N08/4/ENVSY/SP3/ENG/TZ0/XX/M+

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MARKSCHEME

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ENVIRONMENTAL SYSTEMS

Standard Level

Paper 3

15 pages

Subject Details: Environmental Systems SL Paper 3 Markscheme

Mark Allocation

Candidates are required to answer questions from **TWO** of the Options **[2 × 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 sheet.

Option A — Analysing Ecosystems

A1. (a) (i) percentage frequency is a measure of the number of organisms of a particular species in a given area *OWTTE* ;
percentage cover is a measure of the proportion of a given area covered by a particular species *OWTTE* ; ***[2]***

(ii) 1%; ***[1]***

(iii) *species A*: 5% *(accept 3% to 7%)*;
species B: 12% *(accept 9% to 15%)* ;
species C: 83% *(accept 75% to 90%)*;
percentages adding up to 100% *(accept ± 10%)*; ***[4]***

(iv) area of quadrat = $(0.5)^2\ m^2 = 0.25\ m^2$;
5 individuals in quadrat, so density = $4 \times 5 = 20\ m^{-2}$; ***[2]***

(b) (i) total snail population =

$$\frac{\text{Number of snails originally marked} \times \text{Number of snails recaptured}}{\text{Number of marked snails in recapture}}$$

$$/ = \frac{84 \times 40}{12}; = 280;$$

*Allow **[1]** for correct formula and **[1]** for correct answer* ***[2 max]***

(ii) use of non-toxic paint was a sensible choice;
orange paint makes snails more visible to predators;
better to use dark paint/mark on base of shell or other reasonable alternative;
snails were found beneath leaves of plants, so should be put back in same place;
otherwise they may be eaten by predators / become overheated in the sun/other reasonable justification;
during the week some snails may have moved out of the sampling area; ***[3 max]***

(iii) methods of marking and release are likely to make marked individuals more likely to be eaten by predators/die which will make number of snails found marked in recapture sample too low;
week too short to allow populations to remix, so estimate too high/low (allow either);
estimate may be low (because it is an open field and some snails have left the sampling area);
Allow no credit for statement that population estimate will be too high/low without a logical explanation. ***[1 max]***

(c) (i) 1. Mass of food put into enclosure each day;
2. Mass of food left uneaten from previous day;
3. Mass of faeces;
4. Mass of snails at start of experiment;
5. Mass of snails at end of experiment; ***[3 max]***

Accept mass or weight.
*Award **[3]** for 5 correct measurements, **[2]** for 3 or 4 correct measurements, **[1]** for 1 or 2 correct measurements.*

(ii) *GSP* = mass of **food eaten – feces collected** (per unit time) or an equivalent statement;

NSP = mass of snails at end of experiment - mass of snails at start of experiment (per unit time); ***[2]***

Accept NSP = change in mass/weight of snail.
Accept answers expressed in terms of energy rather than mass/weight.

Option B — Impacts of Resource Exploitation

B1. (a) (i) *Aquatic*: herbivores, carnivores, top carnivores / 2nd, 3rd and 4th trophic levels / primary consumers, secondary consumers, tertiary consumers;

Terrestrial: producers, herbivores / 1st and 2nd trophic levels / producers and primary consumers; ***[2]***

(ii) herbivores and carnivores / 2nd and 3rd trophic levels / primary and secondary consumers; ***[1]***

(iii) productivity in oceans is mainly limited to continental shelf areas;
only small proportion of energy is fixed in ocean because of poor light penetration;
many producers on land are eaten by humans, but in oceans only seaweed is eaten;
technologically difficult to exploit deeper parts of the sea;
some areas seriously over-fished;
food is easier to access from terrestrial systems;
large portion of the world's population doesn't have access to aquatic systems;
Accept other reasonable suggestions. ***[2 max]***

(iv) *Differences:* ***[2 max]***
most food is taken from producers in terrestrial but from consumers in aquatic systems;
easier to increase productivity in terrestrial systems by additions such as fertiliser;
more extensive range of organisms farmed in terrestrial systems;
terrestrial farming/selective breeding of organisms developed over thousands of years, but large-scale fish farming is recent;

Similarities: ***[2 max]***
both systems are exploited at most/many trophic levels;
both systems exploit herbivores feeding on indigestible (to humans) cellulose *e.g.* grass;
both farmed and "wild" food obtainable from both systems; ***[4 max]***

(v) *Fertilizers:* ***[1 max]***
use of artificial fertilisers may damage soil structure;
artificial fertilisers require heavy use of energy for manufacture/ transport (energy subsidy);
finite supplies of some raw materials;

Irrigation: ***[1 max]***
irrigation uses up valuable fresh water storages;
irrigation may require use of energy to pump/distribute water;
irrigation may cause salinisation of soils;

Allow other reasonable suggestions. ***[2 max]***

(b) (i) national footprint = population size × *per capita* footprint ;
so a country with a small *per capita* footprint but a large population may have a larger national footprint ;
than a country with a large *per capita* footprint but a small population; ***[2 max]***

(ii) country B has a footprint nearly 13 times larger than its own land area;
so its people depend on using land in other countries;
area of available land per person with current world population is between 1 and 2 ha;
8.6 ha is 4 to 6 times larger, so country is exploiting a disproportionate share of land; ***[2 max]***

(c) *Nuclear power station*
*Advantage: **[2max]***
generates large amounts of electricity from small amounts of fuel;
no carbon dioxide released / reduced emissions that cause global warming (except during construction);
warm cooling water can be used for heating glass houses/captive breeding of endangered crocodiles;
production of radioactive isotopes for medicine and industry;
small area required for amount of energy produced;

*Disadvantages: **[2max]***
problems of disposal of radioactive waste (unsolved);
risk of catastrophic accidents;
terrorist target;
plutonium produced that could be used for weapons/dirty bombs etc;
uranium supplies finite;
high capital cost ;
cost/difficulty of decommissioning at end of useful life;
high level of technical expertise needed to operate and manage;
problems of transport of both nuclear fuel and waste;
massive amounts of warm water can disrupt nearby ecosystems;

Large scale hydroelectric power
*Advantages: **[2max]***
generates large amounts of electricity;
no carbon dioxide released (except during construction);
cheap to run once built;
large water bodies created can be used for tourism/leisure;

*Disadvantages: **[2max]***
land behind dam drowned;
people may be displaced from land;
river flow reduced below dam;
restricting irrigation/fishing etc;
risk of catastrophic dam failure;
silting up of dam over time;
increase in water-borne parasitic diseases;
high capital cost;
ecological impact example *e.g.* migratory fish impeded;
not suitable for every region / most suitable in areas of high relief/ and areas with high constant rainfall;
reduction in rainfall and/or prolonged freezing weather may reduce output; ***[5 max]***

*Award **[4 max]** if advantages and disadvantages have not been addressed for both examples.*

Option C — Conservation and Biodiversity

C1. (a) (i) negative correlation between number of endangered mammals and percentage of remaining habitat / as percentage of remaining habitat increases, number of endangered species decreases;
because number of available niches reduced / organisms have smaller area from which to obtain food/*any other reasonable suggestion*; ***[2]***

(ii) fragmentation means that original area is broken into a number of small isolated/separate/discrete areas;
this may leave too few individuals in each area for successful breeding;
areas may be too far apart/separated by urban/disturbed areas that organisms cannot cross to interbreed;
large carnivores need very large territories / insufficient resources for small areas to be self-contained;
limited genetic diversity/inbreeding may affect fitness of individuals in species;
Any other reasonable suggestion. ***[3 max]***

(b) (i) endangered species are facing a very high risk of extinction in the wild in the near future, whereas vulnerable species are facing a high risk of extinction in the wild in the medium-term future / endangered species are at greater risk of extinction in the near future than vulnerable species ;
examples – must both be in same region/ecosystem for credit and identified as vulnerable/endangered.
e.g. in Cuba
vulnerable – spotted toad;
endangered – Gundlach's Hawk; ***[3]***

http://www.redlist.org/ - search engine in this could be easily used to confirm accuracy in dubious cases.

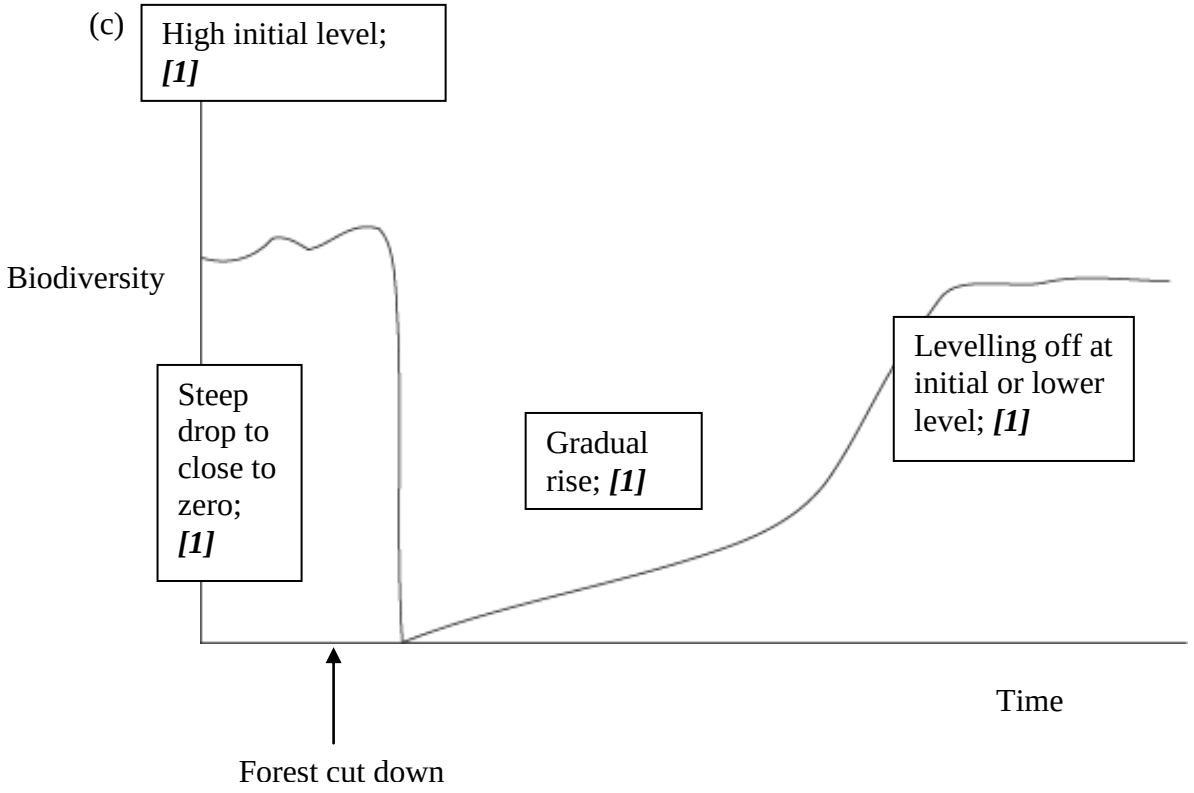
(ii) *e.g.* Giant Panda;
has a very specialised diet of particular species of bamboo so it is often short of food;

e.g. some species of Australian cockatoo;
breeding restricted by number of specialised tree holes available for nesting; ***[2 max]***

(iii) *Allow any suitable suggestions/examples*
e.g. captive breeding may involve capturing individuals from already endangered wild populations;
this may stress captured individuals and others with them at the time reducing their reproductive ability further;
captive animals cannot choose a mate, the choice is made for them;
animals may not receive suitable stimuli to mate in captivity;
eggs can be taken from nests of birds without them noticing and incubated;
birds lay more eggs to complete clutch, so number of chicks per pair is increased;
reintroduction in to the wild often leads to large losses;
because animals have not learned normal survival behaviour from their parents;
suitable example;

[4 max]

(c)



[4 max]

(d) trade in endangered species is restricted;

but only in countries that are members of the convention;
specialist knowledge needed to identify large number of species restricted by convention as they cross borders/enter new countries;
may be impossible to return species to original habitat if identified as illegal trade;
therefore very difficult to enforce;

e.g. Rhino horn is used in Chinese medicine;
attempts to prevent this trade have been made to protect endangered mammal species;
many countries (e.g. Australia) implement the agreement by banning importing shells of endangered species of marine turtles;

Accept any one difficulty from above for ***[1 max]****.*
Any other reasonable suggestion. ***[2 max]***

Option D — Pollution Management

D1. (a) (i) amount of dissolved oxygen needed to break down a given mass of organic matter in a given volume of water *(OWTTE)*; ***[1]***

(ii) A;
because manure/animal feces/slurry or similar from animals may wash into river from farm;

B;
because uneaten fish food and fish feces will be washed into river; ***[2]***

(b) (i) *e.g.* Nuclear power station
type of pollution:
radioactive waste / low, medium and high level waste;
spent fuel;
plutonium;
permitted discharges; (*e.g.* "clean" washing water; excess carbon dioxide coolant (maintenance))
warm cooling water;

e.g. lead mine
type of pollution:
mine tailings;
acidified/contaminated drainage water;
dust (containing lead);
soil contaminated with lead;

e.g. Oil refinery
type of pollution:
escape of (volatile) hydrocarbon vapours;
spilt oils;
SOx and NOx emissions ;
odours *e.g.* H_2S ;
particulates/smoke emissions;

Accept any two correct suggestions for industry pollution source stated. ***[2 max]***

(ii) point source;
because the pollution comes from a defined location / source can be readily identified *OWTTE;* ***[2]***

(c) (i) *e.g.* oil spill at refinery
bund round storage tanks to contain spilt oil; ***[1]***

(ii) *e.g.* oil spill at refinery
removal/sealing off of oil-contaminated soil; ***[1]***

(d) *e.g.* for oil refinery
bunds must be regularly maintained to seal up cracks;
oil must still be removed from bund safely;
risk of fire when oil is spilt, producing air pollution;
soil is a non-renewable resource, and is wasted once contaminated with oil;
sealing off contaminated soil may not prevent leaching into groundwater/adjacent soil;

[4 max]

(e) (i) leaching of effluent into river increasing BOD;
killing of fish as BOD increases and dissolved oxygen drops;
noise/smells;
production of gas (methane which is a greenhouse gas);
vermin; ***[2 max]***

(ii) *Advantage:* ***[1 max]***
produces usable product;
reduces methane production at landfill;
reduces volume of landfill;

Disadvantage: ***[1 max]***
possibly impractical for those without gardens;
if not done correctly may produce smells / encourage vermin;
requires householder to segregate waste / take initiative; ***[2 max]***

(iii) glass can either be recycled into new glass containers or empty bottles can be cleaned and re-used;
unwanted textiles/shoes can be sent to charity shops for re-use or converted to new product *e.g.* felt;
metal cans can only be recycled and made into other steel objects;
paper can be recycled to form newspapers or toilet paper;
paper can be composted / used as mulch / pulverised to form house insulation;
plastics can be recycled and used to make textiles/new containers/wood substitute *e.g.* for fences; ***[3 max]***
Do not credit brief answers lacking explanation or description e.g. glass can be recycled.