2224 – 6504M

Diploma Programme
Programme du diplôme
Programa del Diploma

Markscheme

May 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. Total = **[35]**.

1. A markscheme often has more marking points than the total allows. This is intentional.

2. Each marking point has a separate line and the end is shown by means of a semicolon (;).

3. An alternative answer or wording is indicated in the markscheme by a slash (/). Either wording can be accepted.

4. Words in brackets ( ) in the markscheme are not necessary to gain the mark.

5. Words that are underlined are essential for the mark.

6. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

7. 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).

8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

9. 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.

10. 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(e)**, identify one type of vegetation found within the Cape Floristic Region **[1]**

fynbos/forest/succulent karoo/thicket/vascular plants;

(b) With reference to **Figure 1(d)** and **Figure 1(e)**, outline why the Cape Floristic Region is high in plant diversity. **[2]**

a. range of biome/ecosystems/habitat types (mountains to semi-arid shrubland and coastal dunes) /variety of ecological niches;
b. …due to variation in topography/altitude / wide variety of altitudinal zones;
c. …due to a variety of climates / wide range of climatic conditions;
d. geographical isolation of Cape Floristic Region limiting competition from non-native species;

Note: *Do not accept response 'high rainfall/temperature' or other responses that are focused on high levels of productivity rather than high plant diversity.*
Do not accept 'due to conservation efforts in the area / large area of land / due to geological conditions'.

(c) With reference to **Figure 1(e)**, calculate the percentage of plants that are found only in the Cape Floristic Region. **[1]**

(6200/9000 x100) = 68.89/68.9/69(%)

Note: *Accept answers where there is a dot or dash above the last '8' in 68.8/68.88 as this shows that the '8' is recurring.*
Do not accept incorrect rounding of the answer.

(d) State **one** service provided by the natural capital within the Cape Floristic Region. **[1]**

absorbs carbon dioxide / carbon sink / production of oxygen / climate regulation / water storage / filters water / removes/filters out air pollutants / waste assimilation / flood defenses / protection from soil erosion / provides pollinators/pollination /provide areas for recreation (aesthetic value)/spiritual/cultural activity (eg plants for medicinal use) / provides a habitat (food/water);

Note: *Do not accept tangible goods/products that generate profit e.g. '(sold as) tea / timber / tourism'.*
If tea is identified, the response must indicate it is used as a food and not a commercial good e.g. do not accept only '(Roobios) tea'.
Do not accept only 'air purification / filters pollutants'.
Accept other reasonable responses.

2. (a) Explain why invasive species can lead to soil erosion **[3]**

a. invasive species may have smaller leaf area/canopy leading to increased speed and volume of water runoff leading to erosion;
b. invasive species may change the soil biota that affect soil structure making it more prone to erosion;
c. invasive species communities may be more susceptible to fire than native species (to which the environment is adapted) exposing the soil to erosion (by wind/water);
d. fires are more intensive/extensive (burn longer and at higher temperature) causing loss of top growth/root systems exposing the soil to erosion (by wind/water);
e. invasive plants absorb large amounts of water leading to desertification and the soil more prone to soil erosion (by wind/water);
f. invasive plants may absorb different minerals, altering the nutrient content of the soils causing death of local vegetation and exposing the soil to erosion (by wind/water);
g. loss of vegetation due to fires/desertification/nutrient change/lack of water can lead to loss of roots that bind soil together (resulting in soil erosion);
h. invasive species/herbivores may over-graze native plants, exposing the soil to (wind/water) erosion;
i. invasive species may trample soil destroying plant roots that bind soil together (resulting in soil erosion) / invasive species may trample soil and compact it increasing surface run-off and soil erosion;
j. invasive species may introduce disease which kill native plants leaving soils exposed to erosion (by wind/water);
k. commercial growth of invasive species can lead to over-irrigation and result in topsoil being washed away;

Note: *For credit response must be linked to soil erosion with a clear explanation.*
Do not accept answers that refer to 'degradation of soil quality/weakens soil' rather than 'soil erosion'.
Do not accept 'removal of invasive species causes soil erosion'.

(b) Suggest why the strategy shown in **Figure 2(c)** may be controversial. **[1]**

a. invasive species provide timber/employment within plantations;
b. invasive species provide recreational areas/aesthetic value;
c. removal reduces biodiversity/habitat diversity/ removes habitat / invasive species may provide a food source for other species;
d. removal reduces carbon sink / cutting down trees releases carbon to the atmosphere;
e. removal could lead to soil erosion;
f. invasive species have intrinsic value/biorights / goes against ecocentric beliefs / controversial from an ethical standpoint as it prioritises one life over another;
g. it may be expensive to remove invasive species;
h. removal of invasive species may accidently remove native species;

Note: *Do not accept only 'causes deforestation / removing invasive species endangers them'.*
Do not accept 'use of herbicides/chemicals / damages environment/ecosystem'.

(c) Outline the role of the king protea as a flagship species. **[2]**

a. protea is a popular/well known/attractive species/ national flower of South Africa;
b. …this can be used to promote/encourage conservation efforts / used to raise awareness about conservation through education;
c. useful in promoting fundraising for protea conservation/conserving other species;
d. by protecting it the entire biome/habitat/ecosystem/other species are protected;

3. (a) Identify **one** advantage and **one** disadvantage in the design of the Table Mountain National Park. **[2]**

Advantage: **[1 max]**	(relatively) large area; includes many different ecosystems / includes terrestrial and coastal ecosystems / includes variety of habitats; (designed to include) high number of endemic species/high diversity of species; includes important breeding and nursery grounds;
Disadvantage: **[1 max]**	large edge effect / a lot of edges / high edge to area ratio; large area/edges make it difficult to control tourists/recreational activities/police illegal activities (e.g. poaching)/invasive species; fragmented (by urban areas) / inter-dispersed/mixed within the urban environment / no connecting wildlife corridors/bridges; closeness to urban areas increases risk of poaching/road deaths of animals / closeness to urban areas can increase exposure to (urban air) pollution / lack of buffer zones ; close proximity to urban areas poses risks/challenges for fire management; includes MPA zone where no fishing is allowed (no-take zone) which could have been a source of food/income for the local population;

Note: *For advantages, do not accept only 'includes a Marine Protected Area/marine restricted area/various forms of landscapes / includes geographical range of the Table Mountain ghost frog'.*
For disadvantage, do not accept impacts of tourism such as pollution, focus should be around design of the National Park.
For disadvantages, do not accept only 'close to urban areas / park is scattered / large area makes it difficult to manage / risk of urban expansion/encroachment'.

(b) Explain why the rates of productivity are high within the coastal waters around the Cape Peninsula. **[2]**

a. (where two currents meet) upwelling/mixing results in release of nutrients, high levels of nutrients increase levels of (primary) production / confluence of ocean currents mixes nutrients and waters of different temperatures enhancing productivity;
b. shallow waters allow light penetration and therefore increases photosynthesis;
c. release of nutrients into coastal waters from land-based sources, e.g. sewage, could increase (primary) productivity;
d. higher productivity (at any level in the food chain/web) makes more energy available / transfers more energy to organisms along the food chain;
e. varied marine habitats support a variety of species/ecological niches that contribute to complex food webs and overall high productivity;
f. protected areas/marine restricted zones provide a sanctuary/nursery area for species to breed/grow which increases (secondary) productivity / use of permits/quotas/fish restrictions allow stocks of (immature/young) fish to grow fully increasing (secondary) productivity;

Note: *Do not accept only 'fishing is managed / restriction of fishing / use of permits'.*
Do not accept only 'protected area/habitat'.
Do not accept 'high biodiversity leads to high productivity'.
Do not accept 'fishing restrictions allow species to thrive'.

(c) Identify one criterion used by the IUCN that may have contributed to the change in classification of the Table Mountain ghost frog from 'endangered' (1994) to 'critically endangered' (2004). **[1]**

a. reduction in population size / decrease in number of mature/adult individuals;
b. lower geographical range / lower extent of occurrence / lower area of occupancy;
c. reduction in habitat / loss of quality of habitat;
d. increased level of fragmentation of the habitat;
e. increased probability of extinction in the wild;

For credit response needs to have a comparative word e.g. not just 'population' but 'decreased population'.
Accept responses which relate to loss of habitat e.g. reduction in river sit es/streams are prone to drying up/habitat reduction from fire/loss of streams from reservoir construction.

Note*: Do not accept only 'frogs are in danger from fire/reservoir construction/invasive species'.*
Do not accept only 'reduction in the species'.
Do not accept 'population density'.

(d) Describe how a named abiotic factor within the aquatic habitat of the Table Mountain ghost frog could be monitored. **[2]**

a. e.g. measure dissolved oxygen levels/BOD/pH/temperature/turbidity/suspended solids/nitrates/phosphates/total dissolved solids (TDS)/conductivity/water flow/water levels/light penetration using appropriate method/instrument (eg oxygen/pH probe / Secchi disc);
b. sample at sites representative of the area / take samples at multiple points;
c. take samples/measurements at regular time intervals to monitor any change;

Note: *No marks for only naming the abiotic factor within MPa.*
Only credit responses that relate to an aquatic abiotic factor e.g. do not credit 'fire'.
ECF for marking points b. and c. if incorrect parameter is named.

4. (a) Suggest **two** possible reasons why the African penguin population at Boulders Beach has grown significantly since 1982. **[2]**

a. due to no take zone/location within MPA/reduced competition from human fishing, has resulted in a larger food source;
b. area around Boulders Beach is part of Table Mountain National Park which provides a safe habitat for penguins/mitigates threats from human activities/controls access to breeding areas (resulting in successful breeding) / habitat of the penguin is protected;
c. protection offered at site due to value as tourist attraction / investment from tourism into conservation of penguins/habitats/ecosystem (e.g. habitat restoration/rescue and rehabilitation programs/artificial nesting structures);
d. suitable beaches/habitat for nesting/breeding;
e. low number of predators/killer whales/fur seals / absence of disease that could limit population growth;
f. lack of competition for food resources from other species / large amounts of food resources available;
g. climate change may support more frequent egg production (as conditions may allow birds to nest all year round);
h. penguins breed fairly quickly with high reproductive success rates / penguins may be r-selected species;

Note: *Do not accept only 'penguins are protected'.*
Do not accept only 'available space/habitat / beach is protected by legislation / migration of penguins'.

(b) Outline how climate change may impact the food supply for penguins around the southern African coast. **[1]**

a. reduction in upwelling as ocean conveyor belt slows down/reduces nutrients available for phytoplankton, therefore reducing prey species population (and limiting food resources for penguins);
b. climate change is changing currents around the cape and fish are being displaced to areas outside the penguin's feeding zone/shift in prey population (e.g. herring/anchovies);
c. warmer ocean temperatures are shifting prey towards cooler waters/southern pole / prey species (e.g. herring/anchovies) are unable to survive in/adapt to warmer ocean temperatures / warmer temperatures may reduce levels of dissolved oxygen in the water and adversely affect (plankton and) fish/prey populations;
d. warmer ocean temperatures may attract other species into the area increasing potential prey species;
e. climate change may lead to more competition for food from new species arriving to the area;
f. warmer ocean temperatures may result in reduced plankton growth therefore reducing prey species numbers;
g. warmer ocean temperatures may result in an increase in plankton growth therefore contributing to an increase in prey species numbers;
h. warmer water temperatures can reduce the breeding success and survival rates of fish, leading to a decline in food source for penguins;
i. acidification of oceans can negatively impact plankton and in turn reduce food sources for penguins;

Note: *Response must link to either increase/decrease of prey/source of food.*

(c) With reference to **Figure 4(b)**, outline why a decline in the Killer whale population in the area may cause a decline in African penguin numbers. **[1]**

a. (reduction of killer whale), means increase in fur seals, so increase in predation of the penguin;
b. Increased population of fur seals increases competition for penguins food (sardines)*;*

5. (a) Outline one reason for the variation in the volume of water stored in dams, as shown in Figure 5. **[1]**

a. Fluctuating/periodic/seasonal input from rainfall;
b. Fluctuating/periodic/seasonal extraction for agriculture/urban use;

Note: *Do not accept only 'less rain / more rain / agricultural use / infrequent rainfall'*

(b) Outline one reason for the variation in agricultural water use as shown in **Figure 5**. **[1]**

a. more water is needed when rainfall is low / less water is extracted when it rains;
b. more water is needed when (monthly) temperatures are higher (as shown in Figure1d) due to increased evaporation from soil/plants;
c. (plants require more water when they are growing, so) the greater water use is during the growing season / plants require more water during photosynthesis;

Note: *BOD if incorrect season but an appropriate reason is given.*

(c) Outline two strategies that may have been used to reduce urban water use, as shown in **Figure 5**. **[2]**

a. campaigns to educate public to reduce water use e.g. by encouraging change in individual behavior to reduce water use;
b. promotion/use of water saving appliances/devices;
c. replacing lawns/yards/grass with drought-tolerant gardens/dry-land gardening;
d. recycling/reuse of water/grey water;
e. use of rainwater capture/water butts/barrels to collect rainwater;
f. improvements in infrastructure to reduce water leakage/losses;
g. imposing water usage quotas/water restrictions;
h. installation/use of water meters to encourage less water usage / water tariff rates that increase as use increases / increase in water prices;
i. change from water intensive industries to non-water intensive industries e.g. service-based businesses (within urban areas);
j. promote the use of public swimming pools instead of private/domestic pools;

Note*: Do not accept 'decrease in population'.*
Do not accept only examples without reference to strategy.
Do not accept methods that increase main supply of water e.g. use of desalinisation plants'.
Accept other reasonable responses.

6. Evaluate how the planned changes in the energy supply, shown in Figure 6, are likely to influence carbon emissions in Cape Town. **[3]**

*Pros – reduce carbon emissions **[2max]***

a. decrease in use of coal with high emissions will tend to reduce carbon emissions / switch (from coal with high emissions) to coal with low sulfur emissions reduces overall carbon emissions;
b. decrease in overall use of coal (both low sulfur content and high emissions coal) will decrease carbon emissions / there is a slight decrease in carbon-producing sources;
c. increase in renewables/nuclear/wind/solar will tend to reduce carbon emissions;

*Cons – increase carbon emissions **[2max]***

d. overall increase in energy supply will tend to increase carbon emissions due to construction/maintenance/extraction / production of batteries for renewable energies requires extraction of materials which produces carbon emissions;
e. use of coal with low sulfur content will still produce carbon emissions;
f. overall proportion of carbon producing sources remains fairly constant;

***Note:** For credit for either pros or cons, link must be made to carbon/carbon dioxide emissions.*
For pros, do not accept only 'use of low sulfur coal will reduce emissions'.
*Conclusion **[1max]** needs to be balanced considering both sides of the argument for credit and makes a clear value judgement e.g.:* Although there is a planned increase in the use of renewable energies (associated with low carbon emissions) the majority of energy will still be generated using coal that releases carbon dioxide;
Conclusion is not mandatory, and 3 marks can be achieved through consideration of both pros and cons

7. Discuss how management practices in Cape Town and the Table Mountain National Park are likely to influence species conservation within the Cape Floristic Region. **[6]**

***Advantages [4 max]*:**

a. the national park is a protected area ensuring habitats/species are protected from development/destructive activities/hunting;
b. tourism can help generate funds for conservation projects / tourism can help to promote conservation awareness/environmental stewardship;
c. removal of invasive species reduces competition for indigenous species / removal of invasive species helps to conserve water which will benefit conservation of other (local/indigenous) species;
d. removal of invasive species removes additional contribution to increased risk/extent of fires;
e. no take marine zones provide nursery grounds to marine species / use of quotas/permits can help to conserve species;
f. no take zones reduce competition for fish/food between humans and marine species e.g. African penguins;
g. reducing CO_2 emissions can reduce rate of climate change which can affect food availability for animals/growing conditions for plants / use of low sulfur coal will lower SO_2 emissions and reduce damage to species/habitats;
h. working with local communities will improve chances of conservation being successful/increase awareness of need for conservation/ increase funds available;
i. monitoring stream conditions can help to predict when species are at threat and allow time for action to be taken to preserve the species / reduction in water use would reduce extraction from rivers which could be beneficial to species/habitats;

***Disadvantages [4 max]*:**

j. population growth means urban sprawl/urbanization, reducing habitat for indigenous species / national park is close to urban areas where wildlife can be harmed by (industrial/urban) pollution / close proximity to urban areas increases risk of poaching/road kill negatively influencing species conservation;
k. fragmentation of national park/lack of wildlife corridors reduces genetic diversity due to isolation, reducing effectiveness of conservation measures;
l. removal of invasive species may harm native species/cause soil erosion / use of pesticide/herbicide to control invasive species can also have a detrimental effect on other species;
m. growth in agriculture/plantation forestry reduces habitat for wildlife / agriculture may lead to pollution from pesticides/nutrients/sediments that adversely affect species/habitats;
n. tourists can frighten breeding animals reducing successful reproduction;
o. tourists can trample vegetation/seedlings reducing biodiversity / anchors from tourist boat trips may damage the seabed/marine habitats;
p. water abstraction by humans can reduce flow of water in streams/rivers reducing quality of habitat for organisms / construction of water reservoirs can lead to loss of habitat;
q. building of low emission power sources could require clearing of land negatively impacting biodiversity / continuing use of coal and resultant mining activity destroys habitats;
r. management practices in the National Park have a limited influence overall in species conservation of the Cape Floristic Region since it is just a small proportion of the whole area;

***Conclusion [1 max]*:**
e.g.: Although active removal of invasive species reduces competition for indigenous species and can help to conserve species, overall urbanisation/growth of agriculture continues to reduce the habitat available for successful conservation of species within the Cape Floristic Region;

Note: *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.*
Award ***[5 max]*** *for both advantages and disadvantages.*

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