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# Environmental\_systems\_ and\_societies\_paper\_1\_\_ SL



**Environmental systems and societies**  
**Standard level**  
**Paper 1**

Thursday 21 May 2015 (afternoon)

Candidate session number

1 hour

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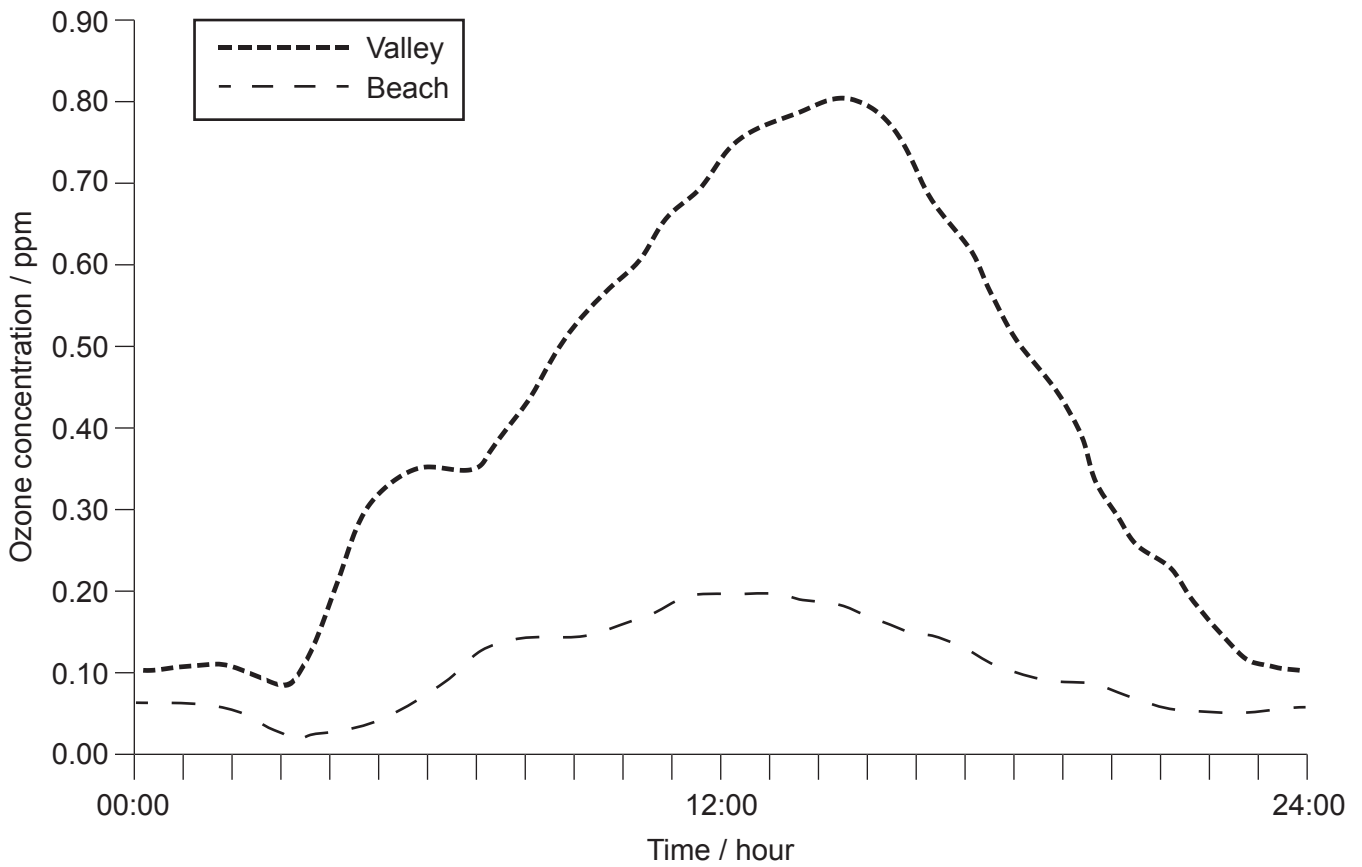
**Instructions to candidates**

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all questions.
- Write your answers in the boxes provided.
- A calculator is required for this paper.
- The maximum mark for this examination paper is **[45 marks]**.



1. **Figure 1:** Changes in atmospheric ozone concentration in Los Angeles (California, USA) over a 24-hour period.

**Figure 1**



[Source: *The Sourcebook for Teaching Science* by Norman Herr. Jossey-Bass/John Wiley ISBN: 978007879-72981. 2007. Chapter 20 "Graphing, Spreadsheets and Scientific Data Analysis", section 20.4: Scatter and Line Graphs. Used with permission from Wiley.]

- (a) State the **two** primary air pollutants from fossil fuels which contribute to the formation of photochemical smog. [1]

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**(Question 1 continued)**

(b) Identify **two** effects of tropospheric ozone. [2]

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(c) With reference to **Figure 1**:

(i) explain why ozone concentration changes over this 24-hour period. [2]

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(ii) explain why ozone levels are highest within the valley. [2]

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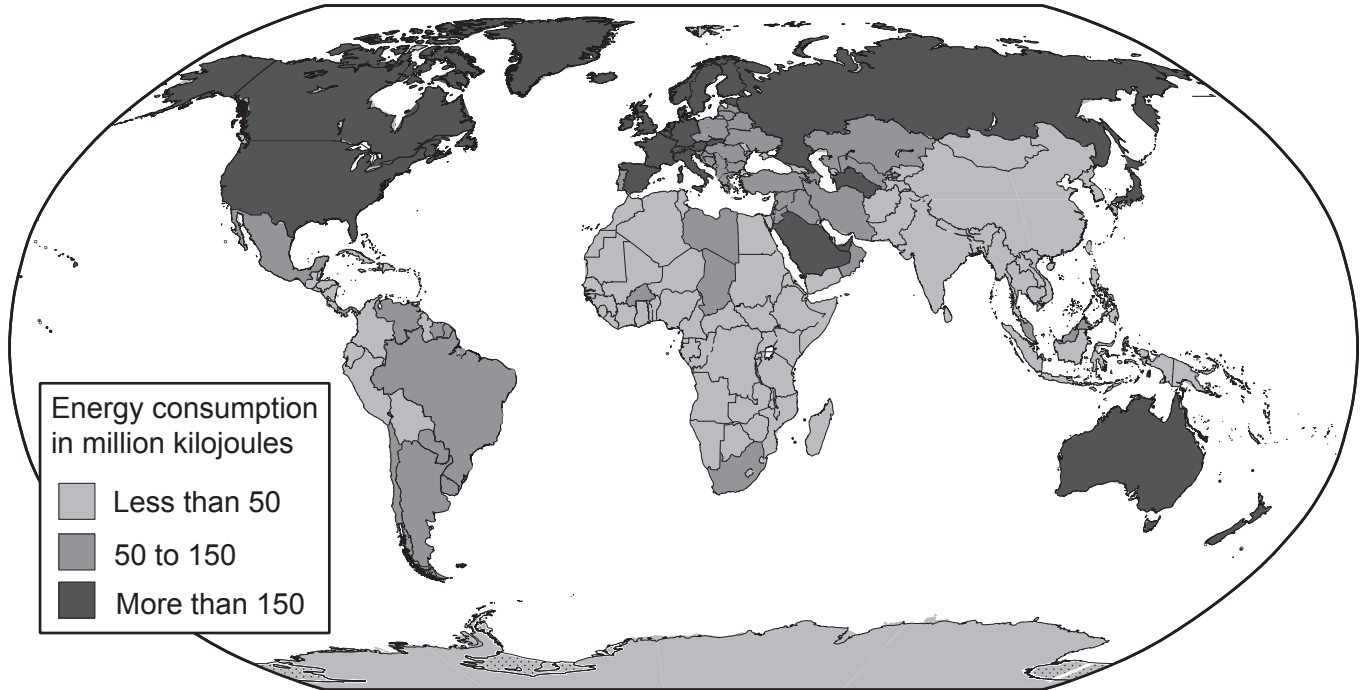
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2. **Figure 2:** Energy consumption *per capita* in 2004.

**Figure 2**



[Source: GRID-Arendal ([www.grida.no](http://www.grida.no))]

(a) Outline **two** reasons for the difference in energy consumption between North and South America.

[2]

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**(Question 2 continued)**

- (b) Explain why **two** countries with similar energy consumption *per capita* may have very different ecological footprints.

[3]

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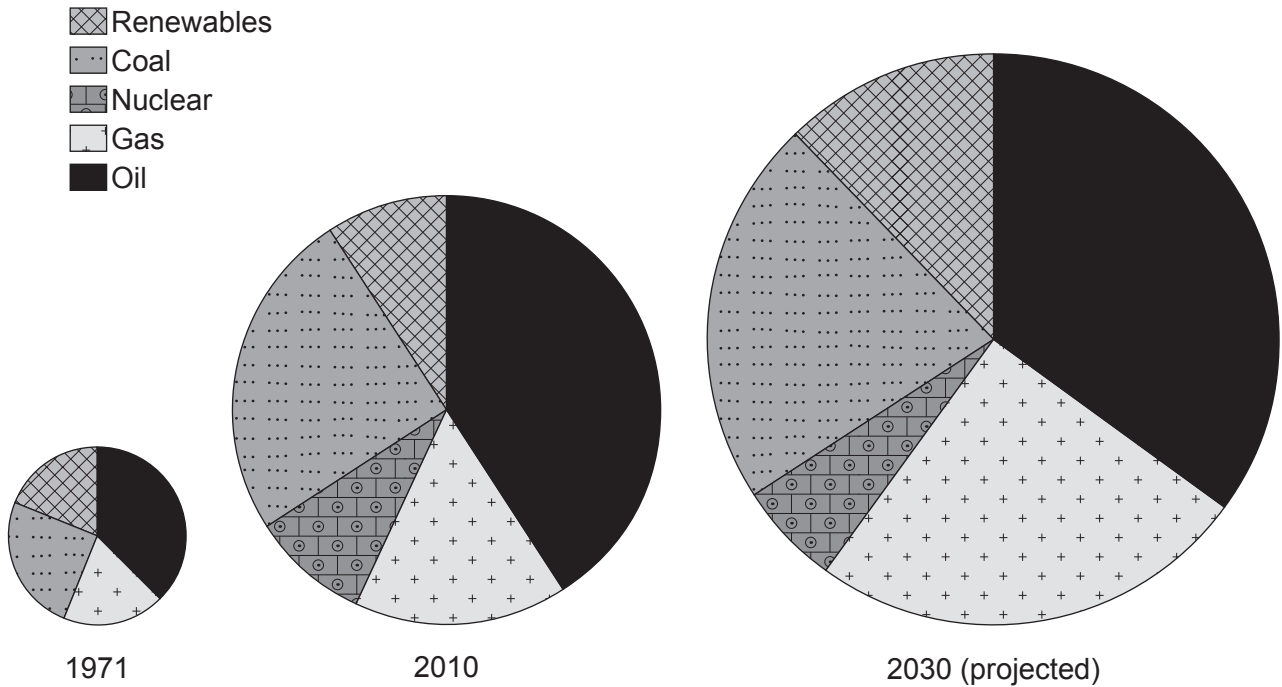
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(Question 2 continued)

Figure 3: Historical and projected changes in the proportions of different energy sources used.

Figure 3



[Source: GRID-Arendal ([www.grida.no](http://www.grida.no))]

(c) Suggest **two** factors that may cause the proportion of non-fossil fuels to be greater than projected for 2030.

[2]

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**(Question 2 continued)**

- (d) State **one** advantage and **one** disadvantage in the table below for each of the energy sources listed.

[2]

Source of energy	Advantage	Disadvantage
Fossil Fuel	.....	.....
Renewable	.....	.....

- (e) Explain how the projected change in demand for nuclear energy over the period shown in **Figure 3** demonstrates the change in the value of a resource over time.

[3]

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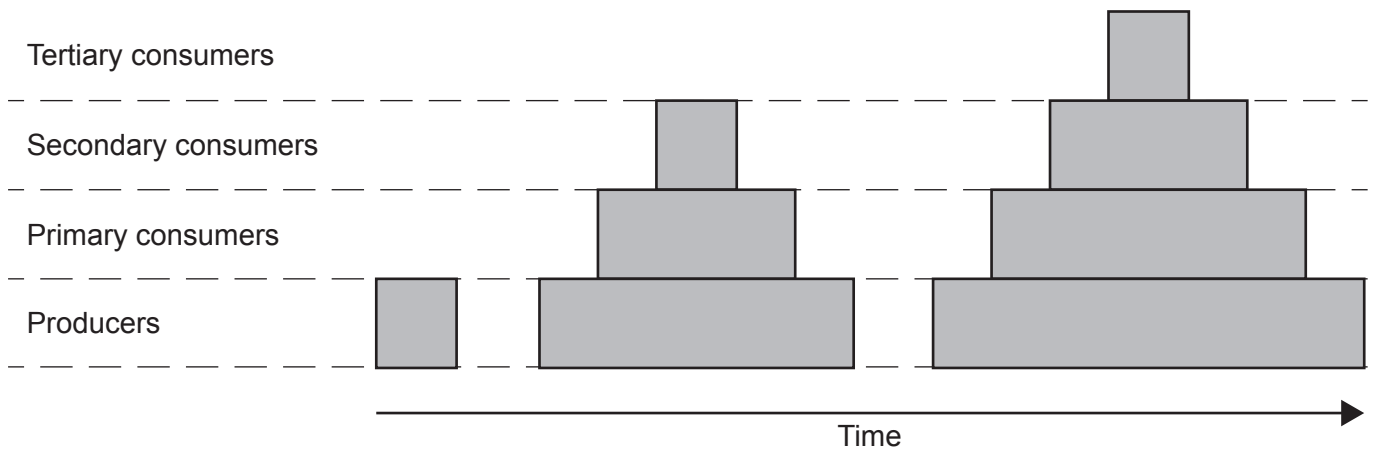
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3. **Figure 4:** Representation of the pyramids of biomass for communities at the same location at different stages of succession.

**Figure 4**



- (a) Identify **two** reasons why biomass tends to be smaller at higher trophic levels. [2]

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- (b) Describe **one** method for estimating the biomass of primary producers. [3]

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**(Question 3 continued)**

- (c) Explain how the process of succession might lead to changes in the productivity of trophic levels in this system.

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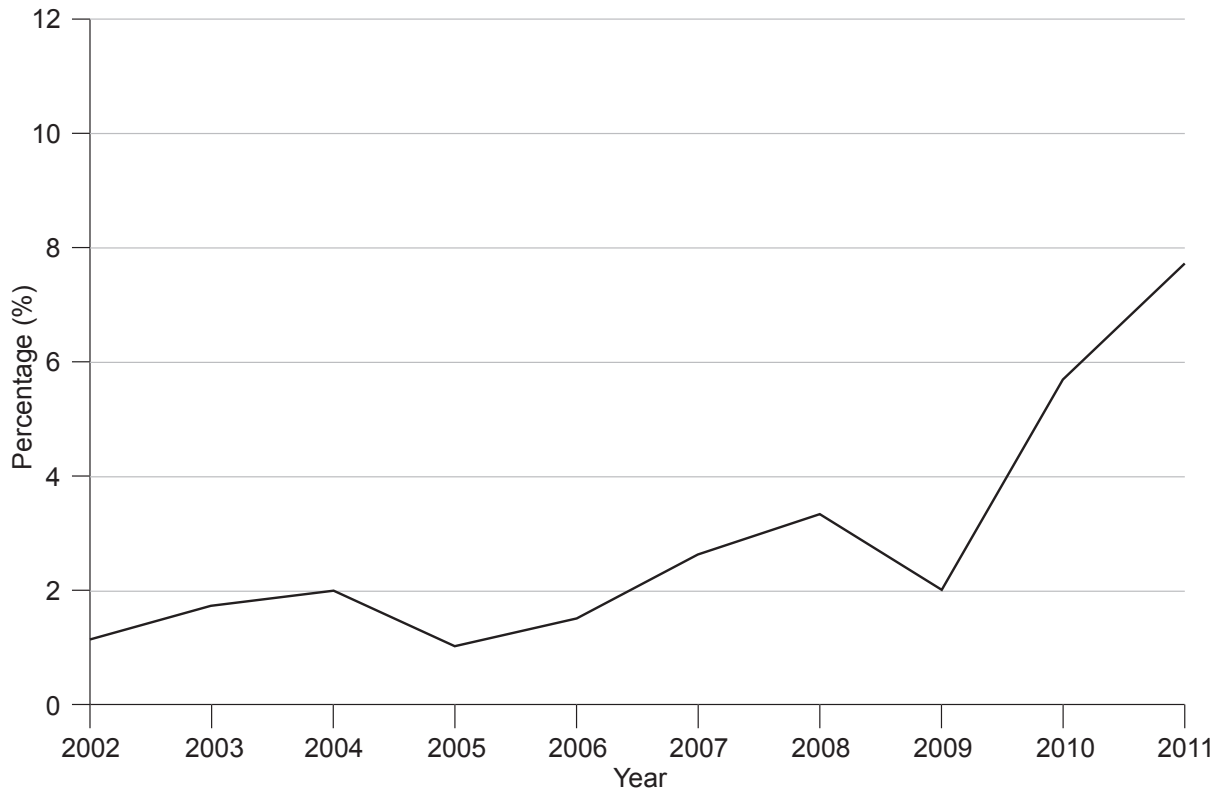
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4. **Figure 5:** Changes in the percentage of total elephant population illegally killed in Africa between 2002 and 2011.

**Figure 5**



[Source: GRID-Arendal ([www.grida.no](http://www.grida.no))]

- (a) Using **Figure 5**, calculate the change in the percentage of elephants killed illegally between 2002 and 2011. [1]

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- (b) Suggest **one** reason for the change in the number of elephants illegally killed over this time period. [1]

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**(Question 4 continued)**

- (c) Identify **one** way in which populations of elephants may be determined. [1]

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- (d) In the IUCN red list the level of threat to the African elephant has been reduced from “endangered” to “vulnerable” status since 2004. Identify **two** possible factors that may have led to this change of status. [2]

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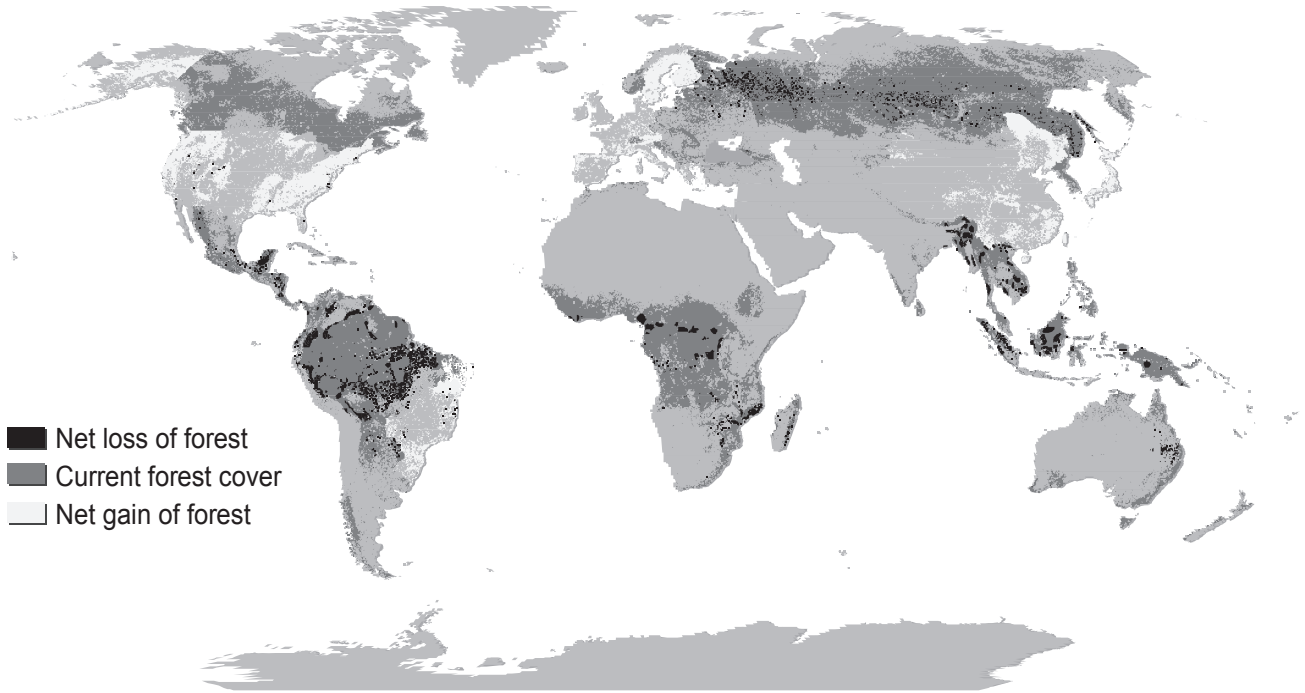
- (e) “The extinction of one large animal species is not a significant loss to the whole biosphere.” With reference to the African elephant, justify your viewpoint on this statement. [3]

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5. **Figure 6:** Changes in forest cover between 1990 and 2000.

**Figure 6**



[Source: GRID-Arendal ([www.grida.no](http://www.grida.no))]

(a) State **two** ways in which the impacts of economic development may lead to net loss of forests. [2]

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(b) Suggest **two** reasons for the net gains in forest area. [2]

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**(Question 5 continued)**

(c) Describe how net loss of forests may lead to an increase in soil degradation. [3]

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(d) Identify **two** natural services provided by forest. [2]

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# Markscheme

May 2015

**Environmental systems and societies**

**Standard level**

**Paper 1**

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## 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](mailto:emarking@ibo.org).

If you have any queries on **administration** please contact:

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E-mail: [helen.griffiths@ibo.org](mailto:helen.griffiths@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 Scoris™ 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. Scoris™ 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 **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.

1. (a) hydrocarbons/volatile organic compounds/VOCs AND nitrogen monoxide/NO<sub>x</sub> [1 max]  
*Note to markers: To award one mark there must be a correct response from each group*
- (b) damages crops/forests/vegetation;  
damages fabrics/rubber materials/building materials  
irritates eyes;  
can cause breathing difficulties;  
may increase risk of infection /depresses immune system;  
increases local temperature that adds to the urban heat island /ozone is a  
greenhouse gas at ground level and contributes to warming/higher temperatures; [2 max]  
*Do not accept only 'negative effect on health'*
- (c) (i) sunlight activates the (photochemical) production of ozone and changes  
over the day;  
industrial/transport/domestic use of fossil fuels increase in daytime  
(releasing pollutants);  
thermal inversions undergo daily cycles; [2 max]  
*Do not accept 'change in temperature influences ozone levels'*
- (ii) high emission of air pollutants in the valley (eg, due to higher concentration  
of industry / higher population increasing vehicle use);  
due to the topography it is more difficult for pollutants to be dispersed by the  
wind;  
calm winds and cold night temperature can allow thermal inversion to occur  
(warm layer of air traps cooler air below it);  
thermal inversion traps the air pollutants/smog in the valley; [2 max]  
*Do not accept only 'more people live in valley', this needs to be related to  
release of pollutants that are precursors of ozone.*

2. (a) greater energy consumption for domestic activities for example, use of electrical devices (such as televisions, computers, air conditioning systems etc) in North America;  
greater energy consumption for industry in North America;  
use of more energy for transport of food/goods in North America;  
greater use of energy for heating in cold winters in parts of North America;  
greater individual travel in North America; **[2 max]**  
*Do not accept only 'more technologically advanced' unless it is linked to an increase in energy use.*  
*Accept responses in the converse.*  
*Accept other reasonable responses.*
- (b) different agricultural systems used for food production may require different amounts of land/water (eg, some crops require less water than others);  
differences in dietary preferences will require different amounts of land/water for production (eg, meat based diet has a higher ecological footprint than a vegetarian diet);  
different climatic conditions may have very different efficiency for food production requiring different areas of land;  
urbanization may be very different taking up different percentage/quantity of available land;  
water consumption will increase ecological footprint and may be different;  
rate of pollution/waste production requiring assimilation by the environment may vary greatly between countries;  
some sources of energy (eg, geothermal) may have a lower ecological footprint than others (eg, fossil fuels);  
by importing goods manufactured in another country, the importing country would not increase their own footprint (the impact will occur in the country of production where energy is used and waste produced); **[3 max]**
- (c) development of new/cheaper/more efficient technologies for renewable energy;  
pressure from environmental organizations/lobbyists/environmental movements/  
green politics;  
effective/powerful international agreements/legislation;  
depleted reserves of fossil fuels /increase prices on fossil fuels;  
increased awareness of detrimental impacts of fossil fuels;  
increasing concern for energy security; **[2 max]**



(d)

	<b>Advantages</b>	<b>Disadvantages</b>
<i>Fossil fuel: coal/oil/gas</i>	large supply currently available/technology/ infrastructure set up to use it/ easy to extract/easy to transport (eg, pipelines for oil)/efficient/ (relatively) cheap	finite resource/will eventually run out/ release of polluting gases (eg CO <sub>2</sub> / NO <sub>x</sub> /SO <sub>x</sub> )/ potential for oil spills / risk of gas explosions /degradation of land due to mining
<i>Renewable: solar/wind/wave</i>	no emission of CO <sub>2</sub> / NO <sub>x</sub> /SO <sub>x</sub> /source is sustainable/ potentially infinite/safe to use/can be used in rural/remote areas	capital cost /expensive (to set up)/ supply can be dependent on weather/sunlight /wind / not all areas are suitable

[2 max]

*Accept other alternative correct answers, including those in which differences in cost are justified by example.*

*Do not accept only 'environmentally friendly/polluting/renewable/non-renewable'.*

*Credit no marks for only one correct response*

*Credit [1] for two or three correct responses*

*Credit [2] for four correct responses*

(e)

in 1971 radioactive substances were not in demand and therefore had little value (eg Uranium once had little use and therefore had low value as a resource); by 2010 the development of nuclear technology, increased demand and led to an increase in value / by 2010 we became aware of global warming/pollution effects of fossil fuel, nuclear energy became more significant and with increase in demand there was an increase in value of uranium; for 2030 the projected decline in use of nuclear power is a consequence of an increase in concern over accidents/safety of radioactive materials and will be reflected in a decline in value of uranium;

*Accept other reasonable answers for each period.*

[3 max]

3. (a) biomass is reduced along a food chain due to energy loss;  
energy is lost in respiration/heat/entropy/movement/metabolism/excretion;  
not all biomass is passed on to next trophic level because not all food/prey is  
discovered/captured/eaten/edible;  
some eaten material is not absorbed/is lost through defecation; [2 max]  
*Do not accept only '10% rule/ 10% of energy is passed onto next level/ 90% of  
energy is lost from one trophic level to the next'. It must be related to loss of  
biomass.*
- (b) *Sampling:* Use random /stratified sampling using quadrats to determine total  
number of producers in community / extract all producers from a known area of  
community;  
*Dehydrating:* Dry/dehydrate a sample of individuals / of all producers taken from a  
known area to find dry weight/organic mass / find dry weight of producer from  
database;  
*Extrapolating:* Multiply the average dry weight of individuals/sample by the  
estimated number of producers/community area; [3 max]
- (c) in early stages of succession the conditions for photosynthesis/plant life/primary  
productivity are very limiting so primary productivity is low;  
...and there are no consumers/insufficient food for consumers so secondary  
productivity is low/zero;  
succession leads to improvement in physical limiting factors so primary  
productivity increases;  
with more food available, secondary productivity (from consumers) increases;  
in later stages, succession leads to establishment of K strategists so the gross  
primary productivity is high;  
...but because of large size/storage/respiratory losses, net primary productivity is  
low;  
the increased food supply will lead to high gross secondary productivity;  
...but the long food chains lead to more respiratory loss/inefficient transfer so low  
net secondary productivity; [4 max]

4. (a) (approx  $7.6 - 1.2$ ) = 6.4%; **[1 max]**  
*Accept between 6.0 to 6.8%*
- (b) increase in demand for ivory products;  
increase in price of ivory;  
trade driven underground due to ivory ban;  
lack of alternative income/food due to effects of drought/civil war;  
lack of wildlife protection due to limited funds/civil war;  
population growth increasing contact and conflict between humans and elephants  
(eg, crop raiding/destruction of property by elephant leading to elephant culls); **[1 max]**
- (c) visual observations/aerial photography/satellite imagery;  
count in one area and extrapolate to whole area;  
radio tagging;  
counting density of faecal material; **[1 max]**  
*Do not accept only 'count elephants'.*  
*Do not accept 'Lincoln index or capture-mark-release-recapture'. Inappropriate method for elephants.*
- (d) increase in population size;  
increase in numbers of mature individuals;  
increase in geographical range;  
reduction in degree of fragmentation;  
increase quality of habitat;  
increased area of occupancy;  
change in classification criteria/thresholds used to determine conservation status; **[2 max]**
- (e) *Agreement with statement:*  
they are only one amongst many species;  
loss of species is part of natural evolution (eg, dinosaurs/dodo);  
ecosystem will adapt to the loss of species/elephants;  
elephants/large species can be a threat/kill humans/raid farms/grain stores;  
*Do not accept 'other species are not dependent on elephants for food'.*
- Disagreement with statement:*  
elephants/every species has right to live (biorights);  
they have an intrinsic/aesthetic value;  
they may be a keystone species/other species may be dependent on them/required to maintain stability;  
loss of elephants/large species will result in loss of biodiversity (species/genetic);  
humans have a moral duty to conserve species; **[3 max]**

*Award marks for justification, not the viewpoint in isolation.  
Credit should only be given for reasons supporting one viewpoint.*

5. (a) logging for timber/resource for industrial use;  
deforestation for agriculture land;  
deforestation for land for urban growth;  
acid rain/precipitation damaging trees;  
greenhouse emissions causing shifting biomes; [2 max]
- (b) afforestation for commercial sale of goods eg timber/rubber/palm oil;  
afforestation to provide forest services to local communities eg soil  
protection/flood reduction/ ecotourism /carbon capture;  
afforestation for the intrinsic value they contribute to landscape;  
afforestation to provide conservation areas for resident species;  
tree planting schemes to restore a habitat;  
government policies to plant more trees eg, plant two for one cut policy; [2 max]  
*Do not accept just 'planting/afforestation' without reason.*
- (c) loss of tree root system to hold soil particles together leading to soil erosion;  
loss of trees that reduced wind velocity and prevented top soil being blown away;  
loss of tree canopy that intercepts rainfall and reduces its impact on the soil and  
reduces soil erosion;  
loss of vegetation increases surface runoff/potential risk of floods and increases  
soil erosion;  
loss of forest (and ecosystem) leads to loss of organic matter;  
deforestation leads to reduced recycling of nutrients;  
alternative use of land eg, intensive/unsustainable agriculture/overgrazing may  
lead to soil exhaustion; [3 max]
- (d) carbon sink/absorption of carbon dioxide;  
production of oxygen;  
climate regulation;  
intercepting rainfall and regulating its flow;  
through plant debris maintains soil quality/nutrient recycling;  
help prevent soil erosion;  
providing habitat for range of species;  
cultural/spiritual value to indigenous groups;  
amenity value which can be used via ecotourism/recreation;  
natural capital eg, goods such as timber/food/medicines; [2 max]  
*Do not accept 'provides shelter'.*
-