

# Markscheme

May 2015

**Environmental systems and societies**

**Standard level**

**Paper 2**

28 pages

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## General marking Instructions

Assistant Examiners (AEs) will be contacted by their team leader (TL) through RM™ Assessor, by e-mail or telephone – if through RM™ Assessor or by e-mail, please reply to confirm that you have downloaded the markscheme from IBIS. The purpose of this initial contact is to allow AEs to raise any queries they have regarding the markscheme and its interpretation. AEs should contact their team leader through RM™ Assessor or by e-mail at any time if they have any problems/queries regarding marking. For any queries regarding the use of RM™ Assessor, please contact [emarking@ibo.org](mailto:emarking@ibo.org).

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1. Follow the markscheme provided, award only whole marks and mark only in **RED**.
2. Make sure that the question you are about to mark is highlighted in the mark panel on the right-hand side of the screen.
3. 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.**
4. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases use RM™ Assessor annotations to support your decision. You are encouraged to write comments where it helps clarity, especially for re-marking purposes. Use a text box for these additional comments. It should be remembered that the script may be returned to the candidate.
5. Personal codes/notations are unacceptable.
6. Where an answer to a part question is worth no marks but the candidate has attempted the part question, enter a zero in the mark panel on the right-hand side of the screen. Where an answer to a part question is worth no marks because the candidate has not attempted the part question, enter an “NR” in the mark panel on the right-hand side of the screen.
7. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers. RM™ Assessor will only award the highest mark or marks in line with the rubric.
8. Ensure that you have viewed **every** page including any additional sheets. Please ensure that you stamp “seen” on any page that contains no other annotation.
9. Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalizing them for what they have got wrong. However, a mark should not be awarded where there is contradiction within an answer. Make a comment to this effect using a text box or the “CON” stamp.

## Subject details: Environmental systems and societies SLP2 Markscheme

### Mark allocation

Candidates are required to answer **ALL** questions in Section A [25] and **TWO** questions in Section B [40]. Maximum total = [65].

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** (or 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.

**Section A**

1. (a) (i) Any two of: tomatoes/cauliflowers/rice/vegetables/fruits/lotus plants/bamboo shoots **[1 max]**

*Note for examiners: no mark for "inle carp" (as it is a fish), "wood" & "weeds" (are used for construction)*

(ii)

evidence	explanation
people survive on local/renewable/diverse resources/ eg. fish sold in local market;	reduces energy lost in transport / reduces costs/food milage/don't exceed sustainable yields/no imports;
use of lotus plants for fibres for weaving;	it can regrow as a renewable resource;
Intha house is raised above the ground;	hence does not take up the ground space or reduce the habitat size;
artisanal fishing/simple boats/locally made nets;	limited yield of fish;
small human population (near carrying capacity);	limited space on the floating gardens / limited food supply;
majority of diet is vegetables;	less energy lost along food chain;
houses use natural building materials	these are renewable;
floating gardens is a farming system adapted to local conditions;	low input/subsistence farming;
Garden fertilization was based on nutrients coming from the lake;	not chemical fertilizers;

**[2 max]**

*Allow no marks if only evidence is given.*

*Allow one mark for each piece of evidence with explanation up to **[2 max]***

*Accept reasonable arguments based on Figure 4.*

*Do not allow explanations on current unsustainable use.*

- (iii) Any three of:  
deforestation due to rice planting/collection of building materials;  
depletion of fish stocks due to fishing/toxic waste/eutrophication;  
reduced light entering lake due to floating gardens/stilt-houses/ water hyacinth;  
pollution due to domestic waste/industrial waste/coal mine and power plants;  
eutrophication due to fertilisers/domestic waste;  
bioaccumulation due to agrochemicals;  
increased turbidity due to run-off/sedimentation/deforestation/algal growth;  
sedimentation/infilling/reduced water depth due to floating gardens/run-off from hillsides/deforestation;  
biodiversity loss due to increased competition from non-native species /increased levels of pollution;  
soil degradation and erosion due to deforestation around the lake;  
*accept answers that give positive environmental impacts such as the examples below:*  
sustainable farming and harvesting practices (e.g., use of agrochemicals and organic fertilizers) result in protection of the lake/bamboo ecosystem;  
floating gardens control flooding;  
floating gardens create land to use for farming or home building;  
*The answer must have impact + link to Inle human activity to gain a mark. Accept any other reasonable suggestion.*

[3 max]

- (b) (i) *inputs – any two of:*  
runoff/overland flow;  
river (inflow)/Nyaung Shwe river;  
precipitation/rain/monsoon /;  
throughflow/groundwater flow;  
power plant discharge water;

[1 max]

- outputs – any two of:*  
river (outflow);  
seepage;  
extraction (by power plant/for domestic use);  
evaporation;  
transpiration/evapotranspiration;  
surface runoff after flooding;  
plant absorption/animals drinking;

[1 max]

*Award 1 mark if one correct input and one correct output are shown.*

- (ii) water inputs minus water outputs/natural inputs minus natural outputs / the difference between the natural inputs and natural outputs;

[1]

*Credit the use of specific examples of water in/outputs. The outputs should NOT include any domestic use of water, as this is the natural income asked for. Do not accept any resource unless it is water.*

(c) (i) Award **[1]** for each type.

Types of pollution	Example from Inle Lake
Point Source	(waste from) local industry/coal mine/power plant/ domestic wastewater (from houses via pipes)* <b>[1]</b>
Non-point Source	fertilizers / pesticides / nutrients/nitrate/ phosphate / domestic wastewater* / sediment into lake <b>[1]</b>

**[2 max]**

\*could be considered as point source *if house can be identified or non-point source if all houses are being considered. Do not credit the same point twice unless specific distinctions are made.*  
*Simple statements of one word are acceptable; many students will write more detail.*

(ii)

	Example in Inle Lake
Altering the human activity	stop creating/maintaining floating gardens; stop/reduce use of fertilizer; use only organic fertilisers; stop residents of houses tipping their waste water/sewage into the lake; stop/reduce discharge from power station/coal mine/industry; Introduce legislation to prevent discharge of pollutants; education about the harmful effects of pollution on the lake (any eg of pollution acceptable); stop deforestation (to reduce sediment runoff into lake); <b>[1 max]</b>
Clean-up and restoration	dredge the bottom of the lake/remove sediment/pump up the mud from lake bottom; remove floating gardens; restock the fish stocks/native species; replant trees at lake sides to reduce run-off; remove non-native species; allow lake to regenerate naturally once pollution stopped; pump in oxygen; <b>[1 max]</b>

**[2 max]**

*All answers should link to pollution in the lake, not, for example overfishing.*



- (iii) fertilizers used on land/floating gardens runs off into the sea/seas around coasts;  
excess nutrients lead to rapid algal growth/blooms/eutrophication;  
this limits light/photosynthesis of other plants thus reducing O<sub>2</sub> levels;  
low O<sub>2</sub> causes plants/animals/fish/algae die;  
increased deaths & decomposition leads to further decrease in O<sub>2</sub>;  
low O<sub>2</sub>/increased deaths increasing decomposition/O<sub>2</sub> reduction is positive feedback;  
most areas affected are in MEDCs which can afford to use fertilizers;  
hypoxic waters may run off into sea from lakes which have excess nutrients/algal growth/eutrophication;

[4 max]

*Note to examiners: NO marks awarded for references to eutrophication caused by urban or industrial waste*

- (d) *Strengths:*  
grass carp is good for control because it naturally feeds on hyacinth;  
grass carp and hyacinth may become a self-regulating/negative feedback system / increased grass carp leads to decreased hyacinth (or vice versa);  
better than chemicals/herbicides as no pollution of the water;  
better than mechanical removal of hyacinth which is very labour-intensive;  
population once introduced will reproduce so only need to do it once;  
inexpensive;  
the grass carp may become a food source for the local populations;  
grass carp may become a part of the natural food web; [3 max]

*Limitations:*  
is a non-native species so may eat other/desired plants/organisms too;  
may out-compete the local carp/other fish species;  
grass carp may overpopulate the lake and become a problem themselves;  
may bring diseases to the endemic fish species;  
risky thing to do as cannot foresee the effect of the grass carp on the ecosystem;  
the local population may use the water hyacinth as a resource, which may now become limited; [3 max]

[4 max]

- (e) *Accept valid points up to [4]. Must be a discussion to include at least one benefit and one drawback for full marks. Award up to [2] for a list of impacts only.*

*Benefits:*

tourists bring different perspectives so open up the society to different ideas;  
sale of local artefacts/souvenirs will increase local income;  
...which may encourage traditional skills to survive eg weaving;  
...which may also lead to increased awareness/appreciation of their own culture;  
tourists are usually more wealthy than the Inle people so may bring other goods (eg cameras, electronic goods, foreign currency) to the Inle people so make the society richer;  
more opportunities to trade/learn skills (changing the society);  
money from jobs (changes society by) allows access to education/healthcare;  
incentive to improve education/go to school to learn a foreign language or a skill required by hotels;  
locals become more optimistic as there is a way of improving their life/gaining more money;  
tourism opens jobs better paid than farming;  
tourism opens new markets / trading opportunities / industries; [3 max]

*Drawbacks:*

petty theft/envy may increase though with so many more consumer goods around;  
values may clash with tourists of different religions/dress codes which could cause conflict;  
traditional roles may diminish as other work in catering for tourists is done;  
growth development of tourism may lead to displacement/takeover of farmland;  
....generating a more commercialised food culture;  
...negatively affecting self-sufficiency/sustainability/cultural values/inheritance of local population;  
...and may lead to increased immigration/emigration/urbanisation;  
influx of new ideas/perspectives / requirement of novel job skills may raise conflicts among locals / create a gap between younger and older people;  
tourism may raise demand for illegal activities eg prostitution, drugs, wildlife trophies;  
government might prioritize funding of projects that please tourists rather than meeting actual needs of locals (or even against their needs);  
tourism might destroy the beauty of the area causing psychological stress to people/ altering the way they see life/ feeling they are losing their traditions/ethos;  
[3 max]

*Accept any other reasonable answer*

**[4 max]**

*Note to examiners: Do not award marks for environmental/ecological impacts.*

### General Essay Markscheme

Each essay is marked out of **[20]** of which **[2]** are for clarity of expression, structure and development of ideas.

- [0]** Quality of expression, structure and development is poor.
- [1]** Quality of expression, structure and development is limited.
- [2]** Quality of expression is clear, structure is good and ideas are well developed.

*Do not penalize candidates for writing in bullet pointed lists – if this technique is used appropriately ie to summarize or outline a list of points within an essay at an appropriate point. However, a candidate who has not shown **any** evidence of being able to write a paragraph with a developed, logical line of reasoning would not be able to achieve maximum marks.*

### Section B

2. (a) *Similarities:*
- both can be population/species interactions (interspecific);
  - in both two individuals are involved (includes both inter- and intra-specific);
  - both can lead to a stable equilibrium in populations;
  - both can lead to extinction of a species;
  - both limit population size;
  - at least one species is negatively affected in both;
    - both are density dependent;
- Differences:*
- predation negatively affects one species / competition (usually) negatively affects both competitors;
  - predation involves animal species / competition may involve animal or plant species;
  - in predation, one species (predators) depends on the other / competition neither are dependent on the other;
  - (only) predation involves direct killing/eating of species;
  - (only) competition reduces available resources for both species;
  - competition can involve competing for habitat not just food;
  - the species involved in predation represent two different trophic levels, whereas competition may represent the same trophic level;

**[4 max]**

*Award **[3 max]** if only similarities or only differences are stated.*

- (b) (i) as population of prey increases, more food is available for predators;  
this leads to increase of predator population;  
...so there is more predation / so prey population decreases;  
...leading to cyclical changes around a stable equilibrium;  
this is negative feedback / density dependent mechanism;

**[3 max]**

*These marks can be awarded for appropriately annotated diagram, clearly demonstrating the marking points.*

*Answers that incorporate good/strong examples can help the student gain marks for EoI.*

*Do not award marks for just giving examples in this question.*

- (ii) there may be excessive/unusually high growth/predation by predator population so the prey species declines;  
...eg if predator is a non-native/invasive/introduced species;  
...or if predator's limiting factors (eg disease/predation/climate) become more favourable;  
predator populations may continue to grow unregulated by a given prey species if they feed on other prey species as well leading to the long-term decline of the given prey species;  
If an environmental change causes decline of other prey species, predators with a choice of prey may focus predation more heavily on remaining species leading to their long-term decline;  
if prey populations fall for some other reason (human hunting), the population may become too small to recover from predation;  
If the prey species does not have time to reproduce then prey numbers will decline / if predation exceeds the natural rate of replenishment of the prey;

**[3 max]**

*These marks can be awarded for appropriately annotated diagram, clearly demonstrating the marking points.*

*Answers that incorporate good/strong examples can help the student gain marks for EoI.*

*Do not award marks for just giving examples in this question.*

- (c) For each of two strategies (do not credit more than two strategies) award **[4 max]**, but only **[3 max]** for an imbalanced discussion.

If more than two strategies are mentioned please credit the two highest scoring strategies.

If no named countries **[6 max]** but award no specific marks for the countries.

The sub-headings below are for guidance only. Credit should be given for the Marking points whether the student identifies them under these titles or not. E.g. One Child Policy may be identified as a strategy or an example etc

*anti-natal policies:*

*Strategy:* tax/welfare disincentives;

*Effect:*

too expensive to have many kids thus causing a reduction in birth rate;  
limits costs to the state of providing facilities for kids;  
the population is law abiding and so will have fewer children so abide by the law;

*Impact:*

gender preference leads to increased selective abortions/abandonment of babies;

For example, one child policy of China and the "little emperors";

the country has an aging population that requires healthcare;

*Strategy:* Education/promotion/provision of free/cheap contraception;

*Effect:*

population growth is slowed;

*Impact:*

individuals control their fertility;  
conflicts with cultural/religious beliefs/norms;

For example, Philippines is a strongly Catholic country where the Church supports the ban on contraception;

*Strategy:* Emancipation/higher status/education of women;

*Effect:*

reduces the fertility rate of women in the country;  
fewer children as women have more decision making/career opportunities available;

*Impact:*

this can enable families to increase economic productivity;  
but this can upset male dominated societies/cultures/religions;

For example, in Uganda the more male children gives greater social status to men;

*Pro-Natal policies*

*Strategy:* Tax incentives;

*Effect:*

may prevent population decline;

...may have political benefits in maintaining economic productivity;

*Impact:*

population may already be unsustainable/beyond carrying capacity;

Is costly to the government;

increase proportion of young people to stabilise population distribution;

For example, France pays a bonus for each extra child born in a family;

free public transport etc to support the overall strategy of increasing family size;

*Strategy:* Welfare incentives/Extended maternity/paternity leave/subsidized childcare;

*Effect:*

increase number of children a family is willing to have, as little cost/allows the parents to be economically independent;

*Impact:*

high cost to businesses/industry as workers unavailable;

can lead to a rapidly growing population of young people;

For example, Singapore in the 1980s covered the cost of maternity leave for the first 4 babies;

*Strategy:* Laws against birth control/family planning;

*Effect:*

population will rise to the required number for the country;

*Impact:*

can be too authoritative with bans on contraception/no control over fertility;

cultural and religious requirements are met;

For example, Romania did ban abortions and strongly discouraged the use of contraception;

*Strategy:* Immigration laws;

*Effect:*

partly effective but illegal immigration still happens;

*Impacts:*

political divisions about what to do to stop illegal entry;

human rights might be breached with deportation of migrants;

*Allow other reasonable answers like healthcare that specify how the population will be stabilised.*

Award **[7 max]** for marking points above, and **[1 max]** for a clear conclusion that is justified by points raised.

*Note to examiners: An isolated statement/opinion e.g. “tax incentives are the most effective strategy” should not be considered as a valid conclusion. A valid conclusion may, however, be stated within the body of the response rather than at the end, and may involve some balanced decision:*

e.g. Emancipation/higher status/education of women is the most effective strategy because it simultaneously addresses many other social issues/human rights;

**[1 max]**

Expression of ideas **[2 max]**

3. (a) “Renewable” resources can be naturally replenished;  
“Sustainable” is the use of resources at a rate less than or equal to their replenishment / that allows similar use for future generations;

“Renewable” refers to the resources themselves;  
“Sustainable” refers to the activities affecting resources (eg extraction/exploitation/use);

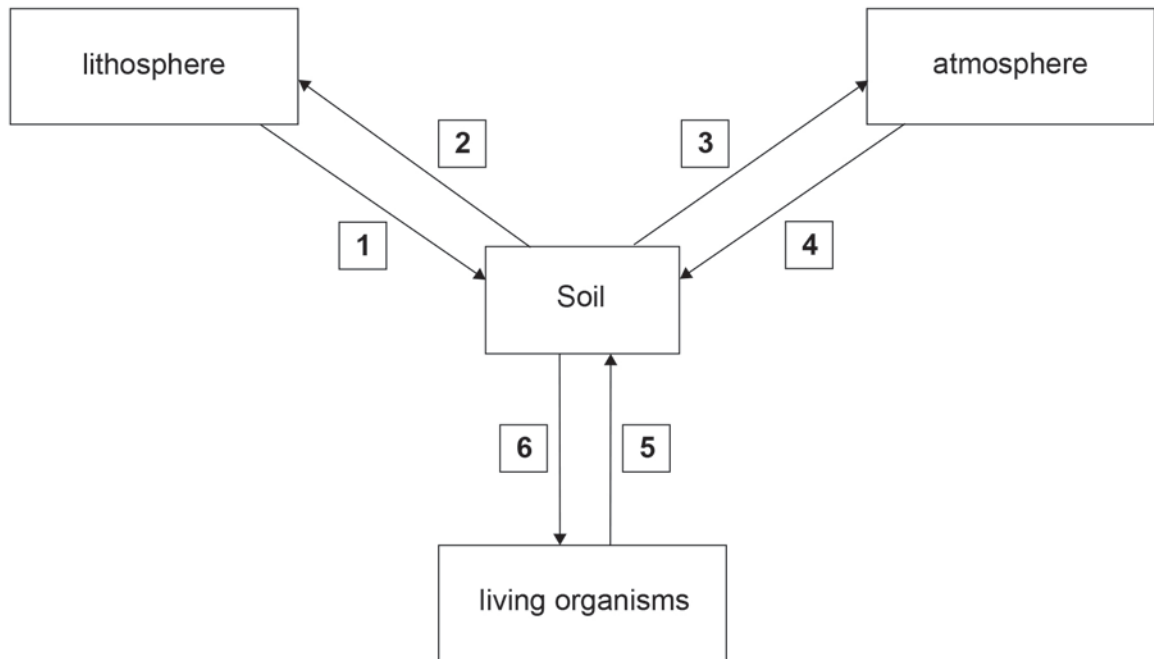
resources may be “renewable” but their current extraction/exploitation/use may, or may not be “sustainable”;

**[1 max]** may be awarded for an appropriate example of BOTH a renewable resource (a good or service e.g timber) AND a sustainable practice (e.g. harvesting only natural income);

**[2 max]** for renewable and **[2 max]** for sustainable

**[4 max]**

(b)



Award **[1 mark]** for each correctly labelled process/flow up to **[4 max]**

Award **[1 mark]** for each valid example of matter up to **[4 max]**

Award **[5 max]** if diagram is unclear/ambiguous



Flow	Label of flow	Example of matter
1	weathering / erosion	particles of rock/parent material
2	sedimentation/deposition / fossilisation	soil particles/dead organisms/shells
3	diffusion (of gases) / evaporation / wind erosion / denitrification / combustion/burning	CO <sub>2</sub> (from respiration/decomposition/combustion) / water / soil particles / N <sub>2</sub>
4	precipitation / diffusion (of gases) / deposition / nitrogen fixing bacteria	water/acid / O <sub>2</sub> (for respiration) / atmospheric particles / N <sub>2</sub>
5	diffusion (of gases) / respiration / death / decomposition / excretion/defecation / human processes that affect soil contamination/pollution(agrochemicals etc)	CO <sub>2</sub> (from respiration/decomposition) / organic matter / minerals / ammonium/urea/faeces / fertilizers/pesticides(any pollutant that may dissolve in water and remain in soil)
6	absorption / feeding / diffusion (of gases) / root uptake	minerals/nitrates / organic matter / O <sub>2</sub> (from respiration) / water

[6 max]

(c) *Use of agrochemicals (technique):*

manure or organic fertilisers may help with increasing the fertility of the soil / water retention of the soil (increase sustainability);  
use biological control may reduce soil contamination by pesticides(increase sustainability);  
artificial fertilisers may toxify the soil if overused (decrease sustainability);  
use of pesticides might contaminate /poison soil(decrease sustainability);

*Tillage/ploughing method (technique):*

contour ploughing may reduce erosion runoff (increase sustainability);  
conservation tillage” (chisel / moldboard plough) is a sustainable technique because techniques that do not destroy the soil structure are applied(increase sustainability);  
tillage is timed to the season with less rain/wind to reduce erosion(increase sustainability);  
gradient ploughing/parallel with slope may increase soil loss through erosion(decrease sustainability);

*Reduction of erosion(technique):*

undivided/large areas may lead to greater wind erosion of soils(decrease sustainability);  
bare land/soil during rains/winter may lead to increased erosion(decrease sustainability);  
wind-breaks/hedges may reduce wind erosion(increase sustainability);  
growing cover crops or mulching after harvest can reduce soil erosion(increase sustainability);

*Cropping technique(technique):*

multiple/mixed cropping may help maintain mineral/nutrient composition(increase sustainability);  
leaving soil fallow / crop rotation with N-fixing plants may help maintain nutrients(increase sustainability);  
use of GM crops to reduce need for fertilizers/water(increase sustainability);  
monocropping may lead to loss of nutrients(decrease sustainability);  
intensive harvesting may lead to nutrient loss(decrease sustainability);  
use of the "wrong" crops / non-native crops that have very high water/nutrients demand from the soil(decrease sustainability);  
Small scale slash and burn agriculture when combined with long resting/fallow periods can be sustainable/when fallow period is too short this is unsustainable;

*Irrigation(technique):*

drip irrigation may reduce leaching/mineral/nutrient loss(increase sustainability);  
overuse of irrigation/inappropriate types of irrigation may lead to leaching/nutrient loss salinization of the soil(decrease sustainability);

*Livestock/pastoral farming:*

rotating fields or letting them rest to avoid overgrazing that could lead  
accelerated erosion or soil compaction(increase sustainability);  
intense or high density grazing leads to accelerated erosion or soil  
compaction(decrease sustainability);

*Award [6 max] if response addresses only increase or only decrease in sustainability.*

*Award [4 max] if sustainability of the technique is not explained.*

**[8 max]**

*Do not award any marks for naming the technique.*

Expression of ideas **[2 max]**

4. (a) natural selection is survival of the fittest/best adapted;  
survivors will pass on favourable, inheritable traits to their offspring;  
populations of a species may become isolated from one another;  
...this may lead to speciation/greater species diversity;  
with natural selection populations will change/adapt over time to their different environments;  
...up to a point where they can no longer interbreed (ie new species formed/speciation);  
natural selection may also favour new mutations/genes adding to the genetic diversity;  
adaptive radiation through natural selection in newly formed/diverse habitats can increase species/genetic diversity in a population;  
natural selection may favour species that modify habitats generating habitat diversity;  
*Accept any other reasonable answer.*

*Answers that incorporate good/strong examples can help the student gain marks for EoI. And no marks for just giving eggs here.*

**[4 max]**

- (b) (i) *Role of atmosphere:*  
atmosphere contributes to patterns of climate/heat/temperature/ precipitation;  
rising hot, damp air at equator condenses as it meets colder air;  
...causing high rainfall and ideal conditions for rainforests in that region;  
descending dry air at slightly higher latitudes/30 degrees N/S;  
...gives rise to desert systems;  
atmospheric circulation transfers heat from equator to higher latitudes;  
...allowing for life-supporting temperatures in temperate grasslands/ forests/tundra biomes;

*Note to examiners: Credit must be given for answers that address biomes not species.*

*Full credit can be given for a well drawn annotated tri-cellular model with biomes and atmospheric flows shown.*

**[3 max]**

- (ii) *Role of plate activity:*  
volcanic activity/plate movement forms mountains;  
...that show a gradient/zonation of ecosystems changing with altitude;  
volcanic activity may also give rise to oceanic islands/land bridges;  
...often, due to their isolation, carrying unique ecosystems/communities;  
plate activity also gives rise to deep oceanic trenches;  
...with unique ecosystems often based on chemosynthetic production;

plate movement may cause separation of previously contiguous ecosystems;

...bringing ecosystems into new climatic regions;

Volcanic eruptions can wipe out entire ecosystems;

.... and may lead to succession/development of new ecosystems;

*Note to examiners: Credit must be given for answers that address diversity of ecosystems not species.*

**[3 max]**

- (c) *The sub-headings below are for guidance only. Credit should be given for the Marking points whether the student identifies them under these titles or not.*

*Global Warming element:*

climate change/biomes shift;

*Distribution:*

biomes move towards higher latitudes / altitudes;

*Credit a detailed example*

*Diversity:*

if the shift is too rapid some species will not be able to survive, decreasing diversity;

if the species are on islands or mountains they may run out of space to migrate to;

keystone species/critical to ecosystem, whole ecosystems may be lost/damaged;

changes to the precipitation/temperature/humidity may make an area more or less conducive to the existing ecosystems;

*For example*, desert areas may receive more rainfall so allowing a more diverse ecosystem;

*For example*, Sub-Saharan areas receive less rainfall leading to desertification / (southward) expansion of Sahara desert

increased fires in tropical rain forests (due to higher temperatures or increased aridity) would lead to loss of species / reduce niches;

altered rainfall patterns might reduce habitat diversity;

*Global Warming element:*

melting ice caps/permafrost;

*Distribution:*

exposed areas after melting in high latitudes and/or altitudes;

*Diversity:*

the newly exposed areas might support new tundra ecosystems, potentially increasing diversity;

if ecosystems space in the tundra is reduced then diversity decreases;

flooding of coastal area ecosystems will reduce ecosystem diversity;

positive feedback loops might occur with the release of methane/clathrates accelerating further global warming/ climate change, stressing ecosystems even more;

*Global Warming element:*

Changes to the oceans/aquatic areas (higher water temperatures/change in El Nino frequency and intensity);

*Distribution:*

areas closer to the surface/shallow depth ecosystems are more exposed to the changes;

*Diversity:*

higher temperatures are likely to bleach/destroy some coral ecosystems;  
...and accelerate ocean acidification, damaging plankton/base of marine ecosystems;

ocean circulation may alter allowing some areas to become more diverse;  
a possible change of deep sea currents may benefit some areas that would receive more nutrients, thus increase species diversity;  
a possible northward movement of Gulf Stream may benefit Iceland and Greenland (ameliorate temperature);

*Global Warming element:*

thermal expansion of sea/ sea level rise;

*Distribution of biomes:*

increased erosion of coast/ alteration of continental shelf landscape may alter the extent of littoral/shallow coastal zone;

flooding of coastal ecosystem may destroy them, e.g., mangroves;

...but at the same time create new littoral/tidal ecosystems;

*Diversity:*

reduce intertidal habitat diversity as some species won't tolerate the shift of tide lines (low & high);

creation of new tidal fronts may bring more nutrients thus increase aquatic species diversity;

*Award [7 max] for marking points above, and [1 max] for a clear conclusion that is justified by points raised.*

*Note to examiners: An isolated statement/opinion e.g. "global warming will alter distribution / diversity of ecosystems" should not be considered as a valid conclusion. A valid conclusion may, however, be stated within the body of the response rather than at the end, and may involve some balanced decision:*

*e.g. effect of global warming would be higher in Polar ecosystems as temperature increase is higher there, so low latitude ecosystems may be only partly affected; [1 max]*

*Award [2max] for part (c) if response just identifies global warming elements with no reference to effect of global warming on either distribution or diversity.*

*Award [5 Max] if the answer addresses only negatives or only positives of distribution and diversity changes*

Expression of ideas [8 max]  
[2 max]

5. (a) use a Biotic Index/calculate the Biotic Index;  
collect (many) samples from the lake/river systematically / from both upstream and downstream / at various intervals along a transect/ along the river;  
over at least a year / twice a year;  
identify the species (usually macroinvertebrates) using keys/photo charts;  
and measure their abundance;  
classify species into (pollution) tolerant, (moderately tolerant) and (pollution) sensitive;  
count how many taxa/species fall into each class/category;**[3 Max]**

measure biological oxygen demand/BOD/Dissolved Oxygen;  
sample the water using an appropriate kit/device/probe;  
take initial and a final dissolved oxygen reading / take (at least) 2 recordings (initial & after 5, 7 or 10 days);  
the difference between the initial and final reading is the BOD / calculate by appropriately graphing the data (DO values);  
The higher the BOD the more organic matter/Dead Organic Matter is in the water;**[3 Max]**

**[4 max]**



- (b) *The sub-headings below are for guidance only. Credit should be given for the Marking points whether the student identifies them under these titles or not.*

*Baseline study:*

provides an inventory of social/cultural aspects / keystone/red-listed species/unique habitats that are of particular value;  
this can help focus/organise/prioritise protective strategies;  
but ...it is time-consuming/expensive exercise;  
may be biased if carried out by surveyors under employment of developer;  
however the inventory may miss some species due to lack of funding/expertise / done fast as project deadlines are pressing;

*Assessment of potential social and ecological impacts/benefits:*

provides a holistic evaluation;  
allows input from all stakeholders;  
comparing to similar projects (already executed) would increase the validity of the EIA;  
but ...may be dominated by majority/commercial interests;  
political interference may occur;  
ecosystems are complex/newly formed and thus it is difficult to predict the potential impacts of a development on the ecosystem

*Recommendations/Mitigations:*

these are designed to limit impact/protect the environment;  
the EIA report is a public document and allows public to disagree;  
...may result in changed/modified construction techniques;  
in some countries the EIA is advisory while in others it is compulsory and so may determine the implementation of mitigation strategies;  
flooded area/lake/water reservoir should be designed to allow recreation activities / provide shelter for migratory birds / form a new ecologically sound habitat;  
but ...they depend on effective enforcement;  
overall project may be so large that some/a lot of ecological destruction will be done (even if the EIA is “ perfect”);

*Monitoring of impacts during development:*

help to ensure developers were keeping to recommended procedures/  
development before damage is irreversible;  
alert authorities to any unforeseen damage to environment;  
but ...this again is time-consuming/expensive;  
despite raising concerns nothing may be done to stop the impact;  
evaluation of social/ecological impacts after the development:  
would inform plans for any necessary restoration;  
enables responsibility/costs for this restoration to be passed on to developers;  
but ...not all damages are restorable/reversible;  
any penalties may simply be absorbed by developers as part of cost;  
developers may press the government to avoid paying for restoration / pass the  
cost to the taxpayers;

*Otherwise, award [6 max] for marking points above, and [1 max] for a clear  
conclusion that is justified by points raised.*

*Note to examiners: An isolated statement/opinion e.g. "EIAs are very helpful"  
should not be considered as a valid conclusion. A valid conclusion may, however,  
be stated within the body of the response rather than at the end, and may involve  
some balanced decision:*

*e.g. An EIA would be effective only if there is political will / enough funding /  
local pressure for its implementation ; [1 max]*

*Award [2max] for whole question if response just describes what an EIA is with  
no reference its effectiveness.*

**[7 max]**

- (c) Deep Ecologists believe in innate rights/biorights of living organisms;  
...and that humans should have minimal impact on other species/ecosystems;  
Natural processes are more important than human societies / humans should observe natural laws;  
Cornucopians believe humans have an unqualified/unlimited right to exploit the environment;  
...and technology will be sufficient to overcome any issues arising;  
will prioritise pro-growth/development goals in the justification of a project;

*Award up to [2 max] for general description of value systems ([1] for each).*

*Deep Ecologists' approach to HEP project [3 max]:*

*Deep Ecologists would oppose the project because...*

...building an HEP would be an example of materialism/unrestrained resource use that is against their beliefs;  
...a large dam will disturb natural processes/ecosystems which is unethical;  
...biorights of native species will be infringed through flooding upstream/changing flow downstream;  
...local cultural values (e.g. river sanctity/"river festivals") might be offended by interfering with the river;  
...animal/human rights of free access to water would probably be infringed by administration of HEP/reservoir;  
they would be against large-scale production plant/would propose smaller unobtrusive renewable energy sources;  
they would be against centralized energy sources/ would propose community based, smaller scale, energy sources;

*Cornucopians' approach to HEP project [3 max]:*

*Cornucopians would be in support of project because...*

the lake/reservoir would "improve" environment for human use e.g. recreation/more reliable water supply;  
HEP would be an efficient power supply to increase standard of living/further technological growth/development;  
it would provide a technological solution to problems of fossil fuel use;  
any ecological issues/disturbances from HEP could be resolved through human ingenuity/further technology;  
possible ecological/cultural losses would be outweighed by potential benefits to the community/society;  
with appropriate scientific design/development, lake/reservoir could increase biodiversity (e.g. aquatic species/migratory birds/new habitats);  
centralised management/regulation is more efficient/reliable at regulating resource use/maintaining sustainability;

*Note to examiners: If candidates have understood the value systems (Deep Ecologists and Cornucopians) the wrong way round, but their responses are consistent with the two opposing views, award [3 max].*

*While some of the above reasons attributable to Deep Ecologists/Cornucopians may be common to other EVS, no credit should be given to responses that explicitly address other EVS instead, or to reasons that are exclusively attributable to other EVS*

*Otherwise, award [6 max] for marking points above, and [1 max] for a clear conclusion that is justified by points raised.*

*Conclusion mark:*

*An isolated statement/opinion e.g. “a deep Ecologist would object the project whereas a Cornucopian would support it” should not be considered as a valid conclusion. A valid conclusion may, however, be stated within the body of the response rather than at the end, and may involve some balanced decision:*

*e.g. From these arguments we can see that the approaches of deep ecologists and cornucopians are at opposite ends of a spectrum, which is why a more central position, such as environmental managers/soft ecologists, is likely to achieve more success; [1 max]*

**[7 max]**

Expression of ideas **[2 max]**

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