Higher Geography

Paper one

Physical and Human environment

Atmosphere

Model answers

Atmosphere Model answers

1. Earth's albedo

"Describe and explain the energy exchanges that result in the Earth's surface receiving only 56% of the solar energy which reaches the outer atmosphere."

- ✓ The earth's surface does not receive all of the insolation that reaches the outer atmosphere.
- ✓ This is due to the processes of reflection and absorption by the atmosphere and the earth's surface.
- ✓ 21% is reflected by highly reflective clouds.
- ✓ 5% is reflected by atmospheric gases and dust.
- ✓ 3% is absorbed by water vapour, gases and particularly dust due to darker, absorbing colour.
- ✓ This results in 44% of insolation never reaching the earth's surface.
- ✓ Of the 56% which does reach the surface 50% is absorbed by the surface (land and vegetation) and 6% is reflected (water, deserts and glaciers)
- ✓ The 32% lost by reflection is called the earth's albedo.

**These percentages are approximates only and may vary depending on the source used.

Atmosphere Model answers

2. The energy budget

"Explain why there is a surplus of solar energy in tropical latitudes and a deficit towards the poles"

Tropical latitudes

- ✓ Sun's rays strike here vertically i.e. from directly overhead.
- ✓ Due to the minimal curvature of the earth here, sun's rays strike surface at right angles.
- ✓ Insolation is therefore concentrated over a small surface area.
- ✓ Again due to the earth's curvature, the sun's rays have less atmosphere to pass through.
- ✓ This means less energy is lost to reflection and absorption.
- ✓ Darker forest surfaces absorb energy.

Polar latitudes

- ✓ The sun's angle in the sky decreases
- ✓ The greater curvature of the earth means insolation is spread over a wide surface area.
- ✓ Again due to the greater curvature, the sun's rays have more atmosphere to pass through.
- ✓ More energy is therefore lost to reflection and absorption.
- ✓ Polar ice caps are highly reflective surfaces.

Atmosphere Model answers

3. Climate change

"Suggest physical and human factors which might have contributed to variations in average work temperature"

Physical factors

- ✓ Sunspot activity

  Changing solar radiation outputs serve to raise and lower world temperatures.

- ✓ Orbital variations
  - "41,000 year tilt" – greater tilt in the Earth's axis increases insolation at the poles.
  - "97,000 year stretch" – earth's orbit around the sun "stretches" to an elliptical shape, decreasing insolation.

- ✓ Volcanic eruptions

  Volcanic dust reduces temperatures by shielding incoming insolation.

- ✓ Increasing methane levels
  - Peat bogs
  - Flatulent termites.

Human factors

- ✓ Increasing CO2 levels
  - Enhanced burning of fossil fuels – industry, agriculture, transport, power stations.
  - Enhanced rainforest deforestation.
  - Above combine to increase atmospheric CO2, trap heat and raise global temperatures.

- ✓ Increased methane levels

- Increasing numbers of flatulent domestic cattle.
- Paddy fields
- Waste disposal sites.

Atmosphere Model answers

4. Global heat transfer

A. Air Masses

"Describe and explain the origin, nature and characteristics of the Tropical Maritime and Tropical Continental air masses"

Tropical maritime

- ✓ Originates over Atlantic Ocean in tropical latitudes.
- ✓ As a result, air is warm, moist and unstable.
- ✓ Associated weather is hot-very hot and humid.

Tropical continental

- ✓ Originates over Sahara Desert, a large land mass in tropical latitudes.
- ✓ As a result, air is warm, dry and stable.
- ✓ Associated weather is very warm, dry weather in winter and extremely hot, dry weather in summer.

B. Global surface winds

"Describe and account for the generalised pattern of surface winds"

- ✓ Intense heating over the equator creates and powers atmospheric circulation cells e.g. Hadley cells and associated surface winds.
- ✓ Within the circulating cells, air rises and descends at different latitudes creating belts of high and low pressure.
- ✓ Surface winds blow from areas of high to low pressure i.e.
    - Subtropical high to equatorial low
    - Polar high to temperate low.
- ✓ The coriolis force deflects surface winds to the right in the Northern Hemisphere and to the left in the Southern Hemisphere.

C. Ocean Currents

"Describe and account for the pattern of ocean currents in either the Atlantic Ocean or the Pacific Ocean"

- ✓ Ocean currents are surface movements of water
- ✓ In the North Atlantic, they follow circular, clockwise routes.
- ✓ In the South Atlantic, they follow circular, anti-clockwise routes.
- ✓ This is because atmospheric circulation cells produce prevailing winds which blow over the surface of the ocean.
- ✓ As a result, the ocean currents are dragged in the same direction as the prevailing winds i.e. clockwise in North hemisphere, anti-clockwise in the Southern hemisphere.

D. Atmospheric circulation

"Describe the role of atmospheric circulation in the redistribution of energy over the globe"

- ✓ Intense heating occurs in tropical latitudes whilst cooling occurs in polar latitudes.
- ✓ This results in warm air rising at the equator and cold air descending at the poles.
- ✓ Rising and descending air creates circulation cells, the most important of which is the sub-tropical Hadley cell.
- ✓ At polar latitudes, the Polar cells develop.
- ✓ Between the Hadley and the Polar cells, the mid-latitude Ferrell cells develop.
- ✓ These circulation cells and their associated wind belts, e.g. the trade winds, transfer heat energy from areas of surplus – the equator – to deficit – the poles.

E. Oceanic circulation

"Describe the role of oceanic circulation in the redistribution of energy over the globe"

- ✓ Equatorial waters are heated to a greater extent than polar waters.
- ✓ Polar waters, being therefore colder, are heavier and sink to the ocean floor.
- ✓ Polar currents, e.g. the Labrador – then flow towards the equator, displacing upwards the lighter, warmer equatorial waters.
- ✓ Simultaneously, the warmer equatorial waters are lighter and rise as surface currents to flow polewards e.g. the Gulf stream.
- ✓ There is therefore a general movement of cold polar water to the equator and warm equatorial water to the poles.
- ✓ Oceanic circulation, like atmospheric circulation, therefore transfers heat energy from areas of surplus to deficit i.e. the equatorial low latitudes to the polar high latitudes.

Atmosphere Model answers

5. The ITCZ

"Describe and account for the variation in rainfall across West Africa"

- ✓ The climate of West Africa has marked seasonal variations.
- ✓ Annual rainfall is high near the coast, but decreases northwards away from the coast with seasonal changes.
- ✓ The seasonal changes are related to the movement of two air masses and the thermal equator – the zone of most intense heating.
- ✓ The Tropical Maritime air mass originates over the Atlantic Ocean and brings rainfall.
- ✓ The Tropical Continental air mass originates over the Sahara Desert and brings warm, dry weather.
- ✓ The ITCZ is where the trade winds converge and creates an area of low pressure which brings rainfall to West Africa.
- ✓ The ITCZ's position is not fixed. It migrates north and south of the equator with the seasonal movement of the thermal equator.

- ✓ In July, the ITCZ migrates north over the Southern Sahara. This allows the Tropical Maritime air mass to feed in north from the Gulf of Guinea and dominate the area's weather, bringing rain.

- ✓ In January, the ITCZ migrates south and the Tropical Continental air mass dominates the region bringing drought conditions. Only the coastal areas are affected by Tropical Maritime air and receive rain.