

# Markscheme

**May 2025**

**Environmental systems and societies**

**Standard level**

**Paper 2**

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## Subject details: Environmental systems and societies SLP2 Markscheme

### Mark allocation

Candidates are required to answer:

- **ALL** questions in Section A [25] and **TWO** questions in Section B [40].
- The maximum total = [65].

1. Environmental systems and societies uses marking points and markbands to determine the achievement of candidates

*When using marking points (All of this paper except Section B, part (c) questions):*

- i. A markscheme often has more marking points than the total allows. This is intentional
- ii. Each marking point has a separate line and the end is shown by means of a semi-colon (;)
- iii. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **precise point** where it becomes clear that the candidate deserves the mark. **One tick to be shown for each mark awarded**
- iv. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

*When using markbands (Only for Section B, part (c) questions):*

- i. Read the response and determine which band the response fits into
- ii. Then re-read the response to determine where the response fits within the band
- iii. Annotate the response to indicate your reasoning behind the awarding of the mark  
**Do not use ticks at this point**
- iv. Decide on a mark for the response
- v. At the end of the response place the required number of ticks to enable RM Assessor to input the correct number of marks for the response.

2. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.
3. Words in brackets ( ) in the markscheme are not necessary to gain the mark.
4. Words that are underlined are essential for the mark.
5. If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).

6. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
7. Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.
8. Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

### Section A

1. (a) Identify the category with the lowest global harvest weight from aquaculture in **Figure 1**. [1]

Marine fish;

- (b) (i) Using **Figure 1**, calculate the projected increase in the harvest of freshwater fish between 2019 and 2050. [1]

(105 million – 58 million) 47 000 000 / 47 million (T) (accept 44 – 50 million T);

**Note to examiners:** Do not accept % value. Units (T) are not required for credit in this question.

- (ii) Outline **one** reason for the increase referred to in **(b)(i)**. [1]

- a. Rising world population causes increased demand for food;
- b. Greater demand for high protein foods;
- c. Improved technology and techniques for catching/aquaculture of freshwater fish;
- d. Greater desire/interest in some countries for locally caught/harvested foods;
- e. Depleted stocks of wild fisheries;

- (c) Describe **two** possible reasons for the difference in global aquaculture harvest between marine fish and molluscs in **Figure 1**. [2]

- a. Molluscs are easier to farm than marine fish / marine fish are more easily captured in wild';
- b. some molluscs are small and less mobile, and so require less area to culture;
- c. Molluscs and their resources/conditions are easier to control than marine fish;
- d. Different species of molluscs can be raised in both freshwater and marine aquaculture environments;
- e. Some molluscs reach maturity for harvesting faster than marine fish / high turnover rate leads to larger harvest;
- f. Market price (per unit weight) is higher for molluscs making aquaculture a profitable choice;

**Note to examiners:** Award credit for converse of MPs b-f (as in MPa).

- (d) Evaluate the use of aquaculture in meeting the projected harvest of global seafood, as shown in **Figure 1**.

**[4]**

**Pros [3max]:**

- a. Seafood demand is expected to rise significantly by 2050, so it can provide new/more sources of food;
- b. Aquaculture harvest would reduce stress on wild fisheries/farming land;
- c. Provides economic opportunities for coastal nations, particularly developing nations;
- d. Waste and nutrients can be cycled, making it more sustainable / usually reduces food miles;
- e. More than one species can be harvested in Integrated multi-trophic aquaculture (IMTA);
- f. Many forms of seafood have a high protein value;
- g. Aquaculture, usually, is more efficient (economically, ecologically) than capture;

**Cons [3max]:**

- a. May lead to loss of habitat in certain ecosystems;
- b. Greater localized aquatic pollution (antibiotics, medicines, nutrient pollution, etc.);
- c. Spread of diseases and escaped species (some involving genetically modified organisms);
- d. Ethical concerns towards mass fish farming or genetically modified organisms (GMOs);
- e. It is not economically viable to farm large marine species like tuna with aquaculture;
- f. May raise local water conflicts;
- g. Difficult to certify for sustainability/social responsibility;
- h. Current frameworks suit better, in most case, large-scale industrial aquaculture (rather than small-scale farmers);
- i. Current share of marine fish coming from aquaculture suggests it is unpopular;
- j. Aquaculture has high set-up/maintenance costs / requires a lot of resources i.e. fish feed/antibiotics;

**Note to examiners:** Credit any valid advantage or disadvantage. Do not credit simplistic arguments, like more costly, more sustainable, more efficient, etc.

*Credit other valid responses*

2. (a) Identify the altitude with the highest concentration of ozone shown in **Figure 2(a)**. [1]  
22–24 km;

**Note to examiners:** Do not credit if units are omitted.

- (b) With reference to **Figure 2(a)**, describe reasons why a decreased concentration of ozone between 20 and 30 kilometers would have impacts on the earth's surface. [2]
- a. Ozone in the stratosphere absorbs ultraviolet radiation from the sun / Less ozone means more ultraviolet radiation reaching the earth's surface;
  - b. Ultraviolet radiation is harmful for living tissues / increasing the incidence of cataracts / mutation during cell division / skin cancer/melanoma;
  - c. Increased ultraviolet radiation may reduce biological productivity and damage photosynthetic organisms including phytoplankton;

**Note to examiners:** Do not credit responses that mistakenly identify global warming/climate change as an impact.

- (c) State **one** possible impact of increased ground-level ozone concentration on human health. [1]  
Damages lungs/lung tissue / irritates respiratory tissue/bronchitis/emphysema / eye irritation / lung cancer / cardiovascular issues;

**Note to examiners:** Do not credit conditions relating to UV radiation or global warming i.e. cataracts, skin cancer etc.

- (d) Outline **two** possible reasons for the change in ozone exposure for Brazil shown in **Figure 2(b)**. [2]
- a. Increased release/production of NO<sub>x</sub>/VOC/ozone from industry/transport/fossil fuel use (due to population increase/raised standard of living);
  - b. Increased number of livestock releasing more methane (a VOC);
  - c. Growing industrial sector but lower environmental standards;
  - d. Climate change influencing increased use of air conditioners/energy releasing heat in urban areas;
  - e. Higher standards of living leading to increased energy use/consumption;
  - f. Climate change led to decreased precipitation/wind speed to wash the air clean (of ozone);

- (e) Outline **two** possible ways countries can reduce their ozone exposure, as shown in **Figure 2(b)**. [2]
  - a. Increased investment into renewable technology/energy sources;
  - b. Stricter laws/taxes for vehicle/industry emissions of NO<sub>x</sub> & VOCs / Set/enforce stricter ozone air concentration standards;
  - c. Public policy initiative (e.g. don't drive days/vehicle bans/improved public transportation/promote biking etc.);
  - d. Technological improvements (e.g. catalytic convertors/scrubbers/electric vehicles);
  - e. Improve energy efficiency in buildings/appliances;
  - f. Promote sustainable agricultural practices that do not emit methane (a VOC);
  - g. Promote sustainable behaviour, like carpooling, reduced use of solvents/paints;
  - h. Planting trees/greening in cities reduces ozone levels;
  
- 3. (a) Identify the household waste category with the highest carbon impact from production in **Figure 3**. [1]

Clothing;
  
- (b) Describe **one** possible reason why paper waste has higher overall carbon impacts than metal waste in **Figure 3**. [1]
  - a. Metal waste is recycled at a much greater level than paper/cardboard waste / metal waste is recycled while paper/cardboard is not / recycling of metal reduces overall carbon impact;
  - b. More paper/cardboard waste is put into landfill than metal waste / landfill increases the overall carbon impact;
  - c. Decomposition of paper releases carbon but metal waste does not (only its production);
  
- (c) Outline **two** disadvantages of using landfill to dispose of food waste, as shown in **Figure 3**. [2]
  - a. Takes up room that could be used for non-biodegradable waste/other uses of land;
  - b. Reduces potential to be composted/upcycled/repurposed;
  - c. Landfill leachates polluting soil/rivers/groundwater resources;
  - d. Potential for vermin/disease;
  - e. Landfill gases can cause explosions/landfills release methane/carbon dioxide contributing to global warming;
  - f. Landfill impacts aesthetics of landscape/creates bad odours that decrease local property value;
  - g. Landfills will increase ecological footprint;
  
- (d) Outline **two** disadvantages with recycling clothing as an approach to decreasing carbon impacts, as shown in **Figure 3**. [2]
  - a. Some clothes cannot be recycled;
  - b. time/labour intensive as components (such as zips/buttons) need to be removed / different fibres need to be separated which is time/labour intensive;
  - c. Fashion may encourage non-recyclable clothing;
  - d. Recycling of clothing may be less profitable than other areas of recycling;
  - e. Some clothing can be reused, which is more efficient than recycling;
  - f. Recycling may involve use of non-renewable energy/fossil fuel use/CO<sub>2</sub> production;

- (e) Suggest **two** pollution management strategies that could be used to decrease the carbon impacts from paper waste in Scotland. **[2]**
- a. Greater local investment into recycling/composting programs;
  - b. Education/publicity campaigns highlighting issue of paper waste/promoting recycled paper/recycling paper;
  - c. Incentives to reduce paper mail towards electronic mail;
  - d. Legislation/incentives to reduce packaging in industries;
  
  - e. Legislation to increase the proportion of recycled material in the manufacture of paper and cardboard;
  - f. Increase price of paper/add paper tax to reduce consumption;
  - g. Reforestation/afforestation to sequester/absorb more carbon;

**Note to examiners:** Do not credit response that simply states "recycling" or responses that address deforestation.

## Section B

4. (a) Identify **four** characteristic features of the tundra biome

[4]

*Tundra biome has:*

- a. Low species diversity;
- b. Low primary productivity/photosynthesis;
- c. Low mean temperatures;
- d. Frozen precipitation;
- e. Permafrost/frozen soils;
- f. Small alpine plants, lichens;
- g. Short food chains;
- h. Slow decomposition rate;
- i. Migratory/hibernating animals;
- j. Limited sunlight due to latitude;

- (b) Explain how a community of carnivores contributes to the stability of the whole ecosystem.

[7]

- a. Carnivores contribute to negative feedback within an ecosystem by...;
- b. ...feeding on the community of herbivores / passing on biomass/being consumed by top carnivore communities...;
- c. ...leading to a reduction in the number of herbivores/carnivores...;
- d. ...which will lead to a reduction in the number of carnivores/top carnivores, etc....;
- e. ...thus regulating the population size of herbivores/top carnivores;;
- f. Through defaecation they will release dead organic matter;
- g. This will provide food/support for a decomposer community;
- h. Their eventual death would also provide food for decomposers;
- i. Carnivores may compete with one another regulating their own populations;
- j. Carnivores may leave some prey biomass uneaten that feeds scavengers;
- k. Carnivores may be at the top of multiple food chains/act as keystone species thus providing cohesion to whole system;
- l. Carnivores will tend to prey more on the most abundant herbivore species allowing a wider diversity of herbivores to coexist;

- (c) To what extent is an anthropocentric value system more appropriate than other value systems in addressing issues of sustainability?

[9]

*Answers may demonstrate:*

- **understanding concepts & terminology** of anthropocentrism/ ecocentrism/technocentrism; social/economic/environmental sustainability; environmental law & legislation; Carbon & water taxes; UNEP; CITES; Montreal protocol; COP conferences; Fishing regulations; quotas; renewable resources; sustainable yield; circular economy; etc.
- **breadth in addressing and linking** range of anthropocentric values/strategies with different aspects of sustainability.
- **examples** of anthropocentric values, strategies, international bodies and aspects of sustainable living/development etc.
- **balanced analysis evaluating** extent to which an anthropocentric value system is more or less beneficial in addressing sustainability than other value systems .
- **a conclusion that is consistent with, and supported by analysis and examples given** e.g. While anthropocentrism may share with ecocentrism a central concern for sustainability it has the added concern to enforce its values through legislation and agreements rather than relying on the widespread altruism of human societies.

*Please see markbands on page 18.*

5. (a) Outline **four** ways in which atmospheric nitrogen and nitrogen oxides may influence natural ecosystems. [4]

- a. Nitrogen may be converted to nitrates by nitrogen fixing bacteria;
- b. The nitrogen can then be used by plants;
- c. Nitrogen thus becomes a constituent of all proteins in the ecosystem;
- d. Lightning may convert nitrogen to nitrates that feed plants;
- e. Nitrogen oxides may combine with water to form acid rain that damages ecosystems;
- f. Nitrous oxide is a greenhouse gas that will lead to higher temperatures in ecosystems;
- g. Nitrogen oxides lead to the formation of tropospheric ozone that damages plants;
- h. Nitrogen oxides lead to the formation of photochemical smog that inhibits photosynthesis;

**Note to examiners:** Credit can be given for applying above MPs to terrestrial or aquatic systems.

- (b) Describe methods that could be used to assess the impact of an industrial effluent on the biotic index of a river. [7]

- a. Identify sites at intervals upstream and downstream from point of effluence;
- b. Take sufficient samples to be statistically significant;
- c. Lay down a quadrat on river bed;
- d. Hold net downstream of quadrat;
- e. Kick/disturb substrate in quadrat;
- f. Empty net contents into tray;
- g. Identify different species using identification key or similar;
- h. Estimate abundance of tolerant and sensitive species;
- i. Return all invertebrates to sample site;
- j. Use data to calculate Biotic Index;
- k. Compare biotic indices upstream and downstream of effluence;

**Note to examiners:** Do not credit methods for direct measurement of pollution, BOD or Simpsons index – Q specifically addresses biotic index.

- (c) With reference to named examples, evaluate the role of ecotourism as part of the conservation strategy for species and habitats.

[9]

*Answers may demonstrate:*

- **understanding concepts & terminology** of conservation; biodiversity; ecotourism; national parks; wild life sanctuaries; local business/employment/hospitality; environmental impacts; ownership; legislation; funding; flagship species etc.;
- **breadth in addressing and linking** range of ecotourism sites/endeavours with conservation objectives and their degree of success.
- **examples** of ecotourism associated with conservation projects etc.
- **balanced analysis evaluating** extent to which ecotourism contributes positively and negatively to the aims of conservation.
- **a conclusion that is consistent with, and supported by analysis and examples given** e.g. While the attraction of large numbers of people will inevitably bring some stress to natural systems, economics is such that the conservation of large areas of habitat has a significant cost that can only be met through ecotourism.

*Please see markbands on page 18.*

6. (a) Outline **four** disadvantages of wind as a renewable source of energy. [4]

- a. Relies on sufficient and consistent supplies of wind;
- b. May provide a hazard to birds in flight;
- c. May be destroy aesthetic appeal of landscape;
- d. May be constructed from non-recyclable materials;
- e. May have limited lifespan;
- f. May have high installation costs;
- g. May cause noise pollution;
- h. Because of noise, amenity etc, sites of wind farms need to be some distance from urban areas;
- i. May decrease property values in vicinity;
- j. Associated batteries may have environmental impact through mining/disposal;

(b) Evaluate **two** strategies for preventing overfishing. [7]

- a. e.g. Restrict fishing to given seasons;  
*Pros:*
  - b. Reduces total quantity of fish harvest;
  - c. Avoids disturbance of fish during reproductive season;
  - d. Prevents capture of immature fish yet to grow;*Cons:*
  - e. Requires policing/fines etc.;
  - f. Restricts constant availability/flow of supply;
  - g. Climate change may lead to changed seasons;
- h. e.g. Restrict fishing intake i.e. net size/number of boats/quotas;  
*Pros:*
  - i. Reduces total quantity of harvest;
  - j. Fixing mesh size can eliminate harvest of immature fish;
  - k. Restrictions can share out total harvest/avoid monopoly;*Cons:*
  - l. Requires policing/fines etc.;
  - m. Reduces profit margins for fishers;
  - n. Appropriate quotas are difficult to determine;
  - o. Monitoring fish harvests can be difficult/inaccurate;

**Note to examiners:** Note award 4 max per strategy (3 max if only pros or only cons are mentioned). Allow credit along similar lines for other strategies e.g. switching to aquaculture / imposing fishing zones/marine protected areas / restricting mesh size etc.

(c) To what extent can technology address the impacts of overpopulation?

[9]

Answers may demonstrate:

- **understanding concepts & terminology** of contraception; pollution; waste management; food production; water stress; carbon capture technology; renewable energy sources; catalytic converters; scrubbers; GMOS; vertical farming; aquaponics; desalination; water treatment; green architecture; etc.
- **breadth in addressing and linking** a range of impacts of overpopulation including impacts on pollution; food & water supply; waste management; urbanisation with technological solutions.
- **examples** of overpopulation impacts in the areas of pollution; food & water supply; waste management etc.
- **balanced analysis evaluating** extent to which technology can be effective or ineffective in addressing issues of overpopulation.
- **a conclusion that is consistent with, and supported by analysis and examples given** e.g. Technology goes a long way to address the impacts of overpopulation but these impacts are probably most severe in countries that do not have the financial and technological resources to apply it.

*Please see markbands on page 18.*

7. (a) Outline the similarities and differences between crude birth rate and doubling time. [4]
- a. Crude birth rate (CBR) is the average number of births per 1000 individuals in a population;
  - b. Doubling time (DT) is the time it would take for a population to double in size;
  - c. DT is estimated as 70 divided by the natural increase rate (as a %);
  - d. Both are based on mean values;
  - e. Both give some indication of potential for growth;
  - f. CBR focuses on number of offspring/DT focuses on growth of whole population;
  - g. Doubling time is an estimation whereas CBR is an accurate calculation;
  - h. DT takes into account death rates whereas CBR does not;

**Note to examiners:** Award 3 max if only similarities or only differences re given

- (b) Evaluate the use of reservoirs and drought-resistant crops as a means of sustainably managing water supply. [7]

**Reservoirs (4 max):**

*Pros: (3 max)*

- a. Dampens seasonal oscillations of available rainfall;
- b. Provides a diversity of habitat;
- c. Can be utilised for leisure activity/water sports;
- d. Low maintenance;

*Cons:(3 max)*

- e. High set-up costs;
- f. Water may still need treatment for human consumption;
- g. Breeding ground for disease vectors (e.g. mosquitoes);
- h. Can lose a lot of water through evaporation;
- i. Construction may destroy habitats/require relocation of settlements;

**Drought-resistant crops (4 max):**

*Pros: (3max)*

- j. Reduces agricultural demand for water supply;
- k. Enables higher crop productivity;
- l. Allows agriculture in previously unproductive lands;

*Cons: (3 max)*

- m. Relatively expensive crops;
- n. Low genetic diversity (if GMOs);
- o. Limited range of such crops available;

- (c) Feedback is a concept relevant to many systems. Justify its usefulness in understanding the sustainability of named systems.

[9]

*Answers may demonstrate:*

- **understanding concepts & terminology** of positive and negative feedback; population dynamics; positive feedback in accelerated early growth; negative feedback in stabilised carrying capacity; predator prey relationships; global warming/cloud formation/melting of glaciers; etc.
- **breadth in addressing and linking** a range of 'feedback' mechanisms to their role in sustainability for a range of systems.
- **examples** of different feedbacks occurring in a range of named systems.
- **balanced analysis evaluating** extent to which the concept of a 'feedback' does or does not contribute to our understanding of how sustainability is achieved in systems.
- **a conclusion that is consistent with, and supported by analysis and examples given** e.g. Negative feedback obviously leads to a stable equilibrium which is the basis for sustainability but positive feedback leads toward accelerated change which in principle will be unsustainable, but may nevertheless contribute to sustainability, for example, in leading to the rapid restoration of a collapsed population.

*Please see markbands on page 18.*

**Section B, part (c) markbands**

Marks	Level descriptor
0	The response does not reach a standard described by the descriptors below and is not relevant to the question.
1–3	<p>The response contains:</p> <ul style="list-style-type: none"> <li>• minimal evidence of knowledge and understanding of ESS issues or concepts</li> <li>• fragmented knowledge statements poorly linked to the context of the question</li> <li>• some appropriate use of ESS terminology</li> <li>• no examples where required, or examples with insufficient explanation/relevance</li> <li>• superficial analysis that amounts to no more than a list of facts/ideas</li> <li>• judgments/conclusions that are vague or not supported by evidence/argument.</li> </ul>
4–6	<p>The response contains:</p> <ul style="list-style-type: none"> <li>• some evidence of sound knowledge and understanding of ESS issues and concepts</li> <li>• knowledge statements effectively linked to the context of the question</li> <li>• largely appropriate use of ESS terminology</li> <li>• some use of relevant examples where required, but with limited explanation</li> <li>• clear analysis that shows a degree of balance</li> <li>• some clear judgments/conclusions, supported by limited evidence/arguments.</li> </ul>
7–9	<p>The response contains:</p> <ul style="list-style-type: none"> <li>• substantial evidence of sound knowledge and understanding of ESS issues and concepts</li> <li>• a wide breadth of knowledge statements effectively linked with each other, and to the context of the question</li> <li>• consistently appropriate and precise use of ESS terminology</li> <li>• effective use of pertinent, well-explained examples, where required, showing some originality</li> <li>• thorough, well-balanced, insightful analysis</li> <li>• explicit judgments/conclusions that are well-supported by evidence/arguments and that include some critical reflection.</li> </ul>