

Markscheme

May 2025

Environmental systems and societies

Standard level

Paper 1

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Subject details: Environmental systems and societies SLP1

Markscheme

Mark allocation

Candidates are required to answer:

- **ALL** questions
- The maximum total = **[35]**.

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

When using marking points:

- 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.
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.

1. (a) With reference to **Figure 1(c)**, identify **one** type of vegetation that is found on the North Island but not on the South Island but not on the South Island. [1]

Subtropical rainforest/shrub steppe;

*Do not accept only “rainforest/subtropical forest/steppe/shrub”.
Only mark the first response if more than one answer is given.*
- (b) With reference to **Figures 1(b) and 1(c)**, identify a relationship between altitude and type of vegetation. [1]
 - a. Low/lower altitude is associated with bog/swamp/grass steppe/shrub steppe/subtropical laurel forest/subtropical rainforest/temperate broadleaf forest;
 - b. High/higher altitude is associated with alpine shrubland/highland steppe/temperate rainforest;
 - c. Mid/middle altitude is associated with temperate rainforest/temperate broadleaf forest;
 - d. Low/lower altitudes are associated with subtropical forests / mid/middle altitudes with temperate forests / high/higher altitudes are associated with grasslands;
 - e. The higher the altitude, the more grass steppe there is;
 - f. Zonation;

Note to examiners: accept any other reasonable responses. Do not accept just “steppe” or “rainforest”, it must be specifically named for the appropriate altitude. Do not accept responses which simply state at which height range a specific vegetation type is located (e.g. Temperate broadleaf forest is located at 1000m-1249m) as this is not a relationship.
2. (a) Explain how tectonic plate movement has influenced evolution and biodiversity in New Zealand. [3]
 - a. Movement of tectonic plates/divergent plates has/have led to separation/isolation of New Zealand/geographical separation of NZ/separate islands/created a physical barrier (e.g. the ocean) from other land masses / convergent plate movements has created mountains, acting as a geographical barrier;
 - b. Isolation of population/populations has led to speciation / allopatric speciation / separation of species prevented them from interbreeding, leading to speciation;
 - c. Isolation/separation of populations has limited gene flow, reducing genetic diversity;
 - d. As the island moved into a new climatic zone/as abiotic conditions change, species adapted/better suited to the environment survived / survival of the fittest;
 - e. Natural selection has contributed to the evolution of new species;
 - f. Evolution of species/speciation has enhanced the biodiversity;
 - g. Radiation/adaptive radiation has occurred over time;
 - h. Volcanic activity/mountain building as a result of tectonic plate movement has provided a variety of altitudes on the island, creating habitat diversity;
- (b) (i) With reference to **Figure 2(c)**, identify the group of species which has the highest percentage in the *threatened* category. [1]

Freshwater fish

(ii) Outline **one** reason the group of species identified in (b)(i) is the most threatened. [1]

- a. Freshwater rivers/lakes/habitats are being polluted;
- b. Detrimently low water levels due to over-abstraction;
- c. Habitat degradation/loss due to destruction/drainage of freshwater systems/rivers/lakes;
- d. dams/culverts/weirs which block migration/prevent fish from accessing breeding/feeding grounds;
- e. Over-fishing/over-harvesting as a result of changing diets/increased demand for healthy proteins/increasing population (which increases the risk of extinction/species loss) / increase in poaching/illegal fishing which exceeds natural replacement rates;
- f. Predation/competitive exclusion/competition by invasive/alien species increasing risk of extinction/species loss;
- g. High degree of endemism/limited distribution which increases their risk of extinction;
- h. Climate change altering water temperatures/flow regimes, which can reduce reproductive success/habitat suitability;
- i. Slow reproductive rates in some (endemic) species making adaptation to changing conditions difficult/making them slow to recover from disturbances;
- j. Reduction in precipitation/increasing evaporation due to climate change reduces water levels;

Note to examiners: Apply ECF if incorrect group of species is identified in 2.(b)(i). Do not accept just 'loss of habitat due to climate change'.

3. (a) State **one** factor which could have contributed to the Kākāpō being classified as critically endangered on the IUCN Red List. [1]

- a. Low/small population numbers/size / total population less than 250 mature individuals / low/small number of mature individuals;
- b. Reduction in population size / population size reduced by more than 90% over the past 10 years or 3 generations (whichever is longer);
- c. Limited distribution / small geographical range/distribution / small number of locations where the species is found / area of occupancy less than 10 km²;
- d. High degree of habitat fragmentation;
- e. Loss of habitat / habitat degradation / extent of occurrence less than 100 km²;
- f. High probability/risk of extinction / probability of extinction is greater than 50% in 10 years or 3 generations (whichever is longer);

Note to examiners: the question does not refer specifically to Figure 3 and therefore all of the IUCN factors are acceptable as a response. Do not accept responses such as hunting or predation, as the question asks for the IUCN Red List factors.

(b) Evaluate the strategy used to conserve the Kākāpō.

[3]

Pros [2 max]:

- a. Strategy is successful because the population has increased (since the mid 1990s) / use of technology (e.g. Transmitters, artificial insemination, data tracking) has improved monitoring and breeding success / intensive management (e.g. supplementary feeding and nest interventions) has increased chick survival rates;
- b. Predator eradication programme also benefits other native/endemic species;
- c. Working together with a large range of stakeholders e.g. The Māori (indigenous people)/local groups/volunteers/government groups, provides ownership of the project and increases its chances of success;
- d. Program adopts a variety of approaches increasing its chances of success;
- e. Separating the birds into smaller, disconnected habitats is a good conservation design choice to reduce the risk of disease spread/natural disasters putting the entire species at risk of extinction;

Cons [2 max]:

- f. The program does not address the issue of habitat loss;
- g. The small number of Kākāpō has resulted in a small gene pool which can result in increase in genetic disorders/low breeding rates;
- h. The population of Kākāpō are isolated from each other limiting the gene pool/genetic diversity;
- i. In recent years/since 2020, population of Kākāpō have stabilized/are declining and appear to have reached carrying capacity;
- j. Removal of predators may impact other species adversely;
- k. Removal/killing of predators could be considered ethically wrong/is against their biorights / removal of predators decreases biodiversity;
- l. This intervention program is very expensive/costly / The high final cost of the programme makes it difficult to sustain long-term without continued funding;
- m. Hunting/poaching of Kākāpō may still be occurring;
- n. Successful breeding appears to be highly dependent on intervention by humans / reliance on human intervention (e.g. Hand-rearing, artificial incubation) means the species is not yet self-sustaining in the wild;
- o. Limited number of suitable predator-free offshore islands restricts future population expansion;
- p. Removal of predators is not complete so they are still a danger;

Note to examiners: the answer must link the responses to the success/strengths or lack of success/weaknesses of the conservation strategy.

Note to examiners: Conclusion [1 max] needs to be balanced considering both sides of the argument for credit and makes a clear value judgement e.g. Although the number of Kākāpō has increase over time, without further conservation/protection of their habitat the long-term survival of Kākāpō is unlikely.

Conclusion is not mandatory and 3 marks can be achieved through consideration of both cons and pros.

4. Describe **one** possible impact of the change in forest cover shown in **Figure 4** on soils. [1]

- a. Reduction in forest/trees reduces root system that holds soil together increasing risk of soil erosion/loss from wind/water;
- b. With reduction in tree canopy/cover, there is increased risk of rain causing soil erosion;
- c. Removal of forest canopy/loss of leaf litter may reduce quantity of organic matter in soil/may reduce nutrient input, leading to nutrient-poor soils;
- d. Loss of forest cover can lead to soil compaction from exposure to wind/rain, reducing water infiltration;

Note to examiners: do not accept responses which simply state the impact, without providing the mechanism for the impact e.g. Do not accept “deforestation causes soil nutrient loss” or “deforestation results in soil erosion”.

5. (a) Describe how the change in cattle numbers since 1990 shown in **Figure 5(d)**, may have impacted the water quality of nearby rivers. [1]

- a. Increase in cattle may result in increase in nutrients (from manure/faeces/urine/fertiliser runoff) entering rivers causing eutrophication/increase BOD;
- b. Increase in cattle may result in increase in sediments (from manure) entering rivers, increasing turbidity/reducing clarity of the water;
- c. Increase in cattle may result in an increase in sediments (from manure) entering rivers that smother/kill riverbed organisms;
- d. Increase in cattle may increase microscopic pathogens (from manure) entering rivers;
- e. Increase in cattle may increase the trampling along riverbanks increasing erosion and sediment loading into rivers and reducing overall water quality / deforestation for increased cattle grazing exposes the soil to wind and water, increasing soil erosion and runoff into the rivers, increasing turbidity;
- f. Increased water extraction for dairy farming reduces river flow, concentrating pollutants and reducing water quality;

Note to examiners: response must indicate the impact on the water quality of the river.

(b) Outline two ways in which farming activity on the Canterbury Plains contributes to climate change. [2]

- a. Cattle (via enteric fermentation/belching/flatulence/flatus) produce methane which is a GHG;
- b. Decomposition of manure produces methane, which is a GHG;
- c. Combustion of fossil fuels in farm machinery produces carbon dioxide/CO₂, which is a GHG;
- d. Nitrous oxide is released from agricultural soil / fertilizers can release nitrous oxide, a GHG;
- e. Land use change (such as converting forest or scrubland to pasture) reduces carbon sequestration (and increases CO₂ in the atmosphere) / soil erosion results in CO₂ release, turning it from a carbon sink into a carbon source;
- f. Irrigation/intensive farming practices increase combustion of fossil fuels (e.g. water pumping), contributing indirectly to GHG emissions;
- g. Increased agriculture can result in increased processing/transport to market/increased export overseas (which results in fossil fuel combustion) contributing GHG to the atmosphere;

- (c) Outline two ways in which climate change may impact farming within the Canterbury Plains in the future.

[2]

- a. Increase in rainfall could increase soil erosion/degradation/cause flooding/leach nutrients and reduce crop yields;
- b. Extreme dry weather periods/drought could reduce crop yields;
- c. Extreme hot weather conditions could reduce crop yields/kill crops;
- d. Extreme rainfall could result in flooding and death of livestock;
- e. Extreme hot and dry conditions could lead to death of livestock;
- f. Drought conditions could cause wildfires, killing livestock/causing loss of crops;
- g. Increased risk of new pests and diseases reducing crop yields/killing livestock;
- h. hotter temperatures increase evaporation, potentially causing soil salinisation;
- i. Changes in climate could result in changing phenology of plants/pollinating insects, reducing success of pollination and reducing yields / changing phenology of insects and predator species may result in greater pest infestations, reducing crop yields;
- k. Warmer temperatures may increase primary productivity/crop yields;
- l. Rising sea levels may reduce land available for agriculture / rising sea levels may result in salinisation of soils/contamination of groundwater used for irrigation, reducing crop yields;

Note to examiners: do not accept just 'extreme weather' or 'climate change' – the answer must specify the climatic condition which is impacting farming.

- (d) Suggest **two** ways in which agriculture in the Canterbury Plains could be adapted to deal with the impacts of climate change.

[2]

- a. Change the variety of crops grown which are more suited to new weather conditions/select more resilient crops/cultivars/shift towards salt-tolerant or drought-tolerant crops;
- b. Breed livestock that are more suitable for changing climate;
- c. Diversify agriculture to reduce risk of losing all crops during one season / use of agroforestry to reduce impact of extreme weather on crops/cattle;
- d. Increase water resources to cover dry periods;
- e. Improve land drainage to avoid risk of floods;
- f. Implement precision agriculture (e.g. GPS-guided irrigation, soil sensors, drip irrigation) to optimise water use;
- g. Use regenerative farming practices (e.g. cover crops, reduced tillage, crop rotation, organic fertilisers) to improve soil health/carbon storage/resilience to extreme weather;
- h. Develop more effective pesticides to address new (tropical) pest species;
- i. Shift to indoor farming, where growing conditions (e.g. temperature, water availability) can be controlled/kept stable;

6. (a) With reference to **Figure 6**, calculate the doubling time (DT) of the population of New Zealand.

[1]

$(70 / \text{growth rate} = 70 / 1.06 \Rightarrow 66.038 \text{ (years)} / 66.04 \text{ (years)} / 66 \text{ (years)})$

Note to examiners: Units are not required

(b) Outline **two** factors which could change the expected doubling time (DT). [2]

- a. Increase in doubling time due to migration out of the country / decrease in doubling time due to immigration/in-migration;
- b. Increase in doubling time due to increase in death rate due to disease e.g. pandemic/increased cost of health care / decrease in doubling time due to decrease in death rate due to advances in health care;
- c. Increase in doubling time due to reduction in birth/fertility rates due to cost of raising children / decrease in doubling time due to increase in births/fertility rates as a result of government financial incentives;
- d. Increase in doubling time due to reduction in birth/fertility rates due to anti-natalist policies / decrease in doubling time due to increase in births/fertility rates as a result of pro-natalist policies;
- e. Increase in doubling time due to economic recession, delaying births / decrease in doubling time due to economic boom;
- f. Increase in doubling time due to emancipation of women (e.g. access to family planning, contraception, higher education, employment), reducing fertility rates/delaying onset of child-bearing/delayed marriage;

Note to examiners: Responses must connect the answer to increasing/decreasing the doubling time. Do not accept catastrophic event/natural disaster as these are short-term events that are unlikely to have an appreciable effect on the doubling time.

7. (a) State **one** way in which New Zealand might achieve net zero carbon emissions without changing its energy source. [1]

reforestation/afforestation / government regulations requiring carbon capture and storage (CCS)/CO₂-reducing technology on all industries / strict government standards on energy efficiency / implementing carbon taxes / improving public transportation infrastructure / government limits/quotas on car purchases/ownership of private vehicles / providing benefits/rewards/incentives to encourage the use of renewables;

Note to examiners: the response should focus on government/country level, rather than individual actions.

(b) With reference to **Figure 7(b)**, calculate the expected percentage increase in electricity generation between 2020 and 2050. [1]

$$((70.0 - 41.8) / 41.8 \times 100 =) 67.46 (\%) / 67.5 (\%) / 67 (\%)$$

(c) Identify the type of renewable energy which is expected to increase the most between 2020 and 2050 in **Figure 7(b)**. [1]

Wind;

Solar;

Note to examiners: there are two potential correct answers for this question. In terms of straight increase in % generation by source, wind is the greatest projected increase (17.5 TWh). In terms of which source has had the greatest projected percent increase, solar is the greatest (4550%).

(d) Outline a strategy to achieve the renewable energy projections for 2050 as indicated in **Figure 7(b)**.

[1]

- a. Economic incentives/subsidies for installing solar panels/wind turbines / investment into other renewables such as tidal and wave energy (due to long coastlines);
- b. Subsidies for batteries to store renewable energy / improved battery technology for storing renewable energy;
- c. Making it easier to obtain planning permits for wind farms/solar farms / reduced bureaucracy in obtaining planning permission to build renewable energy sources;
- d. Better rates for electricity generated through renewable sources rather than via fossil fuels / government taxation on the use of non-renewables/fossil fuels;
- e. Public education and awareness campaigns to encourage household and business uptake of renewable technologies and energy-saving behaviours;
- f. Investment in upgrading the infrastructure/national grid to integrate household sources/distribute variable renewable energy sources (like wind and solar);
- g. Government ban/phase out on the use of fossil fuels;
- h. Increased investment in research and development/developing technology to make renewables more efficient/reliable;

Note to examiners: do not accept responses which relate to individual actions, as this question refers to a strategy.

8. With reference to Figures 8(a) and 8(b), compare and contrast the ecological footprint and biocapacity between New Zealand and the World.

[3]

Similarities [max 2]:

- a. Both have declining biocapacity over time;
- b. The EF for both regions are fluctuating;
- c. Prior to 1970, both New Zealand and the world average had an ecological surplus/EF was lower than the biocapacity;

Differences [max 2]:

- d. The biocapacity falls below the EF for the world whereas/however the biocapacity stays above the EF for NZ / New Zealand maintains an ecological reserve/surplus whereas/but/however the world operates in an ecological deficit;
- e. The biocapacity for NZ has fallen from approximately 21 to 8 (global hectares/person) compared to the world, which has fallen from approximately 3.2 to 1.6 (global hectares/person) / the biocapacity in NZ has fallen more (greater decrease in hectares per capita/13 gph/capita) than the world (1.6 gph/capita);
- f. The biocapacity in NZ is higher than (the biocapacity) for the World;
- g. The overall EF for New Zealand (above 5) is greater than the EF of the world (about 2.5) / World EF is smaller than New Zealand's EF;

Note to examiners: do not accept unrelated statements without an element of comparison or contrast e.g. higher than, both.

9. With reference to the information in the resource booklet, to what extent can New Zealand be considered to be living sustainably?

[6]

Arguments that New Zealand is living sustainably [4 max]:

- a. The EF is below the biocapacity of the country and therefore is sustainable;
- b. Proportion of energy generated from renewable sources (solar, wind, hydro, geothermal) is high and rising, which reduces GHG emissions/which reduces fossil fuel use;
- c. By 2050, all of New Zealand's electricity is projected to be from renewable sources of energy rather than fossil fuels/reducing GHG emissions;
- d. New Zealand is attempting to conserve native/endemic species / conservation efforts have increased the numbers of the critically endangered Kākāpō;
- e. The EF for NZ is beginning to fall/is decreasing, suggesting that they are trying to live more sustainably;

Arguments that New Zealand is not living sustainably [4 max]:

- f. Biocapacity is continuing to decline over time and this is not sustainable in the long term;
- g. EF of New Zealand is greater than the overall biocapacity of the world which is not sustainable / New Zealand's ecological footprint per capita remains high (approx. 5 gha/person), indicating overconsumption compared to global sustainable limits (~1.6 gha/person) / EF of New Zealand is much higher than the world average, which suggests they are consuming resources at a high/unsustainable rate;
- h. 59%/majority of energy used by New Zealand comes from fossil fuels, which release GHG/contribute to climate change/are finite/non-renewable;
- i. New Zealand imports/uses fuel oil which is not renewable/when used produces CO₂ which is a GHG/contributes to climate change;
- j. New Zealand has a high level of car ownership which produces carbon dioxide which is a GHG/contributes to climate change/contributes to photochemical smog;
- k. Continued reliance on high-emission sectors (e.g. agriculture and transport) makes emissions reduction more difficult (despite renewable electricity progress);
- l. Livestock farming has grown significantly over time contributing to methane production/water pollution;
- m. Intensive (arable) farming uses fertilizers which can lead to eutrophication of rivers / intensive arable farming use pesticides which can pollute rivers/kill non-target organisms/cause soil/water toxification / intensive farming has a heavy use of machinery which results in the combustion of fossil fuels/releases CO₂;
- n. New Zealand has lost large areas of forest/deforestation which has increased the risk of soil erosion/loss of habitats/loss of endemic species/loss of biodiversity/loss of a carbon sink;
- o. Introduced predator species/invasive species continue to threaten the biodiversity of New Zealand;
- p. Some species cannot survive without continued human intervention;
- q. Population/immigration is increasing and therefore there will be a greater demand for resources in the future;
- r. A high proportion of NZ's (endemic) species are threatened or at risk which suggests they are not living sustainably/that conservation measures have not been successful;

Note to examiners: Award [5 max] for pros and cons combined. Reserve one mark for the conclusion..

Conclusion [1 max]

For example: Although the ecological footprint for New Zealand is below its biocapacity which makes it appear sustainable, its use of imported oil/fossil fuels means the country is not truly sustainable;

A valid conclusion should be credited if it is explicit, balanced (addresses both sides of the argument) supported by evidence and makes a clear value judgement. Do not credit the conclusion if only one side of the argument has been considered within the overall response.

Accept other reasonable responses supported by the information in the resource booklet.
