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91193



911930



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SUPERVISOR'S USE ONLY

Level 2 Earth and Space Science, 2019

91193 Demonstrate understanding of physical principles related to the Earth System

9.30 a.m. Wednesday 27 November 2019
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 and clearly number the question.

Check that this booklet has pages 2–12 in the correct order and that none of these pages is blank.

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

Merit

TOTAL

13

ASSESSOR'S USE ONLY

QUESTION ONE: THE COLOUR OF CLOUDS

ASSESSOR
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www.thoughtco.com/types-of-clouds-recognize-in-the-sky-4025569

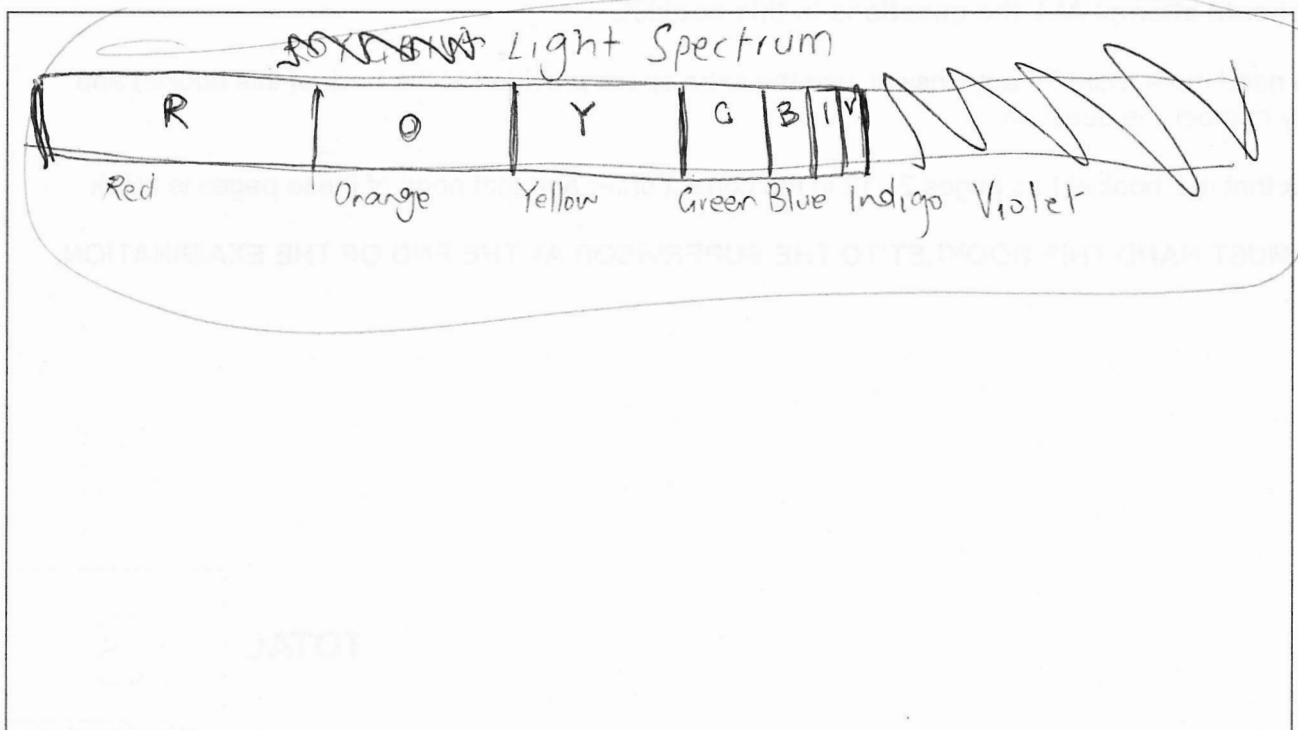
Clouds reduce the amount of sunlight reaching the surface of the Earth, but they do allow some light through.

Explain, in detail, why clouds often appear white.

In your answer, you should consider:

- how light travels through space to reach the Earth
- how colours of the light spectrum differ from each other
- what happens to the light as it travels through the clouds
- why the bases of clouds often look darker.

A diagram may assist your answer.



Light travels through space to reach Earth ~~is by~~ in waves, ultra-violet rays travel to earth in short ~~length~~ length rays. Infra-red radiation also travels in waves. Colours of the light spectrum differ from each other because they have different wave lengths. Red, green and blue are the primary colours of the light spectrum. Red has the longest wavelength and violet has the shortest. Ultra-violet rays have the shortest wavelength. As light from the sun travels through the clouds, some is reflected back into the atmosphere and some continues through the cloud on its journey to Earth.

~~Thus~~ ~~the~~ The bases of clouds often look darker or shadowed. ~~Because the top of the cloud has more light being reflected off it.~~ ~~Also~~ Clouds are denser near the bottom because the hotter, less dense air rises pushing the cooler air down. Because of the increased density at the bottom of the cloud, less ~~light~~ light particles get through, so the bottom of the clouds ~~is~~ look darker.

The tops of the clouds allow light particles in, because it is less dense so there are less collisions pushing the light ~~particles~~ particles away.

Clouds appear white in the blue sky because the ~~condensed~~ evaporated water

condenses into water drops which

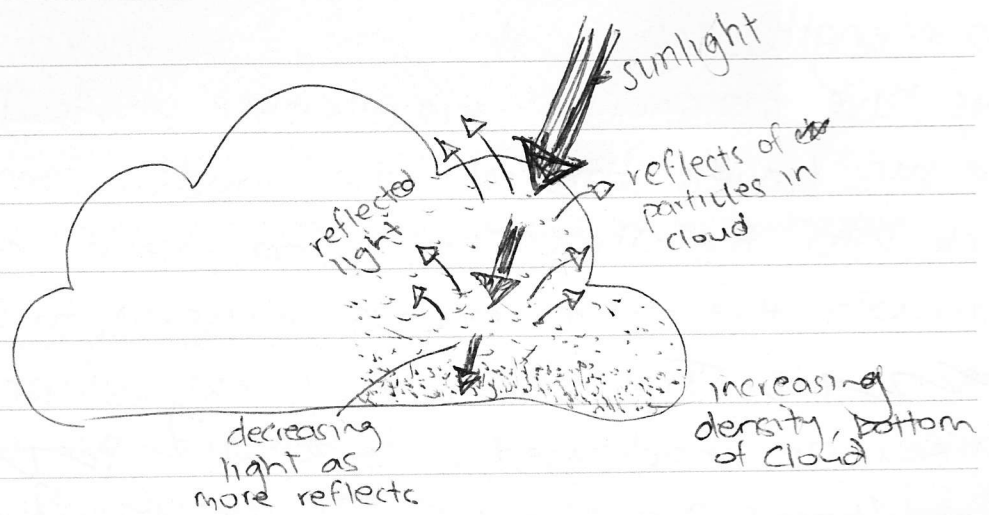
reflects the light from the sun

making clouds look white.

The base of clouds are darker as less light

More space for this
answer is available on
the following page.

is darker, as it reflects reaches the base, so it reflects less light, and appears less white than the lighter, ^{less dense} cloud above it which ~~receives~~ receives and reflects more light.



QUESTION TWO: CLOUD EFFECTS ON EARTH'S RADIATION

Cloud Effects on Earth's Radiation



https://eoimages.gsfc.nasa.gov/images/imagerecords/54000/54219/Clouds_effects.jpg

A NASA satellite is used to measure radiant energy from both the Sun and the Earth at the top of the atmosphere. This has helped scientists to understand the effects clouds have on the temperature of the Earth.

Use the diagram to help you explain in detail the different effects clouds may have on the movement of energy to and from the Earth.

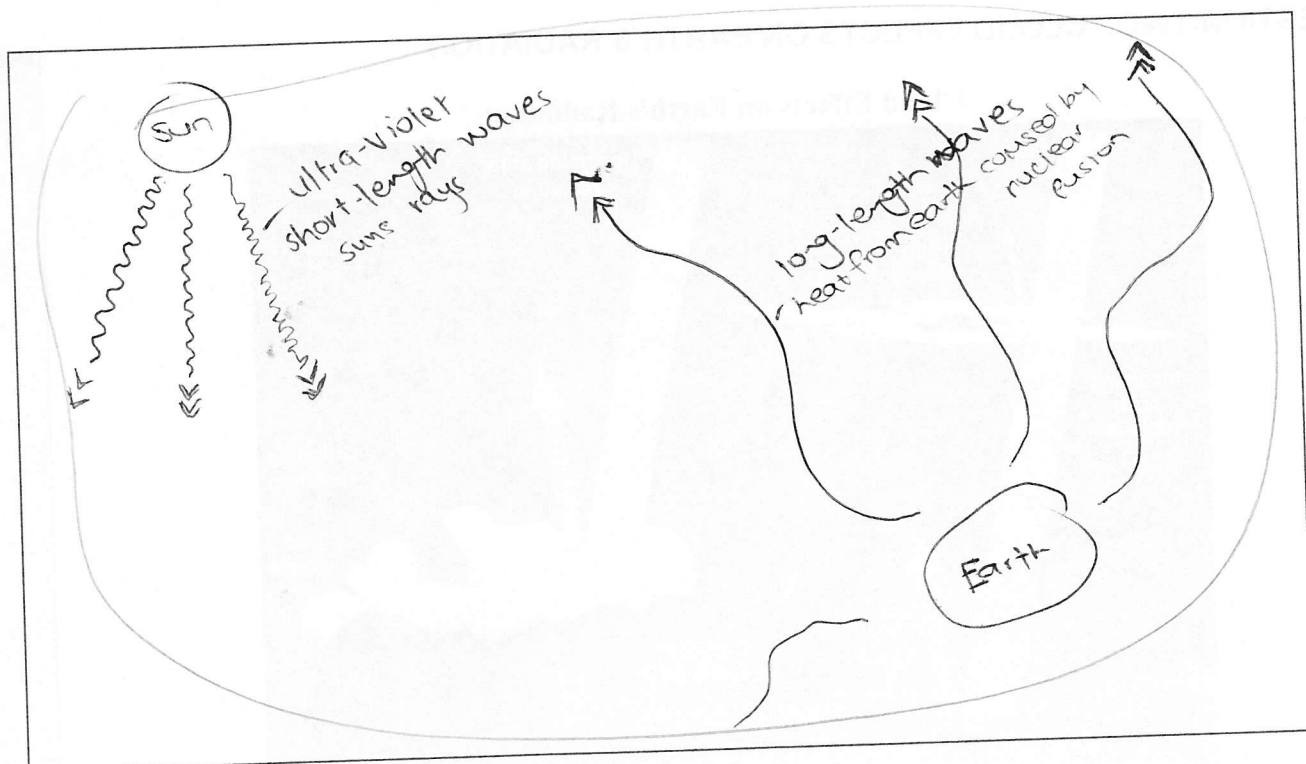
In your answer, you should consider:

- where clouds may form and the effect the different locations may have on energy transfer to and from the Earth
- the difference between the energy from the Sun and the Earth
- whether the clouds may have a warming or cooling effect on the Earth at different times of day.

A diagram may assist your answer; there is space for this on the following page.

There are two main types of clouds. High level clouds and low level clouds. High level clouds are thin and wispy with a low density, low ~~low~~ clouds are thick and fluffy with a high density. ~~Less dense clouds rise as denser ones sink~~. High level clouds are high in the atmosphere while low level clouds are low in the atmosphere.

More space for this answer is available on the following pages.



Energy from the sun, reaches Earth via tiny, short ultra-violet rays. Energy from the Earth travels through the atmosphere via long-length waves.

High level clouds have a warming effect.

Because of their ^{low density} ^{from the sun.} they let the ultra-violet short wave-lengths through to Earth without reflecting much back into the atmosphere.

~~However~~, The ^{long} ~~short~~ wave-length radiation from Earth, ^{some} ~~also~~ reflects ~~straight~~ back to Earth and some carries on through the cloud into the atmosphere, because the

high level clouds let through almost all the sun's ultra-violet rays, ~~they~~ and reflect some of the ~~earth~~ heat from Earth, they have a warming effect. Low-level clouds block most of the sun's ultraviolet rays and reflect it back, ~~it~~ it also holds in more of the heat which earth releases.

Because the low level clouds block most of the ultraviolet rays and let out a bit of ~~Earth~~ the heat from Earth, they have a cooling effect.

More ultra-violet rays get through high level clouds because they are less dense so the rays can pass through with few of the light particles colliding with the cloud particles which would reflect or scatter the light. Long wave-length rays, from Earth, have more collisions, so more of the heat is reflected. This occurs in both types of clouds, however, the denser, low level clouds cause more collisions so they reflect more of the heat. The low-level clouds greater density also means more of the ultra-violet short-length waves collide with particles within the clouds so more ~~rays~~ ultra-violet rays are reflected and less reach Earth.

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During dusk or dawn where there is very little ^{but still outgoing radiation,} sunlight, the clouds reverse roles so the high level clouds have a cooling effect as they reflect less of the outgoing radiation.

The low-level clouds reflect a ~~large~~ amount of outgoing radiation back to Earth which has a warming effect.

QUESTION THREE: OCEAN CIRCULATION

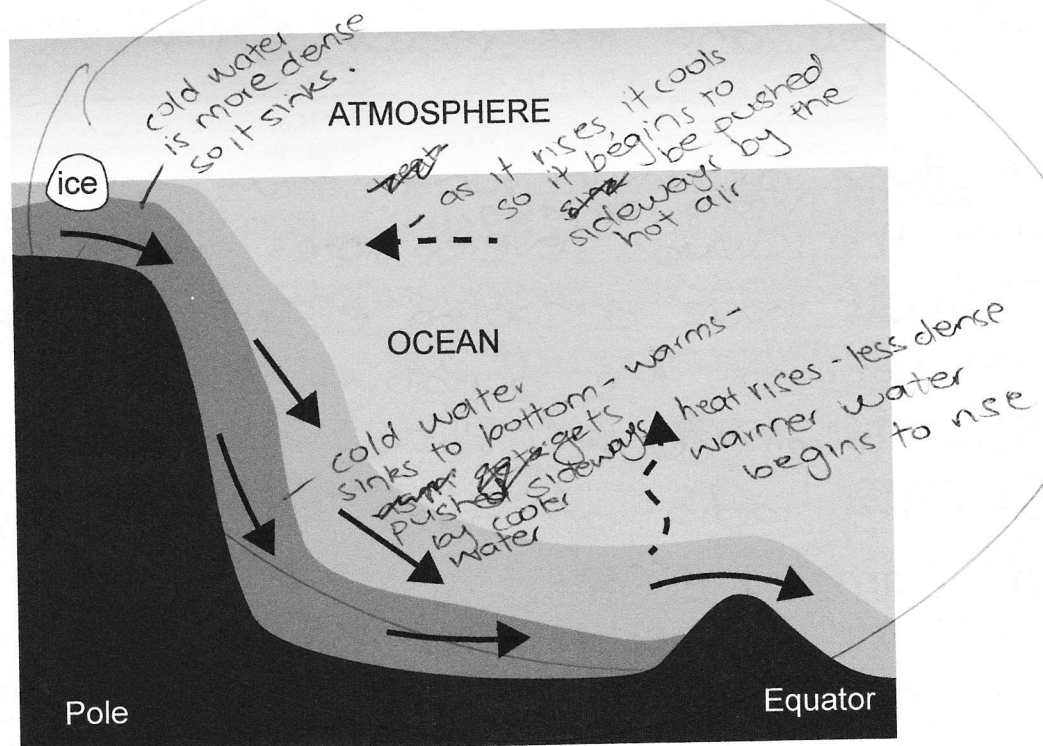
www.jpl.nasa.gov/images/earth/20100325/atlantic20100325-full.jpg

The global ocean conveyor belt is a series of ocean currents that transfer heat around the globe, driven by cold, dense water sinking at the poles. It has a major effect on the Earth's climate, accounting for a quarter of the Earth's heat transport.

Explain in detail the energy transfer processes involved in the global ocean conveyor belt.

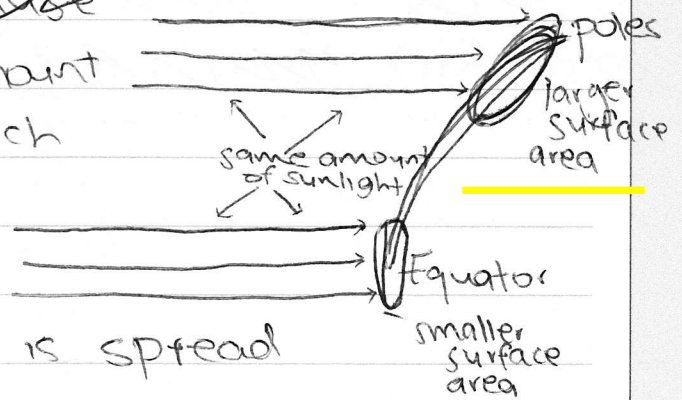
In your answer, you should:

- ✓ label the diagram below, showing heat transfers taking place at different latitudes
- ✓ explain the reason for the temperature difference between the poles and the Equator
- explain, in detail, the energy transfers taking place
- explain the role of these heat transfer processes in the Earth's climate.



The reason for the temperature difference between the poles and the Equator is because the sun shines directly at the Equator so they sunlight/heat is concentrated on a smaller surface area, at the poles the same amount of the sun's light/heat ~~then~~ covers a much larger surface area. ~~Because~~

Because the same amount of sunlight covers a much larger surface area near the poles, the



same amount of heat is spread over a ~~large~~ larger surface area, making it less concentrated than around the Equator so it is also cooler around the poles. So the ocean around the poles are cold and more dense, which makes it sink. The water around the Equator is warmer

so it rises. As the ~~not~~ cold water from the poles gets closer to the Equator it warms and gets pushed along by cold water from poles, as the water reaches the Equator it rises again as it warms, ^{then} it gets pushed back toward the poles ~~where it begins~~ by the hot water continuing to rise, as it moves ~~to~~ closer to the poles, it cools again and will sink and complete the cycle over and over ^{this is the global ocean conveyor belt}.

The cool subsurface flow is the cold, dense water from the poles and the warm

More space for this
answer is available on
the following page.

surface flow is the water from around the Equator where it is warmer. The warm water is less dense so it is above the dense, cold water which is subsurface. This heat transfer process makes Earth's temperature more controlled or balanced so ~~it~~ it doesn't get too hot or too cold for ~~the~~ life to exist on Earth.

Merit Exemplar 2019

Subject	L2 Earth and Space Science	Standard	91193	Total score	13
Q	Grade score	Annotation			
1	A3	<p>The candidate has stated how light travels in waves through space and the link between wavelength with the different colours of that make up visible light.</p> <p>The candidate would have at merit level if they had referred to light being scattered instead of reflected by water particles in the cloud. The diagram indicates an understanding of the concept but uses incorrect vocabulary.</p>			
2	M5	<p>The candidate refers to incoming short wave radiation and out going longer wavelength radiation. (See diagram). The effect of low clouds on the shorter wavelength radiation in relation to the cooling effect on Earth is explained in terms of reflected.</p> <p>The link between the warming effect of high level clouds and shortwave radiation is given but needs to be clarified in relation to the another merit point.</p>			
3	M5	<p>The candidate explains the relationship between sun's heating of Earth surface and the movement of warm water from the Equator to the Poles. The sinking of cold water at the poles is linked to the movement to density.</p> <p>The explanation could have been developed further linking the descending cold water to its movement along the ocean floor and the heat transfer from the ocean to the atmosphere.</p>			

Confirmation of check	Y / N
This exemplar has been checked for similarities with current online exemplars.	Y