

Markscheme

November 2016

Environmental systems and societies

Standard level

Paper 1

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

Subject details: Environmental systems and societies SLP1 markscheme

Mark allocation

Candidates are required to answer **ALL** questions. Total = **[45]**.

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.

1. (a) (16.3 billion - 6.6 billion =) 9.7 billion; **[1 max]**
Accept 9.5 billion to 10 billion.
- (b) strict anti-natal policies;
 higher level of education for women (reduces number of births/leads to lower population);
 disease (can reduce population growth);
 war (can reduce population growth);
 natural disasters (can reduce population growth);
 availability / lack of sufficient resources/water/food (can curtail population growth);
 pro-natal policies;
 lack of access to contraception/birth control/family planning;
 increase access to healthcare;
 technology / technological development (that allows sufficient resources/food to meet demand of growing population);
 varied basic assumptions;
 different modelling methods; **[2 max]**
- (c) (i) lack of sufficient jobs (for increasing number of people) leading to under employment / unemployment;
 unemployment leading to greater demand for unemployment insurance/social assistance;
 unemployment leading to growth in crime requiring more investment in police force/greater insurance costs;
 increase in the number of people in poverty;
 increase in workforce contributing to economic development/growth;
 greater demand for schools/health care increases cost to government;
 greater demand for housing increases economic cost in building;
 increasing demand for limited resources will elevate prices; **[1 max]**
- Accept any other reasonable response.
 Do not accept 'shortage of resources' without link to economic implication.*
- (ii) destruction of protected/marginal areas/clearance of land for agricultural production to feed the larger population/for urban development;
 use of marginal lands for agriculture and increased soil degradation;
 loss of habitat to land development/farming;
 loss of species from loss of habitats/increase in hunting/poaching;
 increase in pollution/waste production (from increased numbers of people);
 increased extraction of water (for drinking/agriculture) leading to water scarcity/water shortages for other species;
 increased need for desalination leading to changes in chemistry in coastal waters; **[1 max]**
- Accept any other reasonable response.
 Do not accept only 'loss/depletion of (natural) resources'.*
- (d) (i) allows projections to be made for planning purposes (e.g. schools/hospitals);
 allows changes to be proposed to policies to slow population growth;
 allows policy makers see what impact a policy might have on population;
 can help with decisions on resource management to meet the needs of the population;
 models are simple to understand; **[1 max]**

- (ii) all models are a simplification and therefore incorrect;
the data on which the modelling is based may be unreliable;
the model/computer program used may be imperfect;
human behaviour can change, so that the prediction is not fulfilled;
many factors in the environment can change, making projections uncertain;
it cannot foresee natural disasters or international conflicts;
potential for human error in calculation/tool
development/application/interpretation of model; **[1 max]**

Do not accept 'not correct/unreliable' without explanation.

Do not accept 'model relies on many factors' as it is the accuracy of the data used that is important.

2. (a) meteorite/asteroid/comet impacts;
significant volcanic events/volcanic eruptions/basalt flows;
climate change/ice age;
catastrophic methane release (e.g. from methane clathrate);
drop in oxygen levels;
sea level changes;
cosmic events/radiation from space that depletes atmospheric ozone; **[2 max]**

Do not accept 'natural disasters/disease/earthquakes/floods/water levels rising'.

- (b) rate of change is faster/happening over a shorter time frame;
caused by another species changing the environment/not caused by natural phenomena as in the past/caused by humans;
humans can prevent current extinction; **[2 max]**

- (c) reach sexual maturity early;
...which means they are able to produce offspring early/have more offspring/have larger populations (and increase their species chances of success);
they can have high reproductive success/produce large number of offspring;
...large populations can increase the chances of their survival;
they are opportunistic /r species able to adapt to a wide variety of conditions;
...this allows them to be present in many habitats / have wide geographical coverage;
they have fast lifecycles (e.g. r species);
...which allows them to adapt quickly to change;
they have a number of habitats they can shelter/live/ are widely distributed;
...so if a population is affected in one habitat (e.g. by disease/predation) the species will still survive in another habitat/location;
they are omnivores/generalist feeders/switching predators;
...this adaptability to eating different foods results in potentially a large available food source/with some food source available even under harsh conditions;
ability to hide/camouflage/successfully fight;
...which can reduce predation rates and increase chances of species survival;
have high genetic diversity;
...they are able to adapt to changing environmental conditions;
valued by humans (e.g. as keystone/flagship species);
..increases human investment/action into conserving the species/its habitat (e.g. Giant Panda);
not considered valuable by humans (e.g. as pets or making ornaments);
...it is not hunted /removed from habitat thereby reducing risk of extinction; **[2 max]**

Award 1 mark for identifying the factor and 1 mark for the explanation.

Accept other reasonable responses.

- (d) organisms in any population vary;
some traits make them better adapted to survive / selection pressures in the environment may favour some variations over others/ 'the survival of the fittest';
thus organisms become adapted to environmental conditions;
some of these variations give it a competitive advantage leading to breeding success / those organisms that survive are able to breed and pass on their traits to their offspring;
where conditions (e.g. climate) change, the organism may respond by adapting to it;
isolation (geographical/ecological/reproductive) may separate a part of a population from others;
differences in the environments may cause speciation/evolution of new species as the population adapts to the new environment;
the new species may be unable to interbreed with the parent species to produce fertile offspring;

[2 max]

3. (a) (primary) succession / colonisation (of islands)/lithosere; **[1 max]**

Do not accept 'secondary succession'.

- (b) select sample areas representative of the area / select sampling sites using random sampling method / use aerial photographs of the area;
do quadrat/transect based sampling to collect data;
record the number of individual plants of each species / proportion of cover;
calculate abundance as % frequency / % cover / using ACFOR scale in the quadrats;
extrapolate for the whole volcano;
record during different seasons; **[3 max]**

- (c) presence of ash increases plant diversity/different type of volcanic surfaces affects speed of colonization/weather differently;
... ash is plant ready whereas lava has to weather before it can support plants;
...having plants in ash will speed up weathering of adjacent lava;
...ash can be nutrient rich enhancing plant growth/diversity;
...plant roots can more easily penetrate ash than lava surfaces thereby contributing to greater plant diversity;
differences in climate/latitude: one is in tropics and experiences high rainfall/and temperature/insolation / one is in temperate latitudes with lower rainfall/temperatures/insolation;
...plants in tropical rainforest biome grow rapidly all year / conditions can support a wide range of plant species;
...plants in temperate latitudes/with less insolation/rainfall/lower temperatures grow more slowly /conditions support a narrower range of plant species;
the level of biodiversity from nearby areas that are the source of the colonising species varies;
...there is a high level of biodiversity near Krakatau;
...there is a lower level of biodiversity near Tarawera;
direction of prevailing winds determine from which areas seeds/species are introduced from;
...Krakatau is downwind of areas which are rich in biodiversity;
...Tarawera is downwind of areas which have lower levels of biodiversity;
development of tourism/human activity in one area could reduce the number of species;
...building of infrastructure/roads/houses/amenities could result in removal of some species; **[4 max]**

2 max for identifying 2 factors and 2 max for explanation of these factors.

Do not accept 'volcanic eruption happened earlier in Krakatau' or difference in latitude/climate without specifying which factors e.g. higher rainfall.

4. (a) respiration; **[1 max]**
- (b) the gain by producers in energy or biomass per unit area per unit time remaining after allowing for respiratory losses (R). **[1 max]**
- (c) the 2nd law of thermodynamics has energy becoming dispersed, in the ecosystem /overtime there is an increase in entropy;
light energy is converted to chemical energy in plants, with some energy being dispersed in less useful forms /with an increase in entropy;
the chemical energy is passed down the food chain through eating/consumption;
the energy is used in respiration which releases some of the energy (in a less useful form) as heat which increases disorder of the system/increases entropy of the system;
90% of energy is lost as heat with each transfer;
the heat goes back to the atmosphere but is removed/lost from the ecosystem; **[2 max]**

Accept answers which correctly apply the concepts of entropy / energy/heat sources and sinks.

- (d) pyramids of numbers display the number of organisms at each trophic level;
...whereas pyramids of productivity refer to the flow of energy through a trophic level (measured in gm/m²/yr or J/m²/yr);
pyramids of numbers can sometimes display different patterns / e.g. an inverted pyramid when individuals at lower trophic levels are relatively large (e.g. oak tree to aphids to blue tits to sparrow hawk);
...whereas a pyramid of productivity always shows a decrease along the food chain;
the data for pyramids of numbers are relatively easier to collect than for pyramids of productivity
...whereas pyramid of productivity requires rate of biomass production overtime which is more difficult to collect;
pyramid of productivity shows the flow of energy overtime; **[2 max]**

BOTH pyramid of numbers and pyramid of productivity must be addressed to achieve maximum 2 marks.

5. (a) oxides of sulphur/SO₂/SO₃/SO_x;
nitrogen oxides/NO/NO₂/NO_x;
carbon dioxide/CO₂; [1 max]

Do not accept carbon monoxide or nitrous oxide.

- (b) (lower pH in) areas of high population density;
(lower pH in) areas of high industrialisation/manufacturing;
(lower pH in) areas of high electricity demand and fossil fuel/coal power stations;
(lower pH in) areas downwind of fossil fuel/coal power stations / prevailing winds blowing pollution to the east/southeast;
(lower pH in) areas of high vehicle/transportation use;
(in areas of low pH) there is a lack of emissions regulations/enforcement; [2 max]

Do not accept only 'pollution is high/ combustion of fossil fuels.

- (c) loss of leaves on trees due to direct deposits of acid rain damaging them/causing dieback of crowns;
acid deposition leaches nutrients from the soil reducing plant productivity/crop yields/ increases nutrient runoff into watercourses;
acid deposition mobilizes toxic elements which reduces crop yields;
e.g. Al/Hg ions become mobilised and poison plants;
some organisms have a narrow pH tolerance/unable to adapt to change, so acidification of the lakes/falling pH results in reduction in phytoplankton/fish kills/reduces aquatic biodiversity;
acid shock (e.g. in spring from snowmelt) can kill fish/frog eggs/lake organisms;
change in pH disrupts fish reproduction;
runoff containing Al ions impacts sensitive species;
e.g. fish gills get clogged and fish die;
geological features which erode more rapidly in acidic conditions e.g. limestone/marble hills / yields from plants that produce rubber are adversely affected by presence of acid rain; [2 max]

Do not accept 'acid deposition causes death of plants / organisms are unable to survive/soil is degraded/infertile' without an explanation.

- (d) to reduce the pollution from the acid rain across a large part of the country;
reduce incidents of photochemical smog that causes health problems;
fossil fuels have a number of environmental problems associated with them that cost money to fix;
e.g. global warming and rising sea levels/acid rain;
reduce air pollution to help attract more visitors/tourists;
to meet increasing demand for energy;
expanding demand for energy has meant that China now imports substantial amounts of coal and oil, so an increased use of renewables reduces costly imports/ renewables can be a cheaper alternative to fossil fuels / renewables are financially a good long term investment;
so they can position themselves in the world as leaders of renewable energy;
can help to generate jobs;
to meet international environmental standards;
rising public demand/desire for renewable energy;
fossil fuels are non-renewable and may run-out/cost will increase;
China has deposits of rare earth minerals needed for the manufacture of equipment/technology to generate solar power;
this allows underdeveloped parts of China to produce electricity through renewables;

Increase energy security/reliable national energy supply/reduce dependency on importing fossil fuel; [3 max]

Accept other reasonable responses.

6. (a) a measure of the amount of dissolved oxygen required to break down the organic material in a given volume of water through aerobic biological activity; [1 max]
OWTTE.

(b) after the point of sewage discharge the turbidity levels rise until about 150m (accept 125-175m) downstream where levels peak/plateau and thereafter steadily decline; [2 max]
turbidity will increase at the point sewage enters the water, as the pollutant is particulate/coloured;
turbidity will increase after the outlet of sewage as bacteria grow rapidly as they consume/decompose the sewage;
turbidity remains high as algae now rapidly grow as there are nutrients from the sewage decomposition available;
turbidity decreases once the nutrients levels fall to the pre-sewage levels and the algae growth declines;
turbidity increases as algae decrease, and then decrease as algae increase;

Award 1 max for a clear description of change in turbidity levels along the stream.

(c) increase in nutrients will lead to rapid algae growth /could cause algal bloom; [3 max]
algae levels will decline as nutrient levels become more restricted downstream from the source;
algae would look like the microorganisms curve in the diagram/ rapidly go up right after the pollution outlet;
algae would also decline, like the microbe curve, as the nutrients run out and algae start to die;
microbes would grow and they could shade out the light for algae causing a further drop in the curve;
the trend observed would be opposite to the current growth curve for algae (on graph C);

Only credit responses that refer to algae levels in Graph C, do not credit descriptions of eutrophication.

(d) point source can be clearly identified; [2 max]
so pollution can be more easily monitored;
solutions should be more easily applied / pollution can be stopped directly;
with non-point pollution, source is widespread/dispersed and difficult to identify;
solutions also have to be widespread/dispersed, so there are increased costs/difficulties of monitoring;
compliance is difficult to ensure with non-point pollution because of widespread/dispersed nature of sources;