

Assessment Schedule – 2015

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

Evidence Statement

Question One:

Expected Coverage	Achievement	Merit	Excellence
<p>The heating of Earth occurs by radiation of the Sun’s heat energy through space and then the atmosphere to the Earth’s surface. (Transmission of infra red radiation)</p> <p>The heat energy from the Sun is radiated back out into the atmosphere from the Earth’s surface and into space, transmitted as infra red radiation.</p> <p>If the atmosphere contains few greenhouse gases such as CO₂, then not all the heat energy is transferred directly into space, but radiated back to Earth’s surface, which enables the planet to maintain a fairly constant temperature.</p> <p>When heat from the Earth is absorbed by carbon dioxide in the atmosphere, two things can occur:</p> <ul style="list-style-type: none"> • The molecule can absorb some of the heat energy or infra red radiation (The movement transfers the heat energy between molecules in the atmosphere and the atmosphere becomes warmer)) The CO₂ molecule then radiates the remaining heat energy out into space. • The molecule can absorb some of the heat energy or infra red radiation The absorbed energy is re-emitted; heat energy is transferred between molecules in the atmosphere, and the atmosphere becomes warmer. The CO₂ molecule then radiates the remaining heat energy not to space but back to the Earth’s surface warming the surface of the Earth again. <p>If the number of CO₂ molecules increased in our atmosphere, then the rate of heat absorption by the molecules would also increase, which would mean that there would be an increase in the Earth’s temperature, as less heat energy would be radiated out to space via the atmosphere.</p>	<p>Describes:</p> <ul style="list-style-type: none"> • Heat transfer/radiation from Sun to Earth • Heat transfer/radiation into space from Earth • Heat transfer into space from a CO₂ molecule • Heat transfer back to Earth from a CO₂ molecule. • Earth would heat up with more CO₂ molecules. • Radiation/Heat energy is off the Earth’s surface. 	<p>Explains:</p> <ul style="list-style-type: none"> • How the Earth is heated by the Sun. • Effect of CO₂ molecules absorbing heat energy or infra-red radiation in atmosphere <p>OR</p> <p>Effect of CO₂ molecules re-radiating heat energy or infra-red radiation to Earth.</p> <ul style="list-style-type: none"> • How Earth temperature would increase. 	<p>Explains in detail:</p> <ul style="list-style-type: none"> • Effect CO₂ has on absorption of heat energy from the Earth. <p>OR</p> <p>Effect CO₂ has on radiation of heat energy from the Earth.</p> <ul style="list-style-type: none"> • Effect of increased CO₂ on the heat energy content of the Earth atmosphere and temperature.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Describes ONE point	Describes TWO points	Describes THREE points	Describes FOUR points.	Explains ONE point.	Explains TWO points.	Explains ONE point in detail.	Explains TWO points in detail.

Question Two:

Expected Coverage	Achievement	Merit	Excellence
<p>On hot days the sun provides the same amount of heat energy (over the same area) to the land and the ocean. This same amount of heat energy causes a difference in temperatures of the land and the ocean, due to the fact that water is an excellent absorber of heat (it has a high specific heat capacity). This means that the land has a higher temperature than the water after prolonged periods of heating, such as afternoons on a hot day. The air above the land also heats up, (conduction) due to the fact the land is very warm, and this means this hot air is less dense and rises (convection current). This is then an area of low air pressure.</p> <p>Over the ocean, where the water has been absorbing the heat energy from the sun, the air is not as warm as that on the land. There is now a pressure difference between the air above the ocean and the air above the land.</p> <p>The air above the ocean will then move into the low pressure area above the land to equalise the pressure, and this is seen as a coastal wind, or on shore breeze. The strength of this wind is determined by the temperature difference between the land and the ocean.</p> <p>At night the converse is true, and the wind flows from land to sea.</p> <p>On stormy days where the air is cooler, there is no uneven heating of the air above the ground and the ocean and so there is no consistent coastal wind that happens later in the afternoon. Storms occur when there are massive areas of low pressure and can happen over any point on the Earth; this means that there are no set directions for winds from storms, and so a consistent wind direction cannot be predicted, although due to the layout of a particular region, storms may be more common from one direction than others.</p>	<p>Describes:</p> <ul style="list-style-type: none"> • Direction of air flow for coastal breeze. • Land heats up faster than ocean or vice versa. • How the sun heats up the oceans-AND land. • The heat transfer process that takes place when the air is heated above the land. • How the land and ocean are heated unevenly. 	<p>Explains:</p> <ul style="list-style-type: none"> • Direction of air flow in terms of uneven heating. (Could be by annotated diagram.) • Air pressure is lower over land during the day due to hot air rising. • How the differing heat capacities of land and ocean can lead to uneven heating. • How wind speed is affected by the difference in air pressures. • Storms are formed by low pressure systems and are mobile/less directional. 	<p>Explains in detail:</p> <ul style="list-style-type: none"> • How the differing heat capacities of land and water create coastal weather patterns. (May include on shore and offshore winds.) • Direction of air flow and speed in terms of high to low pressure. (May relate to storms.)

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Partially describes ONE point.	Describes ONE point.	Describes TWO points.	Describes THREE points.	Explains TWO points.	Explains THREE points.	Explains in detail ONE point.	Explains in detail TWO points.

Question Three:

Expected Coverage	Achievement	Merit	Excellence
<p>Light from the sun travels through space by radiation.</p> <p>Sunlight is made up of multiple colours of light, each with their own wavelengths.</p> <p>Sunlight is made up of three primary colours: red, blue and green. Red is the longest wavelength colour, and blue is the shortest wavelength colour.</p> <p>The atmosphere is made up of gas and other particles, including water molecules.</p> <p>At dawn, the light from the rising sun has further to travel and as it hits the atmospheric particles and the shorter wavelength colours (blue and green) are absorbed or scattered into space. (Rayleigh scattering, relating particle size to wavelength). The longer wavelength colour of red though is transmitted. This means that the red colour reaches our eyes.</p> <p>A red sky in the morning can signal that bad weather is coming, as red sky means there are a lot of particles absorbing or scattering the shorter wavelengths more than the longer wavelengths. The red light is reflected or scattered off the oncoming cloud mass (clouds have high albedo) and subsequently warns of oncoming rain/precipitation.</p>	<p>Describes:</p> <ul style="list-style-type: none"> • Light is made up of different wavelengths of light. (Blue – short wavelength, red the longer wavelength.) • Light travels by radiation. • Lots of particles in the atmosphere scatter blue wavelengths more than red. • Scattering of components of light by particles (gases / dust / water) in the atmosphere. • Clouds are reflective (albedo) and reflect / scatter red light. 	<p>Explains:</p> <ul style="list-style-type: none"> • Bad weather means more particles in the atmosphere, therefore more scattering of light. • Water particles transmit longer wavelength of light <p>OR</p> <p>Water, gas and atmospheric particles absorb or scatter shorter wavelengths of light</p> <ul style="list-style-type: none"> • The effect of distance the light travels through the atmosphere and the degree of scattering. 	<p>Explains in detail:</p> <ul style="list-style-type: none"> • Mornings that show a red sky mean there is an increase in water content in the atmosphere, leading to an increase in light scattering and hence possible bad weather. • How the red and blue wavelengths are affected differently by atmospheric particles (water droplets, dust, gaseous molecules) in the atmosphere.

NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Partially describes ONE point.	Describes ONE point.	Describes TWO points.	Describes THREE points.	Explains ONE points.	Explains TWO points.	Explains in detail ONE point.	Explains in detail BOTH points.

Cut Scores

Not Achieved	Achievement	Achievement with Merit	Achievement with Excellence
0 – 6	7 – 13	14 – 19	20 – 24