Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

November 2024

Environmental systems and societies

Standard level

Paper 1

13 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. (a) Using **Figures 2(a)** and **2(b)**, identify one type of vegetation found in Zermatt **[1]**

Coniferous forest/grassland;

(b) With reference to **Figure 2(a)**, distinguish between the climates of Montana and Zermatt. **[2]**

a. Zermatt is wettest in the summer months of May, June, July and August / peak precipitation in Zermatt is in May / total precipitation per year in Zermatt is 590mm / maximum precipitation in Zermatt is 70mm;
b. Montana is wet all year / peak precipitation in Montana is in December / total precipitation per year in Montana is 830mm / maximum precipitation in Montana is about 99mm;
c. Montana is wetter than/has more precipitation (than Zermatt) / Zermatt has less precipitation/is drier(than Montana);
d. Temperatures range from approximately –1/-2°C to 16/17°C in Montana / highest mean monthly temperature is 16°C in Montana;
e. Temperatures range from approximately –3/-4°C to 14°C in Zermatt / highest mean monthly temperature is 14°C in Zermatt;
f. Temperatures are colder in Zermatt (than in Montana) / Montana is warmer (than Zermatt);

***Note to examiners**: reserve one mark for Montana and one mark for Zermatt. While comparison terms are encouraged, they are not mandatory for this question.*

(c) With reference to **Figure 2(a)**, outline why the vegetation in mountain zones changes with altitude. **[2]**

a. Zonation (parallel bands of vegetation) occurs due to changing abiotic/climatic conditions (e.g. temperature, oxygen levels, carbon dioxide levels, soil depth, wind speed, aspect, water availability, nutrient availability);
b. Plants which can survive in colder conditions are found higher in the mountains (such as conifers, which begin photosynthesizing as soon as temperatures rise above 0°C) / colder temperatures means that not all types of vegetation/species can grow there/changes the types of vegetation;
c. Plants (e.g. deciduous trees) which require longer growing seasons are found lower in the mountains (as the snow melts more quickly in spring) / water availability reduces with altitude which restricts the type of plant species that can grow there;
d. Soils become thinner with altitude, limiting (tree) root development, (creating alpine meadows);
e. Plants that can tolerate thin/nutrient-poor soils dominate higher elevations (leading to alpine meadows rather than dense forests);
f. South-facing slopes are warmer and snow melts more quickly, resulting in higher upper limits for each zone / north-facing slopes are cooler/retain snow longer providing shorter growing seasons and different vegetation zones compared to similar altitudes on south-facing slopes;
g. At higher altitudes, increased exposure to wind reduces tree growth/limits plant height/favours low-growing/wind-resistant species;
h. Increased UV radiation at high altitudes favours plants with protective adaptations (such as waxy leaves or compact growth);
i. With increase in altitude there is a reduction in oxygen levels which results in a change in the types of vegetation;

***Note to examiners**:* Accept the converse where appropriate.
For credit response must link to either zonation or change in vegetation type. Do not accept 'less vegetation' instead of 'changes to the type of vegetation'.

Do not accept only 'changes in vegetation occur due to changes in temperature'.

2. (a) Describe the snowfall data shown in **Figure 3.** **[2]**

a. (Data is) highly variable/fluctuates / there is no (overall) trend;
b. Increasing trend from approximately 1957–1980 / decreasing trend from approximately 1987(–2021);
c. Highest snow depth period was from approximately 1976–1987 (as all snow depths exceeded 600 cm/were higher than the average) / lowest snow depth period was from approximately 2009 to 2016 (as all snow depths were lower than the average);
d. Peak/maximum snow depth in 1969 (of about 1163 cm) / lowest snow depth in 2016 (of about 140 cm);
e. The average total snowfall is about 500 cm;

***Note to examiners**: reserve one mark for quantification. (e.g. year or snow depth).*
Do not accept contradictory marking points e.g. 'no trend' (MPa) followed by description of trend (MPb).
Accept other reasonable responses that are supported by the data in Figure 3.
Do not credit 'there is no data for 2007 and 2008'.

(b) Outline how a reduction in snow cover in the Alps can act as a positive feedback loop for climate change. **[2]**

a. Less snow means a reduction in albedo/reflectivity / more insolation/radiation is absorbed by (darker) bare ground;
b. warmer ground melts surrounding snow, reducing snow cover further / warmer ground heats lower atmosphere, increasing air temperatures reducing snow cover further / warmer conditions allow vegetation to grow lowering albedo/absorbing more sunlight further reducing snow accumulation;
OR
c. Less snow cover results in greater absorption of sunlight, warming the ground and melting permafrost therefore releasing methane;
d. Methane contributes to global warming/increase in temperature which results in further melting/loss of snow cover;

Note to examiners*: Accept the above points in a diagram. Answer must indicate closed loop for full marks.*

3. (a) With reference to **Figure 4(a)**, outline how Swiss glacier retreat will impact the river Rhine. **[1]**

a. as the glacier melts/more melting means higher volume/bigger/faster rivers;
b. as the glaciers lose volume/reduce in size/source begin to disappear the river will become slower/smaller/reduce volume/dry up / reduction in glacial meltwater in summer months could mean lower river levels and drought/water shortages downstream;
c. rapid melt can increase turbidity due to glacial rock flour/suspended sediment;

Note to examiners: *do not accept just an increase or decrease in river size/volume without linking it to the cause of this change.*

(b) With reference to **Figure 4(b)**, calculate the percent decrease in ice volume between 2010 and 2019. **[1]**

((60−53)/60×100=) (-)11.67/11.7/12 (%);

Note to examiners*: also accept 11.66 repeating (with a dot over the final 6). Ignore a negative sign if it is included and mark just the number.*

(c) Describe the processes leading to the development of a pioneer community as the glacier retreats, as shown in **Figures 4(c)** and **4(d)**. **[2]**

a. Primary succession / succession on bare rock / lithosere;
b. Physical factors (temperature, precipitation, freeze-thaw weathering) weather/erode bare rock (creating the mineral/abiotic component/soil base);
c. Plants/seeds/early colonizing species/pioneer species are brought in by wind/animals/birds;
d. Early colonising/pioneer species/r-selected/r-strategist/r-species become established/spread rapidly;
e. Early colonising/pioneer species/leguminous/plants add organic matter/nutrient content/improve soil quality (as they decompose);
f. Root systems of early colonizers help to stabilize the soil layer/reduce erosion;
g. As soil depth increases, more plants can survive/percent cover vegetation increases;

Note to examiners*: Do not credit responses that refer to climax communities.*

(d) Describe a method used to collect the data on percent cover vegetation shown in **Figure 4(d)** **[3]**

a. Decide on the location of a transect using an air photo/map / create a transect from the end of the glacier, moving away in a straight line;
b. Conduct systematic sampling to determine the change along the environmental gradient / sample at (regular) intervals with increasing distance away from the glacier;
c. use quadrat sampling;
d. (visually) estimate/calculate/determine percent cover (at each site/sampling location) / count how many squares have vegetation and add them up;
e. Random sampling at each location for quadrat measurements (to avoid bias in site selection);
f. Repeat measurements (to get average/standard deviation) at each site;

***Note to examiners**: Do not accept only 'systematic sampling/sampling at intervals'.*

4. (a) Using **Figure 5**, calculate the proportion of electricity generated by renewable sources. **[1]**

a. (100-35=) 65(%);
b. 65:35 / 13:7;

(b) Suggest two reasons why the majority of Switzerland's electricity is generated by hydropower. **[2]**

a. Switzerland has high availability of rivers/glacier melt (for hydropower development) / the physical geography/relief of the country makes it suitable for hydropower development;
b. Hydropower is more reliable than other sources of renewable energy (as water can be stored in dams/lakes/reservoirs for use throughout the year);
c. Switzerland does not have any fossil fuel resources of its own/must import fossil fuels (which increase dependency/costs);
d. Switzerland wants to move away from non-renewable resources to become more energy independent / wants to develop energy security by reducing reliance on importing electricity/fossil fuels;
e. Awareness of climate change/sustainability goals means the country wants to use/develop renewable sources of energy / Switzerland wants to move away from non-renewable resources to meet international agreements/Paris Accord agreements / hydropower produces less GHG than burning fossil fuels;
f. Switzerland has the economic ability/money/resources/technology (available to construct/invest in building (expensive) dams);

***Note to examiners:** do not accept 'Switzerland's climate is not favourable for other renewable sources e.g. solar/wind'*

5. (a) With reference to **Figure 6(b)**, state the ecological relationship between the marmot (*Marmota flaviventris*) and the moss campion (*Silene acaulis)*. **[1]**

Herbivory/predation/predator-prey/primary consumer;

Note to examiners: *do not accept just 'herbivore', 'predator', 'food source'. If more than one response is given, mark the first response only.*

(b) Predict how increasing numbers of the Eurasian wolf (*Canis lupus lupus)* will impact the alpine ecosystem. **[2]**

a. (As a top predator) wolves will reduce the population numbers of herbivores/primary consumers/prey species/cow/chamois/marmot by predation;
b. A reduction in herbivores/primary consumers/prey species/cow/chamois/marmot will reduce pressure/grazing on vegetation allowing trees/plants to regenerate/allow vegetation/primary producers to increase/grow;
c. Reduction in herbivores/primary consumers/prey species/cow/chamois/marmot may reduce competition (between cattle/cows and other herbivores) due to more vegetation for food;
d. Reduction in herbivores/primary consumers/prey species/cow/chamois/marmot will result in increased vegetation cover/root systems/forests which will reduce risk of soil erosion;
e. Increased competition with other predators may reduce populations (eg. Lynx);
f. wolf kills provide food sources for scavenger species (vultures, eagles), increasing scavenger biodiversity and strengthening the food web;
g. herbivores/primary consumers/prey species/cow/chamois/marmot may alter movement/grazing patterns to avoid areas of high wolf presence, reducing overgrazing in certain regions and promoting more diverse plant growth;
h. increased vegetation cover due to reduced grazing pressure supports soil stability and water retention, helping maintain ecosystem health and resilience;
i. over the longer term, the reduction in herbivores/increase in primary producers may create opportunities for new species/increase biodiversity / over the longer term, the reduction in herbivores/prey species may result in less food available for the wolves, resulting in a decline in wolf numbers;

Note to examiners: *do not accept 'food web will collapse/become unbalanced'. Do not accept answers which refer to an increase/decrease in populations without a clear cause.*

(c) With reference to **Figures 6(c)** and **6(d)**, evaluate the effectiveness of the protection given to the Eurasian wolf (*Canis lupus lupus*) in Switzerland. **[3]**

Effective [2 max]:

a. Wolf numbers have been recovering (since 1979/1995) / wolf numbers have more than doubled (between 2020 and 2022) so they have been effectively protected;
b. The Bern Convention/Swiss law gives them legal protection (across Europe/numerous countries);

Ineffective [2 max]:

c. Under Swiss law, they can be shot if they are threatening livestock/humans so they are not protected;
d. Wolves are still killed by poachers/by accident and therefore they are not being effectively protected;
e. Wolves are killed to control numbers so they are not protected / the government has killed wolves so they are not committed to protecting them;

***Note to examiners**: One point may be awarded for a balanced conclusion with a value statement. E.g.: While wolf numbers have increased substantially, they are still being killed by poachers/the government and therefore protection is not fully effective.*

For credit there should be clear indication whether the point is effective or ineffective.

Do not accept 'it has been effective because populations are large enough to require culling/reducing'.

6. (a) With reference to **Figure 7**, explain how Swiss dairy farming can be considered sustainable. **[3]**

a. farms are small and most are family-owned which supports the local economy/creates jobs in the local community / dairy farming supports local/rural economies (economically sustainable) / production and processing is local which contributes to the local economy;
b. Farms are small/family owned which maintains traditions/culture of Switzerland/is socially sustainable;
c. Cattle are moved each season to a different location allowing for grasses/soil to recover/preventing overgrazing/preventing soil erosion (increasing environmental sustainability);
d. Grazing in the alpine meadows/eating grass produces less methane/GHG emissions (than eating hay) (increasing environmental sustainability);
e. Alpine meadows used for dairy farming are carbon sinks (increasing environmental sustainability);
f. Production, processing and consumption are local, reducing CO_2/GHG from transport (increasing environmental sustainability);
g. Eating locally produced food reduces the ecological footprint/enhances food security (of Switzerland) (increasing environmental sustainability);

***Note to examiners**: Do not accept a 'reduction in pollution/emissions'.*
Do not accept 'cows provide cultural value/tourism that generates income'.
Do not accept 'small/family farms are more ethical'.

(b) Suggest one method which could be used to encourage dairy farmers to support conservation of wolves. **[1]**

a. Payment of compensation for animals killed by wolves;
b. Education of farmers on the value of wolves (in the ecosystem / in reducing competing herbivore numbers);
c. Local volunteering opportunities to help protect livestock;
d. Education/demonstration projects on using guard/livestock dogs/electric fences/shepherds to protect livestock;
e. Subsidies/grants for protective infrastructure (e.g reinforced fencing or night enclosures) to help farmers safeguard livestock;

***Note to examiners**: Do not accept only measures that can be used to protect the livestock e.g. 'use of fences'.*
Do not accept 'move wolves to other areas'.
Do not accept 'laws prohibiting killing of wolves by farmers'.

7. To what extent will climate change be beneficial for Switzerland? **[6]**

Beneficial [4 max]:

a. More summer tourism in the Alps as people want to escape the heat from the lowlands/southern Europe leading to economic growth;
b. Higher (agricultural/primary) productivity/photosynthesis due to longer summers and warmer winter resulting in more food/economic growth;
c. More grazing/farming (e.g. vineyards/crops) higher in the Alps due to retreat of glaciers/longer summers, boosting productivity/economic growth / warmer weather/longer summers allow cattle to graze on fresh grass/in the alpine meadows for a longer period of time, thereby reducing methane production;
d. Warmer conditions could support agricultural diversification making Switzerland more food secure;
e. (Initially) more river flow, generating more hydroelectric power;
f. (initially) increased river flow/melting of glaciers increases available water resources/drinking water;
g. Reduced snow will reduce avalanche risk, making it safer;
h. Increased biodiversity due to warmer temperatures/climate that create new habitats;
i. Warmer weather may reduce use of fuel/energy to heat houses/building;
j. Higher percentage of vegetation cover (e.g. forest growth after glacial retreat) improves carbon storage, which could be used to off-set carbon dioxide emissions/used in carbon-trading;

Not beneficial [4 max]:

k. Loss of winter tourism as snow/glacier cover reduces (causing economic hardship/loss of income/loss of employment);
l. Increased summer hiking could result in loss of biodiversity due to trampling;
m. Eventually less river flow as glaciers disappear, resulting in water shortages;
n. Reduced water availability for hydroelectric power generation / conversion of river flow from glacial to nival flow regime, reducing reliability of hydroelectric power generation;
o. Melting permafrost on high peaks will result in more landslides/rockfalls / melting glaciers could cause flooding;
p. Loss of biodiversity as high-altitude plants and animals lose habitat / some species may not be able to tolerate higher temperatures resulting in loss of populations (e.g. losses due to migration or death);
q. Climate change may cause more extreme weather leading to heatwaves/droughts/flooding (adversely impacting human health/agricultural productivity/infrastructure/housing);
r. Warmer/wetter conditions could lead to greater prevalence of invasive species/diseases;
s. Hot and dry conditions could increase wildfire risk leading to loss of biodiversity/property/tourism/increasing health risk;
t. Hotter temperatures may require use of air conditioning increasing demand on electricity resources/energy use;

Note to examiner*: reserve one mark for a balanced conclusion with a value statement, such as: "While initially climate change may be beneficial in terms of increased hydroelectric power generation, in the long run the loss of winter tourism will mean that climate change will be detrimental for Switzerland's economy."*
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.