IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

N07/4/ECOSO/SP1/ENG/TZ0/XX+

88076301

ECOSYSTEMS AND SOCIETIES
STANDARD LEVEL
PAPER 1

Friday 2 November 2007 (afternoon)

1 hour

Candidate session number

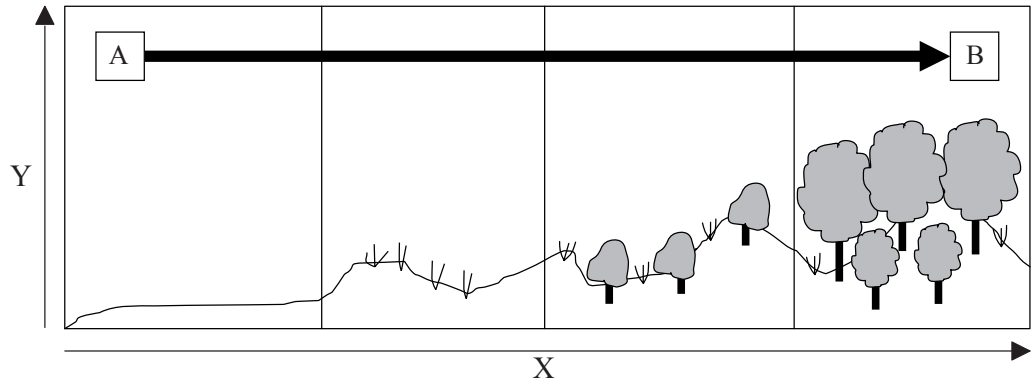
0	0							

INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions in the spaces provided. You may continue your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the number of answer sheets used in the appropriate box on your cover sheet.

1. **Figure 1** shows succession in a sand dune ecosystem.

Figure 1



(a) (i) Define the term *succession*. *[2]*

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(ii) State what variable may be appropriate for the x-axis in **Figure 1**. *[1]*

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(iii) Outline what will happen to soils as the ecosystem in **Figure 1** changes from A to B. *[2]*

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(b) State what is happening within a system when a decrease in variable "P" leads to a decrease in variable "Q" which in turn leads to a further decrease in variable "P". *[1]*

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2. **Figure 2(a)** Relationship between number of rodent species and altitude

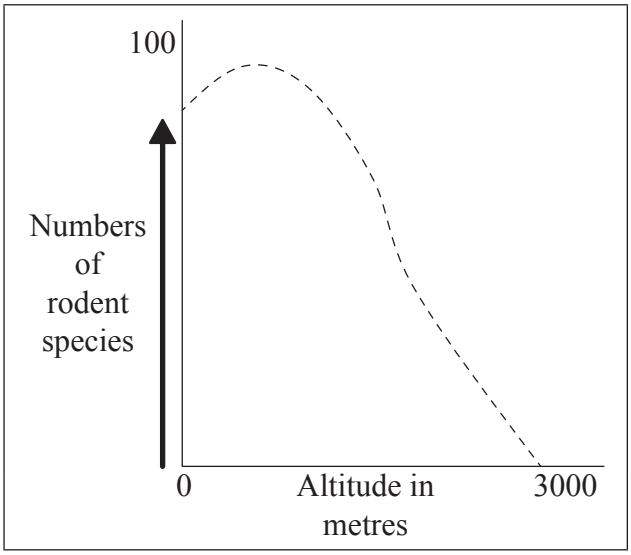
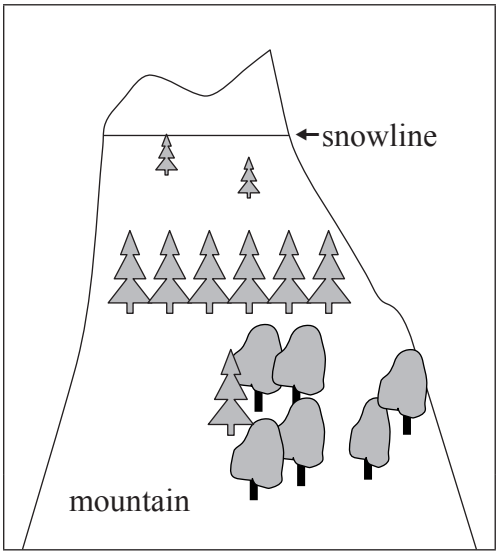


Figure 2(b) Altitude habitat model



(a) With reference to **Figure 2(a)** describe the relationship which appears to exist between altitude and the number of rodent species. *[1]*

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(b) Predict **three** ways in which the altitude habitat model in **Figure 2(b)** might change as a result of global warming. *[3]*

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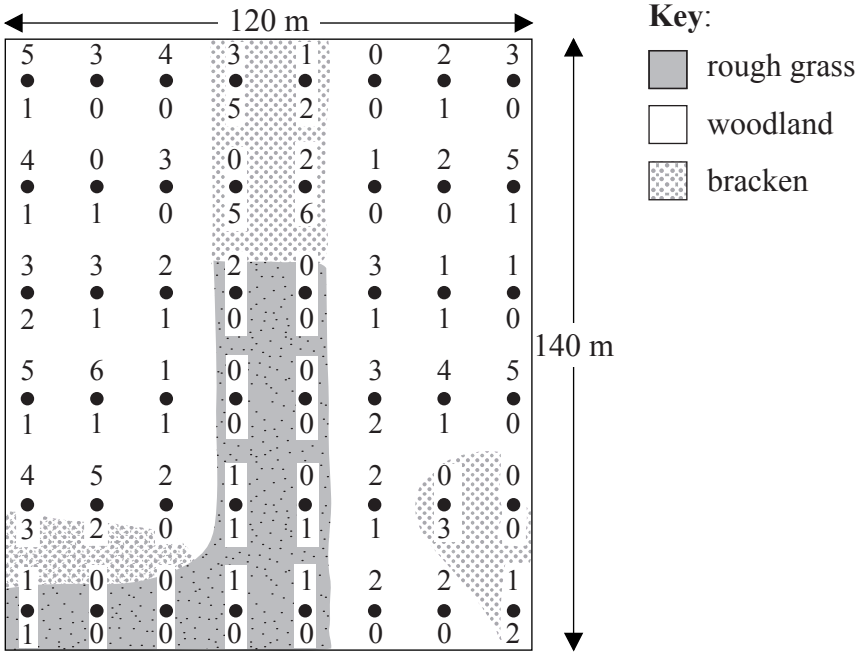
(This question continues on the following page)

(Question 2 continued)

(c) **Figure 3(a)** shows the numbers of wood mice and bank voles collected from traps.

The number above the trapping point (●) represents wood mice and the number below the trapping point (●) represents bank voles.

Figure 3(a)



[Source: A Cadogan and G Best, *Environment and Ecology*, page 51, Blackie and Sons Ltd, 1992]

Figure 3(b)

	Rough grass	Woodland	Bracken
Wood mice	6	50	
Bank voles	3	15	

(This question continues on the following page)

(Question 2(c) continued)

(i) Complete **Figure 3(b)** by calculating the numbers of wood mice and bank voles found in bracken. *[1]*

(ii) Suggest **two** reasons for the relationship between numbers of wood mice and bank voles and habitat shown in **Figure 3(a)** and **Figure 3(b)**. *[2]*

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(iii) Explain why the wood mice and bank voles were marked and released after capture. *[1]*

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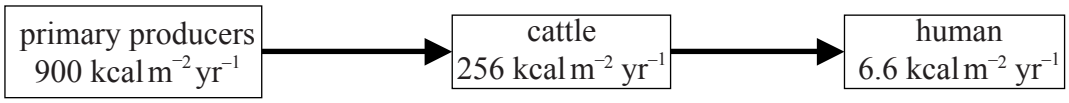
3. **Figure 4** shows energy flow through a food chain.

Figure 4



(a) (i) Calculate the percentage energy loss to humans from the initial input of 900 kcal m^{-2} yr^{-1}. *[2]*

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(ii) Explain why farming systems based on crop production are more energy efficient than harvesting from the sea. *[2]*

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(iii) Suggest **two** ways in which energy may be lost from the system. *[2]*

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(This question continues on the following page)

(Question 3 continued)

(b) (i) Suggest **three** reasons why livestock (cattle, goats, sheep, *etc.*) form a part of most farming systems. *[3]*

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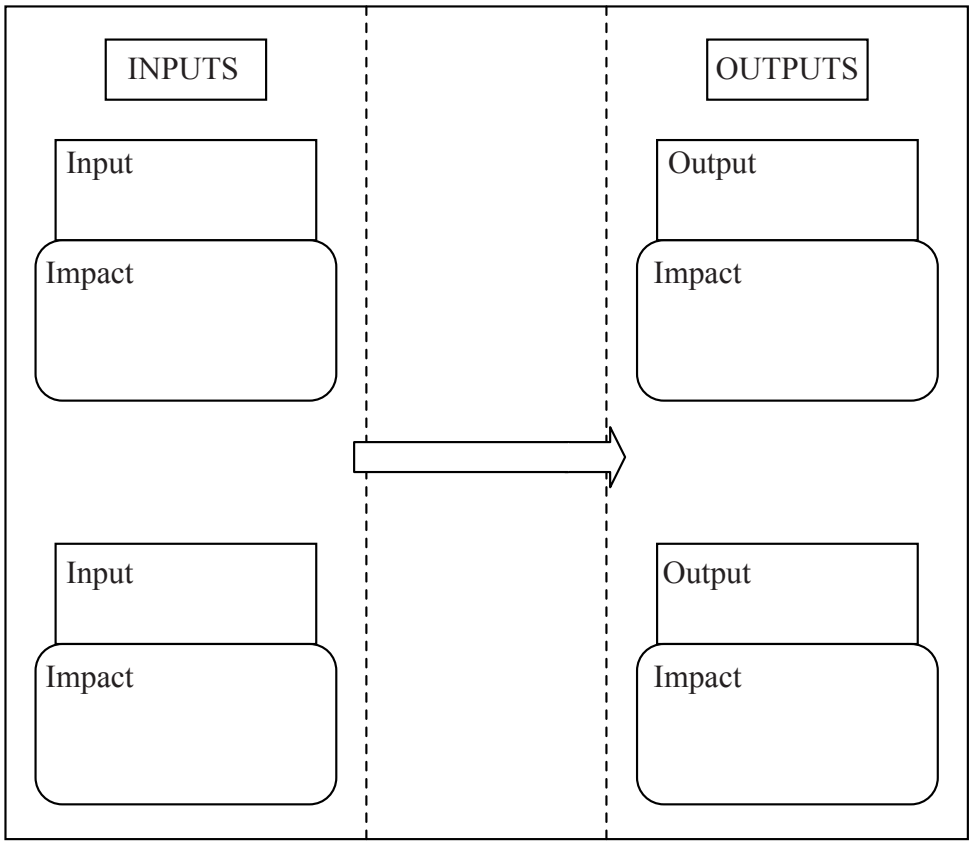
(ii) **Figure 5** shows a systems diagram for a farm. Annotate the diagram to show **two** inputs and **two** outputs, and their possible environmental impacts. *[4]*

Figure 5



4. (a) Suggest why the size of a nature reserve is an important factor for the conservation of large animals. *[3]*

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(b) Outline what is meant by the term *species based conservation*. *[2]*

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(c) Outline **two** historic causes of mass extinction. *[2]*

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(This question continues on the following page)

(Question 4 continued)

(d) **Figure 6** shows reasons why some plant species have become endangered.

Figure 6

Threat	Number of endangered species
Collecting by gardeners/tourists	35
Overgrazing	33
Populations critically low for breeding	31
Clearance for agriculture	22
Industrial and urban growth	16
Logging in forests	12
Dams and flooding	8
Changes in farming practice	6

[Source: adapted from Chapman and Reiss, *Ecology principles and application*, page 279, CUP, 1999]

Select **two** threats from the table in **Figure 6** and suggest a conservation strategy for reducing each threat. *[4]*

Name of threat: . . . . . .

Conservation strategy: . . . . . .

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Name of threat: . . . . . .

Conservation strategy: . . . . . .

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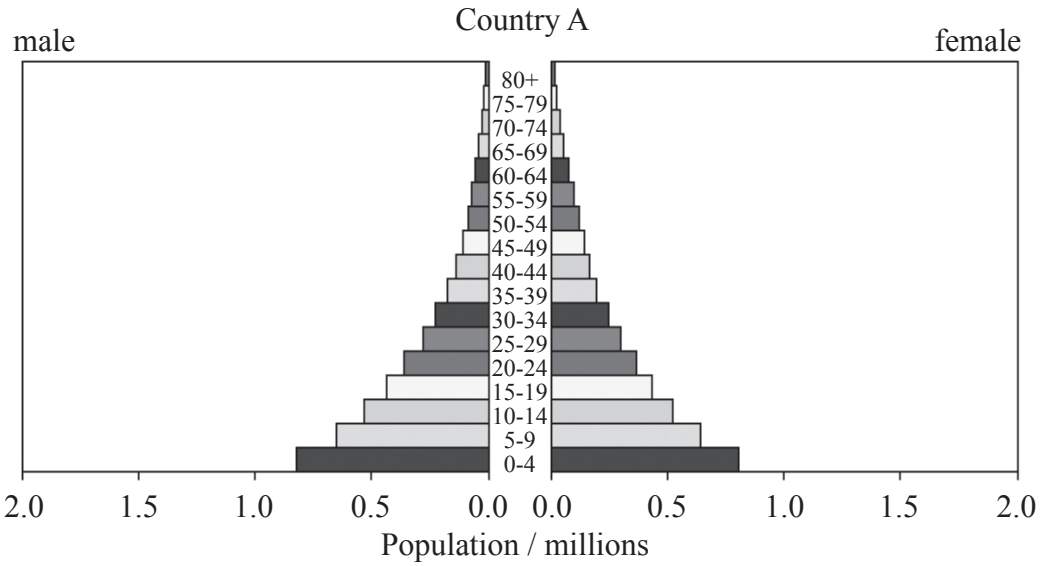
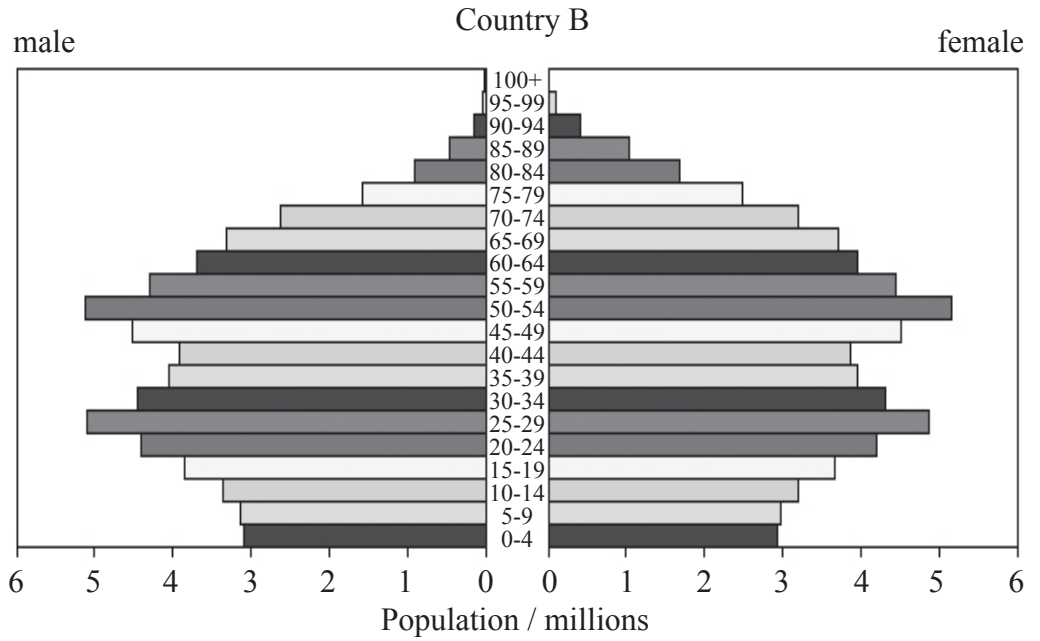
5. **Figure 7(a)** shows the population pyramids for an MEDC and LEDC in the year 2000 and **Figure 7(b)** shows two ecological footprints.

Figure 7(a)





[Source: adapted from http://www.census.gov/cgi-bin/ipc/idbpyrs.pl?cty=CD&out=s&ymax=300]

Figure 7(b)

Ecological footprint for 2001	
Footprint X	1.5 Global hectares per person
Footprint Y	4.3 Global hectares per person

(This question continues on the following page)

(Question 5 continued)

(a) State **two** differences between the population pyramids shown in **Figure 7(a)**. *[2]*

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(b) (i) With reference to **Figure 7(a)** and **Figure 7(b)**, deduce which footprint belongs to country A and which footprint belongs to country B. *[1]*

Country A: . . . . . .

Country B: . . . . . .

(ii) Justify your answer to (b)(i). *[1]*

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6. **Figure 8** shows population change and water consumption for 1971 and 2001 in an MEDC.

Figure 8

	1971	2001	Growth rate per year
Population / 10^6	48.6	57	0.53 %
Total water consumption / 10^6 m^3 day^{-1}	42.7	83.3	2.3 %

(a) Compare relative growth rates for population and water consumption between 1971 and 2001. *[1]*

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(b) Suggest **two** factors which may explain the difference you have identified in (a). *[2]*

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MARKSCHEME

November 2007

ECOSYSTEMS AND SOCIETIES

Standard Level

Paper 1

10 pages

Subject Details: Ecosystems and Societies SLP1 Markscheme

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).
- An alternative answer or wording is indicated in the markscheme by a "/" either wording can be accepted.
- Words in (…) in the markscheme are not necessary to gain the mark.
- Words that are <u>underlined</u> are essential for the mark.
- The order of points does not have to be as written (unless stated otherwise).
- If the candidate's answer has the same meaning or can be clearly interpreted as being the same as that in the mark scheme, then award the mark.
- Mark positively. Give candidates credit for what they have achieved, and for what they have got correct, rather than penalising them for what they have got wrong.
- Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with "**ECF**", error carried forward.
- Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by "**U-1**" at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

1. (a) (i) the orderly process of change over time in a community;
changes in the community of organisms cause changes in the physical environment;
this allows another community to become established and replace the former through competition;
leading often to greater complexity; ***[2 max]***

(ii) time;
distance (from sea); ***[1 max]***

(iii) soils will become more mature;
soils will be deeper;
contain more organic material;
become more complex;
develop distinct horizons; ***[2 max]***

(b) positive feedback; ***[1]***

2. (a) as altitude increases rodent <u>species</u> number decreases;
there are fewer rodent <u>species</u> numbers at high altitude;
there are higher rodent <u>species</u> numbers at low altitude;
inverse relationship; ***[1 max]***

(b) migration of species up the mountain;
melting/loss/reduction of snow cap / migration of snowline up mountain;
appearance of new species;
loss of species / species unable to adapt to rapid changes / lower diversity;
increased growth rates; ***[3 max]***

(c) (i)

	Rough grass	***Woodland***	***Bracken***
Wood mice	*6*	*50*	7;
Bank voles	*3*	*15*	23;

[1]

*Both figures needed to receive **[1]**.*

(ii) species' preference for nesting/shelter sites;
preferred food sources located in particular habitats;
rough grassland marginal for both species because it offers little shelter from predators;
mice and voles occupy different niches; ***[2 max]***

(iii) so that the when animals are recaptured population size/Lincoln index can be calculated; ***[1]***

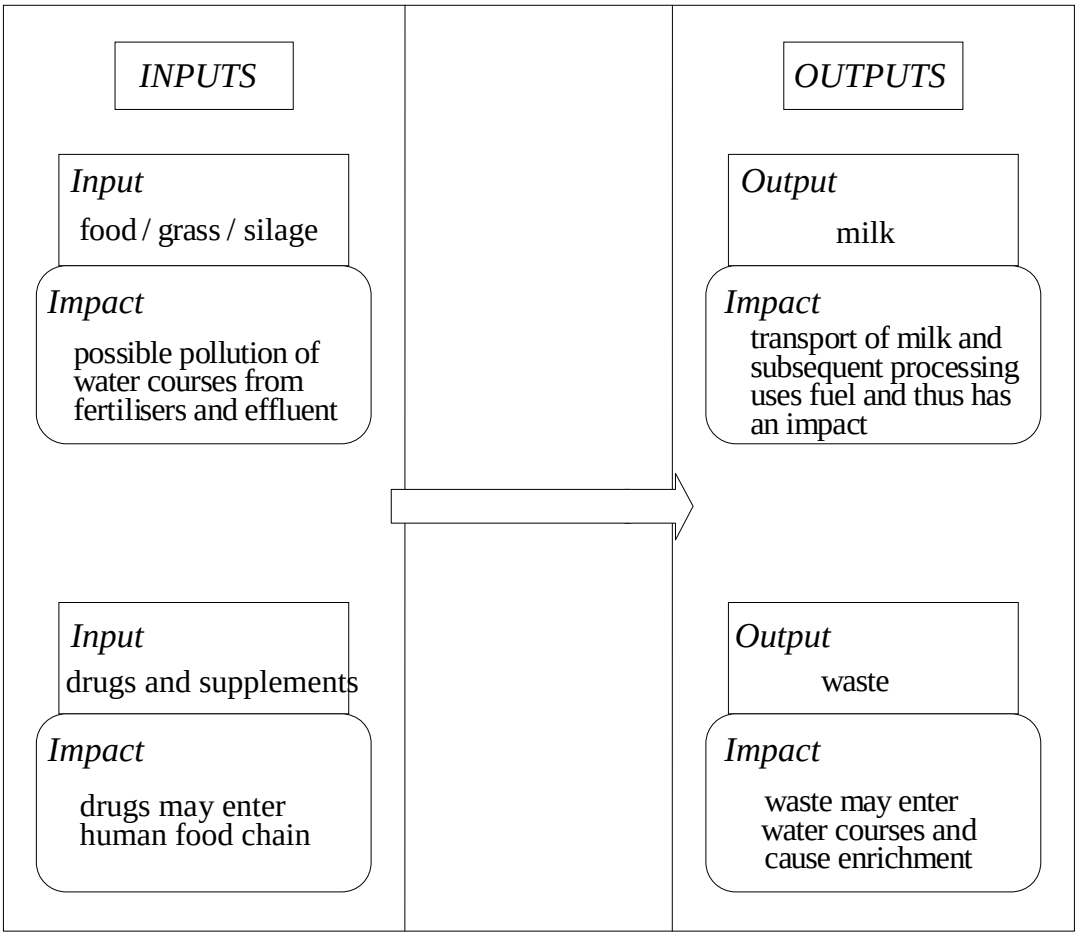
3. (a) (i) $900 - 6.6 = 893.4$ kcal lost;
$\frac{893.4}{900} \times 100$;
$= 99.3\%$ loss; (*accept 99%*) ***[2]***
*Award **[2]** for correct final answer.*

(ii) there is energy lost from respiration and waste production at each level within a food web;
crop production harvests food from lower down in the food web than harvesting fish from the top, therefore it is more efficient;
crops capture energy directly from primary source;
fish harvesting utilizes a resource that is several steps away from primary production; ***[2 max]***

(iii) heat;
respiration;
feces; ***[2 max]***

(b) (i) animals provide a source of protein (essential for the human diet);
animals convert vegetation to food that would not be available to humans directly;
produce diverse products (milk / meat / blood / wool);
taste and culture affect demand;
additional benefit that they are working animals; ***[3 max]***

(ii) *Award **[1]** for two inputs. Award **[1]** for each two associated impacts.*
Award ***[1]*** *for two outputs. Award **[1]** for each two associated impacts.*
e.g. for milk production



[4 max]

Accept any other reasonable answers.

4. (a) large animals require relatively large space for breeding/foraging/hunting/ territoriality;
the area often needs to, be large enough to limit disturbance / include buffer zones;
the area needs to be large enough to minimize the chance of animals wandering outside the reserve and becoming targets for hunters;
if reserves are too small, viable populations of large animals are not sustainable; ***[3 max]***

(b) conservation designed to conserve a particular species;
may not require the preservation of the animal's habitat;
or the animal in the wild;
usually associated with charismatic species, *e.g.* big cats, rhino; ***[2 max]***

(c) global volcanic eruption leading to rapid climate change/hostile environment;
catastrophic events such as meteorite impact leading to rapid climate change /hostile environment;
over hunting of large mammals by man (in the Holocene) to the extent that populations became reproductively unviable/wiped out; ***[2 max]***
Do not accept Ice Age.

(d) *collecting*: ***[2 max]***
using legislation to prevent moving/import of endangered species;
education about impact of collecting to change behaviour;
encouraging non-destructive "collection" *e.g.* photography rather than digging up;

overgrazing: ***[2 max]***
fencing/cordoning off sensitive habitats/biological hotspots;
reducing herd sizes;
providing alternative grazing;
supplementing income through nature tourism; ***[4 max]***
Accept other choices of threat and reasonable strategies.

5. (a) country A is an expanding population, whereas country B is a declining population;
country A has a high proportion of young people/wide base, whereas country B has a low proportion of young people/narrowing base;
country A has low proportion of elderly / narrow top whereas country B has a higher proportion of elderly people / wider top;
country A has a larger population than country B; ***[2 max]***

(b) (i) country A: footprint X;
country B: footprint Y; ***[1]***
*Both answers needed to receive **[1]**.*

(ii) country A is an LEDC and therefore, people use fewer resources/more local resources/generate less pollution, whereas country B is an MEDC and therefore, people use more resources/more imported goods/generate more pollution; ***[1 max]***

6. (a) water consumption has increased at a faster rate than population growth; ***[1]***
Figures are not needed.

(b) increased demand for domestic goods/luxury items *e.g.* washing machines/swimming pools;
increased economic development so more water used in industry;
agricultural development so greater use of water in irrigation (for intensive) farming;
cultural change towards greater personal hygiene; ***[2 max]***

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ECOSYSTEMS AND SOCIETIES
STANDARD LEVEL
PAPER 2

Monday 5 November 2007 (morning)

2 hours

Candidate session number

0	0							

INSTRUCTIONS TO CANDIDATES

- Write your session number in the boxes above.
- Do not open this examination paper until instructed to do so.
- Section A: answer all of Section A in the spaces provided. Refer to the resource booklet which accompanies this question paper.
- Section B: answer two questions from Section B. Write your answers on answer sheets. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the numbers of the questions answered in the candidate box on your cover sheet and indicate the number of sheets used in the appropriate box on your cover sheet.

SECTION A

Answer all of Section A in the spaces provided.

The resource booklet provides information on deep-ocean ecosystems. Use the resource booklet and your own studies to answer the following.

1. (a) State the names of the following.

(i) The deep-ocean zone which is over 1 km deep.

. . . . . .

(ii) The flat plain found on the ocean floor. *[1]*

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(b) Suggest **one** reason why relatively little is known about many species in the deep oceans. *[1]*

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(c) (i) Explain why phytoplankton is found mainly near the surface in ocean ecosystems. *[1]*

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(ii) State an abiotic factor responsible for the zonation observed in the deep ocean. *[1]*

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(iii) With reference to **Figure 2**, state which trophic level is occupied by the seagull. *[1]*

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(This question continues on the following page)

(Question 1 continued)

(d) With reference to **Figure 3**, identify **two** adaptations of the deep-ocean prawn to life on the ocean floor. *[2]*

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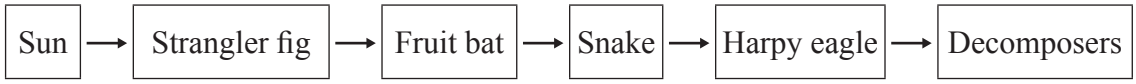
(e) (i) A simplified energy flow diagram for a tropical forest food chain is shown below.



In the space provided below, sketch a simplified energy flow diagram to show how energy flows through the food chain at a deep-ocean vent. *[1]*

(ii) Suggest which features of deep-ocean food webs make them particularly vulnerable to disturbance. *[2]*

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(iii) State **one** way in which organic matter leaves the deep-ocean ecosystem. *[1]*

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(This question continues on the following page)

(Question 1 continued)

(f) (i) With reference to **Figure 6**, describe and explain the pattern shown in the graph of catches of Orange roughy during the 1990s. *[3]*

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(ii) Suggest how the problem of unsustainable fishing practices might be overcome, from an ecocentric viewpoint and a technocentric viewpoint. *[4]*

Ecocentric . . . . . .

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Technocentric . . . . . .

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(This question continues on the following page)

(Question 1 continued)

(g) (i) With reference to **Figure 7**, state the amount of carbon stored in the world's oceans. *[1]*

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(ii) Suggest why scientists are increasingly interested in the role that oceans play as carbon sinks. *[1]*

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(iii) Describe **two** reasons why ocean levels are expected to increase as a result of global warming. *[1]*

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(h) Suggest why there is relatively little public pressure to conserve deep-ocean ecosystems and justify the need for them to be conserved. *[4]*

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SECTION B

*Answer **two** questions. Write your answers on the answer sheets provided. Write your session number on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.*

*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.*

2. (a) Outline what is meant by a *model*. *[2]*

(b) Evaluate the models used:
- to predict the growth of human populations
- to predict climate change
- to assess demands human populations make on their environments. *[9]*

(c) With reference to examples, explain the importance of understanding cultural factors when designing policies to control population growth. *[7]*

Expression of ideas [2]

3. (a) Define the term *pollution*. With reference to a **named** pollutant (other than solid domestic waste) describe the impact it can have on the structure and functioning of an ecosystem you have studied. *[6]*

(b) Describe and evaluate pollution management strategies for the pollutant you have **named** in part (a). *[6]*

(c) State and justify your personal viewpoint on the success of different strategies for managing solid domestic waste. *[6]*

Expression of ideas [2]

4. (a) Outline the concept of sustainability. *[3]*

(b) Evaluate the importance of global summits in shaping attitudes towards sustainability. Refer to specific summits in your answer. *[5]*

(c) Discuss the factors which affect the choice of contrasting energy sources adopted in **two** societies you have studied. *[10]*

Expression of ideas [2]

5. (a) Describe the role of soil in the transfer and transformation of water and nitrogen within an ecosystem. *[5]*

(b) Compare soil management strategies in a **named** commercial farming system with those in a **named** subsistence farming system. *[8]*

(c) Discuss how viewing soils as systems can help farmers to understand and reduce the causes of soil degradation. *[5]*

Expression of ideas [2]

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88076303

ECOSYSTEMS AND SOCIETIES
STANDARD LEVEL
PAPER 2

Monday 5 November 2007 (morning)

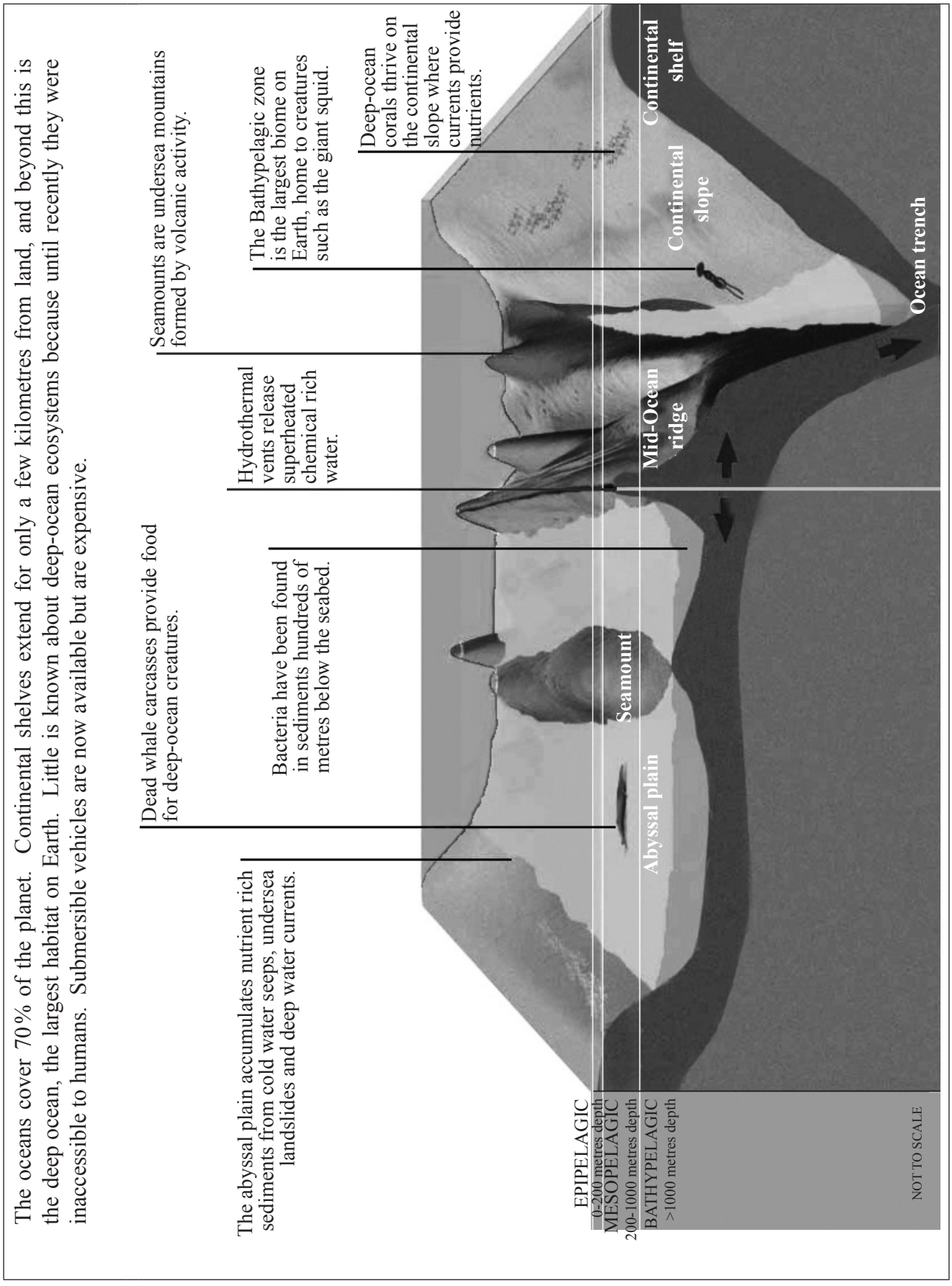
2 hours

RESOURCE BOOKLET

INSTRUCTIONS TO CANDIDATES

- Do not open this booklet until instructed to do so.
- This booklet contains **all** of the resources required to answer question 1.

Figure 1 Diagram of the deep ocean



[Source: adapted from *Mysteries of the deep sea*, www.newscientist.com/channel/earth/deep-sea]

Figure 2 Biotic and abiotic components of the deep-ocean ecosystem

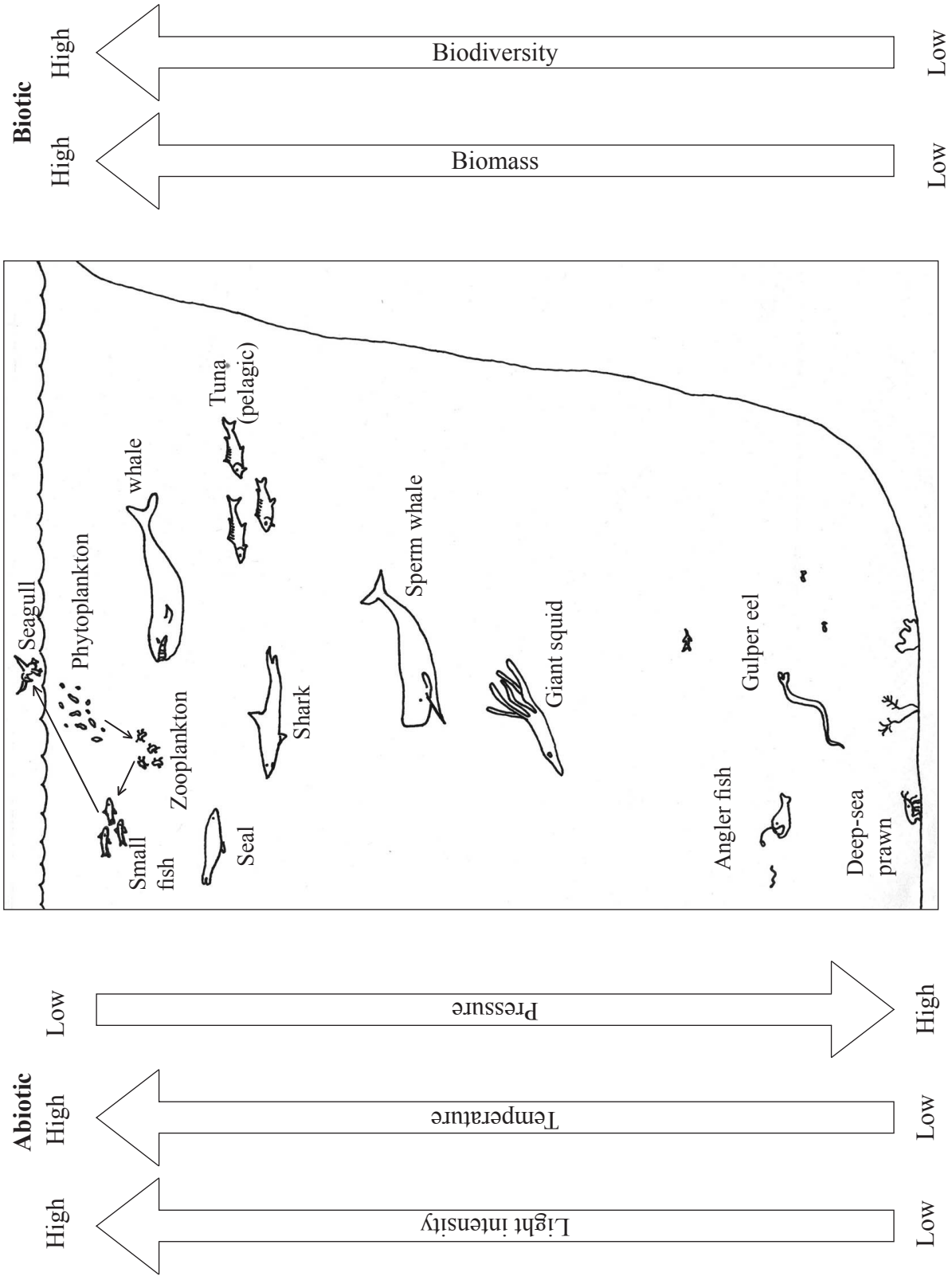
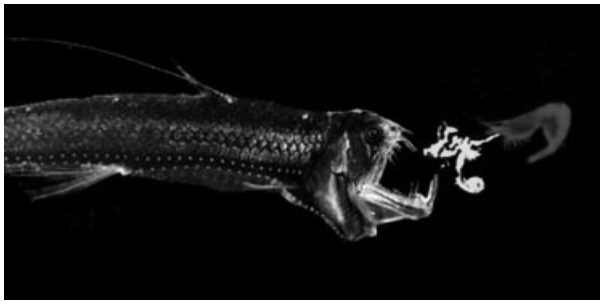


Figure 3 Adaptations to the deep-ocean environment

Examples of adaptations of deep-ocean species:

- long arms and ability to be able to sift through mud and detritus for food
- bioluminescence (the ability to produce light) – used to attract mates, to obtain food, for camouflage or to confuse predators
- nets of tentacles to trap falling detritus for food
- angler fish use light-producing bacteria that live on a special fishing rod-like fin that hangs over the angler's head and wiggles in the water to attract prey
- red or purple colouration (in normal light) *e.g.* deep-ocean prawn – because of the absence of red light at depth these animals are invisible
- bodies that are completely filled with water so that an increase in pressure has little effect. For this reason jellyfish, squid *etc.* have no difficulty when moving through the water column.

[Source: adapted from www.mesa.edu.au/seachange/97/deepsea.htm]



Deep-ocean prawn ejecting bioluminescence

[Source: adapted from http://people.cornellcollege.edu/a-carlson/geo105/whatisbiolum.htm]

Deep-ocean prawn

[Source:www.oceans.gov.au/norfanz/new2creatures.htm]

Angler fish

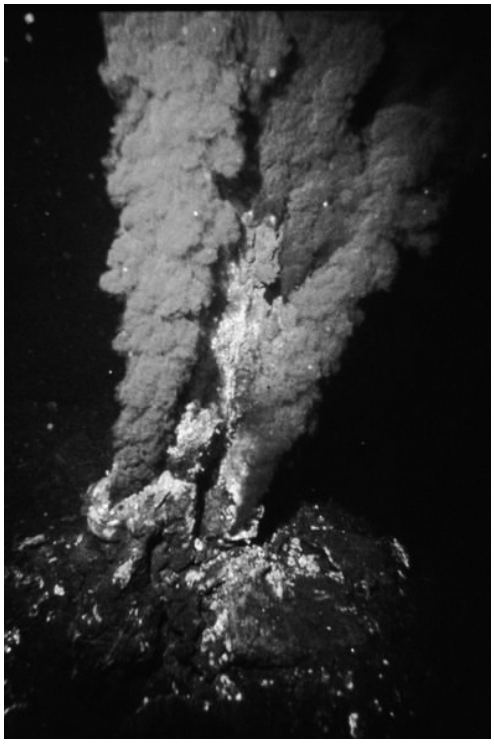
[Source: www.oceanexplorer.noaa.gov]

Figure 4 Diversity hot spots – deep-ocean vents

Of great interest to marine scientists was the discovery of communities of animals living around deep vents on the ocean floor. From these vents pour large quantities of heated seawater which contain high quantities of hydrogen sulfides and dissolved minerals. These vents occur where tectonic plates are slowly moving apart. Clouds of bacteria are found around these vents. The bacteria draw their energy not from the sun as plants do but from the hydrogen sulfides discharged from the vents. The bacteria in turn provide food for a range of other animals including shrimp, crabs and worms, which in turn support species of fish.

Metre-long tube worms in the vents have developed an unusual relationship with the bacteria around the vents. The tube worms have no mouth and no digestive tract. Instead, they have bacteria living inside an interior sac. The red hemoglobin in the tube worms' feathery gills can bind to the hydrogen sulfide in the hot vent water and carry it to the bacteria. The bacteria are able to oxidize the hydrogen sulfide and in doing so, convert large amounts of carbon dioxide from seawater into organic carbon, which is then absorbed by the tube worms.

[Source: adapted from www.mbl.edu/email/images/nur04506_sm.jpg]



Deep-ocean vent

Tube worms

[Source: www.mesa.edu.au/seachange/97/deepsea.htm]

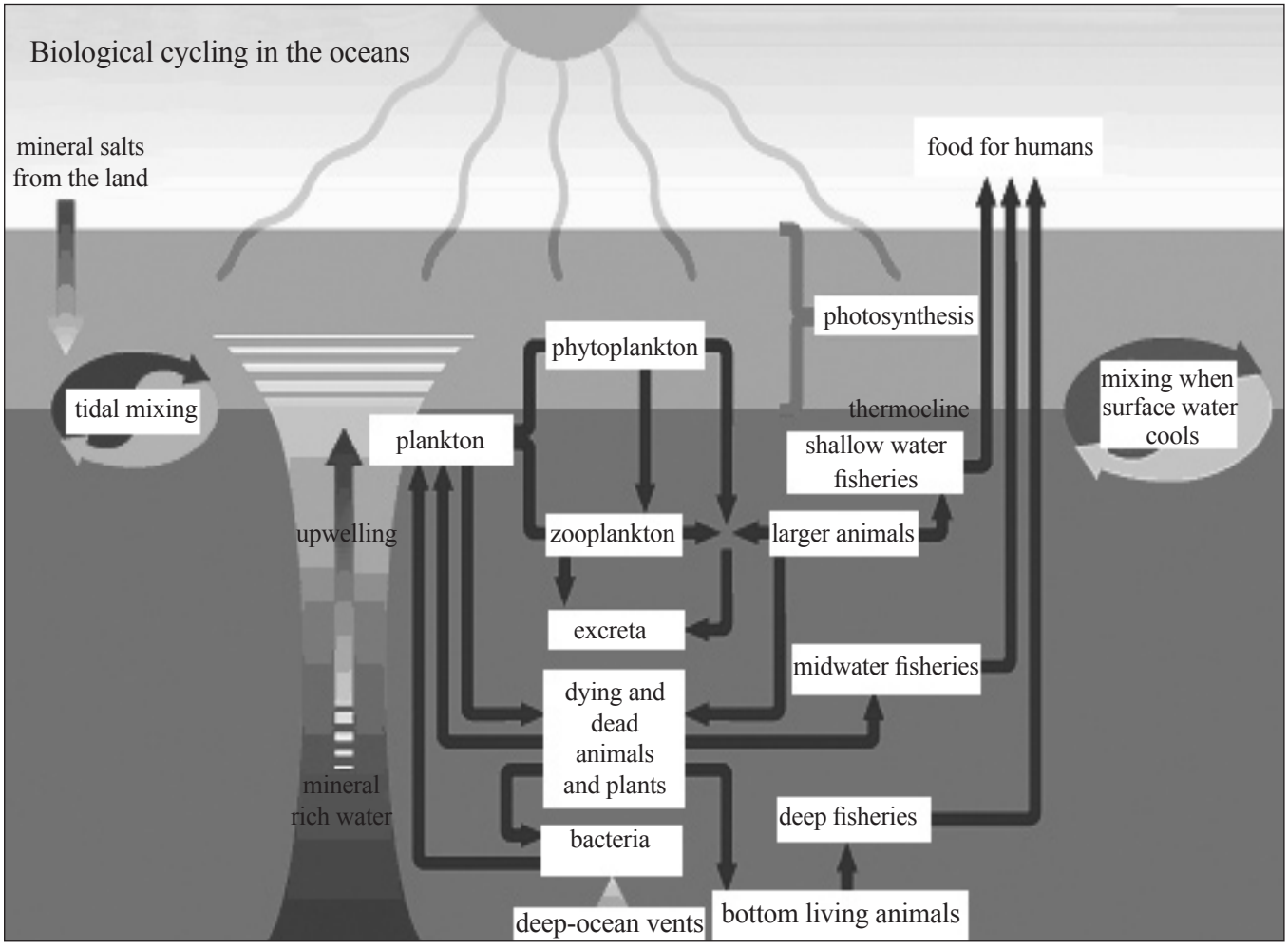
Figure 5 Nutrient cycling in the deep ocean

The habitat is a predominately dark and cold environment with much lower productivity than shallower waters. No light penetrates beyond 1000 m and even at depths of 150 m light levels are reduced to 1 % of those at the surface and are insufficient to support photosynthesis.

Therefore, organic material must be transferred into the deep waters, which occurs in various ways. Dead phytoplankton sink, and though much is consumed as it settles, sufficient amounts enter the deep water to sustain much of the biomass there. The constant rain of organic detritus (remains of organisms from above) can be so thick it is called "marine snow". Many species migrate, feeding in the surface waters and moving down during the day, avoiding predators. In this way, surface production is cascaded through to deeper layers.

Of relatively minor productive importance is organic material from large carcasses (*e.g.* dead whales) sinking to the ocean floor and sulfur-based organic production associated with deep-ocean vents. The concentration of organic material decreases exponentially with depth.

[Source: adapted from www.oceansatlas.org]



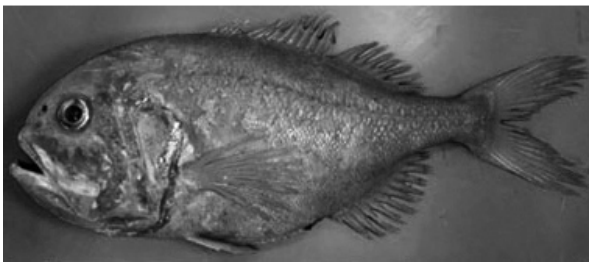
[Source: adapted from www.oceansatlas.com/world_fisheries_and_aquaculture/html/ecosys/coastmarine/typesofeco/img/121.biocycle.gif]

Figure 6 Fishing in the deep ocean

Until recently, the great depth of the oceans has made them difficult to exploit as the existence of more abundant resources in shallower waters have meant that little incentive existed to fish in the deep oceans.

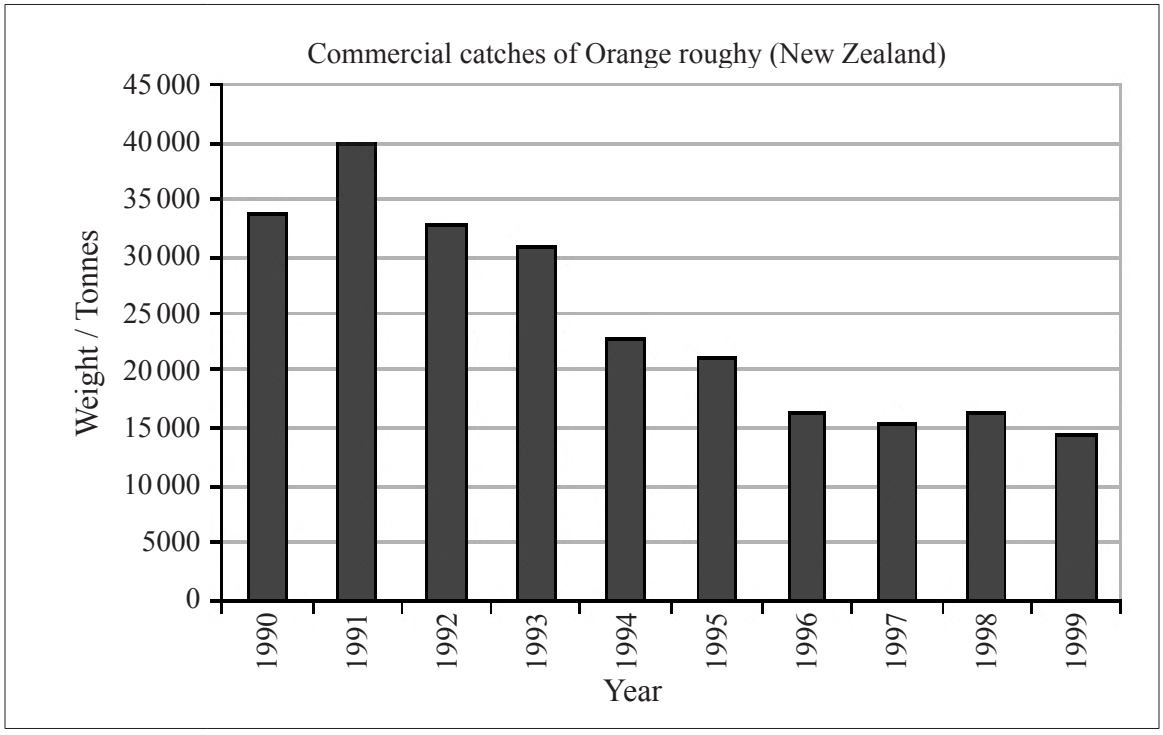
With the reduction of opportunities for development of inshore fisheries and the improvement of fishing technology and navigation instruments, deep-ocean fishing expanded in the 1990s. A well-known example is that of the Orange roughy, a deep-ocean species found around New Zealand. Specially aimed trawling techniques have been developed. Maximum sustainable levels of exploitation of Orange roughy may be as low as 5-10 % of un-fished biomass. Accumulating evidence about stock declines indicates that Orange roughy are being exploited unsustainably and ongoing yields are likely to be around 5 % of those initially obtained.

[Source: adapted from www.oceansatlas.org]



Orange roughy

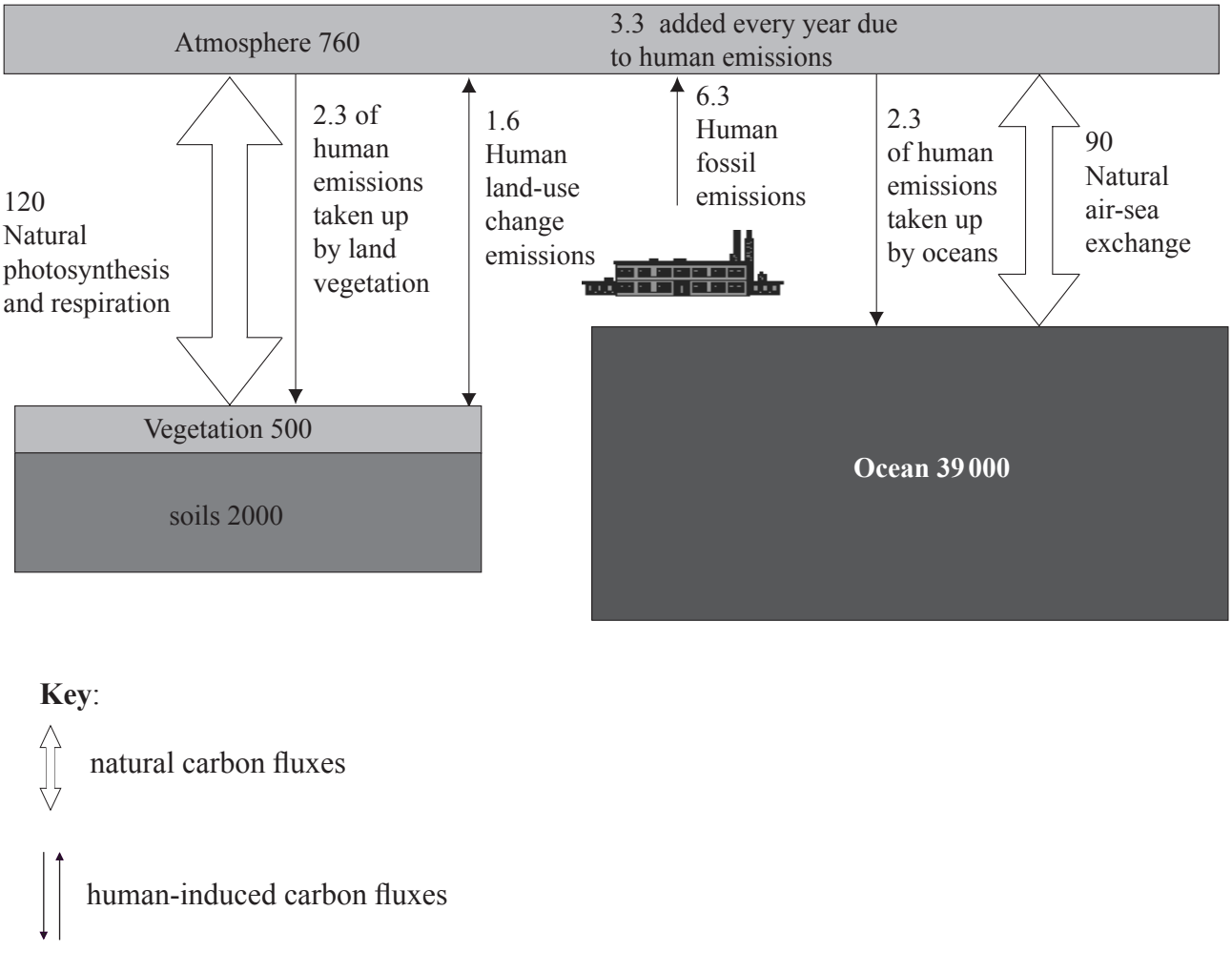
[Source: www.starfish.govt.nz/science/facts/fact-orange-roughy.htm]



[Source: adapted from www.starfish.govt.nz/shared-graphics-for-download/roughy_chart.gif]

Figure 7 The deep ocean as a carbon sink

Simplified global carbon cycle showing stores and flows in Gigatonnes (10^9 tonnes) of carbon per year.



[Source: adapted from IPCC SRLULUCF 2000 and IPCC TAR WGI 2001]

IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

N07/4/ECOSO/SP2/ENG/TZ0/XX/M+

MARKSCHEME

November 2007

ECOSYSTEMS AND SOCIETIES

Standard Level

Paper 2

15 pages

Subject Details: Ecosystems and Societies SLP2 Markscheme

General

A markscheme often has more specific points worthy of a mark than the total allows. This is intentional. Do not award more than the maximum marks allowed for part of a question.

When deciding upon alternative answers by candidates to those given in the markscheme, consider the following points:

- Each marking point has a separate line and the end is signified by means of a semicolon (;).
- An alternative answer or wording is indicated in the markscheme by a "/"; either wording can be accepted.
- Words in (…) in the markscheme are not necessary to gain the mark.
- Words that are underlined are essential for the mark.
- The order of points does not have to be as written (unless stated otherwise).
- If the candidate's answer has the same meaning or can be clearly interpreted as being the same as that in the mark scheme, then award the mark.
- Mark positively. Give candidates credit for what they have achieved and for what they have got correct, rather than penalising them for what they have got wrong.
- Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.
- Occasionally, a part of a question may require a calculation whose answer is required for subsequent parts. If an error is made in the first part then it should be penalized. However, if the incorrect answer is used correctly in subsequent parts then **follow through** marks should be awarded. Indicate this with "**ECF**", error carried forward.
- Units should always be given where appropriate. Omission of units should only be penalized once. Indicate this by "**U-1**" at the first point it occurs. Ignore this, if marks for units are already specified in the markscheme.
- Do not penalize candidates for errors in significant figures, unless it is specifically referred to in the markscheme.

SECTION A

1. (a) (i) bathypelagic;
(ii) abyssal plain; ***[1]***
*Both answers needed to receive **[1]**.*

(b) difficult/expensive to access because of hostile conditions *e.g.* dark/ high pressure/cold;
large area and relatively low density of species to catch; ***[1 max]***

(c) (i) insufficient light lower down for photosynthesis; ***[1]***

(ii) depth/light/temperature/pressure; ***[1]***

(iii) 4 / tertiary consumer / carnivore; ***[1]***

(d) *Possible adaptations could include*:
red colouration;
long legs;
ability to produce bioluminescence; ***[2 max]***

(e) (i) vent / hydrogen sulfide → bacteria → shrimp/crabs/worms; ***[1]***
*To achieve **[1]** answer must begin with vent/hydrogen sulfide followed by bacteria.*

(ii) specialized species (they are vulnerable if niche is lost);
short food chains;
high level of interdependence;
harsh environmental conditions;
slow growing organisms / late maturity / low fecundity; ***[2 max]***

. (iii) fish removed by fishing industry;
upwelling currents;
birds eating fish/plankton; ***[1 max]***

(f) (i) initial increase followed by gradual decline;
interest in species increased in early years as new technology allowed targeting of species;
over fishing of stocks meant reduction in young fish and decline in populations; ***[3]***

(ii) *ecocentric*: ***[2 max]***
small scale technology should be adopted *e.g.* wide net mesh;
community fisheries;
consumer restraint;
fishing quotas;
limits on catch size;

technocentric: ***[2 max]***
stress role of market (costs increase as stocks dwindle so fewer will be fished);
through technology *e.g.* intensive fish farming as an alternative;
scientific research in monitoring populations; ***[4 max]***
*Award **[2]** for each environmental philosophy.*

(g) (i) 39000 gigatonnes / 39×10^9 tonnes; ***[1]***
Units needed.

(ii) possible way to offset global warming as large amounts of carbon could be stored/locked away; ***[1]***

(iii) thermal expansion;
icecaps/glaciers melting; ***[1]***
*Both answers needed to receive **[1]**.*

(h) *why little pressure* ***[3 max]***
no country has ownership of the deep ocean and therefore, difficult to control/legislate for/police;
the deep ocean is remote and not visible to most people;
little is known about the system, therefore, conservation issues are not raised/ known about;
deep-ocean systems are not occupied by humans;

the need for conservation ***[3 max]***
deep-ocean systems represent an important biological resource;
deep-ocean systems are potentially fragile and susceptible to damage from outside influences;
deep-ocean systems represent a biological resource that has not yet been fully understood; ***[4 max]***
*Award **[3 max]** if only why little public pressure or need for conservation is addressed.*

SECTION B

General Essay Markscheme
Each essay is marked out of ***[20]*** of which ***[2]*** are for clarity of expression, structure and development of ideas.

[0] Quality of expression, structure and development is poor.
[1] Quality of expression, structure and development is limited.
[2] Quality of expression is clear, structure is good and ideas are well developed.

2. (a) a simplified description;
designed to show, the structure/workings of an object/system/concept;
require approximations to be made; ***[2 max]***

(b) *predicting the growth of human populations*: ***[3 max]***
growth of human population depends (at a simple level) on birth rates and death rates;
from this rates of natural increase can be calculated and population total predicted;
population pyramids enable policy makers to chart what proportion of the population are in the fertile age bracket helping to predict likely birth rates;
demographic transition model shows how population growth is linked to economic development;
enables the reasons for population growth to be understood;
but not all countries conform to the stages identified;
models are hugely simplified, and may not reflect the complex and unpredictable factors which affect growth rates *e.g.* war / disease;

predicting climate change: ***[3 max]***
models can demonstrate anticipated changes to climate based on carbon emissions;
model only as good as the data that goes in and it may be suspect;
conflicting models can show different effects in same place;
hugely complex in terms of numbers of factors involved in atmospheric systems so in process of oversimplification accuracy is lost;
e.g. role of feedback/ocean systems not fully understood;
Accept other examples of feedback.

assessing demands human populations make on their environments: ***[3 max]***
ecological footprints can be effective for comparing environmental impacts of different societies;
able to provide a quantitative estimate of human carrying capacity;
a quantification of what can be a very complex set of factors;
can be useful tools for getting people to think about their impact;
stresses the systems approach and interconnectedness of eco and social systems;
very difficult to calculate figures *e.g. per capita* CO_2 emissions; ***[9 max]***

To receive full marks answers must have a balance of strengths and weaknesses.
Award credit if other relevant models are evaluated.

(c) strategies for controlling growth include availability of contraception/financial incentives/public information/legislative changes (*e.g.* making abortion illegal);
often the reasons for family size can be attributed to cultural factors so for policies to be effective they need to understand the underlying reasons why people decide to have a certain number of children;
the need for male children in some cultures is linked to the traditional practices and structures *e.g.* inheritance by male heirs and dowries for females;
sometimes cultural factors indirectly play a role in fertility rates *e.g.* education and employment opportunities for women lead to delayed marriages and lower birth rates;
provision of contraception in *e.g.* remote, rural communities may not be enough – programmes to educate males to be willing to use the contraception are also needed;
cultural norms may be ingrained/deeply felt and policies need to address these at the deepest level to change attitudes *e.g.* religious beliefs in catholic countries;
culture and tradition evolve over time / cultural change can occur and governments can be a part of this;
education and economic development are important factors in bringing about cultural change; ***[7 max]***
Award ***[4 max]*** *if no examples are used. Examples can be of cultural practices and do not need to be located in named geographical contexts.*

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

Total: ***[20]***

3. (a) *definition*: ***[2 max]***

the addition to an environment of a substance/an agent (*e.g.* heat) by human activity;
at a rate greater than that at which it can be rendered harmless by the environment;
and which has an appreciable effect on the organisms within it;

impact: ***[4 max]***

e.g. nitrates from agricultural run-off leading to rapid growth of algae;
accumulation of dead organic matter;
high rate of decomposition and lack of oxygen (eutrophication);
positive feedback within the system;
food chains become shortened;
death of aerobic organisms;
increased turbidity;
loss of macrophytes;
and loss of species diversity; ***[6 max]***

*Award **[2 max]** if pollutant is not named. Award **[3 max]** if both structure and function are not addressed.*

(b) *description*: ***[2 max]***

altering the human activity producing pollution *e.g.* by alternative methods of enhancing crop growth (manure);
regulating and reducing pollutants at the point of emission *e.g.* by sewage treatment processes that remove nitrates from the waste;
clean-up and restoration *e.g.* by pumping mud from eutrophic lakes and reintroducing plant and fish species;

evaluation: ***[4 max]***

arguably more cost effective to adopt preventative rather than curative strategies;
costs for implementing strategies will be borne by different communities as eutrophication can occur some way from the farms which caused the problem;
difficult to identify who is causing the problem;
polluter pays is a problematic strategy because it may push up food prices, which will be unpopular with consumers and have economic/political implications; ***[6 max]***

(c) solid domestic waste includes paper, glass, metal, plastics and organic waste, they are produced in large volumes and contribute substantially to landfill;
many types of domestic waste can be recycled and have an economic value;
however, the cost of recycling can have a greater environmental impact than allowing the waste to go to landfill;
charging (taxing) the public for the volume of waste they produce may encourage them to recycle more and/or purchase goods with less packaging;
local government may resist recycling for financial reasons *e.g.* collection cost may be too high;
products could be taxed on packaging volume;
greater incentives to produce less waste from source;
incineration of waste as a biogas/fuel could be a more environmentally acceptable answer to waste management than landfill;
composting of organic waste is a simple and effective way of recycling waste;
education and culture can strongly influence the quantity of recycling; ***[6 max]***
Award ***[5 max]*** *if no personal viewpoint is expressed.*
Accept other reasonable justifications.

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

Total: ***[20]***

4. (a) use of resources at a rate that allows natural regeneration;
and minimizes damage to the environment;
e.g. a system of harvesting renewable resources at a rate that will be replaced by natural growth might be considered to demonstrate sustainability;
any society that supports itself in part by depleting essential forms of natural capital is unsustainable;
if human well-being is dependent on the goods and services provided by certain forms of natural capital, then long-term harvest (or pollution) rates should not exceed rates of capital renewal;
sustainability means living within the means of nature, on the "interest" or sustainable income generated by natural capital; ***[3 max]***

(b) global summits can play a leading role in shaping attitudes to sustainability *e.g.* UN Conference on Human Environment/Stockholm, 1972 was the first time that the international community met to consider global environment and development needs;
and can play a pivotal role in setting targets and shaping action at both an international and local level *e.g.* Rio Earth summit (in 1992) led to Agenda 21 and Rio declaration, which set out key policies;
and to legally binding conventions *e.g.* on climate change / Montreal (1987);
however, countries can break these agreements and there is little the international community can do;
in terms of shaping public opinion media can also be important *e.g.* Silent Spring by Rachel Carson was pivotal;
attitude change may occur without summits *e.g.* UN commissioned the Brundtland report, which established initial definition for sustainable development;
summits may not achieve their initial goals, however, they may act as a catalyst in changing the attitudes of governments, organizations and individuals; ***[5 max]***
Accept any other reasonable answers.
Award ***[3 max]*** *if summits are described but not evaluated.*

(c) *factors could include availability, economic, cultural, environmental and technological factors*:
e.g. fossil fuels in UK
availability – large oil, coal and gas reserves in UK have historically meant they were an obvious choice for exploitation;
as the most easily accessible reserves have been used up, the costs of exploitation have increased and alternative sources have been sought;
changing awareness of environmental implications of fossil fuel exploitation has increased demand for renewable, non-polluting sources;
cultural fears based on perception of nuclear accidents/waste have made this an unpopular choice politically;
leading to greater investment and research into alternatives *e.g.* wind and tidal;
as public awareness of threats of global warming has increased there has been a shift in attitudes towards, say, wind power, despite the aesthetic and environmental implications;

e.g. firewood in India
in India a huge proportion of population rely on local sources of firewood for energy because it is most readily available/cheap;
it is the traditional source of energy, which has always been used;
and technology such as solar powered stoves is not available/affordable;
in a drive to develop economically the Indian government has sought to harness other sources of cheap energy to stimulate industrial development;
specifically hydroelectric power, which has sometimes been extremely controversial for social/environmental reasons *e.g.* Narmada dam; ***[10 max]***
Award credit if figures are used. Award ***[5 max]*** *if no societies are referred to. Societies do not need to be contrasting, but energy sources should be.*
Accept other reasonable responses.

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

Total: ***[20]***

5. (a) *Transfers:* ***[3 max]***

transfers normally flow through a system and involve a change in location;
water will flow through soil (infiltration) to replenish groundwater (transfer);
excessive flow of water through a very porous soil will wash away the nitrates into rivers and sea (leaching);
water can flow from soil into plants by uptake into roots;

Transformation: ***[3 max]***

lead to an interaction within a system in the formation of a new end product / involve a change of state;
soil water may evaporate back into the atmosphere (transformation);
few plants have the ability to absorb atmospheric nitrogen directly, so it has to be converted by bacteria;
these bacteria exist, in decaying remains/in the soil, to form nitrates which can be taken in by the plants in solution with water in the ground (nitrification);
but people can also add nitrogen to the soil in the form of artificial fertilizers;
by planting leguminous crops *e.g.* peas / beans / clover, which are able to fix atmospheric nitrogen;
the soil is the home of bacteria and if it becomes waterlogged near the surface the bacteria are unable to breakdown the decaying plant and animal matter;
then the poorly decomposed matter forms peat on the surface *e.g.* in a peat bog (denitrification); ***[5 max]***

(b) large scale cereal cultivation in the prairies, USA – high technology approach to minimizing wind erosion;
e.g. use of specially adapted ploughs;
shelterbelts of trees planted;
GM crops with shorter stalks to minimize wind damage and exposure of soil;
application of fertilizer to retain fertility of soil;
small scale agriculture *e.g.* vegetable farming in Thailand – manure from working livestock allowed to fertilize soil;
terraces built by hand to reduce run-off;
fields allowed to be fallow/rest by crop rotation / soil is rested;
variety of crops grown reduces the likelihood of exposure of soil at different times;
commercial farming system relies on a technological approach to managing the soil (technocentric);
whereas subsistence depends more on traditional practices, which have evolved over time as people live on the land (ecocentric) *e.g.* application of manure;
tend to be low tech and simple;
but system can breakdown when population pressure leads to abandonment of traditional methods;
e.g. shortage of firewood means manure is burnt for fuel instead of being returned to land; ***[8 max]***

Accept any other reasonable answers.
Award ***[1]*** *for naming commercial and subsistence farming systems. Award* ***[4 max]*** *if no named systems are mentioned.*
Answer needs to show comparison. If systems are simply described award ***[6 max]****.*

(c) systems are models with inputs, outputs and storages;
activities such as overgrazing, deforestation, unsustainable agriculture and irrigation cause processes of degradation;
these include soil erosion, toxification and salinization;
systems approach stresses the interconnectedness of soils and emphasizes the knock-on impact that actions can have;
with overgrazing an understanding of the balance of animals that can be supported before the critical threshold is reached will help farmers plan herd size;
seeing soils as renewable resources in equilibrium (inputs of nutrients through rain and organic matter) and outputs through natural leaching;
will help farmers to compensate for the losses to overall nutrient balance by removing crops, and the importance of returning nutrients through the use of fertilizers;
understanding that soils are living systems which are integral parts of ecosystems will help farmers to take a broader perspective when managing their land *e.g.* deforestation on nearby slopes can have an impact on water flows and likelihood of soil erosion in flash flood conditions;
some processes of degradation are examples of positive feedback *e.g.* less vegetation → greater wind speeds → more soil erosion → less top soil → less vegetation *etc*., understanding this can help farmers to break the cycle; ***[5 max]***
Do not accept arguments that are not linked to the concept of systems.

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

Total: ***[20]***