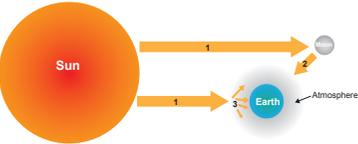


Assessment Schedule – 2025

Earth and Space Science: Demonstrate understanding of physical principles related to the Earth System (91193)

Evidence Statement

Question One

Q	Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
(a)	 <p>1 Transmission 2 Reflection 3 Scattering</p>	<ul style="list-style-type: none"> • 2 out of 3 correct. 		
(b)	<p>Visible light or visible spectrum is made up of different component colours, which represent different energy levels and wavelengths. The combination of these wavelengths makes visible light appear white.</p> <p>Each colour is characterised by a particular wavelength and frequency. The shortest wavelengths (highest frequencies) are at the blue and violet end of the spectrum, whilst the long wavelengths (low frequencies) are the red and orange colours. The shorter wavelengths are a higher energy level.</p> <p>When light reaches the atmosphere, the shorter wavelengths interact with oxygen and nitrogen molecules due to their similar size, and their light is scattered. The scattered light gives the sky its blue appearance and is known as Rayleigh Scattering.</p>	<p>Describes:</p> <ul style="list-style-type: none"> • visible light is made up of a range of colours / wavelengths • blue colour is short wavelength (high frequency) <p>OR</p> <p>red light is the long wavelength (low frequency)</p> <ul style="list-style-type: none"> • short wavelengths of visible light are higher in energy than the longer wavelengths • that the blue wavelength (light) is scattered by gases in the atmosphere. 	<p>Explains:</p> <ul style="list-style-type: none"> • the relationship between energy, wavelengths, frequencies, and the colours of the visible spectrum • the relationship between wavelengths of the colours of the visible spectrum, and transmission and scattering in the atmosphere. 	<p>Explains comprehensively:</p> <ul style="list-style-type: none"> • the nature of the visible spectrum and the way it interacts with the atmosphere to produce a blue sky.

<p>(c)</p>	<p>When the Moon rises, the reflected light from the Moon has further to travel through the Earth’s atmosphere, than if directly overhead.</p> <p>As light travels through the atmosphere, the amount of scattering depends on the distance the light travels through the atmosphere. The longest wavelength, red light in the visible spectrum, is affected the least, and is transmitted the greatest distance. Shorter wavelengths, i.e. mainly the violet, blue parts of the spectrum. This results in the yellow appearance as the shorter wavelengths are scattered into space by the main atmospheric gases.</p> <p>During bushfires, a large quantity of ash and dust rises into the atmosphere. The reflected light from the Moon must pass through this atmosphere loaded with dust and ash. Since at moonrise, the reflected light has further to travel through the polluted atmosphere, more of the shorter wavelengths i.e. blue, violet, green, yellow will be scattered by the extra dust and ash. This leaves the remaining longer wavelengths of red and orange. Consequently, the Moon appears blood red.</p> <p><i>Evidence may be taken from an annotated diagram.</i></p> <p><i>Evidence may be taken from any section of the question.</i></p>	<ul style="list-style-type: none"> • that the Moon is observed from Earth because light is reflected from the Sun • that reflected light from the Moon has further to travel through the atmosphere at moonrise • short wavelengths are scattered (OR longer wavelengths are scattered least) resulting in a yellow moon • dust and ash particles scatter more wavelengths leaving a red-coloured Moon. 	<ul style="list-style-type: none"> • why the reflected light from the Moon has a longer path to travel through the atmosphere at moonrise, which allows for more light scattering of moonlight • why the atmosphere scatters the shorter wavelengths of light, leaving for transmission of longer wavelengths and the moon’s yellow colour • the link between atmospheric ash and dust with scattering of the different wavelengths of light creating a blood red moon. 	<ul style="list-style-type: none"> • the reason for the appearance of the yellow-coloured Moon at moonrise • the reason for the red-coloured Moon at moonrise during the period of the bushfires.
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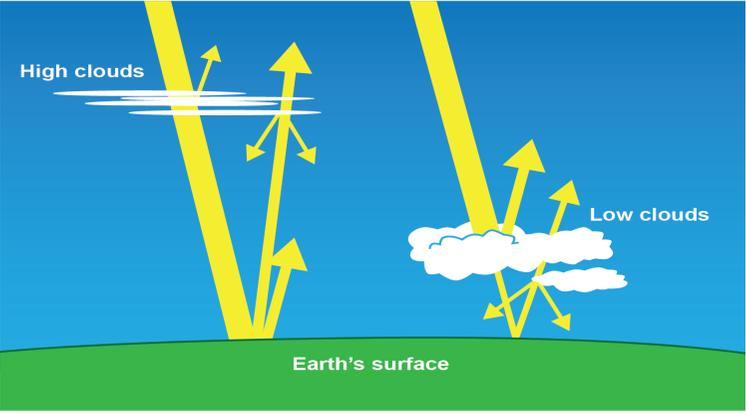
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE idea at the Achievement level.	Describes TWO ideas at the Achievement level.	Describes THREE ideas at the Achievement level.	Describes FOUR ideas at the Achievement level.	Explains ONE idea at Merit level.	Explains TWO ideas at Merit level.	Explains ONE point at Excellence level	Explains TWO points at Excellence level.

Question Two

Q	Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
(a)	<p>The Earth’s surface, land and water, is heated by absorption of shortwave solar radiation (ultraviolet and visible).</p>	<p>Describes:</p> <ul style="list-style-type: none"> • solar radiation as a source of heat 	<p>Explains:</p> <ul style="list-style-type: none"> • the link between heat capacity and temperature changes in the ocean during day and night 	<p>Explains comprehensively:</p> <ul style="list-style-type: none"> • the links between absorption of solar radiation and heat capacity to differences in land and ocean temperatures during the day
(b)	<p>Water has a higher specific heat capacity than land. This means that it takes more heat energy to change the temperature of water by a degree, compared to the equivalent mass of land changing its temperature by a degree.</p> <p>This means that during the day, the same amount of solar radiation absorbed (heat energy) will increase the temperature of the land faster than the equivalent amount of ocean, leading to a temperature difference between the two.</p> <p>Conversely, at night, the ocean is much slower to cool down than the land, as it must emit more heat energy per degree temperature drop compared to land, meaning the land’s temperature drops faster in comparison.</p>	<ul style="list-style-type: none"> • heat capacity in terms of rate of temperature change • water having a higher heat capacity than land (or vice versa) • how the Earth’s surface absorbs heat energy during the day • how the Earth’s surface emits heat energy during the night 	<ul style="list-style-type: none"> • the link between heat capacity and temperature changes of the land during day and night 	<ul style="list-style-type: none"> • the links between the loss of heat energy and heat capacity to differences in land and ocean temperatures during the night
(c)	<p>When the ocean is warmer than the air above, heat transfer will take place, either through radiation or conduction and convection. Heat energy moves from an area of high temperature to an area of low temperature.</p> <p>Heat energy is transferred to the air in contact with the warmer ocean surface via conduction. This takes place through particle collision of higher energy water particles with air particles directly above.</p> <p>The warmer air lying above the ocean surface rises, as it is less dense due to increased particle motion, and is replaced by cooler air. This sets up a convection current, with heat being transferred into the atmosphere.</p> <p>The air above the ocean can also be warmed by radiation from the ocean’s surface.</p> <p>This creates warmer air over the coastal area of New Plymouth.</p> <p><i>Evidence may be taken from an annotated diagram.</i></p> <p><i>Evidence may be taken from any section of the question.</i></p>	<ul style="list-style-type: none"> • the heat transfer from the ocean to atmosphere • heat transfer from the sea to land • breeze/wind formation of due to the heating of land and sea • movement of heat energy from warmer temperatures to cooler temperature • transfer of heat by radiation from the ocean to the atmosphere. 	<ul style="list-style-type: none"> • the heat transfer process of conduction where heat energy from the ocean moves to the atmosphere directly above the ocean surface • the formation of the convection current due to changes in density OR air pressure because of heating and cooling of Earth’s surface. 	<ul style="list-style-type: none"> • the links between the heat transfer process from the ocean to the atmosphere that can lead to a milder coastal climate.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE idea at the Achievement level.	Describes TWO ideas at the Achievement level.	Describes THREE ideas at the Achievement level.	Describes FOUR ideas at the Achievement level.	Explains ONE idea at Merit level.	Explains TWO ideas at Merit level.	Explains ONE point at Excellence level	Explains TWO points at Excellence level.

Question Three

Q	Expected Coverage	Achievement	Achievement with Merit	Achievement with Excellence
(a)	 <p>The diagram illustrates the interaction of solar radiation with different cloud types. On the left, 'High clouds' are shown as thin, white layers. Yellow arrows representing incoming solar radiation pass through them and reach the 'Earth's surface'. From the surface, arrows point upwards, representing outgoing long-wave radiation. Some of these arrows are reflected back down towards the surface by the high clouds. On the right, 'Low clouds' are shown as thicker, white layers. Yellow arrows representing incoming solar radiation are mostly reflected back into space by the low clouds. A smaller amount reaches the 'Earth's surface'. From the surface, arrows point upwards, and a significant portion is reflected back down towards the surface by the low clouds.</p>	<ul style="list-style-type: none"> • A minimum of two arrows showing correct radiation movement 		
(b)	<p>Incoming solar radiation is shortwave radiation, predominately ultraviolet and visible. As it travels towards the Earth's surface, high-level clouds are transparent and allow the shortwave radiation to reach the Earth's surface and where it is absorbed or reflected into the atmosphere and space.</p> <p>Low-level clouds behave differently. Being denser, thicker and made up of water droplets. They have a high albedo and will reflect a greater proportion of the incoming shortwave radiation back into space. Only a small amount in comparison reaches the Earth's surface, though this depends on cloud thickness.</p> <p>Shortwave radiation, once absorbed by the Earth's surface, is re-emitted as longer wave infra-red radiation or heat. Water vapour (and droplets) is a greenhouse gas; therefore, clouds can act as a greenhouse gas. High-level clouds and low-level clouds will absorb out-going long-wave radiation and re-emit it in all directions, into the lower and upper atmosphere. The effect of this will be to warm the surrounding atmosphere increasing local temperatures.</p>	<p>Describes:</p> <ul style="list-style-type: none"> • incoming radiation as shortwave or ultraviolet and visible light • outgoing or re-emitted radiation as long wave radiation or heat or infra-red • transparency of high-level clouds to incoming radiation • reflectivity of low-level clouds to incoming solar radiation • absorption and emission of outgoing (long wave) radiation back into the atmosphere by low level cloud cover • atmospheric water vapour (or droplets or clouds) acts as a greenhouse gas 	<p>Explains:</p> <ul style="list-style-type: none"> • the relationship between the different types of cloud cover and the interaction with incoming and outgoing radiation • how low-level cloud cover influences the Earth's atmospheric temperature by re-emission of absorbed long-wave radiation. 	<p>Explains comprehensively:</p> <ul style="list-style-type: none"> • the link between the properties of incoming and outgoing radiation with low-level and high-level clouds and the heating of Earth's atmosphere.

(c)	<p>An increase in cloud cover in regions, such as the Himalayas, can lead to an increase in atmospheric temperatures.</p> <p>Although there will be less incoming shortwave radiation reaching the surface due to the high albedo of the low-level cloud, both the high- and low-level clouds act as a barrier to long-wave or infrared radiation, which means more heat will be trapped in the atmosphere within the region.</p> <p>Clouds create a greenhouse effect. (Water molecules absorb the long-wave (infrared radiation) and then re-emit the radiation back in all directions randomly in the atmosphere.) This effectively warms the atmosphere, as most of the outgoing radiation is prevented from escaping into space. Increased cloud cover means there will be an enhanced greenhouse effect, as more water is present. This means the atmosphere will be warmer.</p> <p>As a result of the warmer atmosphere, there will be greater / faster snow or ice melt. Conditions will not be as suitable for precipitation as snow, but more rain will fall. The snow line will move higher up the mountain range. Increased temperatures will mean increase in atmospheric water, enhancing further the greenhouse effect and accelerating the snow melt etc.</p> <p><i>Evidence may be taken from an annotated diagram.</i></p> <p><i>Evidence may be taken from any section of the question.</i></p>	<ul style="list-style-type: none"> • increase in cloud cover leads to more heat energy being trapped in the atmosphere • increase in cloud cover can lead to less short-wave radiation reaching the surface • increased snowmelt due to warmer atmospheric temperature • increase in atmospheric temperature leading to more rain and less snow. 	<ul style="list-style-type: none"> • how an increase in cloud cover may affect incoming radiation and atmospheric temperatures • how an increase in cloud cover may affect outgoing radiation and atmospheric temperatures • how changes in cloud cover may result in changes to snow levels and precipitation. 	<ul style="list-style-type: none"> • the changes caused by the increase in high-level and low-level cloud formation that will result in atmospheric warming in mountainous regions • the links between the increase in cloud cover to an enhanced “greenhouse effect” resulting in the changes to the climates of mountainous regions.
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N0	N1	N2	A3	A4	M5	M6	E7	E8
No response or response does not relate to the question.	Describes ONE idea at the Achievement level.	Describes TWO ideas at the Achievement level.	Describes THREE ideas at the Achievement level.	Describes FOUR ideas at the Achievement level.	Explains ONE idea at Merit level.	Explains TWO ideas at Merit level.	Explains ONE point at Excellence level	Explains TWO points at Excellence level.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 12	13 – 18	19 – 24