N09/4/ENVSY/SP3/ENG/TZ0/XX/M+

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MARKSCHEME

NOVEMBER 2009

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 3

14 pages

General Marking Instructions

Assistant Examiners (AEs) will be contacted by their team leader (TL) by e-mail (or telephone) – if 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 by e-mail at any time if they have any problems/queries during the marking process.

Note:
The DHL courier service must be used to send assessment material to your team leader/senior moderator and to IB Cardiff. (However, this service is not available in every country.) The cost is met directly by the IB. It is vitally important that the correct DHL account number is used.

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

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1. Follow the markscheme provided, award only whole marks and mark only in **RED**.

2. 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.**

3. Sometimes, careful consideration is required to decide whether or not to award a mark. In these cases write a brief annotation to explain your decision. You are encouraged to write comments where it helps clarity, especially for moderation and re-marking. It should be remembered that the script may be returned to the candidate.

4. Unexplained symbols or personal codes/notations are unacceptable.

5. Record marks in the right-hand margin against each mark allocation shown in square brackets *e.g.* ***[2]***. The total mark for a question must equal the number of ticks for the question.

6. Do **not** circle sub-totals. **Circle the total mark** for the question in the right-hand margin **at the end of the question.**

7. Where an answer to a part question is worth no marks, put a zero in the right-hand margin next to the square bracket.

8. Where work is submitted on additional sheets the marks awarded should be shown as ticks and a note made to show that these marks have been transferred to the appropriate square bracket in the body of the script.

9. For each Option: Add the totals for each question in the Option and write it in the Examiner column on the front cover.
Total: Add the marks awarded and enter this in the box marked TOTAL in the Examiner column on the cover sheet.

10. After entering the marks on the front cover check your addition to ensure that you have not made an error. Check also that you have transferred the marks correctly to the cover sheet. **All scripts are checked and a note of all clerical errors will be given in feedback to examiners.**

11. If an answer extends over more than one page and no marks have been awarded on a section draw a diagonal line through that section to indicate that it has been marked.

12. If a candidate has attempted more than the required number of questions within a paper or section of a paper, mark all the answers and use the marks of those answers that have the highest mark, **unless the candidate has indicated the question(s) to be marked on the front cover**.

13. A mark should not be awarded where there is contradiction within an answer. Make a comment to this effect in the left hand margin.

Subject Details: Environmental Systems SL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the Options **[2 x 20 marks]**.
Maximum total = **[40 marks]**

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

2. Each marking point has a separate line and the end is signified 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 writing ***OWTTE*** (or words to that effect).

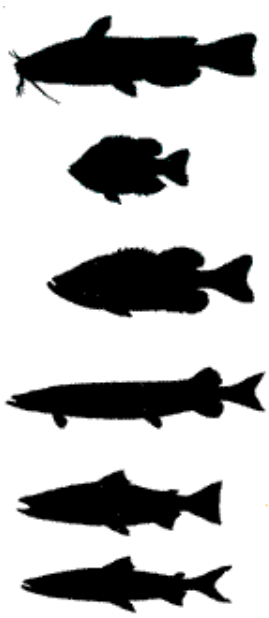
8. Remember that many candidates are writing in a second language. Effective communication is more important than grammatical accuracy.

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. Indicate this with **ECF** (error carried forward).

10. Only consider units at the end of a calculation. Unless directed otherwise in the markscheme, unit errors should only be penalized once in the paper. Indicate this by writing **–1(U)** at the first point it occurs and **U** on the cover page.

Option A — Analysing Ecosystems

A1. (a) (i)

	Species
	Bullhead; …… Sunfish; …… Largemouth Bass; …… Muskellunge; …… *Chinook* …… *Lake Trout* ……

*Allow **[1]** for each correct response.* ***[4]***

(ii) fish change in size as they grow;
so a young Largemouth Bass could be smaller than an adult Sunfish;
proportions of different body parts are less likely to change;
no scale provided / "large" and "small" are subjective/comparative; ***[1 max]***

(b) (i) Largemouth Bass **and** Muskellunge ***[1]***
Allow for ECF from (a)(i).

(ii)

Latitude / ^{o} N of equator	*Species most likely to survive*
60–70	Chinook and Lake Trout;
0–30	Bullhead, Sunfish, Largemouth Bass; *(any two of these acceptable)*

[2]
Allow ECF from (a)(i).

(iii) take measurements regularly throughout the year;
to determine lowest/highest temperatures of water;

take measurements in warm and cold seasons;
because this is when water temperatures will be lowest/highest; ***[2 max]***

(iv) some years are colder/warmer than others ***[1]***

(c) (i) dissimilar numbers of individuals in each population within the community;
uneven distribution of numbers between different species; ***[1 max]***
Allow reference to measurement of habitat or genetic diversity.

(ii) sampling populations annually;
recording numbers of individuals caught of each species;
and number of species;
stating Simpson's diversity index formula;
explaining use of above;
use/explanation of mark and recapture; ***[3 max]***

(d) (i) the mass of organic material in organisms/ecosystems (per unit area) ***[1]***

(ii) biomass/energy gained by heterotrophs/consumers/animals through feeding/absorption;
after metabolic/respiration losses; ***[2]***

(iii) measure increase in biomass over time;
convert biomass to energy using conversion tables/bomb calorimeter; ***[2]***

Option B — Impacts of Resource Exploitation

B1. (a) (i) emissions from fossil fuels are much higher than those from other sources;
nuclear/hydro/wind have lowest emissions;
coal has highest emissions of fossil fuels / gas has lowest; ***[2 max]***
Simple statement of data values is not sufficient.

(ii) CO_2 produced in cement manufacture and cement used in construction;
CO_2 released by transport of nuclear fuel/waste/construction materials/maintenance;
CO_2 released during manufacture of components for nuclear and renewable energy systems; ***[1 max]***
Allow other reasonable suggestions, but must have some detail for credit.

(iii) *e.g. wind*:
only generates about 40 % of time;
because wind sometimes too light or too strong for turbines to function;
aesthetic impact;
bird strikes;
noise;
hazard to aircraft;
interferes with radar;
cost of infrastructure;

e.g. wave:
variable energy, depending on weather (so unreliable);
may be destroyed by large waves;
hazard to shipping;
disruption of fishing;
aesthetic impact;
still not fully commercially developed;

e.g. tidal:
only generates at some stages of tidal cycles;
still not fully commercially developed;
hazard to shipping;
disruption of fishing;
costly to build;
environmental impact on estuaries;

e.g. biomass:
takes up land used for food production;
drives up price of food crops *e.g.* corn;
environmental impact of monoculture;
produces CO_2 in combustion;
bulky/costly to transport to power plant;

e.g. solar:
costly technology;
less effective in higher latitudes;
generates only in daytime;
large area required;
noxious pollutants produced during production of solar panels; ***[4 max]***

Any other reasonable suggestions.

Nuclear is non-renewable/non-replenishable because uranium resources are finite and fast breeder technology and fusion are still uncommercial.

(b) (i) area of land or water needed to support a person at a given standard of living;
takes account of both resources needed and assimilation of waste; ***[2]***

(ii) CO_2 produced in much larger amounts by fossil fuels than by other energy resources;
extra CO_2 must be absorbed by plants which need space to grow;
so larger area of land needed to absorb waste, making footprint larger; ***[2 max]***

(iii) large amounts of energy lost at each level of food chain;
eating meat involves feeding at second trophic level or above;
so requires much more land to grow food than eating plant products;
animals are often fed grain which could be eaten directly by humans;
area of land needed to support an animal is ten times greater than that required to grow plant food of same energy value; ***[2 max]***

(c) farm higher percentage of arable crops/fewer animals;
improve storage to reduce waste;
develop crops that require fewer inputs of water and nutrients;
genetic modification for higher yields;
fertilizers/pesticides; ***[2 max]***
Any other reasonable suggestions.

(d) (i) $(1293\times10^6\times(0.65+0.80)=)$
$1\,874\,850\,000$ ha / 1.874850×10^9 ha / 1.9×10^9 ha / 1.9 Gha *or any other correct equivalent* ***[1]***
Workings not required but units must be shown for mark.

(ii) *No more than two points to be credited from each list below.*
implications:
China has less than the world average amount of productive land *per capita*;
China's ecological footprint is much larger than the land available;
China's ecological footprint is still small compared to other nations;
pollution produced by China from burning fossil fuels would need entire land area available to absorb it;
leaving no land for food production;

solutions:
change to renewable/nuclear/more efficient methods of energy generation to reduce pollution;
encourage use of public transport/walking/cycling instead of cars;
improve fertility of marginal lands;
use of advances in biotechnology *e.g.* salt-tolerant GM rice varieties; ***[4 max]***

Option C — Conservation and Biodiversity

C1. (a) (i) species diversity is the number of species per unit area;
genetic diversity is the richness of an area with respect to genetic material;
genetic diversity may refer to wide genetic variation between individuals of one species;
large number of different species implies high genetic diversity; ***[2 max]***
Accept responses that use examples to explain the distinction between the terms.

(ii) newly replanted area has fewer ecological niches because stratification has not yet developed / a single species stand provides fewer habitats so some species unable to exist in that area anymore;
fewer species means less genetic diversity by definition;
fewer individuals of a species means less genetic diversity within that species;
plantation crop stands often contain a very low level of genetic diversity; ***[3 max]***
References to habitat, species <u>and</u> genetic diversity must be made for full credit.

(b) (i) Site 2 ***[1]***

(ii) Site 1: May;
Site 2: March;
Site 3: May;
Site 4: March; ***[1]***
*All four must be correct for **[1]**.*

(iii) number of species increases in January to March (spring) as temperature increases/eggs hatch/animals migrate back;
sites 1 and 3 may have colder conditions/greater altitude/different pH of water/strength of current;
consequently organisms reproduce/hatch out later in season;
variety of available habitats/niches may be greater in sites with higher overall diversity; ***[2 max]***
Allow any other reasonable suggestions.

(c) (i) having long legs enabled lizards to run away faster;
so they were less likely to be eaten by predators and therefore survived better than short-legged lizards;
long-legged lizards tend to have long-legged progeny; ***[2 max]***

(ii) short-legged lizards that climbed trees/spent more time above ground level were less likely to be caught and eaten than those running very fast;
faster running predators caught more food so had better chance of survival;
so for lizards, running fast became a less successful strategy than climbing high to escape;
short-legged lizards tend to have short-legged progeny; ***[2 max]***
Accept other reasonable arguments.

(d) conserving habitats protects many species;
increased habitat diversity results in increased species diversity;
species can only exist beyond their habitat in an artificial environment *e.g.* a zoo;
ultimately only very low numbers of organisms can be conserved in such artificial environments;
consequently genetic diversity of captive organisms is also limited;
species are uniquely adapted to their niche, of which habitat is one aspect; ***[2 max]***
Accept other reasonable suggestions.

(e) (i) name of area **and brief** relevant defining features
e.g. location/biome/habitat types, range or type of species/habitat needing conservation;
e.g. Doñana National Park, Southern Spain, important European wetland; ***[1 max]***

(ii) *e.g.* named top predator was very low in numbers because of hunting and now recovering;
designation of protected area has reduced logging or other human activities and allowed habitat to recover; ***[2]***
Accept any valid example.

(iii) *feature:* reserve has very small area
explanation: which restricts genetic diversity/food supply for species within reserve;

feature: local people resent ban on access/hunting
explanation: so poaching is still a problem;

feature: increasing populations of predators
explanation: have been raiding local farmers' livestock;

feature: war/natural disasters
explanation: have prevented management/destroyed conservation achieved; ***[2 max]***

*Award **[1]** for a feature **and** explanation.*
Accept any other reasonable arguments, provided there is a stated feature and an explanation.

Option D — Pollution Management

D1. (a) (i) TSP ***[1]***

(ii) $50\% \pm 5\%$ ***[1]***

(b) vehicles;
industries;
electricity generation;
bushfires;
domestic heating; ***[1 max]***
Accept any other valid suggestions.
*Any three for **[1]**.*

(c) in industrial areas levels of all pollutants are higher;
because there are more sources;(E)

protected and rural areas very similar for nitrogen oxides;
because gas is mobile / similar traffic densities;(E)

values for protected areas less for TSP and sulfur dioxide;
few sources in these areas;(E)

TSP higher in industrial areas;
because tends to remain close to source;(E) ***[3 max]***

At least one (E) point necessary for full credit.
Accept any other valid suggestions.

(d) use of a biotic index to monitor presence-absence / relative abundance of organisms;
as organisms vary in their tolerance of different conditions;
so identification/measurement of abundance of organisms at a site provides a useful indication of the nature of the environment;

use of measurement of species diversity;
by collection under standard conditions for a set time;
and comparing results at different sites/times;

use of indicator organisms;
organisms vary in their tolerance of different levels of pollution;
examples: low abundance of lichens close to industrial areas;
tar spot on sycamore leaves in rural areas; ***[3 max]***

D2. (a) nitrates;
phosphates; ***[2]***

(b) increase of nitrates/phosphates encourage algal growth;
algae block light to macrophytes;
organisms die and decompose;
mud/water becomes stagnant/turgid/necrotic; ***[2 max]***

(c) loss of species diversity is detrimental;
reduction in length of food chains makes ecosystem less stable;
aesthetic deterioration (smell, *etc.*) is undesirable;
water is unsuitable for recreation/drinking, *etc.*;
remediation is costly; ***[3 max]***
Any other reasonable point.

(d) removing eutrophic mud from the lake bottom;
removing algal film;
oxygenation/aeration;
replanting indigenous plant species;
harvesting macrophytes *e.g.* water hyacinth;
restocking with fish/other fauna;
use "natural" filters *e.g.* reed beds;
addition of lime to remove phosphates; ***[4 max]***
Any other reasonable point.