8825 – 6604M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

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Environmental systems and societies

Standard level

Paper 1

12 pages

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.

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 **WTTE** (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. Using **Figure 2**, identify the ecosystem of Mindo. **[1]**

Cloud forest.

Note to examiners: *Only mark first response if more than one answer is given.*

2. (a) Using **Figure 4**, calculate the difference between the ecological footprint and the biocapacity per person for 1985. **[1]**

(4– 2) = 2 (global hectares)

Note to examiners: *units and calculations not required. Accept answers in the range of 1.8 to 2.2 gh. Do not accept negative numbers.*

(b) Suggest how Ecuador could meet the needs of its population if the ecological footprint exceeds biocapacity in the future. **[2]**

a. Reduce exports of food products (to feed its people) / reduce exports of goods (to keep resources in their country) / Develop national food-security policies ensuring domestic demand is prioritised (before export quotas are met);
b. Import more food products/resources (to meet the needs of its people);
c. Invest in/develop technocentric strategies to increase crop yields (e.g. GMOs/use of sensors/drones to detect when to apply fertilizers/use water efficiently);
d. Promote sustainable/regenerative farming practices to increase food output/crop yields (e.g. aquaculture, agroforestry, soil regeneration, crop rotation) / grow food crops with lower water demand/lower resource requirements;
e. Improve efficiency of resource use / develop circular economy initiatives (to reduce resources needed) / recycle more to reduce (primary) resources extracted/used;
f. Increase/invest in renewable energy production (instead of using fossil fuels thereby reducing consumption of resources) / invest in public transportation to reduce use of fossil fuels;
g. Reduce use of resources (e.g. water) through educational/awareness campaigns;
h. Encourage diversification of the economy to reduce dependence on resource-intensive exports (e.g. oil, bananas, shrimp);
i. Strengthen government policies/regulations for sustainable land/water management to prevent further degradation / use legislation to reduce over-exploitation/use of resources;

Note to examiners*: Credit any other reasonable strategy that relates to reduction of resources used or increases goods available to the population of Ecuador.*
Do not credit a reduction in population.
Do not accept generic statements e.g. "improve sustainability".
Do not accept strategies that are focused on reducing carbon dioxide emissions.
Do not accept only "education/awareness/policies".
Do not accept "regulate resources" instead of "reduce use of resources".

3. (a) Using the data in **Figure 5**, calculate the percentage of plants that are endemic to Ecuador. **[1]**

(5348 ÷ 25,560 x 100) = 20.92/20.9/21 (%)

Note to examiners: *Calculations and units not required. If a student correctly calculates the number but then rounds incorrectly, stamp CON and do not award the mark.*

(b) Explain why Ecuador supports a high level of biodiversity. **[3]**

a. Wide variation in topography/altitude allows for range of ecosystems/habitats/ecological niches;
b. Variation in climatic conditions leads to a range of ecosystems/habitats/ecological niches;
c. Wide range of biomes/ecosystems/habitats (e.g. marine and terrestrial) lead to high levels of biodiversity/large number of species;
d. Wide range of biomes/ecosystems/habitats allows for wide variety of ecological niches;
e. Geographical isolation (e.g. due to mountains) in Ecuador limits competition from non-native species (and preserves high biodiversity);
f. Geographical isolation leads to speciation and increased diversity;
g. Tropical location allows for high levels of precipitation/insolation/warm temperatures leading to high levels of primary productivity/photosynthesis (that supports high biodiversity);

***Note to examiners**: Do not accept only "wide range of biomes/ecosystems/habitats" without direct reference to high biodiversity.*

4. (a) With reference to **Figure 6(a)**, suggest one advantage of using the proposed southern route compared to the northern route for the OCP pipeline. **[1]**

a. Southern route does not cut across as many of the protected areas/goes around protected area;
b. Southern route is shorter;
c. Southern route connects to existing SOTE pipeline and therefore its construction would result in less environmental degradation/is cheaper (than northern/OCP pipeline);

***Note to examiners:** Do not accept a disadvantage of using the northern route.*
Do not accept southern route is cheaper without reason.

(b) With reference to **Figure 6(a),** suggest a possible reason as to why the southern route was rejected in favour of the northern route for the OCP pipeline. **[1]**

a. Private company (OCP) and governmental company (SOTE) may not have found a way to cooperate, which would have been required with the southern route / OCP did not want to share profits with SOTE;
b. For southern route, payments may have needed to be made to SOTE/other private landowners, (making it the more expensive option);
c. OCP may want/be required to avoid going near a highly populated area/city;
d. Opposition from indigenous communities (rejecting oil development on their ancestral land);
e. It/southern route is a longer route / Northern route provides a more direct/shorter connection;

***Note to examiners:** Do not accept faster/short time.*
Do not accept only "provides a shorter route" without specifying it is the northern route.

(c) With reference to **Figure 6(b)**, identify one conflict associated with the building of the OCP pipeline and sustainability. **[1]**

a. Oil spills contaminated freshwater (2003/2009/2022);
b. Oil spills reduced drinking water (Quito in 2003/2009)
c. Oil spills contaminated habitats/estuaries (2003/2009/2013/2022);
d. Oil spills harmed wildlife (2009);
e. Oil spills adversely affected indigenous communities (2022);
f. Construction resulted in loss of habitats/deforestation (2003);
g. Social tensions between oil companies and local people (impacting social sustainability, 2023);
i. Conflict between oil company and environment/national park;
j. Financial obligation to repay the loan (2000) places a burden on the population/state;

(d) With reference to one specific event in **Figure 6(b),** outline a strategy which could be used to reduce incidents of oil pollution. **[1]**

a. To avoid future oil spills as occurred in 2003/2009/2013/2022, option is to remove the pipeline/bury the pipelines more deeply;
b. Change the route of the OCP pipeline to avoid areas with high risk of landslides/mudslides as occurred in 2020/2021/2022;
c. Improve maintenance of pipeline/quality of material used to avoid oil spills as occurred in 2003/2009/2013/2022;
d. Use land use mapping to clearly indicate location of the pipelines to avoid unintended damage as occurred in 2003;
e. Improved communication about the location of the pipeline between SOTE and OCP could prevent unintended damage as occurred in 2003;
f. In order to monitor potential breaks/stress forces within pipes use sensors/technology to better predict areas that require reinforcement/action to be taken to avoid incidents as occurred in 2009/2013;
g. Reinforce/use materials that can withstand the forces caused by earthquakes, landslides and volcanoes as occurred in 2020/2022;
h. Reduce risk of landslides/mudslides, as occurred in 2020/2021/2022, by planting vegetation/improving water drainage/installing structures such as retaining walls/terraces;
i. Reduce river erosion/collapse of bridge by planting vegetation on banks/hard engineering to protect the banks as occurred in 2023;
j. To avoid criminal damage as occurred in 2022, more policing/surveillance is required along the pipeline;

Note to examiners: *For credit response needs to refer to either a specific year or named event (e.g. Santa Rosa spill/ Esmerelda spill) with the associated strategy.*
Response must relate to avoiding an incident, rather than mitigation of an incident.
Do not accept "build the pipeline away from sensitive areas" as it does not stop the incident from happening.
Do not accept 2018 (when monitoring system was installed) as an example of an event.

5. With reference to **Figure 7(b),** outline two reasons for the change in use of hydropower between 1965 and 2022. **[2]**

a. Over time, overall population/energy demand has increased;
b. Hydropower has become more affordable/accessible due to advances in technology/financial investment;
c. Cost to repair all the pipeline leak accidents and pollution clean-up make use of oil less profitable;
d. Fossil fuels are a finite resource, so they are developing more sustainable alternatives;
e. Increased concern for the environment/awareness of climate change has resulted in a greater demand for hydropower;
f. International pressure/climate agreements/indigenous activism have encouraged Ecuador to increase use of hydropower;

***Note to examiners**: reason must be connected to the observed increase in hydropower.*
Do not accept only "development/building of hydropower" without a reason.
Do not accept only "advances in technology / hydropower is more affordable/cheaper/cleaner".

6. Using **Figure 8**, identify which product makes up the greatest proportion of Ecuador's exports. **[1]**

Crude and refined oil

***Note to examiners:** Only mark first response if more than one answer is given.*

7. (a) With reference to **Figure 9(a)**, outline the general relationship between altitude and cloud frequency. **[1]**

a. Positive correlation up to 2000m;
b. The highest cloud frequency is at about 2000m;
c. Cloud frequency decreases above 2000m;
d. Cloud frequency decreases below 2000m;

***Note to examiners:** Do not accept just "positive correlation".*
Accept a range of values from 1000m to 2000m as the peak for maximum cloud cover.
Do not accept a description of the data from the resource booklet without including relationship e.g. at 0m altitude the cloud frequency is between 60-70% / at 1000m the cloud frequency is 80-90%.

(b) Identify **one** transfer and **one** transformation in the hydrological cycle shown in **Figures 9(b)** and **9(c)**. **[2]**

Transfer: precipitation / rainfall / streamflow / infiltration / trade wind / wind / stem flow / absorption / fog drip;

Transformation: evapotranspiration / condensation;

***Note to examiners:** Only mark first response for each category (transformation/transfer) if more than one answer is given*

(c) With reference to **Figures 9(b)** and **9(c)**, describe a feedback loop that could be triggered by deforestation in the cloud forest. **[2]**

Deforestation/fewer trees – less evaporation/evapotranspiration;
Reduced precipitation/rain / reduced soil moisture – reduced tree growth/fewer trees;

OR

Deforestation/fewer trees → greater (surface) run-off/streamflow / less infiltration;
reduced soil moisture → reduced tree growth/fewer trees;
OR
Deforestation/fewer trees → more soil exposed → lower albedo/soil absorbs more insolation/energy;
reduced soil moisture → reduced tree growth/fewer trees;

***Note to examiners**: Accept any other appropriate cause and effect which relates to the water cycle and begins with deforestation/fewer trees. Second mark is awarded for making the connection back to fewer trees.*
The second point can be awarded even if the first part of the loop is not included/correct.

(d) Outline how the cloud forest may provide a **named** example of natural income. **[1]**

a. Growth of vegetation can provide yields of timber/wood resources/fire wood/food/cacao/medicinal plants (if harvested within MSY);
b. Forest can provide a sustainable/annual yield of timber/wood resources/fire wood/food/cacao/honey/medicinal plants (if harvested within MSY);
c. Forest can provide erosion control through root systems/interception of water by the canopy;
d. Forest can provide flood prevention by increasing soil infiltration;
e. Forest can provide climate regulation by cooling the air through shade/evapotranspiration;
f. Forest can provide carbon sequestration/oxygen through photosynthesis;
g. Forest can provide freshwater through directing moisture into the ground (for groundwater)/through evapotranspiration resulting in more precipitation/through cloud-canopy interaction;
h. Cloud forests can increase income through tourism;

***Note to examiners:** Do not accept only a list/identification of goods or services eg timber/food. Do not accept clean air as a service.*

(e) Describe **two** ways in which climate change could affect the cloud forest ecosystem. **[2]**

a. Rising temperatures may cause cloud layer to occur at higher elevation (causing biome shift);
b. Higher temperatures may lead to death of organisms/decrease in growth (as they are pushed beyond their limits of tolerance) / Increased global temperature may increase evapotranspiration in cloud forest leading to stress/death of plants;
c. Higher temperatures/reduced precipitation/droughts which may increase risk of forest fires;
d. Higher temperatures/higher precipitation may result in higher plant growth/primary productivity;
e. Drought/reduction in precipitation may reduce plant/tree growth/primary productivity (due to reduction in water availability);
f. Higher precipitation may result in soil erosion and reduction in plant growth/primary productivity;
g. Higher/more intense precipitation may lead to flooding that results in the death of plants/forest/organisms;

Note to examiners: *For credit the response must include both climatic change and its impact on the cloud forest ecosystem.*
Do not accept only "reduction in biodiversity" as an effect.

8. (a) Outline **one** impact that a reduction in the Mindo harlequin toad population may have on the food web in **Figure 10(b)**. **[1]**

a. Chocó Toucan would be reduced due to a loss of food/prey;
b. Cicada would increase in population due to reduced predation (by the Mindo harlequin toad);
c. Spectacled bear would increase due to greater availability of its food (Cicada);
d. Cicada/Chirimoya would decrease due to increased predation from the Chocó Toucan;

Note to examiners: *Do not accept a general response e.g. food web would collapse/be destroyed/harmed/loss of biodiversity/no change.*
Do not accept named species (e.g. Chocó Toucan) would die/become extinct (as they have other food sources).
For credit species impacted should be named with direction of change and a cause.
Accept any other appropriate response from Figure 10(b).

(b) Explain how the disease in the Mindo harlequin toad could contribute to the evolution of resistance to this disease in the species for future generations. **[2]**

a. Natural selection/survival of the fittest;
b. Random (genetic) mutations/variations in each generation would eventually produce some individuals with a (genetic) resistance to the fungus / The disease acts as a selection pressure, meaning only individuals with advantageous alleles survive;
c. Those that survive would produce offspring inheriting that same resistance;
d. Over many generations, the frequency of the resistance allele/gene increases in the population;
e. This leads to a population better suited to survive in environments where the fungus is present;

Note to examiners: *do not accept responses which state that organisms adapt to the disease.*

9. With reference to **Figure 11**, evaluate the potential effectiveness of the proposed southern corridor for wildlife conservation. **[3]**

***Strengths**: [2 max]*

a. Southern corridor will increase habitats/access to additional resources for local wildlife;
b. Corridor would allow gene mixing between different populations of wide-ranging animals thereby increasing genetic diversity of these populations / corridors help increase gene flow increasing genetic diversity;
c. Corridor allows for safe migration of species / corridor would allow migration of species threatened by climate change (avoiding possible extinctions);
d. Corridor may help to reduce human-animal conflicts;
e. The corridor may raise awareness in the local community/population and broaden/improve their involvement in conservation efforts;

***Weaknesses**: [2 max]*

f. Corridor (shape) would have a high edge effect / corridor may increase risk to species traveling between reserve areas due to predators/poachers / the shape of the corridor may make it more difficult to manage/secure against poaching;
g. Corridor may increase spread of diseases/invasive species;
h. Southern corridor may force local people off their land and create friction/resentment towards conservation efforts;

Conclusion [1 max] needs to be balanced considering both sides of the argument for credit and makes a clear value judgement e.g.:
While there may be issues with edge effect and potential poaching along the corridor, overall the connection of the smaller reserve in Mindo Nambillo to the larger reserve will be effective due to increased habitat and genetic mixing.
While the corridor increases habitat and improves genetic mixing, the problems posed by local opposition due to land confiscations and the spread of invasive species and diseases outweighs the benefits, making the corridor ineffective for wildlife conservation.

***Note to examiners:** Conclusion is not mandatory, and 3 marks can be achieved through consideration of both strengths and weaknesses.*
Do not accept only there is an increase in area.

10. With reference to the information in the resource booklet, discuss to what extent Ecuador has been effective at meeting its legal obligation to conserve nature (Pachamama). **[6]**

Ecuador has been effective [4 max]:

a. Significant areas (one third) of the cloud forest are legally protected / there are several protected areas in Ecuador;
b. Development of wildlife corridor will link protected areas/allow safe migration of animals/increase access to habitat/increase genetic mixing;
c. Organizations are working with local communities/indigenous groups/farmers to reduce damage to habitats from farming (e.g. from cattle grazing/growing cacao);
d. More organizations are cooperating internationally/combining resources to protect vulnerable species like the Mindo harlequin toad;
e. Ecuadorians have voted against oil development/production in/near National Parks which would protect habitats;
f. Oil companies are required to restore areas/create new forests;
g. Ecotourism to Ecuador raises income/educates people which supports conservation efforts;

Ecuador has not been effective [4 max]:

h. The OCP/oil pipeline was built, damaging large areas of habitats/ecosystems/protected areas / Oil pipeline has had several accidents/leaks that destroyed/damaged habitats/contaminated ecosystems;
i. Ecuador still relies on non-renewable sources/fossil fuels which can damage ecosystems/habitats during their extraction;
j. Ecuador is highly dependent on oil/fossil fuels which release GHGs which contribute to climate change/extreme weather, which in turn damages habitats/kills wildlife;
k. Development of hydropower can lead to loss of habitats/species;
l. Many of Ecuador's species are still endangered (according to IUCN Red List);
m. Invasive species continue to be a threat to endemic species;
n. Use of pesticides results in a loss of biodiversity/degradation of ecosystems;
o. Development of cacao plantations/cattle ranching/agriculture may result in deforestation/loss of biodiversity;
p. Biocapacity continues to fall suggesting lack of conservation;
q. High level of export/catches of shrimp/crabs may lead to over-exploitation of natural resources;
r. Only one third of cloud forest are protected/two thirds of cloud forest are not protected which could lead to their over-exploitation;
s. The southern phase of the corridor has still not been created/protected areas are still not all connected, limiting nature conservation (e.g. by limiting genetic diversity of species);
t. Large numbers of tourists can disturb/damage wildlife/habitats/ecosystems (e.g. high levels of trampling causing vegetation loss / tourists disturbing wildlife during mating season);

Award [5 max] for both strengths and weaknesses.

Conclusion [1 max]
For example:
While Ecuador has been working to improve agricultural practices and protect habitats, they have not met their legal obligation to conserve nature as shown by frequent oil pipeline spills and invasive species threatening endemic wildlife.

Note to examiners: *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 in the overall response.*

Accept other reasonable responses supported by the information in the resource booklet.
Do not credit Ecuador is rich in biodiversity/has high number of endemic species.
Do not credit that Ecuadoran constitution recognizes the rights of nature/they were the first to recognize the legal rights of nature.