N14/4/ENVSO/SP2/ENG/TZ0/XX/M

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# MARKSCHEME

## November 2014

## ENVIRONMENTAL SYSTEMS AND SOCIETIES

## Standard Level

## Paper 2

26 pages

**General Marking Instructions**

*Assistant Examiners (AEs) will be contacted by their team leader (TL) through Scoris™, by e-mail or telephone – if through Scoris™ 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 Scoris™ or by e-mail at any time if they have any problems/queries regarding marking. For any queries regarding the use of Scoris™, please contact emarking@ibo.org.*

**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 marks]*** and **TWO** questions in Section B ***[40 marks]***. Maximum total = ***[65 marks]***.

**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 ***OWTTE*** (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) *Award **[1]** for ecologically valuable*
*because it includes/provides:* 75% of Africa's mangroves / habitat for critical/endangered/endemic species / meeting point for chimp populations / coastal protection/flood regulation / fish nursery in mangroves / high biodiversity / better water quality;

(ii) *Award **[1]** for economically valuable*
*because it provides/supplies:* resources of oil/fossil fuels/timber/fish/palm oil / marine fisheries / hunting / ecotourism / some employment;

(iii) *Award **[1]** for socio-culturally valuable*
*because it provides:* livelihood/habitat/home for 20 million people/many ethnic groups / spiritual(/cultural significance) for the Ogoni people who worship it / aesthetically beautiful landscape/species / opportunities for scientific research/education; ***[3 max]***

(b)

| Feature of pyramid | How this shows it's an LEDC |
|---|---|
| narrow top | low life expectancy;<br>because less elderly people/few people live above 80;<br>*do not accept high death rate/mortality by itself, if a reasonable explanation is attached a BOD and point can be awarded* |
| wide base | families have many children;<br>because of high birth rate/population momentum;<br>high birth rate; |
| shape of pyramid | shows an expanding population/birth rates higher than death rates / slight concave middle / stage 2 / youthful population (of Demographic transition model);<br>*The points from the previous rows should not just be repeated* |

***[3 max]***

(c) 14 / 14.2 / 14.28 / 14.29 / 14.3%;
(20million/140million x 100)
*Units and calculation are **NOT** required for a correct answer* ***[1]***

(d) (i) 750 USD;
*Accept answers in the range 740 – 760.*
*Units are **NOT** required for a correct answer* ***[1]***

(ii) They are positively correlated (as oil production increases so does the GDP). (OWTTE); ***[1]***

(e) (A biodiversity hotspot is a biogeographic region that is both a significant reservoir of biodiversity and is threatened with destruction), the Niger Delta swamp is threatened by oil production;
populations isolated in swamps allow for speciation/many endemic species to occur;
many different habitats/niches / habitat diversity (*eg* Pools/forests /islands/mangroves/river);
mangroves have high diversity as they are at the interface of land and sea;
high temperatures and high precipitation all year round so constant growth; ***[2 max]***

(f) nitrous/nitrogen oxides/sulphur dioxide are released (when gas is burned);
combine with rainfall and become nitric acid/sulphuric acid;
or deposited directly as dry deposition; ***[2 max]***

(g) delta is low lying so more likely to be flooded as sea levels rise;
removal of mangroves removes coastal protection and increase sea level causes more damage/increased/larger storms impact coast more;
high level of poverty/low development so people are vulnerable/not very resilient to increased climate disasters eg floods/large storms;
already tensions/conflict in the area so tensions could easily increase as flooding occurs/land is lost to flooding;
resources are already being used unsustainably/shortages of resources for example salt intrusion of drinking water;
agricultural land too close to the sea coast, so more vulnerable to (potential) salt water inundation / loss of food crops;
global warming will compound other environmental problems *eg* oil pollution/deforestation/acid deposition;
high population density so large numbers of people to be affected by any changes in the delta's sea level;
this region will be prone to fatal tropical diseases such as Malaria that will spread more rapidly with GW;
social unrest/stress as the traditional worship species may be lost as they cannot adapt to changes due to global warming (*eg* too hot/too much salt water);
any severe degradation to the land or drying of river due to GW may be considered as divine punishment and lead to panic/psychological stress/tensions/upheavals due to religious reasons;
the river may dry up and so will the supply of freshwater/loss of freshwater supply (due to river drying up) will be devastating as people directly depend on the river water for drinking / have no established water network infrastructure;
lack of preventive infrastructure would exacerbate any issue caused by GW *eg* flooding / drying of rivers / coastal erosion;
*Valid responses should address* issues that *would be "particularly bad" for people in this area ...not just generally bad effects of GW e.g. no mark for "GW may increase spread of disease" but 1 mark for "this region will be prone to fatal tropical diseases that will spread more rapidly with GW"*
*The candidates are not expected to have a detailed knowledge of the Niger Delta, so answers should indicate how GW effects are exacerbated by local features eg*

*geographical (delta/coastal/tropical), or cultural (LEDC/poverty/religious values);* ***[3 max]***

(h) they feel strongly about the land because of their spiritual connections to it/this is the only homeland they have / Ogoni people don't wish to live lavishly so they don't care to exploit the oil / their tradition is ecocentric so fight for their land;
they are organized into a pressure group/NGO which has more power than an individual;
their campaign was non-violent and therefore did not alienate people;
Ken Saro-Wiwa execution raised their profile/caught media attention;
their land has been particularly badly affected so most of the Ogoni were affected/so consensus was reached in campaigning;
UNEP report raised awareness about the issues they faced leading to recognition of the campaign / leading to awarding of $1 billion (US) for clean-up;
they have been campaigning for over 20 years/since 1990/a long-running campaign of over 20 years/since 1990 means continual pressure on the companies and local continued involvement; ***[3 max]***

(i) it is a very expensive process, Nigeria/Ogoniland is poor/marginalized;
TNCs are very powerful/may refuse to pay/already refuse to pay fines for polluting;
high levels of conflict/tension in the area so a distrust of government clean-up/oil industry clean-up;
not clear that the Government in Nigeria will take action on pollution as oil companies already do not follow guidelines / political resistance to conservation efforts / possible corruption involved;
evidence that TNCs are not abiding by minimum standards as areas cleaned by the firms are still contaminated;
little history of protection/conservation in the Delta/there is no large scale formal protection there / data on biodiversity to save is little;
scale/extent of the pollution problem is huge / the area affected is vast ($70000km^2$);
it is one of the five most polluted spots on Earth/ 1.5 million tonnes of oil spilt in 50 years;
soil contamination is 5m deep so difficult to clean up / oil is microscopic/widely dispersed making clean up complex;
It will be difficult to regrow mangrove areas;
low level of development/education and poverty of local people leads to increased pressure on resources / people will still fish/harvest timber to satisfy short term needs;
*Accept other reasonable responses of equivalent validity, relevance and significance.* ***[4 max]***

(j) that more attention was paid to the smaller spill in the Gulf of Mexico/America than to the bigger pollution issue/spill in West Africa / that Africa is wondering why Americans are so concerned over a much smaller issue / that the spills in West Africa are a much bigger problem than the BP oil spill in the US;
America's eyebrows/expression suggest Western society/America is shocked/concerned/screaming at pollution nearby, when there are much greater concerns further away/in LEDCs;
Africa's eyes/expression suggest they may be more resigned/undisturbed by their pollution (perhaps because of more pressing issues of survival);
Africa is wondering why such attention is not paid to their pollution issue too;
The question mark may suggest Africa/everyone is relatively unaware of the pollution in Africa / there is no easy solution to the issue; ***[2 max]***

## SECTION B

**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.

*Candidates can use bullet-pointed lists in responses where these are appropriate eg for questions using command terms such as state and identify. However, for command terms such as discuss, compare and contrast, explain and evaluate, bullet points alone, without **any** evidence of a developed, logical line of reasoning, could gain no credit for EoI.*

**2.** (a) *Award **[1 max]** for definition and **[1 max]** for example of each. NB: Credit may be given for definition where the key concept is explicitly identified within the example. Please add a comment on the work if you give credit in this manner.*

*Negative feedback:*
Definition:
Feedback that tends to damp down/neutralize/counteract/self-regulate any deviation from an equilibrium/promote stability; ***[1 max]***
examples:
*eg* increased global temperatures cause more evaporation/cloud cover that reduces input of solar radiation thus decreasing temperatures;
*eg* increase in predator population increases consumption of prey reducing food available for predators thus decreasing predator population; ***[1 max]***

*Positive feedback:*
Definition:
Feedback that amplifies/increases change / leads to exponential deviation away from an equilibrium; ***[1 max]***
examples:
*eg* increased global temperatures cause melting/shrinking of ice sheets reducing albedo/reflected energy thus further increasing global temperatures;
*eg* melting permafrost releases methane that increases global warming/temperatures thus further increasing the melting of permafrost; ***[1 max]***

*NB: Valid examples must link a change in a named factor to the subsequent reversal/acceleration of change in that <u>same</u> factor.*
*Do not accept non-environmental system examples such as blood temperature or thermostat regulation.* ***[4 max]***

(b) *Award **[1 max]** for each of three valid policies; and **[1 max]** for a valid explanation of each policy named*

*development policy:*
Increased education/empowerment for women; ***[1 max]***
*explanation:*
evidence shows that the longer females stay in school, the lower their fertility rate; women have more choice and are able to make informed decisions about having children; ***[1 max]***

*development policy:*
Increased education about contraception/birth control/family planning; ***[1 max]***
*explanation:*
as people learn more about the ranges of contraception then more likely to choose to use them and reduce fertility rate;
as people learn about child spacing and the benefits to mother/child health of smaller families the fertility rate will reduce; ***[1 max]***

*development policy:*
Increased access to free/cheap contraception; ***[1 max]***
*explanation:*
greater availability/access to contraception (particularly in rural areas) gives greater choice to reduce fertility; ***[1 max]***

*development policy:*
Improved sanitation / access to clean water; ***[1 max]***
*explanation:*
improving sanitation / access to clean water decreases avoidable childhood deaths (due to gastrointestinal problems) from contaminated water, which then leads to decreased CBR; ***[1 max]***

*development policy:*
Increased healthcare; ***[1 max]***
*explanation:*
vaccination programmes reducing child deaths/more doctors/nurses/clinics so illness and disease can be treated early to reduce infant mortality leads to reducing CDR which then leads to decreased CBR;
*eg* Access to smoke-free cooking in homes so reducing deaths which then leads to decreased CBR;
*eg* Improved nutrition for children by educated mothers so reducing deaths which then leads to decreased CBR;
*eg* Mothers can read instructions on medication so reducing child deaths which then leads to decreased CBR; ***[1 max]***

*development policy:*
Government fertility/anti-natal policies *eg* one child policy in China / tax on more children; ***[1 max]***
*explanation:*
China has successfully reduced its CBR through implementation of a one child per family policy; ***[1 max]***

*development policy:*
Empowerment of landless and marginal people; ***[1 max]***
*explanation:*
evidence has shown that giving landless and marginal people more power and choice in their lives successfully reduces fertility in these populations; ***[1 max]***

*development policy:*
Improved cooperation / transfer of technology / transfer of funds, between MEDCs and LEDCs / Sustainable development; ***[1 max]***
*explanation:*
improved economy provides funds for education and workforce opportunities away from agriculture, moving away from agrarian society and less need for children to support family; ***[1 max]***

*Accept other reasonable responses of equivalent validity, relevance and significance.* ***[6 max]***

(c) *Arguments supporting claim:*
Ecological/ecosystems: vegetarian means eating at the first trophic level/producers/plants;
second law of thermodynamics explains that energy is lost at each transfer as heat; so reducing the length of food chains, reduces energy loss/maximizes efficiency (of energy transfer);
less land area/water is needed when only first trophic level is consumed / lower ecological footprint / when animals are consumed more land/water is needed (for same quantity of food) / higher ecological footprint;
less land being used for agriculture means less loss of biodiversity/environmental degradation;
meat production results in large amounts of greenhouse gases being released/global warming;
ecocentrics may support vegetarianism as it may reduce exploitation of resources/may attribute greater intrinsic value to animals;
ecocentrics support self-sufficiency which is more easily supported in an urbanized environment through growing vegetables rather than managing livestock;

*Counterarguments:*
Ecological/ecosystems: some livestock eat on pastures where human food crops cannot grow, so can be environmentally sound *eg* goats and sheep;
vegetarianism may be worse in some locations if supply requires long-distance transport/high food miles;
some animals eat the leftovers/peelings of human food production *eg* pigs and chickens reducing waste;
open water fish farming and wild fish harvesting can be practised sustainably providing better quality protein/without increasing land use;
technocentrics believe that humans are ingenious and could resolve impacts of meat production through technology;
*eg* genetically modified cattle/cattle feed to produce fewer greenhouse gases / laboratory-grown meat / harvesting of insect protein;
cornucopians would believe that whatever resources (meat or vegetable) are available are valid for human exploitation;

*Award **[1 max]** for an explicit and valid conclusion.*

*Alternative points of equivalent validity, significance and relevance to those given, should be credited.*
*Award **[5 max]** for responses that do not address both ecological principles and value systems, or only address one side of the argument.*
*Otherwise, award **[7 max]** for marking points above, and **[1 max]** for a clear conclusion.*

***[8 max]***

*Expression of ideas*: ***[2 max]***

*Total*: ***[20]***

**3.** (a) *Award **[2 max]** for each pyramid type*
*pyramid of numbers:*
displays the numbers of individuals/population size at each trophic level of a food chain/ecosystem;
may differ greatly in shape / may be inverted (depending on *eg* size of organisms/time of year/reproductive strategies);
represents storages;
represents quantities present at a given moment/snapshot in time; ***[2 max]***

*pyramid of productivity:*
represents the gain in biomass/flow of energy at each level;
is measured in units of g/m2/yr or J/m2/yr;
tends to be pyramid-shaped;
represents flows;
represents rates/changes over a period of time; **[2 max]**

*Award **[1 max]** for a diagram showing differing shape of pyramids of numbers v productivity for the <u>same</u> named food chain/ecosystem.* ***[4 max]***

(b) *Award **[1 max]** for each of three strategies and **[1 max]** for accompanying explanation:*

*Strategy:*
use organic fertilizers/manure/animal waste on agricultural fields;
*Explanation:*
this should reduce runoff/amounts of nitrates/phosphates;

*Strategy:*
legislate in favor of organic farming, / setting water quality standards;
*Explanation:*
would prevent unsustainable/polluting practices / overuse of agrochemicals;

*Strategy:*
legislate for/encourage restraint in use of artificial fertilizers/phosphate-rich detergents;
*Explanation:*
this will reduce quantity of nitrates/phosphates released into environment;

*Strategy:*
practice mixed cropping/crop rotation;
*Explanation:*
this will reduce the need for artificial fertilizers;

*Strategy:*
planting buffer zones around agricultural fields;
*Explanation:*
This helps absorb the excess nitrates/phosphates before they reach water bodies;

*Strategy:*
effective sewage treatment of urban waste;

*Explanation:*
this removes the excess phosphates and nitrates from the sewage before it reaches the water bodies;

*Strategy:*
safe collection of slurry from livestock farms;
*Explanation:*
prevent nitrates/phosphates from reaching water bodies/this will reduce concentrations of nitrates/phosphates in water bodies;

*Strategy:*
control application of fertilizers to times/seasons where run-off will be minimum;
*Explanation:*
this will reduce quantity of nitrates/phosphates entering water bodies;

*Strategy:*
mud-pumping/removal of nutrient-rich sediment/bottom sediment from affected water bodies;
*Explanation:*
this will prevent ongoing release of nutrients/eutrophication;

*Strategy:*
introduce surface plants to take up excess nutrients;
*Explanation:*
this will reduce quantity of nitrates/phosphates in the water bodies;

*Accept other reasonable responses of equivalent validity, relevance and significance.*

***[6 max]***

(c) *Outline of impacts:*
*Award **[3 max]** if examples are not specifically named*
Example 1: *eg* intensive wheat/corn production in USA:
using large quantities of herbicide/pesticides/agrochemicals reduces the biodiversity in surrounding areas/locally / eg may kill off many useful insects;
agrochemicals may affect top predators/birds through biomagnification/bioaccumulation / will intoxicate soils / kill soil invertebrates;
using a GMO (genetically modified organism) crop (*eg* Bt corn) reduces biodiversity;
heavy use of artificial/inorganic fertilisers may cause eutrophication of local water bodies;
use of agrochemicals/over-cultivation/heavy machinery may lead to loss of soil quality/compaction/salinization/toxification;
heavy irrigation/use of agrochemicals may lead to depletion/pollution of aquifers/water reservoirs;
irrigation/leaving fields bare after harvesting may lead to soil erosion; ***[2 max]***

Example 2: *eg* cattle farming in Brazil:
land clearance/deforestation of tropical rainforest/cerrado vegetation results in loss of habitat/biodiversity / reduces a major global carbon sink/storage increasing global warming;
use of agrochemicals/pesticides/antibiotics leads to pollution of local habitats/loss of biodiversity;
displacement of indigenous people and their way of life reduces stewardship of local environment;
deforestation and overgrazing of the cattle increases soil erosion/desertification;
methane production by cattle contributes to global warming; ***[2 max]***

Counterarguments and balancing factors relating to either or both systems:
impacts of inorganic fertilisers can be reduced/prevented by use of buffer zones;
use of agrochemicals/GM/intensive technology can increase yields per area reducing land required for food production;
drip irrigation technology can be used on a commercial scale to reduce water consumption;
GMO crops may be pest-resistant reducing need for pesticides;
crop-farming is ecologically more efficient than meat production (cattle farming);
cattle farming on Brazil has greater global impact than wheat farming in USA through its significant contribution to global warming;
tropical rainforest has particularly high biodiversity and so deforestation there causes a greater biodiversity loss; ***[4 max]***

*Award **[1 max]** for an explicit and valid conclusion.*

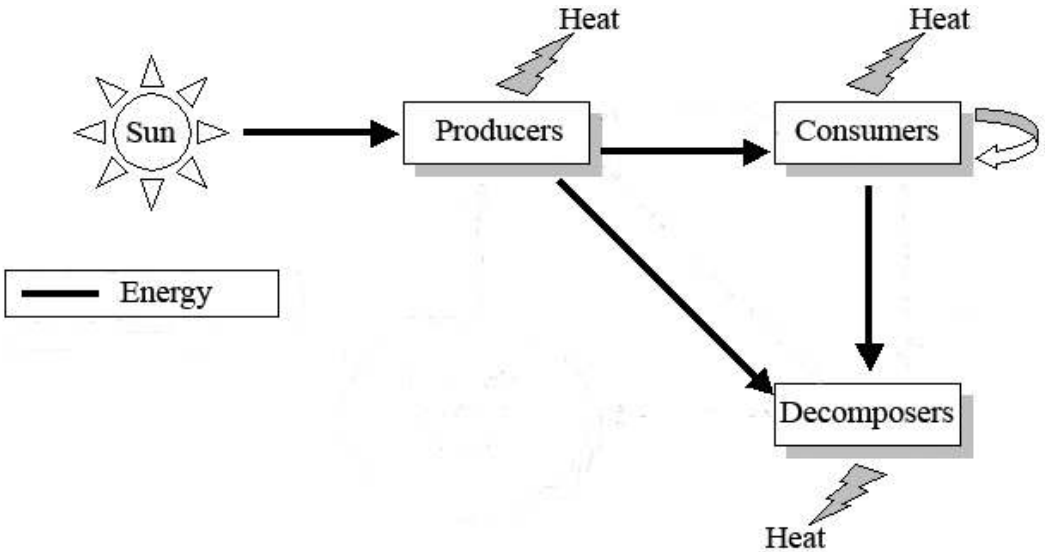
*Alternative points of equivalent validity, significance and relevance to those given, should be credited.*
*ie award **[7 max]** for marking points above, and **[1 max]** for a clear conclusion.*

***[8 max]***
*Expression of ideas*: ***[2 max]***
*Total*: ***[20]***

**4.** (a) natural selection leads to survival of the fittest;
leading to adaptation of species/populations to new environmental conditions;
isolation occurs when members of a population are prevented from interbreeding due to geographical barriers / *eg*, mountain formations/continental drift/island formation;
isolation occurs when members of a population are prevented from interbreeding due to reproductive barriers / *eg* behavioural/seasonal/ecological/mechanical differences/incompatibilities;
the isolated groups within the population may then be subject to different selective pressures/natural selection;
so that the separate groups evolve increasingly different characteristics and become unable to reproduce fertile offspring between them;
in this way natural selection can lead to formation of new species/speciation;
*award **[1 max]** for a good example of natural selection due to isolation* ***[4 max]***

(b) energy enters (most) ecosystems from the sun / energy enters (some) ecosystems from geothermal vents;
plants/(archae)bacteria/autotrophs convert this energy into biomass/glucose/chemical energy / plants use photosynthesis to convert light energy into chemical energy;
energy is transferred from the autotrophs to consumers by feeding/consumption/food chain;
energy is lost as heat (entropy) in respiration (as it is transferred along a food chain);
this heat is transferred to atmosphere where it is absorbed/reflected back to earth/lost to space;
this illustrates the second law of thermodynamics(–increasing entropy in a system);
only 10% of the available energy in one trophic level is passed onto the next/higher trophic level;
chemical energy is transferred to decomposers via waste / death; ***[4 max]***

*award up to **[2 max]** for a diagram which shows at least producers, consumers and decomposers with flows going the right direction (accept plant/herbivore/carnivore/detritivore or named examples of each);*
*an energy source (sun/geothermal) and losses (heat / decomposers);*




***[6 max]***

(c) *Why it is endangered **[5 max]**. Award **[3 max]** if only one of the following categories is addressed:*
*eg Tiger*

*Biological/ecological factors:*
as a top carnivore it requires a large ecosystem/food production base / typically having relatively low population size;
as a mammal with relatively long gestation/low reproduction rate population growth is slow;

*Human activities:*
direct killing/hunting/poaching by humans / invasive predator leads to reduction in population;
fragmentation of habitat through human land use leads to lack of gene flow/inbreeding/low genetic diversity;
loss of habitat/prey species through pollution/hunting/habitat disturbance leads to increased competition for resources *eg* prey/shelter/mates;

*Conservation difficulties:*
tiger habitat may cross national boundaries making cooperative management/international protection agreements difficult;
protection undermined by corruption/black market demand for tiger parts;
low employment may promote poaching / local poverty limits effectiveness of enforcement/protection;

*Why it should be preserved **[5 max]**. Award **[3 max]** if only two or fewer of the following categories are addressed:*

*Ethical reasons:*
because it has intrinsic value/biorights / humans have no rights to destroy species;
many religions/local cultures attach particular spiritual/cultural significance to the tiger;
…although not all cultures/value systems will acknowledge spiritual/intrinsic values;
we owe it to future generations to pass on the same environmental heritage we received;

*Economic reasons:*
each species in ecosystem contributes to the overall natural capital/sustainable resources/goods and services the system provides;
tigers provide a significant source of income from ecotourism;

*Aesthetic reasons:*
tigers are beautiful/unique/interesting and make the world more pleasurable;
all species add to the diversity/quality of human experience;

*Ecological reasons:*
as top carnivores, tigers have an important role in maintain balances within their ecosystem / may be a keystone/umbrella species;
all species add to the diversity of a system, making it more stable/resistant to change;

*Reasons for other species may also include:*
genetic variation in plant and animal species provides the means for sustaining and improving production in farms, forestry, animal husbandry and fisheries;
many organisms contain chemicals which may be of medical or commercial value;

*Award **[1 max]** for an explicit and valid conclusion.*

*Award **[7 max]** for marking points above **[6 max]** if no named species, and **[1 max]** for a clear conclusion.* ***[8 max]***

*Expression of ideas*: ***[2 max]***

*Total*: ***[20]***

**5.** (a) fossil record extinctions occurred over relatively long timescales / over thousands to hundreds of thousands of years;
present day extinctions occurring over relatively short timescales / decades/hundreds of years;
extinctions within historic period largely attributable to anthropogenic / human causes *eg* over hunting / habitat loss / pollution / climate change;
past mass extinctions are linked to natural causes / *eg* meteorite impact / ice ages / extreme volcanic activity / changes in atmospheric composition;
current extinction is being more accurately recorded whereas in the past extinctions it is hard to see/identify species from fossils;

*Award **[1 max]** for a named example or time of a mass extinction, eg K-T boundary (dinosaurs) / Triassic / Permian / Devonian / Ordovician;*

*Award **[1 max]** for a named example of a present day organism that has gone extinct due to human causes*
*eg Passenger pigeon;*

*Award **[2 max]** if only the fossil extinctions or only the recent extinctions are mentioned.* ***[4 max]***

(b) *Explanation of models:*
models are simplified representations of natural systems that enable predictions for change based on pre-existing data;
climate models are mathematical formulae/computer programmes that scientists/IPCC use to predict future changes in climate based on historic climatic data; ***[1 max]***

*Strengths:*
provides information/range of scenarios to policy/decision makers;
allows predictions/extrapolations to be made based on wide input of historic data;
large quantities of data (from a variety of sources) can provide statistical certainty to predictions;
can provide relatively objective information to political/emotional/contentious issues;
can lead to greater understanding of complex relationships between environmental factors;
visualizes projected effects / *eg* images of projected changes in global average temperatures;
shows that some regions are more vulnerable than others / *eg* poles might undergo higher temperature increase than the Tropics;

*Limitations:*
conflicting results from different models can lead to uncertainty/confusion for policy/decision makers;
…and enable politicians to pick those that are most supportive to their cause;
approximations/simplifications are necessary and lead to uncertainties;
only a few experts/not all policy/decision-makers will fully understand the statistical limitations/reliability/application of models;
data used may be inaccurate as in-depth recordings have only been made recently;

data comes from many sources and instrumentation/methodologies may not be consistent/compatible;
models generally rely on assumptions that factors will operate in the way they have historically which may not always be valid;

***Appraisal:*** *Award* ***[1 max]*** *for a clear appraisal that is consistent with argument of response.*
*eg while models have significant limitations they are the best available means of planning appropriately for the future;*
*eg there is so much political manipulation in the current use of models that they are of very limited value;*
***[5 max]*** *if no clear appraisal regarding relative strengths or weaknesses:*
***[3 max]*** *if only strengths or only limitations are discussed.*

***[6 max]***

(c) *Award **[2 max]** for clear definitions of the two chosen EVS.*

*Definition:*
*eg* Ecocentric viewpoint is a nature-centred viewpoint with a minimum disturbance to the natural world;
anthropocentric viewpoint is a people-centred viewpoint with strong regulations about the environment;
technocentric viewpoint is a technology centred viewpoint with a strong emphasis on scientific analysis/market structures;
(accept equivalent definitions for their chosen value systems eg. deep ecologists / soft ecologists / environmental managers / cornucopians)

*Responses should identify effects of GW on the Tundra and the responses to this effect of two different value systems (eg deep ecologists / soft ecologists / environmental managers / cornucopians). Broader categories can be accepted eg ecocentrics / anthropocentrics / technocentrics), but they should not be chosen in conjunction with narrower categories that they include eg ecocentrics & deep ecologists. Other than that, any <u>two</u> systems can be contrasted.*

*Any number of relevant and appropriate responses other than those given below should be credited, but do not credit responses from more than <u>two</u> environmental value systems.*

*Effect:*
Melting of permafrost would cause the biome to disappear/reduce; ***[1 max]***
*Responses:*
deep ecologists would consider this unethical per se;
cornucopians would consider it a chance to implement new modes of farming;
and they may search/exploit new resources now more easily accessed;
environmental managers would enforce legislations protecting the remaining habitat;
soft ecologists would call for the local and national community to take action; ***[3 max]***

*Effect:*
Loss of biodiversity through competition by invasive species better adapted to the "improved" conditions; ***[1 max]***
*Responses:*
deep ecologists would object to the infringement of biorights for the displaced species;
cornucopians would be optimistic that these new conditions will offer new resources to humans;
environmental managers would call for assigning endangered status to species and implement protection plan ;
soft ecologists (might collaborate with EMs) to protect species through active involvement of locals; ***[3 max]***

*Effect:*
Conditions becoming warmer / growing season longer / precipitation patterns changing (less snowfall, more rainfall); ***[1 max]***
*Responses:*
deep ecologists believe in intrinsic importance of any process, thus would consider such change unacceptable;
they would advocate changes/simplification of lifestyles to reduce energy consumption/global warming;
cornucopians would call for investments in technology to help people survive in such conditions;
would see opportunities for exploiting a new frontier/new resources;
environmental managers would call for compensation to those who experience adverse effects due to these changes;
soft ecologists would advocate for small-scale adjustments in human settlements and/or work conditions to alleviate any issues arising from the changed conditions; ***[3 max]***

*Effect:*
rising sea level reduces available land mass/habitat leading to loss of species/biodiversity; ***[1 max]***
*Responses:*
deep ecologists would deplore the loss of intrinsic value in the ecosystem/species;
environmental managers would legislate to reduce production of greenhouse gases;
they may set up reserves to protect remaining populations;
technocentrics would invest in technology to mitigate for GW;
cornucopians would oppose any restrictions of human activities leading to GW; ***[3 max]***

*Award **[1 max]** for an explicit and valid conclusion.*

*Alternative points of equivalent validity, significance and relevance to those given, should be credited.*
*Award **[4 max]** if only one EVS discussed or if EVS are incorrectly identified.*
*Award **[4 max]** if only one or no effects of global warming are identified.*

*Otherwise, award **[7 max]** for marking points above, and **[1 max]** for a clear conclusion.* ***[8 max]***

*Expression of ideas*: ***[2 max]***

*Total*: ***[20]***