

Markscheme

November 2015

Environmental systems and societies

Standard level

Paper 2

This markscheme is the property of the International Baccalaureate and must **not** be reproduced or distributed to any other person without the authorization of the IB Assessment Centre.

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) a group of organisms that interbreed and produce fertile offspring; [1]
- (b) helping to break down and remove decaying organisms;
scavengers will themselves die and decay returning nutrients to the soil;
natural competition with other organisms *eg* Golden eagles;
pathway for energy/nutrients through the ecosystem; [2 max]
- (c) coloration of feathers;
wingspan;
shape of tail feathers; [2 max]
- (d) mature slowly so populations take a while to increase;
small clutch sizes/only one or two eggs at a time **so** populations take a while to increase;
consume carrion/dead meat which can contain lead shot **so** vulnerable to lead poisoning;
feed off carrion **so** can be mistakenly thought responsible for killing it and can be shot by farmers; [2 max]
*To credit for full point must state the feature **and** provide a brief explanation of it.*
- (e) capture, mark (tag), release, recapture/Lincoln index;
counting nests;
identifying individuals through markings to count them; [1 max]
- (f) K strategists because:
only lay one or two eggs/small clutch size/few babies;
long lifespan;
care for the young; [2 max]
- (g) (i) biomagnification / lead moves up the food chain;
bioaccumulation / lead builds up in tissues/body over time;
one carcass may have a lot/fatal amount of lead in it;
lead is toxic / persistent / non-biodegradable; [1 max]
- (ii) biotic index/indicator species; [1]

(h)

Process of pollution	Strategy for reducing impacts from this case study.
Human activity producing pollutant	Replacing lead bullets with non lead bullets
Release of lead into the environment	Ridley-Tree act to ban lead bullets;
Long term impact of lead on the environment	condor reintroduction programme;

[2]

- (i) *Similarities:*
both believe it is acceptable/ok to kill condors **[1]**;

Differences:

Chumash believed in the spiritual importance of the condor/used it in sacrifices and cultural dances;

farmers saw them as a menace/pest who killed their livestock **[1 max]**;

[2 max]

- (j) intrinsic value of the species/biorights;
cultural value to Chumash and other Indians;
future generations should have the right to see them;
a lot of money has been put into saving them so far, shame to waste it;
role in ecosystem as clearing up carcasses;
economic argument to attract ecotourists;
one of the rarest species in the world, if we do not act now they will become extinct;
inspiring story – shows it can be done;

[2 max]

Individuals or organizations	How they are playing a role in the conservation of Californian condors.
Individual citizens	paying for National conservation programmes through taxes/joining NGOs;
The Government of the state of California	passing legislation on lead bullets/enforcing conservation policy;
NGO	NGOs lobbying government/raising awareness/running ecotourism initiatives;

[3]

Accept other reasonable responses.

- (l) *If only strengths or weaknesses of the programme are addressed award [3 max].*

population has increased from X to Y;
needs of condors appear to now be factored into decision making;
legislation passed to ban lead bullets;
captive breeding programme is teaching young condors to avoid power lines and turbines;

However...

condors still dying from lead poisoning;
population growth and development mean habitat is still at risk;
some farmers still shoot them;
legislation only in one state;

[4 max]

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) renewable natural capital includes natural resources that have a sustainable yield/harvest equal to or less than their natural productivity;
eg food crops/timber (geothermal energy);
replenishable natural capital include non-living natural resources that depend on the energy of the sun (for their replenishment);
eg groundwater/ozone; **[4]**
- (b) a system is an assemblage of parts and the relationships between them, which together constitute an entity or whole;
global climate can be considered a closed system / a system in which energy, but not matter, is exchanged with its surroundings;
sun's energy drives/powers the system / sun's energy enters (input) the system;
energy may leave the system in the form of biomass / heat / kinetic energy;
matter within the system includes water and atmospheric gases;
transfers in the system include wind / reflection of light energy;
transformations in the system include evaporation / precipitation / photosynthesis;
stores in the system include atmospheric gases / water;
humans change the composition of atmospheric gases / particles (black carbon);
increasing levels of greenhouse gases causes more energy to be retained in the system;
humans change the land cover of an area;
this leads to changes in energy flow (albedo and photosynthesis); **[6 max]**

- (c) *Accept alternative ways of structuring this answer provided environmental value systems are discussed.*

Technocentric:

technocentric approaches will focus on how technology can assist in reducing greenhouse emissions (mitigation) / and also adapt to the impacts of global warming;
 these could include geo-engineering solutions such as carbon capture / renewable energy technology / energy efficiency improvements;
 these strategies are varied in predicted success due to being untested on a large scale;
 they may be expensive;
 may require large scale changes in how a country provides energy, eg a smart grid to ensure energy reliability;
 may require government subsidies to enhance their adoption / implementation;
 do not require large changes to lifestyles and so more favourably received by richer societies;
 may not be affordable by less wealthy societies and so slow to be adopted;

Anthropocentric:

anthropocentric approaches involve the use of laws and government agreements to manage and lower greenhouse gas emissions;
 these include intergovernmental and international agreements (for example, Kyoto Agreement and subsequent updates) / carbon tax / carbon trading / carbon emission targets;
 at an international level these approaches have proved to be very difficult to negotiate;
 at a national level they have been variably successful / dependent on determination of individual governments;
 help to encourage changes in business and personal behavior;
 carbon taxing and trading has had limited success due to underpricing of carbon;
 as global warming is a global problem international cooperation is essential as part of the solution;

Ecocentric:

ecocentric approaches involve the change of personal behavior and education to reduce greenhouse gas emissions;
 changes in personal behavior could include using public transport / buying local produce / eating less meat / investing in insulation for home / flying less;
 education could be at a local, a national or international level and funded on a small or large scale;
 changes in personal behavior can be easy for an individual to make but only effective if many change their behavior;
 education is effective in raising awareness but then depends on individuals to change their behavior / way of life;
 these approaches are sometimes not supported by people who do not want to risk a lowering of their standard of living;

Combination:

it is likely that individuals may lean towards one strategy but see the benefits of a combination of different strategies;

[8 max]

[4 Max] if only one EVS considered.

Expression of ideas **[2 max]**

3. (a) carrying capacity is defined as the maximum number of a species/“load” that can be sustainably supported by an environment;
 human carrying capacity can exceed the “natural” carrying capacity through importing goods / use of technology;
 the ecological footprint of a population is defined as the area of land (and water) required to support a (defined) human population at a given standard of living;
 the measure takes account of the area required to provide all the resources needed by the population, and the assimilation/absorption of all wastes;
 an ecological footprint may exceed the amount of land directly available to a given human population;
 ecological footprints are the inverse of carrying capacity;

[4 max]

- (b) *Example Data (from World Bank 2013) to help marking team:*
Australia’s electricity production is mostly from fossil fuels (91 %) with 5 % from hydropower / Chile’s electricity production is 60 % from fossil fuels and 36 % from hydropower / Argentina’s electricity production is 66 % from fossil fuels and 27 % from hydropower / Almost 100 % of Mozambique’s electricity production is from hydropower / 82 % of energy produced (not just electricity) is from biomass products and waste and only about 12 % of the population has access to electricity mostly in urban centres.

Eg China and Switzerland: Switzerland’s electricity production is split between hydropower (about 60 %) and nuclear (about 40 %) with a very small percentage from fossil fuels while China’s electricity production is split between fossil fuel (about 80 %) to hydropower (about 20 %);

Availability:

location (eg coastal for tidal / offshore wind / thin crust for geothermal / high solar input for solar energy);
 topography (mountains/rivers for HEP);
 geology (reserves of coal/oil/gas);
 eg China has vast reserves of coal;
 eg China is the world’s largest producer of renewable energy;
 eg Switzerland’s topography has allowed development of large hydropower system;

Economic:

high standard of living/technological development requires high capacity;
 national wealth may limit choice of affordable technology/resources;
 balance between economic development and environmental impacts;
 China has (until recently) prioritized economic development over environmental costs;
 vast coal reserves have provided China with cheap energy and allow it to be energy independent;

Continued...

Political:

countries may need to respond to changing values in their own population eg (rising ecocentrism);
eg Switzerland's political system has encouraged a low dependence on fossil fuels;
eg Switzerland's political system has encouraged energy independence as much as possible;
international agreements (through the COP discussions) may place pressure to change energy mix;
eg China's air pollution problems have led to pressure to reduce use of coal (near cities);

Cultural:

countries may have strong historical traditions/value systems/international reputations to maintain;
historical events may influence decisions (eg countries experiencing nuclear disasters / oil embargoes);

Technological:

technological developments may make new choices available;
countries may or may not have technical expertise for certain choices;
eg China is the largest producer of photovoltaic cells in the world and this may mean increasing use of this technology within the country and not just for export;
eg Switzerland is increasingly using ground source heating for new housing developments, reducing need for oil for heating;

Future planning:

countries may need to meet international agreements or unilaterally decide to reduce emissions of greenhouse gases;
eg China has plans to reduce its dependence on fossil fuels;
eg Switzerland has put in place political guidelines to reduce per capita energy use;

[6 max]

[Max 4] if only one society is considered.

- (c) domestic and international development policies may stimulate rapid population growth by lowering mortality without significantly affecting fertility; such policies include agricultural development / improved public health / sanitation / better service infrastructure; but reduction in death rate can encourage fall in birth rate as families see children survive; some analysts believe that birth rates will come down by themselves as economic welfare improves and that the population problem is therefore better solved through policies to stimulate economic growth; education about birth control encourages family planning; widely available contraception encourages a fall in birth rates; parents may be dependent on their children for support in their later years and this may create an incentive to have many children; urbanization may also be a factor in reducing crude birth rates as families less reliant on children to work the land; policies directed towards the education of women, enabling women to have greater personal and economic independence, may be the most effective method for reducing population pressure; international development policies stem from the Millennium development goals and have been influential in focusing national policies and directing inter-governmental aid and loans; international population conferences (eg Cairo 1994 and Strasbourg 2004) shape strategic direction of decision making at a national level;

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

4. (a) transfers (normally flow through a system and) involve a change in location;
eg runoff / precipitation / movement of water bodies / movement of clouds;
transformations (lead to an interaction within a system in the formation of a new
end product, or involve a change of state);
eg evaporation / condensation / melting / formation of ice; [4]

- (b) *Named biome: eg deserts;*
deserts are located around 30° N&S of the equator;
this is an area where dry air descends, limiting the rainfall in these regions;
deserts are also associated with rain-shadows formed from mountains /
cold ocean currents, limiting rainfall;
their location ensures that deserts receive relatively high levels of insolation /
solar radiation;
due to lack of moisture and cloud formation and the high insolation, deserts are
subject to relatively high diurnal temperature fluctuations;
due to lack of water, deserts have low relative productivity;
lack of primary production leads to nutrient poor soils;
this leads to a very simple ecosystem structure with short food chains; [6 max]

- (c) *Named case study: eg Jordan and Israel's use of the Dead Sea;*

Environmental Issues Identified:

the water in the Dead Sea is not currently used sustainably;
the Dead Sea is rapidly shrinking because of diversion of incoming water /
unsustainable use from the Jordan River to the north;
ground water dropping;
sinkholes appearing as water dissolving underground salt deposits;

Proposed solutions to using the resource:

Management plan proposed by Jordan includes:

take water from Red Sea, desalinize and waste water pumped into Dead Sea;
desalinated water to be used in Southern Israel and Jordan, partly for agriculture;

Possible impacts / evaluation of management plan:

very high costs (4 × normal desalinization) to pump water to Dead Sea;
mineral composition of Dead Sea will change causing unknown effects on the
ecosystem and aesthetically;

Links to environmental philosophies:

this management plan is highly technocentric;
ecologists argue that it will not solve the cause of the problem – unsustainable
use of the River Jordan which supplies the Dead Sea;
they argue for more ecocentric approaches mainly focusing on water
conservation; [8 max]

[6 max] without evaluation points or mention of environmental value systems.

Expression of ideas [2 max]

5. (a) succession is the (orderly) process of change over time in a community; changes in the community of organisms frequently cause changes in the physical environment that allow another community to become established and replace the former through competition; zonation is the arrangement/patterning of communities/ecosystems into zones over distance/space (due to a change in an environmental factor); in succession biotic changes lead to changes in abiotic conditions while in zonation changes in abiotic conditions lead to changes in biotic composition; an example of succession is formation of sand dunes / community formation after volcanic eruptions / wildfires and an example of zonation is biomes on a global scale / changes in communities with altitude on a mountain / changes in communities associated with tidelines;

[4 max]**[1] available for example of succession and zonation**

- (b) ecosystem stability refers to the resilience of the system (and its tendency to avoid tipping points), and its ability to maintain stability; a complex ecosystem, with the variety of nutrient and energy pathways it provides contributes to its stability; habitat diversity is associated with high levels of species diversity / high levels of species diversity are associated with high levels of genetic diversity; a steady state equilibrium allows for the maintenance of a high level of genetic diversity through constant population sizes; high levels of biodiversity (habitat, species and genetic diversity) are intrinsically linked with ecosystem stability; during the initial stages of colonisation, biodiversity increases greatly but then stabilizes / a climax community is more diverse and thus stable than the earlier stages of succession; during earlier stages of succession, the communities can become diverted due to human interference (when the system has less resilience); ecosystems that have evolved over long periods of time can reach a steady state condition, withstanding disturbances; an ecosystem's capacity to survive change may depend on diversity (resilience and inertia); a climax community (with simple nutrient and energy pathways) in a tundra biome may be less resistant to change (resilient) than a climax community (with complex nutrient and energy pathways) in a tropical rainforest;

[6 max]

- (c) *Guidance to examiners: Social systems refer to the inter-relationships between individuals, groups and organisations. Reference to social systems may make either implicit or explicit references to economic systems. This is acceptable.*

MEDCs

tend to have more intensive food production systems;
 rely upon (and build) infrastructure to support intensive food production systems;
 centralise processing facilities;
 subsidise food production systems;
 e.g European common agriculture policy / US subsidised corn production
 e.g locked-in production deals between supermarkets and producers in UK
 e.g overwintering farm animals indoors to reduce stress on land / to utilise summer production of feed
 e.g one abattoir used for most animal slaughter in US

LEDCS

are usually more varied and range from intensive systems (such as rice farming) to subsistence farming (including slash and burn systems);
 some have evolved over thousands of years to integrate local geography;
 more likely to remain tied to historic cultural systems;
 farmers more vulnerable to economic and meteorological fluctuations;
 e.g rice-fish farming in Vietnam evolved to exploit local weather conditions
 e.g low scale slash and burn systems in Brazil threatened by encroachment by intensive farming
 e.g farmers in north India committing suicide as a result of droughts

General

many farming systems are based on a capitalist model which is not always dependant on the development of the country;
 the social system of the country is not always the key determinant of the food production system;
 other factors that may influence the food production system include the population density / soil fertility / access to appropriate technology / influence of political and other institutions;

Award [1] for naming at least one food production system. For each food production system identified, award [1] for a description of it, up to a maximum of [3]. Award [1 max] for an explicit and valid conclusion.

*Note to examiners: An isolated statement e.g “developed countries have intensive food production systems” or an unjustified opinion e.g “I think developed countries have the best food production” should not be considered as a valid conclusion. The conclusion must be **supported/justified** by points raised that must have at least addressed both sides of the argument. A valid conclusion may, however, be stated within the body of the response rather than at the end, and may involve some balanced decision.*

[8 max]

Expression of ideas **[2 max]**