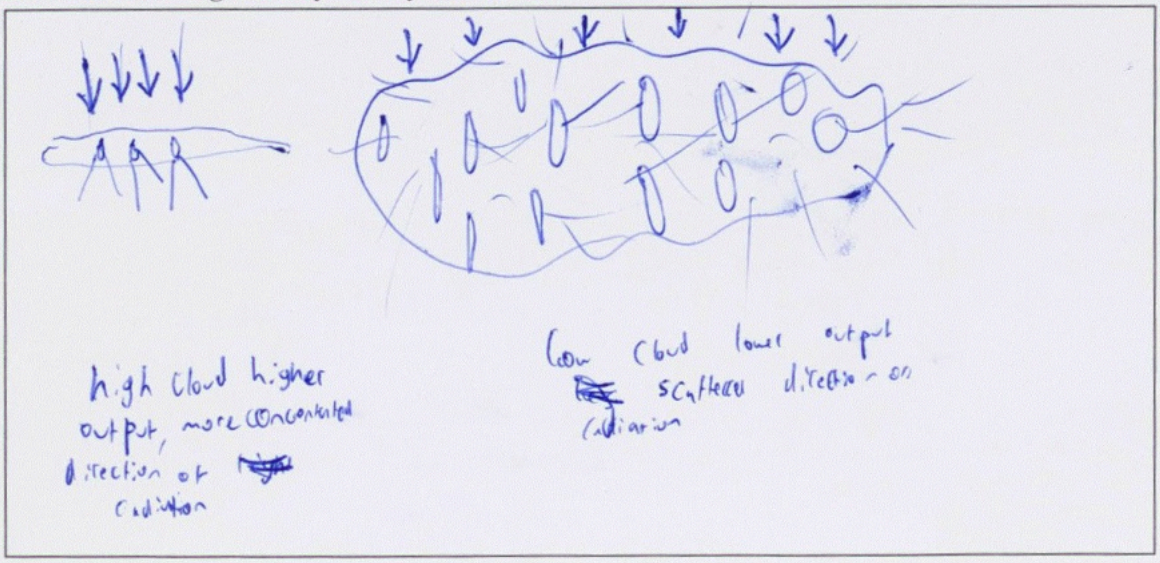
Adapted from: https://scijinks.gov/solar-energy-and-clouds/

(b) Explain, in detail, the effect high- and low-level clouds can have on incoming solar radiation and re-radiated outgoing radiation, and how this relates to the Earth's atmospheric temperature.

In your answer you should consider:

- your answer to part (a)
- the difference between the incoming solar and re-radiated outgoing radiation
- the greenhouse effect
- the relationship to Earth's atmospheric temperature.

An annotated diagram may assist your answer.



When light interacts with water the light scatters, Since clouds are also made up of water they also scatter light. Low clouds are thicker meaning they scatter a lot of solar radiation while higher clouds are thinner meaning they scatter less Solar radiation. This is the green house effect and because of this effect, whenever you go under a low cloud when it is sunny, the surface temperature tends to be colder because of this scattered light, compared to the less dense high clouds which have little to no effect on radiation scattering. ~~the re radiated radiation is less~~

The re-radiated radiation is less potent then incoming Solar radiation. This is for two reasons, the Scattering of the light from the reflection of the water within the low clouds and the absorbtion of the radiation that the low clouds, which are made up of water, have.

This relates to the Earths atmospheric temperature as there would be less Solar radiation causing a lower atmospheric temperature. This is why even a high UV index day that has a higher than usual UV index can still be a Semi-cold day because of clouds.

Question Three continues on the next page.

(c) Climate warming is resulting in an increase in the amount of cloud cover to mountainous regions like the Himalayas.

Explain, in detail, how the change in cloud cover could increase the atmospheric temperatures and climate in this region.

In your answer you should consider:

- the change in high- and low-level cloud cover
- changes in the greenhouse effect
- atmospheric temperatures and climate in mountainous regions.

An annotated diagram may assist your answer.

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

QUESTION NUMBER

Extra space if required.
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QUESTION NUMBER

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

QUESTION NUMBER

Achievement

Subject: L2 Earth & Space Science

Standard: 91193

Total score: 9

Q	Grade score	Marker commentary
One	N2	The candidate provides a statement as to the fact the sky is blue, and it is related to the wavelengths of light but goes no further. The response lacks any description of the reason why the sky is blue. The reason for viewing the moon at night is given and the changes in the Moon's appearance given but no description as to the reason for the appearance.
Two	A4	Whilst the candidate acknowledges solar radiation as the source of heating, there is some confusion as to the role of heat capacity. Water is acknowledged as having a high heat capacity and the consequence of this is described. The diagram assists the description. New Plymouth's climate in winter linked to the ocean and the ocean's heat capacity, with heat transfer occurring via radiation and convection.
Three	A3	Although using light scattering the candidate applies this to the behaviour of incoming radiation and cloud cover. This though is incorrectly linked to the Greenhouse effect and demonstrates a common misconception held about the Greenhouse effect. Part c was not attempted.