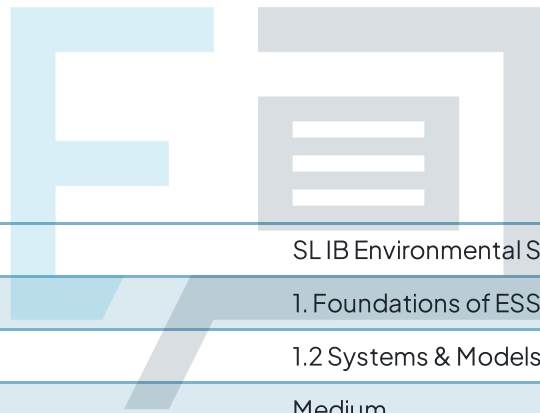




1.2 Systems & Models

Mark Schemes



Course	SL IB Environmental Systems & Societies (ESS)
Section	1. Foundations of ESS
Topic	1.2 Systems & Models
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

1a

Indicative Content	Commentary
<p><i>A system is:</i></p> <ul style="list-style-type: none"> • An assemblage/collection of components/parts; [1 mark] • ...that are interconnected OR that work together; [1 mark] • ...to carry out a specific purpose/function OR that together constitute an entity/whole; [1 mark] 	<p>The command word 'define' requires you to give the precise meaning of a word, phrase, concept or physical quantity</p> <p>The number of marks available here indicates that there are three parts to this definition that the examiner will be looking for</p>

1b

Indicative Content	Commentary
<p><i>Storages within the carbon cycle system include:</i></p> <p>Any two from the following:</p> <ul style="list-style-type: none"> • The atmosphere (as carbon dioxide); [1 mark] • Sedimentary rocks; [1 mark] • Fossil fuels OR coal/oil/gas; [1 mark] • Soil / organic matter; [1 mark] • Living organisms / animals / vegetation (e.g. as cellulose); [1 mark] • Dead organisms; [1 mark] • Dissolved in the oceans (as carbon dioxide); [1 mark] <p><i>Flows within the carbon cycle system include:</i></p> <p>Any two from the following:</p>	<p>The command word 'state' requires you to give a specific name, value or other brief answer without explanation or calculation</p> <p>Make sure you learn the various storages and flows for all systems covered in the ESS course</p> <p>This includes:</p> <ul style="list-style-type: none"> • The carbon cycle

<ul style="list-style-type: none"> • Consumption/feeding; [1 mark] • Decomposition; [1 mark] • Photosynthesis; [1 mark] • Respiration; [1 mark] • Dissolving; [1 mark] • Fossilisation; [1 mark] • Combustion; [1 mark] 	<ul style="list-style-type: none"> • The nitrogen cycle • The hydrological cycle • The soil system • The atmospheric system
--	---

2a

Indicative Content	Commentary
<p><i>The Earth and the atmosphere surrounding it can be viewed as a closed system for the following reasons:</i></p> <p>Any three from the following:</p> <ul style="list-style-type: none"> • Energy is exchanged across the boundary of the system but matter is not OR energy, but not matter, is exchanged between the system and its surroundings; [1 mark] • The main input of energy occurs via solar radiation; [1 mark] • The main output of energy occurs via heat / re-radiation of infrared waves from the Earth's surface; [1 mark] • Although small amounts of matter e.g. meteorites /spaceships/satellites enter or leave the system, these are considered negligible; [1 mark] • Matter is recycled completely within the system OR Earth's geochemical/carbon/nitrogen/hydrological cycles, recycle matter within the system; [1 mark] 	<p>The command word 'explain' requires you to give a detailed account, including reasons or causes</p> <p>'Energy is exchanged across the boundary of the system but matter is not' is a good initial statement, but as this question requires an explanation, you need to provide supporting statements that back this point up, such as specific examples of energy inputs and outputs</p> <p>Providing specific examples of matter recycling, such as the cycling of carbon and nitrogen, would also</p>

	strengthen your explanation
--	-----------------------------

2b

Indicative Content	Commentary
<p><i>Transfers and transformations in the hydrological cycle can be distinguished as follows:</i></p> <ul style="list-style-type: none"> • Transfers involve the flow of water (through the hydrological cycle/system) without it changing (physical) state OR transfers involve a change in the (physical) location of water (within the hydrological cycle/system) OR transfers are the movement of matter or energy from one component of the system to another, without any change in form or quality • Examples of transfers include (surface) runoff / precipitation / movement of water bodies (e.g. overland flow or flow of water from a river into a lake) / movement of clouds • Transformations take the form of an interaction within the hydrological cycle/system, leading to the formation of a new end product / a change of state OR transformations involve a change in the form or quality of matter or energy as it moves through the system • Examples of transformations include evaporation / condensation / melting / freezing/ice formation 	<p>The command word 'distinguish' requires you to make clear the differences between two or more concepts or items</p> <p>As the question states, you must make your answer specific to the hydrological cycle, by providing relevant examples of hydrological cycle transfers and transformations</p> <p>The flows of matter and energy within the carbon, nitrogen and hydrological cycles take the form of either transfers or transformations - make sure you revise this and know the difference between these two terms</p>

3a

Indicative Content	Commentary
<p><i>A holistic approach and a reductionist approach for studying systems can be distinguished as follows:</i></p> <p>Any two from the following:</p> <ul style="list-style-type: none"> • A holistic approach considers the entire system as a whole, whereas a reductionist approach focuses on studying individual parts (of the system) in detail; [1 mark] • A holistic approach recognises/takes into account the interconnectedness/interdependencies between (system) components, whereas a reductionist approach considers these (system) components in isolation; [1 mark] • A holistic approach aims to study/capture/assess/analyse the emergent properties / overall behavior of the system, whereas a reductionist approach aims for a more detailed understanding of specific components/interactions of the system; [1 mark] • A holistic approach can be more complex if this approach is used to assess a highly complex system, whereas the reductionist approach simplifies the system (by analysing individual parts); [1 mark] • A holistic approach is often applied in ecological studies / for examining the interactions within ecosystems, whereas a reductionist approach may not be as suitable for studying environmental systems due to their highly interconnected nature; [1 mark] 	<p>The command word 'distinguish' requires you to make clear the differences between two or more concepts or items</p> <p>Whenever you are asked to contrast or distinguish between two approaches, a good technique is to use the word 'whereas' in the middle of each of your contrasting points, to demonstrate to the examiner that you are directly contrasting one approach with the other</p>

3b

Indicative Content

A community of trees in a tropical rainforest could be viewed as a system in the following ways:

Any **six** from the following:

- Components of the system: an explanation that individuals or species of trees form the components of the system [1 mark]
- Interrelationships and interdependence: an explanation that these components are interrelated, interdependent, and form an integrated whole [1 mark]
- Examples of interrelationships and interdependence within the tree community: examples such as population regulation through competition and contribution to the succession of the rainforest community [1 mark]
- Flows of matter and energy: an explanation that there are transfers of matter and energy between the components or storages in the system [1 mark]
- Examples of matter and energy flows within the tree community: examples such as nutrient cycling through leaf fall decomposition, pollination, gene exchange, food storage in seeds, and the transport of glucose within the trees [1 mark]
- Processes and transformations: an explanation that the components carry out processes and transformations within the system [1 mark]
- Examples of processes and transformations within the tree community: examples such as photosynthesis, respiration, and growth [1 mark]
- Open system: an explanation that the tree community is an open system, exchanging matter and energy with its surroundings [1 mark]
- Examples of matter and energy exchange with the surroundings: examples such as the absorption of solar energy and the provision of nutrients for non-tree species [1 mark]
- Feedback mechanisms: an explanation that the system has feedback mechanisms to maintain equilibrium and balanced inputs and outputs [1 mark]

- Examples of feedback mechanisms within the tree community: examples such as increased seed production leading to more competition between seedlings, resulting in fewer viable offspring, or the death of trees leading to more light entering the canopy and promoting more tree growth [1 mark]

Model Answer	Commentary
<p><i>The trees interact with each other through competition, which regulates populations and contributes to succession within the rainforest community [1 mark]. The tree community has flows and transfers of matter and energy between its components and storages [1 mark]. For example, leaf fall provides nutrients through decomposition, benefiting other trees, and pollination and genetic exchange contribute to the overall biodiversity of the rainforest tree community [1 mark]. The components of the tree community carry out transformations such as photosynthesis, respiration, and growth [1 mark]. The tree community is an open system, exchanging matter and energy with its surroundings, as it absorbs solar energy for photosynthesis and provides nutrients for other organisms [1 mark]. Overall, the tree community in a tropical rainforest demonstrates the characteristics of a system,</i></p>	<p>The command word 'explain' requires you to give a detailed account, including reasons or causes</p> <p>'The tree community has flows and transfers of matter and energy between its components and storages' is a valid statement, but as this question requires an explanation, you need to provide supporting statements that back this point up, such as specific examples of these flows and storages</p> <p>Providing specific examples of energy and matter exchange, to make it clear why the tree community can be viewed as an open system, would also strengthen your explanation</p> <p>Be careful - the question asks you to refer specifically to the community of trees, rather than all the other species of plants and animals that are also contained within the tropical rainforest ecosystem, so it is a good idea to keep referring back to this in your answer</p> <p>A short concluding statement is useful to summarise a longer answer like this one</p>

<i>exhibiting interconnections, interactions, and flows of matter and energy [1 mark].</i>	
--	--

4a

Indicative Content	Commentary
<p><i>A model is:</i></p> <ul style="list-style-type: none"> • A simplified version/representation/approximation of a complex system / a phenomenon / reality; [1 mark] • That can be used / that is a tool to understand/study/analyse/predict the behaviour/characteristics of the system/phenomenon/reality; [1 mark] 	<p>The command word 'define' requires you to give the precise meaning of a word, phrase, concept or physical quantity</p> <p>The number of marks available here indicates that there are two parts to this definition that the examiner will be looking for</p>

4b

Indicative Content	Commentary
<p><i>Strengths of environmental models include:</i></p> <p>Any two from the following:</p> <ul style="list-style-type: none"> • They simplify complex environmental systems; [1 mark] • They allow predictions to be made about how environmental systems will react in response to change OR they enable predictions/extrapolations based on a wide input of historical data; [1 mark] • Utilisation of large quantities of data from diverse sources provides greater statistical certainty to predictions; [1 mark] 	<p>The command word 'evaluate' requires you to make an appraisal (i.e. a judgement or assessment of</p>



- Their inputs can be changed to observe effects/outputs, without the need to wait for real-life environmental events to occur; [1 mark]
- They are easier to understand than real environmental systems; [1 mark]
- Results from models can be shared between environmental scientists/engineers/companies; [1 mark]
- They provide relatively objective information to address political/emotional/contentious environmental issues; [1 mark]
- Results from models can be communicated to the public; [1 mark]
- Results from models can warn us about future environmental issues and how to avoid them or minimise their impact; [1 mark]

Limitations of environmental models include:

Any **two** from the following:

- They can be oversimplified/inaccurate **OR** approximations/simplifications are necessary in modelling, which can introduce uncertainties in predictions/outcomes; [1 mark]
- Results from models depend on the quality of the data inputs going into them; [1 mark]
- Results from models become more uncertain the further they predict into the future; [1 mark]
- Different models can show vastly different outputs even if they are given the same data inputs **OR** the availability of multiple models allows politicians to selectively choose those that align with their agendas, potentially undermining the objectivity of decision-making processes; [1 mark]
- Results from models can be interpreted by different people in different ways **OR** conflicting outputs from different models can introduce uncertainty and confusion for policy and decision-makers; [1 mark]

something)
by weighing
up the
strengths
and
limitations

Look at how
many marks
the question
is worth and
try and give a
balanced
evaluation by
providing an
even number
of strengths
and
weaknesses
- in this case
4 marks
indicates you
should give
at least two
strengths
and two
limitations



- Environmental systems are often incredibly complex / have many interacting factors so it is impossible to take all possible variables into account; [1 mark]
- Models often rely on assumptions that historical patterns and factors will continue to operate in the same manner, which may not always be valid; [1 mark]



Exam Papers Practice