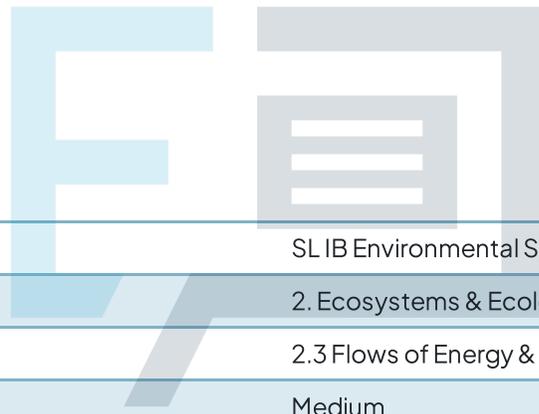




2.3 Flows of Energy & Matter

Mark Schemes



Course	SL IB Environmental Systems & Societies (ESS)
Section	2. Ecosystems & Ecology
Topic	2.3 Flows of Energy & Matter
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>i) Processes X and Y are:</i></p> <ul style="list-style-type: none"> • X = combustion/burning; [1 mark] • Y = decomposition/decay; [1 mark] <p><i>ii) Carbon is released during process Y in the following way:</i></p> <p>Any three from the following:</p> <ul style="list-style-type: none"> • Decomposers/bacteria/fungi release enzymes; [1 mark] • Decomposers/bacteria/fungi break down the (carbon-containing) molecules in dead tissue(s); [1 mark] • Carbon is released in the form of carbon dioxide/CO₂; [1 mark] • Carbon dioxide/CO₂ is the product of respiration (in decomposers); [1 mark] 	<p>Respiration would also be acceptable as an answer for Y, as it is the respiration of decomposers that releases carbon dioxide during decomposition.</p> <p>Decomposers such as fungi gain their nutrition by secreting enzymes onto their food. These enzymes break down the molecules in their food which can then be absorbed and used by the decomposers in respiration. Carbon dioxide is a product of respiration and is released into the atmosphere.</p>

1b

Indicative Content	Commentary
<p><i>i) Fossil fuel combustion contributes to rising average global temperatures because:</i></p> <p>Any two from the following:</p> <ul style="list-style-type: none"> • Carbon dioxide/CO₂ is released; [1 mark] • Carbon dioxide/CO₂ is a greenhouse gas; [1 mark] • Greenhouse gases trap heat energy inside the (Earth's) atmosphere; [1 mark] <p><i>ii) Deforestation increases the problem of global warming because:</i></p> <ul style="list-style-type: none"> • Less carbon dioxide will be removed if there are fewer trees / if trees are cut down; [1 mark] • As there will be less photosynthesis occurring / carried out by trees; [1 mark] 	<p>Although greenhouse gases and global warming are covered later in the course, it is essential that you are able to make the connection between the carbon cycle and the impact of human activities on global warming</p> <p>The combined impact of burning fossil fuels and cutting down trees is an increase in atmospheric carbon dioxide concentration, which has been linked by scientific research to rising global temperatures</p>

2a

Indicative Content
<p><i>The role of bacteria in the nitrogen cycle includes:</i></p> <p>Any five of the following:</p> <ul style="list-style-type: none"> • (Some are called) nitrogen fixing (bacteria) / (which are responsible for) nitrogen fixation; [1 mark] • (During nitrogen fixation) nitrogen gas (in the atmosphere is converted) to ammonia / nitrates / amino acids; [1 mark]

- (Some are called) nitrifying (bacteria) / (which are responsible for) nitrification; [1 mark]
- (During nitrification) ammonia (is converted) to nitrite / nitrite (is converted) to nitrate / ammonia (is converted) to nitrate; [1 mark]
- (Some are called) denitrifying (bacteria) / (which are responsible for) denitrification; [1 mark]
- (During denitrification) nitrate (is converted) to nitrogen gas / (denitrification) reduces (the amount of) nitrogen available to plants; [1 mark]

2b

Indicative Content	Commentary
<p><i>The farm may be causing the increase in nitrate concentration by:</i></p> <ul style="list-style-type: none"> • Excessive use / overuse of fertilisers; [1 mark] • (Which can lead to) run-off / leaching (into stream); [1 mark] 	<p>Fertilisers used by farmers contain nitrates as these are essential for the successful growth of crops</p> <p>Sometimes, farmers apply more fertiliser than the crops need or can use at a particular time</p> <p>This can mean that the unused fertilisers (and the nitrates they contain) become dissolved in rainwater or irrigation water and then wash ("run-off") into waterways such as nearby ponds or rivers - this process is known as leaching</p>

3a

Indicative Content	Commentary
<p><i>The term gross primary productivity refers to:</i></p> <ul style="list-style-type: none"> • The <u>rate</u> at which plants/primary producers (are able to) store chemical energy (as biomass); [1 mark] • ...via photosynthesis/chemosynthesis; [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</p>

OR

- The amount of light energy converted to chemical energy in plant biomass; [1 mark]
- ...in a given area (or a given volume in an aquatic system) in a given amount/period of time; [1 mark]

available here indicates that there are two parts to this definition that the examiner will be looking for

Gross primary production can be abbreviated to GPP

Primary productivity is a measure of the rate of primary production, so must include a unit of time

3b

Indicative Content	Commentary
<p><i>Only 1% of light energy is made available to other organisms because:</i></p> <p>Any four of the following:</p> <ul style="list-style-type: none"> • Energy is <u>reflected</u> back into space by clouds/(atmospheric) dust; [1 mark] • Energy is <u>absorbed</u> by the atmosphere/dust/molecules/clouds; [1 mark] • Only certain wavelengths (of light) are absorbed during photosynthesis / some light reflects off leaves; [1 mark] • Not all light falls on photosynthesising parts of the plant / not all light hits/enters/falls on the chloroplasts; [1 mark] • Light may fall away from plants (e.g. light may hit bare ground/open water) so can't be absorbed; [1 mark] 	<p>Don't include the fact that the Sun radiates energy in all directions, and only a tiny fraction reaches Earth</p> <p>The question starts with the amount of energy reaching the Earth's atmosphere</p> <p>The final marking point recognises that other factors (such as</p>

<ul style="list-style-type: none"> Other factors e.g. low temperature/carbon dioxide concentration may limit the rate of photosynthesis/primary production/productivity; [1 mark] 	<p>temperature and CO₂ availability) can sometimes be the limiting factor in photosynthesis and primary production</p>
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4a

Indicative Content	Commentary
<p><i>i) Net primary production does not represent the total amount of plant biomass formed per year by photosynthesis because:</i></p> <p>Any one from:</p> <ul style="list-style-type: none"> (Some) biomass is respired; [1 mark] Net primary production = gross primary production - respiration; [1 mark] NPP = GPP - R; [1 mark] (Some) biomass is lost as carbon dioxide/CO₂; [1 mark] <p><i>ii) There is a greater number of woodlice in site X than in site Y because:</i></p>	<p>Gross primary production (GPP) is the total amount of chemical energy converted from light energy by plants, in a given area, in a given time</p> <p>Approximately 50% of GPP is lost to the environment as heat when the plants respire</p> <p>This is known as respiratory loss (R)</p> <p>Net primary production (NPP) is the remaining energy available to a plant (after respiratory losses) for growth and reproduction - the energy is stored in the plant's biomass</p> <p>It is also the energy available to organisms at the next stage in the food chain (the next trophic level), which includes herbivores and decomposers/detritivores (such as woodlice)</p>

<ul style="list-style-type: none"> (Site X has a) greater net primary production/NPP, (so / meaning that site X has) more food/energy available for the woodlice; [1 mark] <p><i>iii) The energy lost as heat from respiration from one square metre of this grass in one year is:</i></p> <ul style="list-style-type: none"> 8 000 kJ; [1 mark] 	<p>Net primary production (NPP) = gross primary production (GPP) - respiration (R). This can be rearranged to give:</p> $R = GPP - NPP$ $R = 20\,000 \text{ kJ m}^{-2} \text{ yr}^{-1} - 12\,000 \text{ kJ m}^{-2} \text{ yr}^{-1}$ $R = 8\,000 \text{ kJ m}^{-2} \text{ yr}^{-1}$ <p>This means the grass is losing 8 000 kJ of energy per square metre per year</p>
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4b

Indicative Content	Commentary
<p><i>The efficiency of energy transfer for zooplankton is:</i></p> <ul style="list-style-type: none"> $(1120 \div 8900) \times 100$; [1 mark] 12.6 / 12.58 (%); [1 mark] 	<p>Full marks would be awarded for the correct answer in the absence of calculations but it is always a good idea to show your working as you may still receive a mark for this even if your final answer is incorrect</p>