2226 – 4633M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 2026

Environmental systems and societies

Standard level

Paper 2

14 pages

Subject details: Environmental systems and societies SLP2 Markscheme

Mark allocation

Candidates are required to answer:
- **ALL** questions in Section A **[40]** and **ONE** questions in Section B **[20]**.
- The maximum total = **[65]**.

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

When using marking points (<u>All of this paper except</u> 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 **<u>precise point</u>** where it becomes clear that the candidate deserves the mark. **<u>One tick to be shown for each mark awarded</u>**
iv. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

When using markbands (<u>Only</u> 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 <u>underlined</u> 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) State **one** feature, visible in **Figure 1**, that can be used to distinguish Irrawaddy dolphin from Indus River dolphin in a dichotomous key **[1]**

a. No beak/nose/snout;
b. Pointed flippers;
c. Pointed/sharper dorsal fin;

(b) Suggest **one** factor that could be used to determine the conservation status of Irrawaddy dolphins. **[1]**

a. Population size;
b. Rate of population increase/decrease;
c. Reproductive potential;
d. Geographic range;
e. Habitat quality/fragmentation;
f. Probability of extinction/known threats;
g. Number of mature/breeding adults;
h. Population/genetic diversity;

Note to examiner: *Do not credit "population" without reference to its size.*

(c) Describe practical procedures for estimating the population size of Irrawaddy dolphins in the Mekong River. **[3]**

a. Capture sample of dolphins;
b. Tag the dolphins appropriately/take photograph of fin;
c. Release tagged dolphins back into the same environment;
d. Recapture and then count number tagged;
e. Use Lincoln Index / m_1 x n_2 / m_2 calculation;

(d) Outline the mechanism by which a species of river dolphin might evolve a greater tolerance to higher salinity. **[3]**

a. Due to genetic variation/mutation some are able to tolerate higher salinity;
b. Tolerant individuals are more likely to survive/reproduce (survival of the fittest);
c. Survivors will pass on trait to next generation;
d. Over generations, tolerance will dominate/increase in frequency;

(e) Explain how fertilizer run-off from nearby farms impacts the population of Indus River dolphins. **[3]**

a. Increase in nutrient/nitrate/phosphate pollution…;
b. …Causing excessive growth of phytoplankton/algae / eutrophication;
c. Death of phytoplankton and high rates of decomposition;
d. Rapid consumption of dissolved oxygen leading to hypoxia/anoxia;
e. Death of aquatic life (fish) / reduction in food sources;
f. Higher mortality of dolphins;

2. (a) Calculate the percentage of energy generated from hydroelectricity in 2025. **[1]**

Accept range: 4300–4800 (Hydro)
Overall: 10 800 -11 200
4500 x 100 / 11000
= 41% (Accept: 38 – 44%)

(b) Suggest **two** reasons why renewable energy sources are not the main source of energy in many countries. **[2]**

a. Renewables are expensive to develop / countries cannot afford them;
b. Requires significant changes in infrastructure;
c. May require specific weather condition/geography (insolation/wind/rivers) not available;
d. May not have necessary technological development/resources;
e. Difficulty of recycling these products in end-of-life management;
f. Some countries have large source of non-renewable energy they want to use;
g. Some countries may not prioritize renewable energy over more immediate needs e.g. health/food/water;
h. Lag time of training qualified workers;
i. May threaten wildlife/biodiversity;

Note to examiner: *Accept any other possible answer.*

(c) State why energy production from some renewable sources creates the need for energy storage system. **[1]**

a. Energy sources may be highly variable and dependent on weather/season/time of day/tides;
b. Energy needs to be stored during periods of high production for periods of low production;

Note to examiner: *Do not credit "due to overproduction/producing too much etc"*

(d) Describe why natural capital such as coal has a dynamic value. **[2]**

a. Cultural values/awareness may become more ecocentric;
b. Impacts of fossil fuels may become more prominent/urgent;
c. Technology for extraction of coal may become more effective/economical;
d. 'Cleaner coal' techniques may make coal more attractive option;
e. There may be cultural/political pressure to reduce pollution/carbon emissions;
f. Development of alternative energy sources may reduce value of coal;

(e) Outline **one** energy conservation strategy to reduce consumption of energy. **[1]**

a. Turning off lights/appliances;
b. Insulating buildings to reduce use of heating/air-conditioning;
c. Travel less by fossil fuel driven vehicles/car pooling/public transport;
d. Education to raise awareness;
e. Development of energy efficient technology (e.g. LED lights);
f. Government policy to encourage green transport e.g. cycle to work scheme;

3. (a) Describe how trees in forests can act as stores, sinks and sources in the carbon cycle. **[3]**

Stores (1 max):
a. Mature forests/trees retain carbon over time;
b. Carbon is stored in biomass of trees;
c. Trees have long lifespans during which carbon is fixed;

Sinks (1 max):
d. Young forests/trees absorb atmospheric carbon;
e. Trees take in CO_2 for photosynthesis;
f. Trees transform inorganic carbon into organic biomass;

Sources (1 max):
g. Forest fires release CO_2;
h. Slash & burn agriculture releases CO_2 from trees;
i. Decomposition of dead trees releases CO_2;

Note to examiner: *Correct responses should indicate/imply 'absorption' for sinks, 'containing' for stores and 'release' for sources. Do not credit responses that are too brief e.g. "Trees store carbon dioxide".*

(b) Construct a feedback loop diagram showing the impact of rising global temperatures on ice cover. **[4]**

**diagram should show a feedback loop*

a. Rising global temperatures --> ;
b. Melting ice cover -->;
c. Increasing area of bare rock / release of trapped CO_2 -->;
d. Albedo reduced / increase of greenhouse gas --> ;
e. More heat radiated from Earth surface / more heat trapped in atmosphere -->;

Note to examiner: *Allow 3max if expressed just in words with no diagram.*

(c) Outline how a **named** adaptation strategy contributes to the achievement of environmental justice. **[2]**

Named strategy (1 max): flood defenses/desalination plants/drought-resistant crops/vaccination;

Reason (1 max):
Flood defenses: improve the living standards of the local citizens;
Desalination plants: increase water availability/reduce water prices;
Drought-resistant crops: food security for whole population;
Vaccination: improves health of whole population;

(d) Explain how forest fires (bushfires) contribute to an enhanced greenhouse effect. **[2]**

a. Burning organic matter releases CO_2 / greenhouse gases;
b. Ground surface re-radiates heat;
c. Greenhouse gases in atmosphere trap outgoing heat radiation;
d. Loss of forest leads to reduction in photosynthesis/carbon sink;
e. ...so less CO_2 absorbed / CO_2 accumulates;

(e) Evaluate **one** strategy supported by technocentric-inclined societies to reduce the impact of human activities on the carbon cycle. **[3]**

e.g. Carbon capture and storage

Pros [1 max]:
Allows the continued use of fossil fuel;
Reduces atmospheric carbon dioxide, helping to slow down global warming;

Cons [1 max]:
High cost/energy use to capture and transport;
Does not address the root cause;
Limited suitable storage location;

[1 max] for valid appraisal
Temporary solution but better to target the emission of carbon dioxide;

4. (a) Calculate the temperature difference between the coldest and the hottest month. **[1]**

26.0 – 21.1;
4.9°C;

Note to examiner: *Do not credit response with no units*

(b) In many coffee plantations, farmers add fertilizers to the coffee trees. This is usually done between May and September. Using the data in the table, explain why farmers add fertilizers at this time of year. **[2]**

a. Low precipitation;
b. Fertilizer will not be washed off (by rain);
c. Fertilizer can be absorbed;

(c) The increase in coffee plantation has led to deforestation in Brazil. Describe how deforestation can result in soil erosion. **[3]**

a. Soil is no longer held in place by roots;
b. Reduced infiltration / increased run-off;
c. ...so soil is washed away;
d. Trees act as wind breaks;
e. Without trees, wind blows soil away;

(d) As part of a sustainability program, coffee farmers are encouraged to grow additional crops between coffee trees, a technique known as intercropping. Suggest two benefits for farmers implementing this technique. **[2]**

a. Legumes could fix nitrogen increasing soil fertility;
b. More dead plant materials add nutrients to soil;
c. Maximizes the use of land/resources/produce more crops in a small area;
d. Reduces the risk of total crop failure;
e. Reduces spread of pests and diseases;
f. Diversified income for farmers;
g. Reduces vulnerability to soil erosion;

Section B

5. (a) With reference to named examples, identify four areas of influence that have shaped the environmental movement over the last century. **[4]**

a. Individual activists e.g. Greta Thunberg;
b. Author/literature e.g. Rachel Carson's Silent Spring;
c. Media e.g. Al Gore's documentary, An Inconvenient Truth;
d. Environmental disaster e.g. Chernobyl incident;
e. International agreements/environmental organisations e.g. Montreal Protocol;
f. Technological developments e.g. Green Revolution;
g. Scientific discovery e.g. Genetically modified crops;

Note to examiner: *credit may be awarded for other valid examples*

(b) Explain how the concepts of footprints and biocapacity can be used to assess the sustainability of a human population. **[7]**

a. Ecological footprint is the area of land necessary to provide resources and assimilate waste;
b. It depends on the rate of resource use and waste production of a given population;
c. Sustainability can be measured by comparing it to the area of land available;
d. Ecological footprint is the reciprocal of the carrying capacity;
e. Biocapacity represents an area's ability to produce resources and assimilate wastes;
f. Unsustainability results if a population's ecological footprint exceeds the biocapacity of their area;
g. Carbon footprints measure the amount of carbon (CO_2/CH_4 etc) emitted;
h. If the carbon footprint exceeds the local net primary productivity/rates of carbon absorption then this is unsustainable;
i. Water footprints measure the amount of water consumed by a population (in cubic meters per year);
j. If this exceeds the precipitation/ water input per year it will be unsustainable;
k. Footprints can be measured at different scales e.g. per person/country/global/organization/product;
l. Biocapacity/footprints are dynamic/change over time;

(c) To what extent do the various concepts and models associated with human population dynamics enable us to predict human population growth? **[9]**

Answers may demonstrate:

- **understanding concepts & terminology** of crude birth rate; crude death rate; immigration rates; total fertility rate; life expectancy; natural increase; doubling time; UN Projection models/scenarios; age-sex pyramids; five stages of demographic transition model; etc
- **breadth in addressing and linking** range of relevant concepts and models with their usefulness/reliability in predicting human population growth.
- **examples** of demographic concepts and models and their effectiveness in predicting human population growth.
- **balanced analysis evaluating** both strengths and limitations of different concepts and models in predicting human population growth.
- **a conclusion that is consistent with, and supported by analysis and examples given** e.g. using age-sex pyramids to identify a population's position on the Demographic Transition Model is an effective way of gaining some insight into future population growth but, as the UN projections demonstrate, this will still depend on unknown variation of fertility rates.

Please see markbands on page 14.

6. (a) Outline four conditions that determine the niche of a named species. **[4]**

a. Optimum range of temperature;
b. Sufficient supply of dissolved oxygen;
c. Availability of food/diet/plant/prey species;
d. Interactions of other species e.g. competition/predation/symbiosis etc;
e. Optimum range of soil/water pH;
f. Availability of sunlight/insolation;
g. Optimum range of salinity;
h. Availability of nesting sites/materials;
i. Availability of potable water;
j. Degree of environmental disturbance;

Note to examiner: *Award 3 max if no suitable named species is identified.*

(b) Explain how bioaccumulation **and** biomagnification of toxins may occur in food chains. **[7]**

a. Non-biodegradable toxins/POPs may be taken in with the food;
b. Since they are not metabolized they remain in the organism;
c. Over time, more will accumulate since they are not metabolized/excreted;
d. This accumulation of toxin over time in individuals is bioaccumulation;
e. Biomass containing the toxin is passed along the food chain;
f. Normal biodegradable biomass will be lost along chain due to respiration etc;
g. This loss increases the concentration of non-biodegradable toxin;
h. Resulting in higher concentrations in higher trophic levels;
i. This increase in concentration of POPs along food chain is biomagnification;
j. Bioaccumulation occurs within a single organism, whereas biomagnification occurs along the chains;

Note to examiner*: Do not credit responses that attempt to explain biomagnification as being due to higher trophic levels eating large quantity of organisms from a lower trophic level (this is not a valid explanation).*

(c) Evaluate the approaches to conservation likely to be adopted by different environmental perspectives and value systems. **[9]**

Answers may demonstrate:

- **understanding concepts & terminology** of environmental perspectives; environmental value systems; worldviews; technocentric; anthropocentric; ecocentric; ecotourism; genetic resources; natural capital; ecosystem services; intrinsic v instrumental value; in situ v ex situ strategies; species-based, habitat-based & mixed approaches; flagship species; keystone species; Convention on Biological Diversity; rewilding; community support; legislation; CITES; zoos; gene banks; etc
- **breadth in addressing and linking** the influences of a range of environmental perspectives and value systems on a variety of approaches to conservation.
- **examples** of named environmental perspectives and value systems and different approaches to conservation.
- **balanced analysis evaluating** both strengths and limitations of a range of different approaches to conservation.
- **a conclusion that is consistent with, and supported by analysis and examples given** e.g. the success of conservation efforts tend to rely heavily on community support which is perhaps most successfully managed by certain variations of an anthropocentric perspective that values the role of education and legislation.

Please see markbands on page 14.

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	The response contains: • minimal evidence of knowledge and understanding of ESS issues or concepts • fragmented knowledge statements poorly linked to the context of the question • some appropriate use of ESS terminology • no examples where required, or examples with insufficient explanation/relevance • superficial analysis that amounts to no more than a list of facts/ideas • judgments/conclusions that are vague or not supported by evidence/argument.
4–6	The response contains: • some evidence of sound knowledge and understanding of ESS issues and concepts • knowledge statements effectively linked to the context of the question • largely appropriate use of ESS terminology • some use of relevant examples where required, but with limited explanation • clear analysis that shows a degree of balance • some clear judgments/conclusions, supported by limited evidence/arguments.
7–9	The response contains: • substantial evidence of sound knowledge and understanding of ESS issues and concepts • a wide breadth of knowledge statements effectively linked with each other, and to the context of the question • consistently appropriate and precise use of ESS terminology • effective use of pertinent, well-explained examples, where required, showing some originality • thorough, well-balanced, insightful analysis • explicit judgments/conclusions that are well-supported by evidence/arguments and that include some critical reflection.