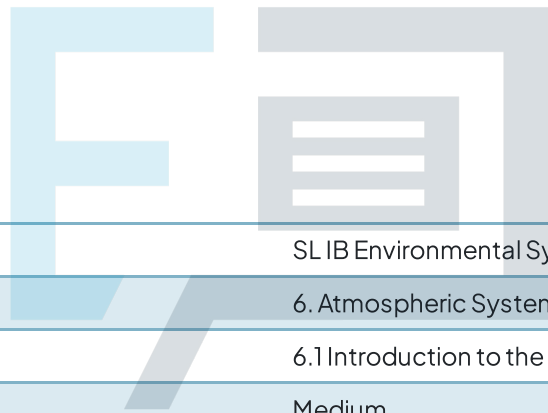




6.1 Introduction to the Atmosphere

Mark Schemes



Course	SL IB Environmental Systems & Societies (ESS)
Section	6. Atmospheric Systems & Societies
Topic	6.1 Introduction to the Atmosphere
Difficulty	Medium

Exam Papers Practice

To be used by all students preparing for
SL IB Environmental Systems & Societies (ESS)
Students of other boards may also find this useful

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Indicative Content

The albedo effect and its significance in regulating the global temperature can be explained as follows:

Any **four** from the following:

- Albedo refers to / is a measure of a surface's reflectivity/reflectiveness, which is normally high(er) for smooth(er) / light(er)-coloured surfaces / low(er) for rough(er) / dark(er)-coloured surfaces; [1 mark]
- Surfaces with high albedo reflect solar radiation away, which contributes to reducing temperatures **OR** surfaces with low albedo absorb solar radiation, leading to temperature increases; [1 mark]
- The Earth's albedo is significantly influenced by oceans/ice/clouds, which have a crucial role in the planet's overall reflectivity
- The level/balance of Earth's surface albedo involves complex feedback loops; [1 mark]
- Negative feedback loops work to counteract changes, preserving the albedo balance/ratio, stabilising the global temperature; [1 mark]
- E.g. if the global temperature rises, increased evaporation may lead to more cloud cover, which increases albedo, reflecting solar radiation and thereby reducing temperature; [1 mark]
- (But) changes in the level/balance of (Earth's surface) albedo can trigger a positive feedback loop, amplifying changes and causing a rise in the Earth's global temperature; [1 mark]
- E.g. the (current) rise in global temperature is leading to ice cap melting, decreasing albedo, increasing absorption of solar radiation, and further elevating global temperatures; [1 mark]

Indicative Content	Commentary
<p>The role of the natural greenhouse effect in regulating Earth's temperature can be described as follows:</p> <p>Any four from the following:</p> <ul style="list-style-type: none"> • Key greenhouse gases / GHGs include carbon dioxide / CO₂ / methane / CH₄ / water vapour / H₂O / nitrous oxide / N₂O; [1 mark] • These gases are found naturally occurring in the troposphere; [1 mark] • Solar radiation / sunlight / visible/short wavelengths penetrate / pass through these greenhouse gases, reaching Earth's surface and warming it; [1 mark] • The warmed Earth's surface re-radiates / emits this energy (outwards/away from Earth's surface) as infrared radiation / heat; [1 mark] • Greenhouse gases absorb/trap outgoing long wavelength / infrared radiation; [1 mark] • (Therefore) a significant portion of the heat energy is retained, maintaining Earth's average surface temperature (approximately 15°C); [1 mark] 	<p>As this question is about the natural greenhouse effect you would not gain marks for giving anthropogenic greenhouse gases, such as tropospheric ozone, CFCs or HFCs</p> <p>When describing the greenhouse effect, be careful not to say that light/heat/solar radiation is "reflected" by the Earth's surface - instead use the terms absorbed and emitted, or re-radiated (see marking point 4)</p>

3a

Indicative Content	Commentary
<p>Transfers of energy occurring within the atmospheric system include:</p> <p>Any two from the following:</p> <ul style="list-style-type: none">• Radiation of sunlight / solar energy / heat / light directed towards the Earth's surface; [1 mark]• Heat / IR radiation emitted / re-radiated away from the Earth's surface; [1 mark]• Reflection of light/heat (back) towards space from clouds / Earth's surface; [1 mark]• Scattering of light/heat due to atmospheric particles / particulate matter in the atmosphere; [1 mark]• Movement/convection of heat towards poles due to wind currents / tricellular winds / Hadley Cell / convection cells / hurricanes / tropical cyclones; [1 mark]• Advection / the horizontal movement of warm or cold air masses, transferring heat energy from one region to another; [1 mark]• Latent heat transfer through water vapor movement in winds; [1 mark]• Gravitational potential energy transformed into kinetic energy in falling raindrops; [1 mark]	<p>Matter transfer refers to the movement or transfer of matter from one location or state to another</p>

3b

Indicative Content	Commentary
<p>Transformations of matter occurring within the atmospheric system include:</p> <p>Any two from the following:</p> <ul style="list-style-type: none"> • Condensation OR water vapour changing into liquid water; [1 mark] • Evaporation OR liquid water changing into water vapour; [1 mark] • Freezing OR liquid water turning into solid ice; [1 mark] • Melting OR solid ice changing into liquid water (melting); [1 mark] • Ozone destruction (by UV radiation) OR ozone converting into oxygen gas and (atomic) oxygen OR $O_3 \rightarrow O_2 + O$; [1 mark] • Chlorine reacting with ozone to produce chlorine monoxide and oxygen gas OR $Cl + O_3 \rightarrow ClO + O_2$; [1 mark] • Sulphur trioxide reacting with water to form sulphuric acid OR $SO_3 + H_2O \rightarrow H_2SO_4$; [1 mark] • Nitrogen oxides reacting with water to produce nitric acid OR $NO_x + H_2O \rightarrow HNO_3$; [1 mark] 	<p>Matter transformation refers to the changes that matter undergoes as it transitions from one form or state to another</p>

Indicative Content

Human activities affect atmospheric components in the following ways:

Any **two** of the following pairs of answers:

- Ozone; [1 mark]
- Reduced/decreased by the release of ozone-depleting substances e.g. CFCs used in aerosols / gas-blown plastics / pesticides / flame retardants / refrigerants); [1 mark]

OR

- Carbon dioxide; [1 mark]
- Increased by burning fossil fuels / deforestation / industrial processes; [1 mark]

OR

- Water vapour; [1 mark]
- Disrupted/increased/decreased by land use changes / agriculture / deforestation / industrial processes; [1 mark]

OR

- Methane; [1 mark]
- Increased by agriculture (livestock / rice production) / fossil fuel extraction/use / waste management (landfill sites); [1 mark]

OR

- Nitrous oxide; [1 mark]
- Increased by agriculture (fertiliser use / animal waste) / combustion processes e.g. in vehicle engines / industrial activities; [1 mark]

OR

- Aerosols e.g. fine particles / soot / dust / gases like sulphur dioxide / nitrogen oxides; [1 mark]
- Increased by industrial processes / biomass burning / vehicle emissions; [1 mark]