

Assessment Schedule – 2017

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>White light (sunlight) is made up of red, blue and green light. Red light has the longest wavelength and blue has the shortest wavelength.</p> <p>As the Sun is rising, the low angle of the Sun in the sky means the light from the Sun has a long distance to travel through the atmosphere. Our atmosphere is full of particles such as dust and gas etc and these particles scatter light rays. The longest wavelength colour (red) is least affected by the particles and so are transmitted through the sky whereas the shortest wavelength colour (blue) is scattered by the particles in the sky and is absorbed by the particles, leaving only the red light to travel to the viewer.</p> <p>As the Sun is rising, it is lighting up the sky with all the colours of white light, but it is at such a low angle to the earth that all the colours of light have to travel further through the earth's atmosphere. As the light rays hit the dust and molecules of gas in the earth's atmosphere, the shorter wavelength colours of indigo, violet, blue and yellow are absorbed or scattered, while longer wavelength colours of orange and red are transmitted. We therefore only see the longer wavelength colours, and so the sunrise is seen as red.</p>	<p>Describes with understanding:</p> <ul style="list-style-type: none"> light travels as solar radiation through space and the atmosphere sunlight made up of blue, red and green visible light wavelength of blue light shortest / red light longest scattering of light is carried out by particles (molecules, dust, water droplets) in the atmosphere particles in the atmosphere will scatter blue light (wavelengths) more than red that when blue light is absorbed or scattered red light can be seen. that light has further to travel through the atmosphere at sunrise and sunset. 	<p>Explains in detail:</p> <ul style="list-style-type: none"> red light is not scattered by particles in the atmosphere and is transmitted through the atmosphere OR blue light is scattered/absorbed by particles in the atmosphere and is not transmitted through the atmosphere the rising Sun has low angle in the sky and therefore light from Sun has a longer path through the atmosphere travelling through more particles in the air. water droplets in the clouds scatter or reflect the red light (wavelengths) so the sky appears red at sunrise / sunset. 	<p>Comprehensively explains:</p> <ul style="list-style-type: none"> That as the light travels further in the atmosphere the short wavelength colours are scattered by atmospheric particles (water droplets, dust, gaseous molecules) by virtue of their similarity in size leaving the longer wavelength red light to reach the viewer of the sunrise and it is seen as red.

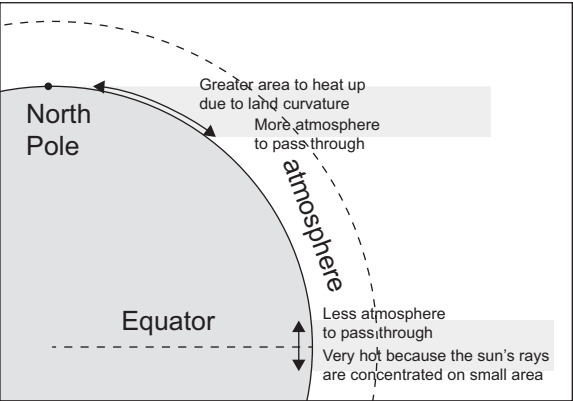
Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Partial description of one or more points.	Describes ONE point.	Describes with understanding TWO points.	Describes with understanding THREE points.	Explains in depth ONE-points.	Explains in depth TWO points.	Comprehensive explanation with minor omission/error	Comprehensive explanation.

Question Two

Expected Coverage	Achievement	Merit	Excellence
<p>A large volcanic eruption could mean a drop in the mean temperature of the earth in the years following the eruption.</p> <p>Ash particles that are heavy will drop quickly from the atmosphere due to gravity. The smaller volcanic particles stay in the atmosphere and can reflect heat energy back into space. If the small volcanic particles are in the lower part of the atmosphere, heat transmission is affected and a smaller amount of heat radiation is transmitted to the Earth’s surface, which means the mean temperature of the earth will be lower. If the volcanic particles are in the upper atmosphere, the particles are in the atmosphere a very long time and reflect solar radiation from the Sun back into space and less solar radiation is transmitted to Earth. therefore lots of dust / volcanic particles in the upper atmosphere can cause the earth’s temperature to drop after an eruption.</p> <p>The greenhouse gases emitted in a volcanic eruption allow radiation to be transmitted through them to the Earth’s surface. They do not allow re-radiated heat from the Earth’s surface to be reflected back into space. This would cause the Earth’s temperature to rise.</p> <p>Overall a major volcanic eruption can cause the Earth’s temperature to be lower due to the huge amounts of dust particles in the upper atmosphere as the heating effect of a relatively small amount of greenhouse gases is more than cancelled out.</p>	<p>Candidate describes:</p> <ul style="list-style-type: none"> • temperature of Earth after a major volcanic eruption will change • volcanic particles in atmosphere will reflect / trap solar radiation from reaching earth surface • the extent of cooling by volcanic ash will depend on the amount / or time the ash is in the atmosphere • the effect of greenhouse gases on heat transmission • the effect of greenhouse gases on the temperature of the Earth. 	<p>Candidate explains:</p> <ul style="list-style-type: none"> • how size and / or location of volcanic particles affects reflection of solar radiation • the effect of greenhouse gases will have on radiated heat (infra-red radiation) from Earths surface. • how greenhouse gases or volcanic particles will alter the temperature of the Earth. 	<p>Candidate explains comprehensively:</p> <ul style="list-style-type: none"> • how size, location and time in atmosphere of volcanic particles affect reflection of solar radiation • how greenhouse gas emissions would affect Earth’s temperature but low amount of gases ejected compared to amount of volcanic particles emitted means overall the Earth’s mean temperature is lowered.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Partial description of one or more points.	Describes ONE point.	Describes with understanding TWO points.	Describes with understanding THREE points.	Explains in depth ONE-points.	Explains in depth TWO points.	Comprehensive explanation with minor omission/error.	Comprehensive explanation.

Question Three

Expected Coverage	Achievement	Merit	Excellence
<p>Water absorbs heat energy from the Sun and stores it. At the equator, the Sun’s rays are concentrated in a small area of ocean and so the tropical water receives more heat energy than higher latitude water, so this water will absorb more heat energy and be of a higher temperature.</p> <p>The Gulf Stream (GS) begins just above the Equator moving northwards and carries the warm water from the equator north east. This is due to the Earth rotating towards the East (Coriolis effect) and the prevailing winds. It acts as a conveyor belt of fast-moving warm water. As the current moves north east across the Atlantic, heat from the water particles is transferred by conduction to the air around it (conduction occurs when two or more objects at different temperatures are in contact with each other). Heat energy flows from the warmer object (water) to the cooler object (air) until they are both at the same temperature.</p> <p>Air flowing across this warm gulf stream current flows onto costal land warming the air of the land, and so Porto in Portugal is warmed by the GS even in winter, which means it is warmer than NYC, which doesn’t have the benefit of being warmed by the warm GS current.</p>  <p>NYC has cold Labrador Current which originates in the Arctic and brings cold dense water past NYC. This chills the air above it and leads to cool air flowing onto NYC also leading to cooler temperatures in NYC in winter than Porto.</p>	<p>Describes:</p> <ul style="list-style-type: none"> • how the earth is unevenly heated by the sun • how GS originates near the Equator • how GS is a warm current • how surface currents are driven by atmosphere movement (wind) • how Earth’s rotation effects winds and ocean movement (Coriolis Effect) • how the ocean influences land temperature. 	<p>Explains:</p> <ul style="list-style-type: none"> • why sun unevenly warms the equator compared to the higher arctic latitudes • how the earth’s rotation drives the poleward flowing currents eastward • how GS is a warm current that originates at the Equator where water is warmer • how warm ocean water causes warm air to flow onto land, raising land temperature. 	<p>Explains comprehensively:</p> <ul style="list-style-type: none"> • how warming at Equator generates the warm GS current which travels northeast because of earth’s rotation and prevailing wind. This current will warm the winter temperatures off Porto. The cold weather in NYC is due to cooling effect of the Labrador current flowing down form the Arctic.

Not Achieved			Achievement		Achievement with Merit		Achievement with Excellence	
NØ	N1	N2	A3	A4	M5	M6	E7	E8
No response; no relevant evidence.	Partial description of one or more points.	Describes ONE point.	Describes with understanding TWO points.	Describes with understanding THREE points.	Explains in depth ONE-points.	Explains in depth TWO points.	Comprehensive explanation with minor omission/error	Comprehensive explanation.

Cut Scores

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