N19/4/ENVSO/SP2/ENG/TZ0/XX/M

Diploma Programme
Programme du diplôme
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# Markscheme

## November 2019

## Environmental systems and societies

## Standard level

## Paper 2

19 pages

# 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]**.
- The maximum total = **[65]**.

**1.** Environmental systems and societies uses marking points and markbands to determine the achievement of candidates

*When using marking points (<u>All of this paper except</u> Section B, part (c) questions):*

i. A markscheme often has more marking points than the total allows. This is intentional
ii. Each marking point has a separate line and the end is shown by means of a semi-colon (;)
iii. Where a mark is awarded, a tick/check (✓) **must** be placed in the text at the **<u>precise point</u>** where it becomes clear that the candidate deserves the mark. **<u>One tick to be shown for each mark awarded</u>**
iv. The order of marking points does not have to be as in the markscheme, unless stated otherwise.

*When using markbands (<u>Only</u> for Section B, part (c) questions):*

i. Read the response and determine which band the response fits into
ii. Then re-read the response to determine where the response fits within the band
iii. Annotate the response to indicate your reasoning behind the awarding of the mark
**Do not use ticks at this point**
iv. Decide on a mark for the response
v. At the end of the response place the required number of ticks to enable RM Assessor to input the correct number of marks for the response.

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

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

**4.** Words that are <u>underlined</u> are essential for the mark.

**5.** If the candidate's answer has the same "meaning" or can be clearly interpreted as being of equivalent significance, detail and validity as that in the markscheme then award the mark. Where this point is considered to be particularly relevant in a question it is emphasized by **OWTTE** (or words to that effect).

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

**7.** Occasionally, a part of a question may require an answer that is required for subsequent marking points. If an error is made in the first marking point then it should be penalized. However, if the incorrect answer is used correctly in subsequent marking points then **follow through** marks should be awarded. When marking, indicate this by adding **ECF** (error carried forward) on the script.

**8.** Do **not** penalize candidates for errors in units or significant figures, **unless** it is specifically referred to in the markscheme.

## Section A

**1.** (a) (i) State **one** transfer of matter occurring within the soil profile. **[1 max]**

biological mixing by soil animals/earthworms / leaching / seepage / capillary action / drainage / percolation / infiltration / eluviation / absorption of minerals/water by living organisms;

*Do not accept INPUTS of matter eg precipitation, leaf litter, parent material, particle deposition or OUTPUTS of matter* eg *erosion; or TRANSFORMATIONS of matter* eg *evaporation/weathering.*

(ii) State **one** transformation process occurring within the soil profile. **[1 max]**

decomposition;
humus formation/humification of organic matter;
weathering of primary minerals/parent rock;
nutrient cycling/nitrogen fixation/nitrification/denitrification/ammonification;
evaporation;
rusting soil;

*Do not accept inputs, outputs or transfers of matter or transformations that do not occur within the soil profile.*

(iii) Identify **one** example of an output to the atmosphere from the soil system. **[1]**

Nitrogen (from denitrification) / water (vapour from evaporation) / heat (from radiation/conduction) / soil particles/erosion (from wind) / $CO_2$ (from soil organism respiration) / methane (from anaerobic decomposition);

*Do not credit the processes in brackets ... these may give rise to the outputs but are not themselves an output from the soil.*

(b) Describe **two** characteristics of soil with high primary productivity. **[2]**

optimum/medium particle size / loam soils / mixed/balanced composition of sand/silt/clay;
allow good drainage/permeability/resist water-logging;
prevent excessive leaching/good water-holding capacity;
provide sufficient air space/porosity for root growth/$O_2$ supply;
contain ample dead organic matter/humus (for decomposers);
healthy/abundant decomposing community/soil organisms;
high availability of minerals/inorganic nutrients;
appropriate pH (6.0–6.8);

(c) Outline **two** conservation methods that could be used to reduce soil erosion. **[2 max]**

*Cultivation techniques:*
contour ploughing with furrows following the contour lines/at right angles to the slope/to reduce runoff;
terrace farming forms a series of steps in the hillside area/to prevent run-off;
maintaining cover crops/plant roots/stubble/mixed agriculture/agroforestry to hold soil in place between harvesting;

mulching consists of applying organic material over the exposed soil / preventing surface runoff;
buffer strips/vegetative areas by watercourses to reduce run-off/water erosion;
adding soil conditioners/lime/humus/organic material/fertilizers to increase root growth/hold soil together;
wind reduction techniques, *eg* wind/shelter breaks to prevent wind erosion;
avoid overgrazing/over-cropping/monoculture which degrades soil texture;
zero/minimum tillage reduces soil agitation/potential for erosion;
trickle/drip irrigation reduces run-off causing erosion;

*Note: As an 'outline' Q, response requires just a little more than just naming a technique eg 'terrace farming involves creating steps on a hillside' or 'terrace farming prevents run-off' are acceptable ...but 'terrace farming' alone is insufficient.*

**2.** (a) Using **Figure 2**, identify **one** reason for the trend shown in the curve for:

(i) *aquaculture*

*Increased demand for aquaculture due to:* **[1 max]**

increased human population/increased demand for more food / decrease in some capture fisheries / genetic improvements in stock / technological advances in farming / shift of diet preferences to healthier provision of protein / increased demand for fishmeal/fish oil/animal feed / economically more viable/attractive / perceived as more ecologically effective than terrestrial livestock / need for food security (especially in Asian countries);

*(ii) capture fisheries*

*Reasons for increase, and reasons for less increase than aquaculture or stabilization should equally be credited* **[1 max]**

capture fisheries increased due to increased demand/human population/improved fishing technology;
capture fisheries have increased less than aquaculture/stabilized due to depleted stocks/overfishing / negative impact of climate change / marine pollution / international regulations / growth of aquaculture reducing demand / most fish grounds have no more potential for production increase / reduced cost-effectiveness;

(b) Outline **two** negative environmental impacts of aquaculture. **[2 max]**

loss/degradation of natural habitats;
disease spread through farms;
organic waste/excess food causing eutrophication/build-up of sediment/red tides;
antibiotics/chemical treatments causing pollution;
GMOs/non-indigenous species accidentally escaping, affecting the wild fish populations;
depletion of freshwater reserves/salinization/aquifer depletion;

(c) Describe **two** strategies for the management of sustainable capture fisheries. **[2 max]**

regulation of quotas/minimum size of fish caught / harvesting less than or equal to the maximum sustainable yield (MSY);
designation of marine protected areas (exclusion zones) / limited fishing zones;
restriction on mesh size of nets/bottom-trawling/drift-netting/explosion/methods that decrease bycatch/damage habitat;
restriction to fishing seasons / to let stocks recover;
international/local efforts to monitor/study fish populations and identify MSY/sustainable limits of fishing;
enforcing global treaties on sustainable practices / reducing unsustainable subsidies;
reduce marine/plastic pollution that causes fish deaths/reduces stock;
provide incentives for move toward aquaculture / reconciling the rights of various stakeholders;

**3.** (a) Identify the region with the highest fertility rate in the period 2005–2010. **[1]**

Sub-Saharan Africa;

(b) Outline **two** possible reasons for the projected change in total fertility rate in Sub-Saharan Africa in the period 2045–2050. **[2 max]**

increased level of education;
emancipation/empowerment/greater independence of women economically/in having children;
material ambition/increased economic cost of large families / urbanization;
decrease in need to use children for labour; (due to increased mechanization of agriculture)
(increased foreign funding toward) spread of family planning/ contraception;
reduced child mortality (due to health improvements) would allow having less children;
political decision/governmental initiatives to reduce young dependents and improve development / increased implementation of anti-natalist policies;

*Note: TFR is an average figure per capita so responses making reference to overall size of population are irrelevant and should not be credited.*

(c) Identify **two** reasons for the projected increase in total fertility rate in Europe by the period 2045–2050. **[2 max]**

pronatal policies/governmental incentives (to address economic issues/increasing dependency ratio/international competition);
*eg* reduced taxation/financial support for extra children;
longer maternity/paternity leave;
better day-care facilities/nurseries for infants/more flexible working hours for parents with small children;

*Do not credit 'migration'. This may affect growth rate but would have an uncertain effect on TFR (unless candidates include the conditions of the migration coming from a country with high TFR that is subsequently maintained in host-country).*

**4.** (a) Using **Figure 4**, identify the country that is above the threshold for high human development and below the Earth's biocapacity. **[1]**

Cuba;

(b) Outline the relationship between carrying capacity and ecological footprint. **[2 max]**

ecological footprint (EF) is the reciprocal/inverse of carrying capacity (CC);
populations with high per capita EF will have low CC / a population with a low EF would be less limited by CC in a given area (and vice versa) / EF determines whether a population is living within limits of CC;
EF identifies area needed (to satisfy the needs of a designated population) whereas CC identifies maximum population for sustainability (a designated area may sustain);
EF is easier to calculate but has clear implications for CC;
both EF and CC depend upon rate of resource consumption/waste produced;
both EF and CC depend upon local environmental resources/waste processing ability;
both EF and CC facilitate a quantitative assessment of sustainability;
local EF may increase by import of goods produced elsewhere, whereas CC is dependent only to local productivity / CC may decrease through export of goods;
EF is not applied to non-human populations (whereas CC is difficult to apply to human populations);

(c) To meet the minimum criteria for sustainability, a country needs to raise its human welfare above the threshold of high human development and have an ecological footprint below the Earth's biocapacity.

Evaluate **two** strategies a country can implement to achieve the minimum criteria for sustainability. **[4 max]**

*There is a huge range of potentially creditable responses/strategies for sustainability so do credit responses not listed below but of equivalent relevance and detail.*

*Strategy:* reducing consumption of resources by change in lifestyle/reduced population growth/improved efficiency/imposing sustainable limits/ etc;
*Advantage*: addresses problem at the source / may simultaneously solve multiple problems / etc;
*Disadvantage:* may be unpopular / depends upon uncertain technological advance / may reduce economic development in LEDCs / etc;

*Strategy:* reducing pollution through reducing consumption / limiting/regulating emissions / cleaning-up/restoring polluted ecosystems / finding cleaner resources/alternatives / etc;
*Advantage*: some levels are more effective as they attack root of problem / helps to preserve biodiversity / reduces ecological footprint / etc;
*Disadvantage:* clean-up may be expensive/ineffective / regulations may hinder development / production / technological advances may not be forthcoming / etc.

*Strategy:* improving conservation/protection of species through conservation areas/CITES/*ex-situ* institutions/public campaigns/ etc;
*Advantage*: biodiversity is maintained improving resilience/increasing stability / potential human resources are preserved / local populations may be educated/involved / etc;

*Disadvantage: ex-situ* conservation does not provide full range of habitat resources/genetic diversity / conservation areas may conflict with local population needs / policing/monitoring may be ineffective / etc;

*Award **[3 max]** if the response gives either no advantages or no disadvantages.*
*Award **[2 max]** if the response gives neither advantages nor disadvantages.*
*Award **[0]** if no strategies are identified.*

## Section B

***Part (c) questions in Section B are all to be assessed using the markbands on page 19 with the guidance given below for each question.***

**5.** (a) Outline, using examples, the differences between primary and secondary pollution. **[4 max]**

*Primary pollution:*
is active upon emission of pollutant;
*eg* carbon dioxide/sulphur oxides/ozone/lead/nitrates/phosphates/heat/light;

*Secondary pollution:*
occurs when primary pollutants undergo some kind of physical or chemical change;
nitrogen/sulphur oxides combining with water to form nitric acid/sulphur acid/acid rain;
nitrogen oxides/VOCs combining to form tropospheric ozone/photochemical smog;

*Note: some pollutants (*eg *ozone/sulphur oxides) can be credited as both a primary and secondary pollutant but to gain credit for the latter there must be an identification of a primary pollutant from which it is derived.*

*Do not accept eutrophication (*eg *toxic substances released from algal blooms) as example of secondary pollutant*

(b) Explain the causes and effects of acid deposition on natural ecosystems. **[7 max]**

*Causes:*
burning of fossil fuels releases $NO_x$ / $SO_x$;
the sources of these are mainly coal-burning industries/transportation/electricity generation;
emissions from livestock/use & production of inorganic fertilizers also contribute;
volcanic eruptions can also cause acid rain/release oxides of N/S;
$NO_x$/$SO_x$ react with water to form acid deposition;
this acid may be deposited locally as dry deposition or dissolve in air moisture and reach ground by wet precipitation;
nitrous oxides produce nitric acid / sulphur oxides produce sulphuric acid;
wind may carry primary pollutants causing ecological damage to be widespread;

*Effects:*
direct adverse effect of acidity on living organisms *eg* kills lichens / plankton / fish / soil microbiota;
causing leaf-fall/thinning of waxy cuticle/reduced immunity to disease/root damage in terrestrial plants;
leading to reduced primary production/plant growth;
indirect toxic effect by changing chemistry of soil/water;
*eg* increased solubility/leaching of plant nutrients/reduced soil fertility;
*eg* increased solubility/release of toxic metals/aluminium damaging fish/plants;
such toxic metals might undergo bioconcentration/biomagnification;
overall, may therefore cause loss of biodiversity/reduction in food chains/webs etc;

*Note: Do not credit biomagnification except in the explicit context of releasing heavy metals. And do not credit impacts of ocean acidification or impacts on limestone/urban infrastructure which are beyond the limits of this question.*
*Award **[5 max]** if either causes or effects are not included in response.*

(c) To what extent is pollution impacting human food production systems? **[9 max]**

*The following guide for using the markbands suggests certain features that may be offered in responses. The five headings coincide with the criteria given in each of the markbands (although 'ESS terminology' has been conflated with 'Understanding concepts'). This guide simply provides some **possible** inclusions and should not be seen as requisite or comprehensive. It outlines the kind of elements to look for when deciding on the appropriate markband and the specific mark within that band.*

*Answers may include:*

- **understanding concepts and terminology** of aquatic and terrestrial food production; aquaculture, capture fisheries, aquatic sp. harvesting; provision of food to a growing population; aquatic pollution sources; wide range of parameters lowering water quality; soil content; soil degradation; soil fertility; sustainability of TPSs influenced by industrialization, fossil fuel use, mechanization, fertilizers, pesticides; acid deposition; tropospheric ozone; ozone depletion; eutrophication; dead zones; climate change *(Note: Relevant examples will be of pollution affecting food production NOT the other way round)*;
- **breadth in addressing and linking** a range of pollutants/polluting activities (fertilizer use/emissions from combustion of fossil fuels/mining/waste disposal etc) and their impacts on food production systems (aquaculture/terrestrial farming systems) and methods of limiting these impacts (alternative sources/ regulations/clean-up procedures);
- **examples** of food production systems; farming practices (aquatic and terrestrial); impacts of pollutants/polluting activities; and methods of limiting impacts;
- **balanced analysis** of the extent to which a range of pollution events are impacting, or being restored/prevented from impacting, a range of different food production systems;
- **a conclusion that is consistent with, and supported by, analysis and examples given** *eg* 'Terrestrial FPSs are affected by a wider range of pollutants and polluting activities, thus aquatic FPSs show a greater potential for sustainable production feeding the fast-growing global population'

*Please see markbands on page 22.*

**6.** (a) Outline the factors that contribute to total biodiversity of an ecosystem. **[4 max]**

biodiversity includes the diversity of species, habitat and genes;
species diversity involves both the variety/number of species/richness and their relative proportions/evenness;
habitat diversity refers to the range of different habitats in an ecosystem or biome;
...which may vary due to environmental gradients/changing abiotic conditions/altitude/latitude/major disturbances (volcanic activity/landslides, etc);
habitat/niche diversification promotes species diversity;
genetic diversity refers to the range of genetic material/genes in a population/species;
...which is influenced by mutation/sexual reproduction/natural selection/speciation;
high primary productivity/insolation/precipitation/optimum abiotic conditions promote biodiversity;
succession promotes greater biodiversity by increasing length/branching of food chains / because it leads to improved abiotic conditions;

*Credit can be gained through description of particular ecosystems eg. climax communities; hotspots; but the specific factors must be identified to gain credit. Do not credit human impacts or any factor reducing biodiversity.*

(b) Explain how ecological techniques can be used to study the effects of human activities on the biodiversity of a named ecosystem. **[7 max]**

named ecosystem, *eg* shallow stream running through woodland;

studies should be made before and after human activity/in proximal and distal positions from activity;
*Explanation:* to provide evidence of human causation/correlation;

transects and quadrats may be used to sample area;
*Exp:* to reduce overall workload but be representative of area;

sampling should be repeated over time/distance;
*Exp:* to increase reliability;

abundance/biomass of biotic components may be measured;
*Exp:* to assess whether population size/productivity of populations/species have been affected.

numbers of motile organisms can be measured using Lincoln Index/mark–release–recapture;
*Exp*: because quadrats are ineffective if organisms are constantly on the move;

abiotic components may be measured using probes/thermometers/chemical tests, etc;
*Exp*: because human activity may alter prevailing abiotic conditions;

indicator species may be identified/quantified (using keys);
*Exp:* because their presence/abundance will indicate degree of human impact;

species diversity can be measured using a diversity index (*eg* Simpson's);

*Exp:* because the index takes into account both species richness and equitability/distribution/relative abundance / can quantitatively compare different habitats/same habitat over time;

genetic & habitat diversity can be identified;
*Exp:* because these are also components of overall biodiversity.

*Award **[6 max]** if no named ecosystem.*
*Award **[4 max]** if no explanations for use of techniques are given*
*There should be no credit given for extra detail of methods/techniques or for potential results of those methods. Focus of question is on purpose of techniques.*

(c) To what extent are strategies to promote the conservation of biodiversity successful? **[9 max]**

*The following guide for using the markbands suggests certain features that may be offered in responses. The five headings coincide with the criteria given in each of the markbands (although 'ESS terminology' has been conflated with 'Understanding concepts'). This guide simply provides some **possible** inclusions and should not be seen as requisite or comprehensive. It outlines the kind of elements to look for when deciding on the appropriate markband and the specific mark within that band.*

*Answers may include:*

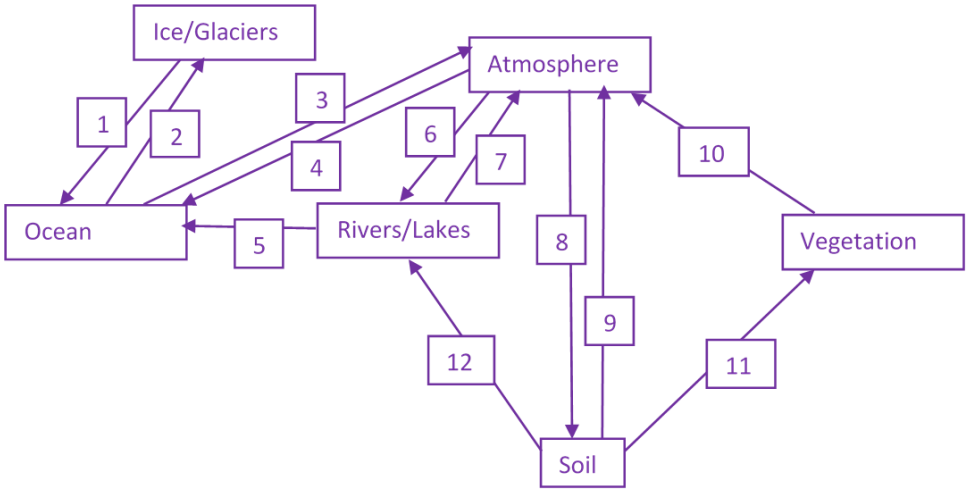
- **understanding concepts and terminology** of the roles of organizations in conserving and restoring ecosystems and biodiversity; roles of international conventions on biodiversity; role of IUCN and Red List; CITES; captive breeding and reintroduction programmes; zoos, botanical gardens and seed banks; role of charismatic/flagship species *vs* keystone species; design of protected areas and impact of community involvement; genetic/species/ habitat diversity; threats to biodiversity; impact of extinction/biodiversity loss; strategy approach depending on EVS; habitat *vs* species *vs* mixed approach; etc;
- **breadth in addressing and linking** a range of strategies for conservation to their relative success in addressing biodiversity as measured by a range of criteria (including measures of biodiversity; costs; resilience of systems; public popularity/engagement; rarity of protected species/habitats; etc;)
- **examples** can include a range of specific conservation measures / protected areas/zoos / means of assessing success / case-studies.
- **balanced analysis** of the extent to which conservation has or has not been successful in conserving biodiversity.
- **a conclusion that is consistent with, and supported by, analysis and examples given** *eg* 'there are individual success stories, such as the observed increase in panda populations in Western China or increased counts of the tiger in India, and these are associated with increases in biodiversity to support these species, but the overall trend in biodiversity is down with massive percentages of species threatened by habitat degradation and climate change';

*Please see markbands on page 22.*

**7.** (a) Outline how energy drives the hydrological cycle. **[4 max]**

primary source of energy driving hydrological cycle is solar energy;
solar energy causes changes of state in water *eg* evaporation/sublimation/melting/transpiration;
condensation of water releases (latent) heat energy causing air to rise/hurricanes;
solar energy causes the temperature differences that create winds/cause movement of water vapour in the atmosphere/advection;
kinetic/wind energy moves clouds (from ocean over land, usually);
solar energy melts ice producing streams/lakes/rising ocean levels;
solar energy causes both transfers (*eg* advection) and transformations (*eg* evaporation) in hydrological cycle;
precipitation/run-off/streamflow occurs due to gravitational energy/difference in potential energy between the high and low positions;
transpiration is driven by opening of leaf stomata which is due to chemical energy (cellular respiration in mitochondria);

(b) Explain, with the use of a system diagram, how human activities affect flows in the global water cycle. **[7 max]**




*Award up to **[4 max]** for identifying following impacts either on the diagram or in words:*

melting (1) will increase due to global warming/climate change/increased greenhouse gas emissions;
freezing (2) will decrease due to global warming/climate change/etc;
precipitation (4,6,8) will be polluted due to acid formation/emissions of $NO_x$ & $SO_x$/ combustion of coal;
precipitation (4,6,8) could change/increase/decrease due to climate change/etc;
percolation/infiltration (8) will decrease due to urbanisation / soil compaction caused by *eg* overgrazing;
run-off (5) will increase due to urbanization/deforestation;
warmer/polluted streams (5) due to thermal/toxic pollution from industrial effluent;
evaporation (3,7,9) will increase due to global warming/climate change/etc;
evapotranspiration (10) will increase due to global warming/climate change/etc;
evapotranspiration (10) will be reduced due to deforestation;
uptake by plants (11) will be reduced due to deforestation / urbanization / long fallow periods;
groundwater flow/aquifers (12) will change dependent on climatic impacts/precipitation / rate of human extraction;

cloud seeding increases precipitation (4,6,8) (addressing problem of drought/fog around airports);

*Award up to a further **[3 max]** for quality of diagram, giving 1 mark for every 3 correctly labelled flows or storages. No marks for less than 3.*

(c) To what extent do the approaches and strategies of different environmental value systems improve access to fresh water? **[9 max]**

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*Answers may include:*

- **understanding concepts and terminology of** availability & distribution of water; water security; climate change; water pollution; sustainable management of freshwater resources; reservoirs; desalination; artificial recharge; water conservation; environmental value systems; increasing demand for water; water scarcity; etc:
- **breadth in addressing and linking** a range of environmental value systems to specific management strategies AND general approaches that improve or hinder widespread access to freshwater in a range of geographical locations differing in freshwater availability/quality and societies of different economic development; etc;
- **examples** could include a range of strategies and human management activities/approaches linked to specific value systems that impact water accessibility;
- **balanced analysis** of the extent to which different management strategies / political decisions / legislation and agreements linked to a range of environmental value systems influence, both positively and negatively, the global accessibility of freshwater
- **a conclusion that is consistent with, and supported by, analysis and examples given** *eg* 'I believe that all environmental value systems have something to offer when considering access to fresh water, however an anthropocentric value system may be most successful as it will implement strategies that include the best of both extremes of technological scale and personal life styles';

*Please see markbands on page 22.*

**8.** (a) Outline how the concept of sustainability can be applied to managing natural capital. **[4 max]**

natural capital refers to natural resources that can supply a natural income of goods or services;
natural income is the yield/growth obtained from natural resources/capital;
to be sustainable, natural capital must be used at rate slower than its replenishment / within maximum sustainable yield / that fulfils current needs without compromising future availability;
if more than the natural income is extracted, then the use is unsustainable;
exploitation of natural capital may also be unsustainable due to processes of extraction/transport/processing / environment should be in same condition as at outset to be sustainable;
altering human behaviour/values/choices through policies/legislations/campaigns so that unsustainable exploitation of natural capital is reduced;
non-renewable natural capital is either irreplaceable or can only be replaced over geological timescales / non-renewable natural capital can never be used sustainably;

*The question addresses the essential nature (concept) of sustainability rather than specific practices. However, do credit candidates for valid and specific examples if they exemplify any of the generic principles above.*

(b) Explain how environmental indicators are used to assess sustainability. **[7 max]**

environmental indicators (EIs) may involve measures of biodiversity/ pollution/population/climate/emissions/resource consumption;
EIs are tools for measuring progress toward sustainability/supporting policy evaluation/informing the public/comparing nations;
EIs involve the setting of measurable goals from established baseline measurements;
EIs can be used at a range of scales from local to global;
after some time, measures can be reassessed and compared to the baselines/ domestic objectives/international agreements (*eg* Kyoto/Montreal Protocol);
environmental impact assessments (EIAs) are EIs that measure a wide profile of indicators usually before and after some development;
ecological footprints(EFs) are EIs that focus on rates of consumption compared to rates of natural income;
if a population's EF is greater than the area available this indicates unsustainability;
the Millennium Ecosystem Assessment used indicators to give a scientific appraisal of the condition/trends in the world's ecosystems and services;
certain species can be used as indicators of pollution;
some indicator species are particularly sensitive to pollution so a low abundance may suggest heavy pollution / high abundance suggest clean environment (*eg* lichens);
loss of these sensitive species may be an effective indicator for appealing to the public;
some indicator species are particularly resistant to pollution so a high abundance/dominance of these species may suggest high pollution (*eg* tubifex worms/coliform bacteria);

(c) To what extent does sustainability play a role in making decisions about energy and climate change policies at national and international levels? **[9 max]**

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*Answers may include:*

- **Understanding concepts and terminology** of climate change; sustainability; fossil fuels & renewable energies; factors affecting energy choice; (energy security, availability, scientific and technological developments; cultural attitudes; political, economic and environmental factors); adaptation; mitigation; international negotiations; energy efficiency & conservation; etc;
- **breadth in addressing and linking** the role/significance of sustainability (*eg renewable vs non-renewable*) in a range of different national and international decision-making bodies, with a range of different value systems and states of economic development for addressing energy choice and response to climate change;
- **examples** could include a range of country-specific energy choices and climate change policies and plans;
- **balanced analysis** of extent to which energy choice and adaptation/mitigation strategies for climate change are, or are not, influenced or by concept of sustainability;
- **a conclusion that is consistent with, and supported by, analysis and examples given** *eg* 'Sustainability should be the driving factor in constructing energy and climate change policy and many countries demonstrate this, however some countries choose to prioritize other factors, such as short-term energy security and economic gain';

*Please see markbands on page 22.*

## Section B, part (c) markbands

| Marks | Level descriptor |
|---|---|
| **0** | The response does not reach a standard described by the descriptors below and is not relevant to the question. |
| **1–3** | The response contains:<br>• minimal evidence of knowledge and understanding of ESS issues or concepts<br>• fragmented knowledge statements poorly linked to the context of the question<br>• some appropriate use of ESS terminology<br>• no examples where required, or examples with insufficient explanation/relevance<br>• superficial analysis that amounts to no more than a list of facts/ideas<br>• judgments/conclusions that are vague or not supported by evidence/argument. |
| **4–6** | The response contains:<br>• some evidence of sound knowledge and understanding of ESS issues and concepts<br>• knowledge statements effectively linked to the context of the question<br>• largely appropriate use of ESS terminology<br>• some use of relevant examples where required, but with limited explanation<br>• clear analysis that shows a degree of balance<br>• some clear judgments/conclusions, supported by limited evidence/arguments. |
| **7–9** | The response contains:<br>• substantial evidence of sound knowledge and understanding of ESS issues and concepts<br>• a wide breadth of knowledge statements effectively linked with each other, and to the context of the question<br>• consistently appropriate and precise use of ESS terminology<br>• effective use of pertinent, well-explained examples, where required, showing some originality<br>• thorough, well-balanced, insightful analysis<br>• explicit judgments/conclusions that are well-supported by evidence/arguments and that include some critical reflection. |