SUPERVISOR'S USE ONLY

2

91193

911930

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

+

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.

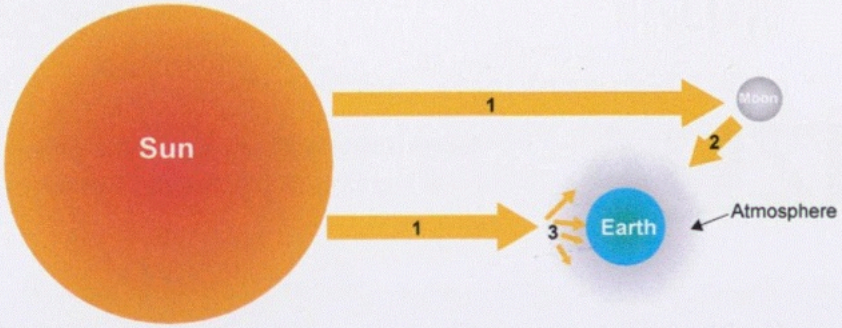
YOU MUST HAND THIS BOOKLET TO THE SUPERVISOR AT THE END OF THE EXAMINATION.

Merit

TOTAL 16

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.



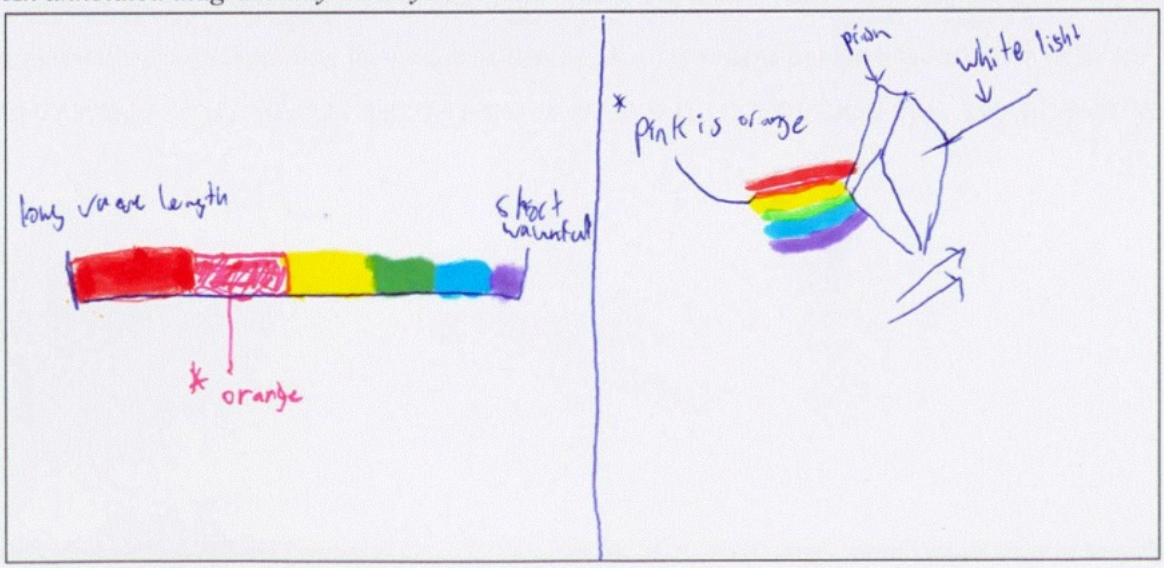
Number	Physical Process
1	Solar Radiation
2	Moonlight
3	wavelength radiation ~~Solar Radiation~~ ~~gas~~

(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.



The visible light to the human eye is white, ~~and~~ & on the spectrum there is violet, blue, green, orange, Yellow, and Red. When shown through a prism there are the colour White, At the start of the Spectrum the colours are Red and orange, these two ~~were~~ ~~the~~ have the longest ~~shortest~~ wavelenght and ~~the middle two colours~~ smallest amount of energy, the middle two colours are Yellow and green, they have medium wavelenght and medium energy, and the last two colours are ~~red~~ blue and violet, these colours have the shortest wavelength and the highest amount of energy. Red is ~~the~~ at the start of the scale and violet is at the end. The earths atmosphere appears blue because the other colours ~~and~~ light ~~the~~ scatter to other particles and dont have enough energy, and violet is to strong while Blue has enough energy and ~~scatters~~ the blue light in the atmosphere making it appear blue.

(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

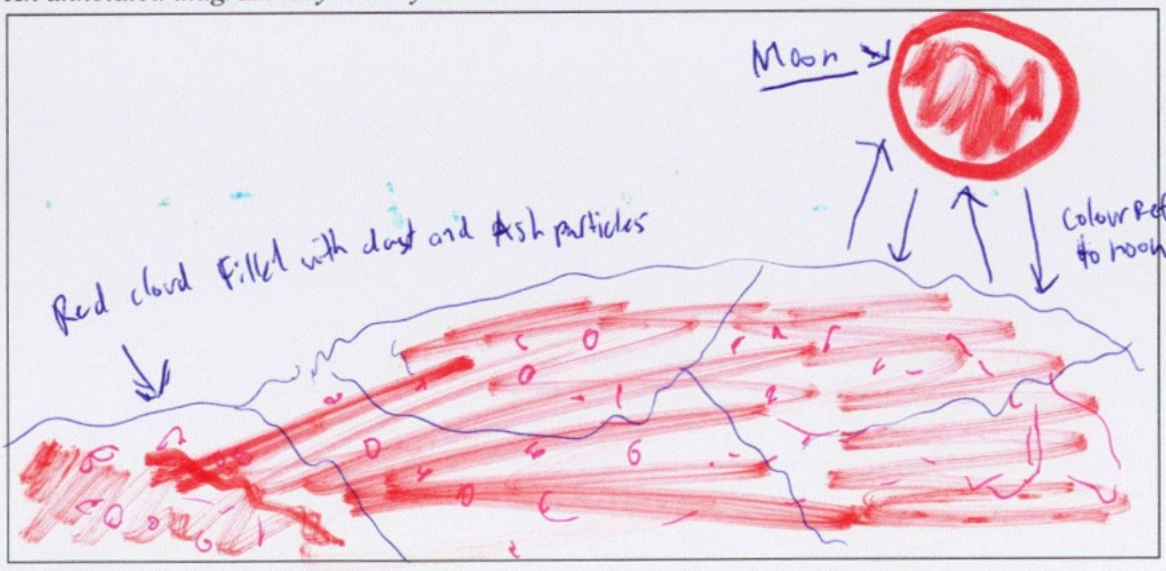
Blood-red moonrise
Source: https://inhabitat.com/how-to-watch-the-blood-moon-rising-across-north-america-tonight/

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

In your answer you should consider:

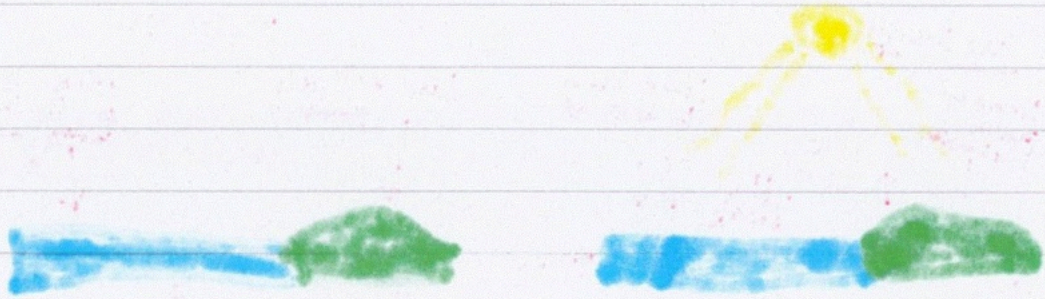
- why the Moon normally appears yellow/orange at moonrise
- why the bushfires made the Moon appear blood-red.

An annotated diagram may assist your answer.



The moon normally appears yellow as while it's rising the sun is in post setting stage and the radiant light shining of it is Yellow/orange, therefore the color is reflected onto the moon which makes it appear Yellow/orange. The moon appears a blood red colour during the bush fires in Australia because of

Visible light Spectrum and the dust and ash particles in the air. The bush fires were so ~~severe~~ that some parts of the sky in Australia were just Red and Cloudy looking for a long period of time, due to this when the moon rises the visible light it emits is shining to the Red dusty clouds below it, ~~the colour red is reflected off the particles and to the moon making it appear Red. The Red and the wavelength gets scattered by~~ the colour Reds short wavelength is scattered by the many dust particles and reflected off them to the moon, making the moon appear blood Red.



QUESTION TWO: COASTAL CLIMATES

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

The earths surface is heated by the Sun and its Solar radiation it emits, and also by the earths internal heat source.

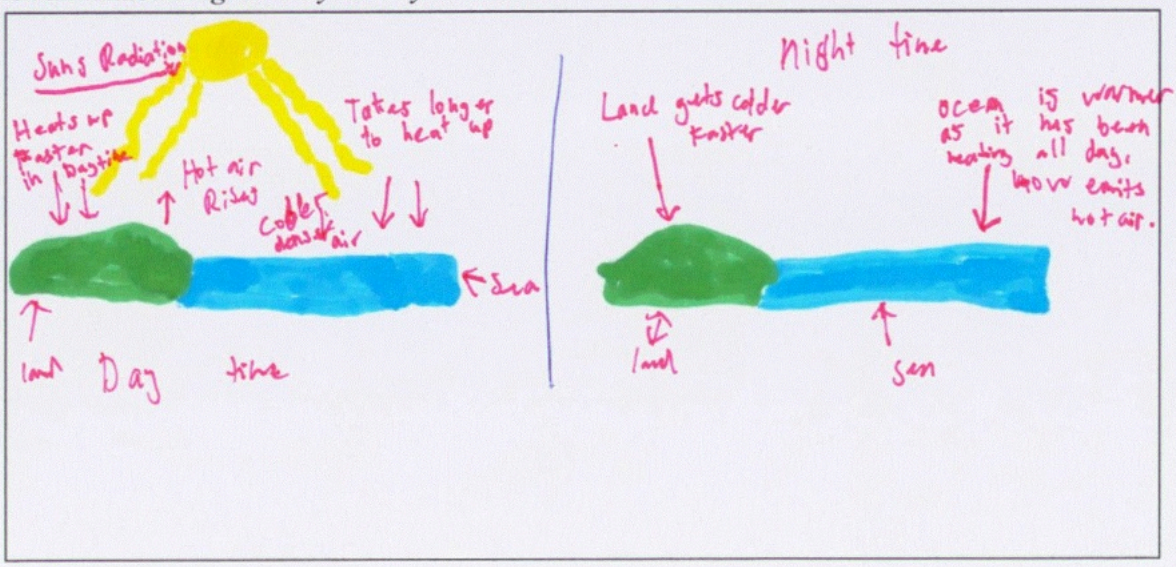
(b) During the day, the average land surface temperatures are higher than the average ocean surface temperatures. At night, these reverse.

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.



The lands surface temperatures are hotter during the day because lands surface heat capity is low, it emits heat back into the atmosphere instead of absorbing it. Meanwhile the ocean surface area is cooler during the day as it has more volume than land, therefore taking longer to heat up, then the sun ~~Rays~~ emits Radiation the at the ocean absorbs it, the ocean is a heat sink and it

takes longer to cool down as it has high heat capacity so the hot air during the day time is emitted to the land and ocean and it Rises as it is less dense and more buoyant, while cool air is more dense and sinks, so when it's night time the hot air from land rises as its not absorbed, leaving low pressure environment and the cooler air sinks as a replacement. While ~~the heat in the~~ the ocean has absorbed the Suns heat and has turned the water warm so the oceans surface area takes longer to cool down. Therefore, the lands surface temperature are hotter during the day compared to the ocean, but are reversed at night.

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

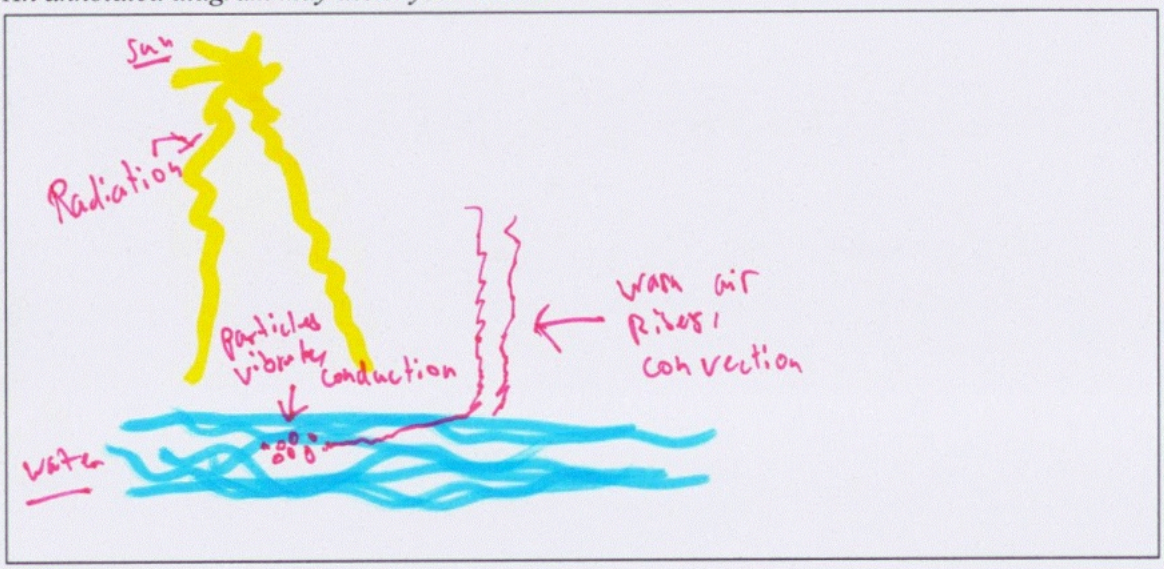
During the month of June, the average atmospheric temperature in New Plymouth is 12 °C, whilst the ocean temperature averages 15 °C.

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.



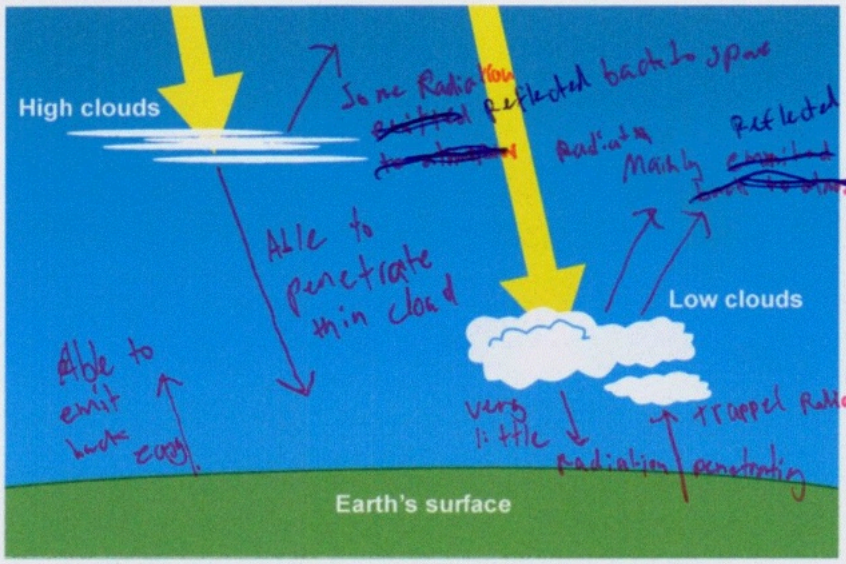
The ocean temperature can contribute to the mild June climate in New Plymouth because of the wind and ocean currents. the oceans deep water current flows heat around the world, and the wind moves hot air from the ocean around the world. ~~The ocean is heated to New Zealand by the~~ The ocean is still a little warm from the summer, as radiation, wind, and deep water currents warm it up it ~~heats~~ warms the atmosphere temperature warmer. the sun radiates heat onto the ocean, the ocean absorbs that heat the particles in the water rub together and vibrate by conduction causing the ocean to heat up, that air then rises

from particle to particle in the air by convection, the warm air ~~goes~~ emits into the atmosphere therefore the reason how the ocean temperature can contribute to the mild June climate in New Plymouth.

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.



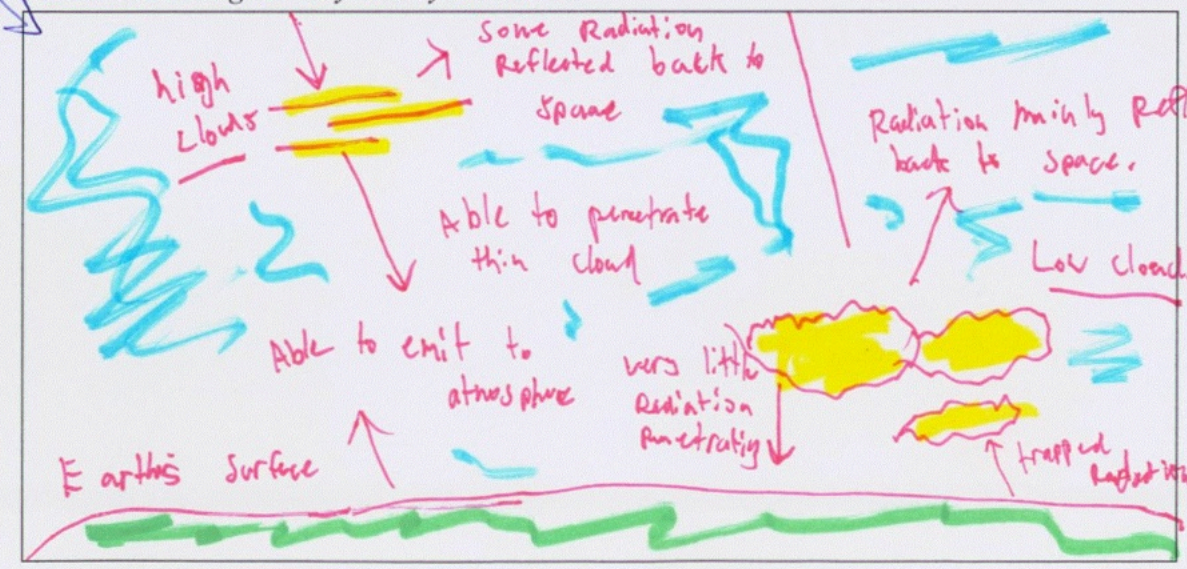
Adapted from: https://scijinks.gov/solar-energy-and-clouds/

(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.



Most Radiation can penetrate through the high-level clouds as they are thin and less dense while not so much radiation can penetrate through low-level clouds as the thick and more dense, meaning most radiation will transmit through the high-level clouds with only a little bit reflecting back, and most Radiation will reflect back off of low-level clouds with only a little transmitting through, the low-level clouds are more opaque and dense making it harder to transmit through while the high-level clouds are thinner and more transparent. Incoming solar radiation has more energy, while out going has less energy and can get trapped in the atmosphere. The greenhouse effect relates to the atmospheric temperature, the greenhouse gasses are carbon dioxide, nitrous oxide, water vapour, and methane, the greenhouse effect is when air gets trapped surrounding the earth and therefore heating it up. If there are more low-level clouds the atmospheric temperature will be colder as there won't be as much Radiation/heat penetrating through the clouds, it gets reflected back into space meaning the atmosphere will be cooler than if there are only high level clouds, this is because most of the radiation/heat can penetrate through the cloud and into the atmosphere and the earths surface, and can be re-radiated into the Atmosphere and because of that the atmospheric temperature will be hotter.

Question Three continues on the next page.

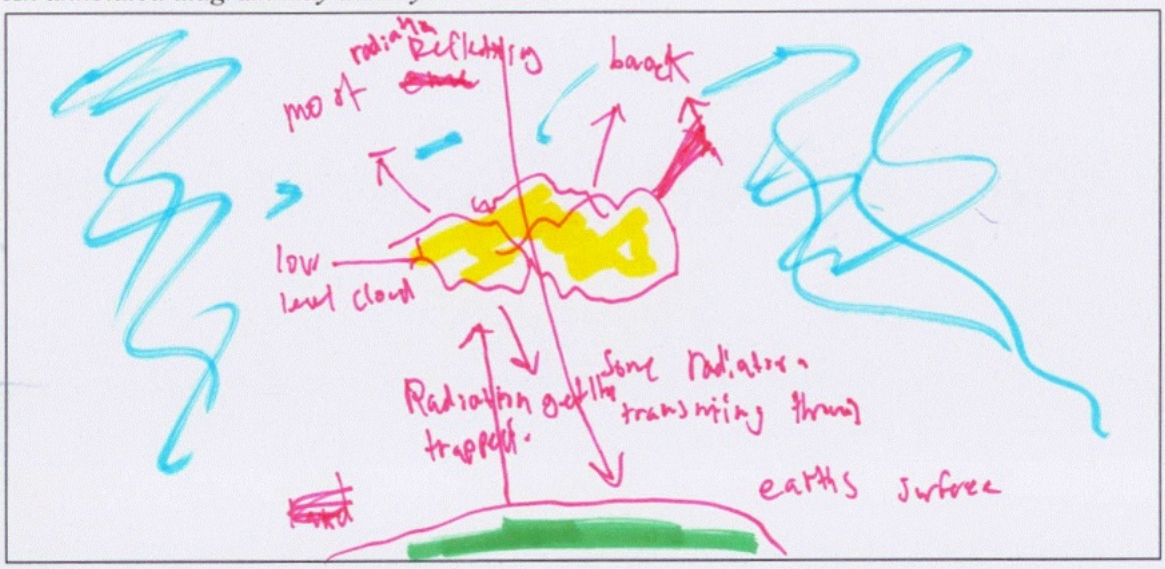
(c) Climate warming is resulting in an increase in the amount of cloud cover to mountainous regions like the Himalayas.

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.



The increase in cloud cover could mean that when radiation penetrates through the low-level cloud cover it could be trapped in the atmosphere as it can't penetrate through the cloud as well when reflecting back, meaning hot air is trapped in the greenhouse gas effect and the atmospheric temperature increases. There would be more water vapour with that amount of cloud cover, making the climate more moist, and damp feeling. The climate wouldn't be as sunny, but it would still be warm as the hot air is trapped, so the hot air and more water vapor will make the climate humid.

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

QUESTION NUMBER

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

QUESTION NUMBER

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

QUESTION NUMBER

91193

Merit

Subject: L2 Earth & Space Science

Standard: 91193

Total score: 16

Q	Grade score	Marker commentary
One	M5	The candidate links the colours of the visible spectrum to energy and wavelength. Diagrams are used to assist the response. Blue light is given as being scattered, though the reasoning is mixed. The reason for the Moon being seen at night is given however the explanation as to its appearance misinterprets which wavelengths are scattered.
Two	M5	An annotated diagram is used. The explanation shows some understanding of difference in heat capacity between land and water and its consequence. The movement of heat energy day and night between Earth's surface and the atmosphere is explained though extended to sea breezes which was not part of the question's context. This explanation is applied to part c. However, whilst the principal idea shows some understanding of heat transfer during the winter months, the explanation needed extending to the heat transfer from air to land.
Three	M6	The initial diagram was developed further and annotated to explain the behaviour of incoming and outgoing radiation and cloud cover. The effect cloud cover and greenhouse gases in atmospheric warming was explained, though not linked to the question's context in part c.