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MARKSCHEME

May 2003

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 2

11 pages

General Marking Instructions

Subject Details: Environmental Systems SL Paper 2 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.

- ◆ 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 not achieved or what they have got wrong.

- ◆ 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)   the amount of biological or living diversity per unit area / number of different species / species richness (and relative abundance of different species);   *[1]*

        (b)   *Award [1] each for any two of the following descriptions.*
                high number of species near the Equator;
                low number in higher latitudes;
                low number $10° – 30°$ N in Africa;
                highest numbers in East Asia and Australia;
                swallow tails as a group have a wide distribution;

                Award [1] for one of the following reasons, consistent with the description.
                complexity / high productivity of tropical biome;
                simplicity / low productivity of high latitude and desert biomes (*e.g.* Sahara);
                diversity possibly caused by isolation on islands in South East Asia;
                adaptation to a variety of environments / butterflies better adapted to warmer climates;   *[3 max]*
                Accept any other valid suggestion.

        (c)   (i) $0°$ to $10°$ South / $10°$ South;   *[1]*

                (ii)   0 to 80 species / 80 species;   *[1]*

        (d)   *Award [1] for species name.*
                name of species (*e.g.* snowy owl);
                Vague answers e.g. grass, fish, insects etc. are insufficient.

                Award [1] for any one factor.
                e.g. competition / parasitism / mutualism / predation / herbivory;

                Award [1] for explanation.
                e.g. low populations of prey (*e.g.* lemmings) reduce numbers of snowy owls because they lack food;   *[3 max]*

2.   (a)   (i)   China;   *[1]*

(ii)   200 %;   *[1]*

(b)   *Award [1] for any of the following, up to [3 max].*

Nigeria:
birth rate high;
medical care and sanitation improvements;
infant mortality decreasing;
death rate decreasing;
relatively little use of family planning methods;
social factors (*e.g.* young age of marriage);
religious beliefs (*e.g.* Islam encourages larger families);
children needed to work on land;

or

China:
birth rate high;
medical care and sanitation improvements;
infant mortality decreasing;
death rate decreasing;
recent efforts to control population growth (*e.g.* one child policy) / improved access
to contraception methods;
social factors (*e.g.* ratio male : female / preference for boys : girls);   *[3 max]*

(c)   (i)   the extent to which a given interaction with the environment exploits and
utilizes the natural income without causing long-term deterioration to the
natural capital / (improving the quality of human life while) living within the
carrying capacity of supporting ecosystems / *OWTTE*;   *[1]*

(ii)   *Award [1] each for any two of the following.*
level of technology (enables resources otherwise unavailable to be used);
rate of energy use;
materials-goods consumption;
amount of imports-exports;
standard of living;
social and cultural changes;
fertility of soil;
availability of resources;   *[2 max]*
Accept any other reasonable points.

(d)   open system;

Award [1] each for any two of the following.
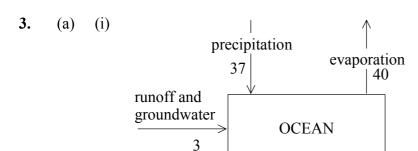the population of a city has both inputs and outputs;
a city has an exchange of matter and energy with its surroundings;
inputs = *e.g.* population immigrating, food imported;
outputs = *e.g.* population emigrating, heat lost by metabolism, waste and rubbish
(garbage) removed;   *[3 max]*
Accept any other valid point.

3. (a) (i)

precipitation
37

evaporation
40

runoff and
groundwater
3

OCEAN

[2]

Award three correct labels [2], two correct [1]. Labels on flows should include both name of process and number. If either is omitted, award only [1].

(ii) $9 \times 10^{13} \, m^3 \, (yr^{-1})$; *(units needed)* **[1]**

(b) *Award [1] for named activity.*
e.g. agriculture / mining / construction of dams / irrigation / urbanization / deforestation / pumping of water from aquifers / burning fossil fuels;
Accept any other valid activity.

Award [2 max] for influence on the hydrological cycle. For credit, explanation should indicate possible changes in hydrological flows or storages, resulting from the named human activity [1] and explain how the changes affect the hydrological cycle [1].
e.g. deforestation;
reduces evapo-transpiration from vegetation;
which reduces cloud formation / precipitation / increases run-off; **[3 max]**

(c) (i) *Award [1] each for any two of the following.*
surface run-off / flowing of water;
wind;
deforestation / logging;
overgrazing by livestock;
burning of vegetation;
plowing across contours;
hedgerow removal; **[2 max]**
Accept any other valid suggestion.

(ii) *Award [1] each for any two of the following.*
terracing;
contour cultivation;
wind breaks / hedge planting;
intercropping;
use of organic fertilizers;
reducing use of inorganic fertilizers because they damage soil structure;
maintaining vegetation cover;
increasing planted areas; **[2 max]**
Accept any other valid suggestion.

SECTION B

General Essay Markscheme

Each essay is marked out of *[20]* of which *[3]* are for expression and development of ideas (EDI).

  [0] No expression of relevant ideas.
  [1] Expression and development of relevant ideas is limited.
  [2] Ideas are relevant, satisfactorily expressed and reasonably well developed.
  [3] Ideas are relevant, very well expressed and well developed.

4. (a) (i) *For example, comparing tropical rainforest with desert*
               tropical rainforest has much higher productivity than desert;
               year-round growing season in tropical rainforest;
               desert – low precipitation, tropical rainforest – high precipitation;
               periodicity / unevenness of rainfall;
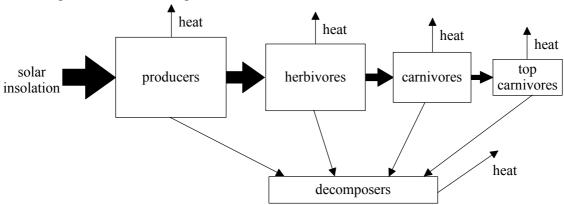   resulting in lower photosynthesis in desert;   *[4 max]*
               Accept any other reasonable evaluation of the data.

          (ii) *Award [1] each for any two of the following factors.*
               precipitation;
               temperature;
               soil fertility;
               light intensity;
               altitude;
               slope angle;   *[2 max]*
               Accept any other reasonable suggestion.

   (b) *Award [3 max] for the diagram.*
       at least three trophic levels identified as storages;
       at least three correct flows in correct direction;
       completeness *i.e.* decomposers and/or heat loss included;

       Award [1] each for any four of the following, [4 max]. Accept any other reasonable points.
       only 10 % of energy available for next trophic level;
       primary consumers (herbivores) / secondary consumers (carnivores) / decomposers;
       conversion of light to chemical energy;
       re-radiation of heat energy to atmosphere;
       loss of radiation through reflection or absorption;
       law of conservation of energy / first law of thermodynamics;   *[7 max]*

(c)   *Award [2 max] for structure, [2 max] for distribution.*

Tundra	Rainforest
single layer of vegetation	many layers;
simplicity	complexity;
high latitude	low latitude;
less affected by human activities	reduced and fragmented by human activities;

[4]

A table format is not required but each comparison made must have a statement about each region to gain the mark.

Expression of ideas [3 max]

Total [20]

5.   (a)   *Any four of the following [1] each, [4 max], plus [3 max] for the diagram.*

stores: energy and matter stored in the biomass of vegetation;
                             tissues of seabirds;

inputs of energy: in sunlight through photosynthesis;
                             immigrating seabirds;
                             food brought from surrounding ocean;

inputs of matter: immigrating seabirds;
                             food gathered;
                             rainfall (water and dissolved substances, *e.g.* NaCl);

internal flows: defecation by seabirds adds nutrients (*e.g.* nitrogen and phosphorus)
                             to soil;
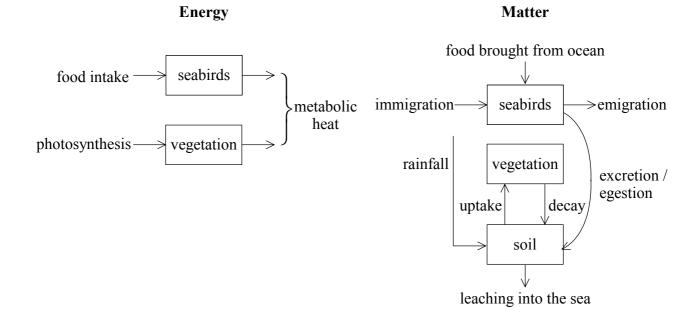   uptake of nutrients from soil to vegetation;

outputs: matter - leaching of nutrients into ocean;
                             emigrating of (especially young) seabirds;
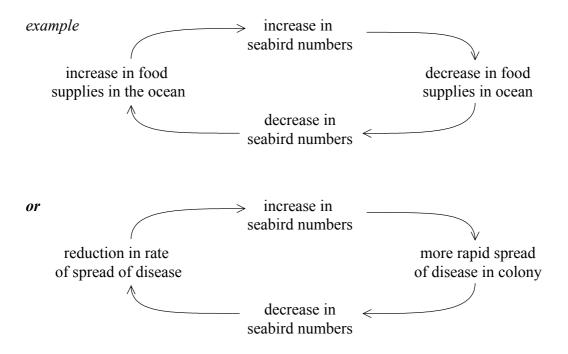   energy - metabolic heat released into atmosphere;

Possible examples of diagrams which may be produced:

Energy   **Matter**

food intake ⟶ [seabirds] ⟶ ⎫
                                                    ⎬ metabolic heat
photosynthesis ⟶ [vegetation] ⟶ ⎭

food brought from ocean
                              ↓
immigration ⟶ [seabirds] ⟶ emigration
rainfall | [vegetation]
uptake ↑ ↓ decay   excretion / egestion
         [soil]
              ↓
leaching into the sea

*Not all the above stores and flows are necessary. Energy and matter, plus stores
and flows, must be shown for the full [3] marks. Energy and matter may be shown
on the same diagram.*   *[7 max]*

(b) negative feedback is feedback that tends to damp down, neutralize or counteract any
deviation from an equilibrium, and promotes stability / *OWTTE*;
population may be controlled by availability of food / some other resource such as
nesting sites / disease;

example

increase in seabird numbers → decrease in food supplies in ocean → decrease in seabird numbers → increase in food supplies in the ocean → increase in seabird numbers

or

increase in seabird numbers → more rapid spread of disease in colony → decrease in seabird numbers → reduction in rate of spread of disease → increase in seabird numbers

Award [2] for appropriate example.   *[4 max]*

(c) *Answers must have at least one point from each (herbivore and predator) for full marks.*
herbivore:
plant biomass reduced;
reduction in photosynthesis;
turnover of nutrients through herbivores' feces (nitrogen and phosphorus) increased;
reduction in competing herbivores;

predator:
decline in numbers / biomass of birds;
decline in flow of nutrients from ocean to island;
decline in nutrients entering soil from feces;
long-term decline in productivity / biomass of vegetation;   *[6 max]*
Any other reasonable points.

Expression of ideas [3 max]

Total [20]

6.   (a)   *Award [2 max] for description.*
steady increase / exponential growth in carbon dioxide concentration until 1990;
carbon dioxide concentration increased from about 315 ppm in 1960 to about 370 ppm in 2000 / increased by about 50 ppm over 40 years / increased by about 1 ppm per year;
slight acceleration of rate of increase between 1985 and 1990;
Accept any other reasonable points.

Award [4 max] for explanation.
carbon dioxide increased mainly by human activity (*e.g.* mostly burning of fossil fuels);
human population has increased significantly since 1960 which has increased human activity;
electricity demand has increased steadily since 1960, increasing fossil fuel use in power stations;
car ownership / road traffic increased dramatically since 1960, increasing fossil fuel use;
forests cleared for agriculture / timber / development;
standard of living increased markedly, since 1960, increasing fossil fuel use in industry / homes;
Accept any other reasonable explanations.   *[6 max]*

  (b)   increased global warming / greenhouse effect;
sea level rise / flooding of low lying lands;
melting of icecaps / retreat of glaciers;
which reduces planetary albedo;
and further increases warming, which is a positive feedback effect;
increased frequency of hurricanes;
some areas become cooler and some hotter than before;
some areas becoming drier and some wetter;
effects of climate change on biomes and ecosystems;
possible famine as food production is affected;
examples of changes in distribution of named species;
greater rate of photosynthesis;
therefore accelerated plant growth;
which may act as negative feedback effect to reduce carbon dioxide levels;   *[6 max]*
Accept any other reasonable point.

  (c)   international agreements;
more efficient appliances *e.g.* low energy light bulbs;
insulation of buildings to reduce heating / cooling needed;
replanting of trees / reforestation;
use of more nuclear power;
use of more renewable energy sources;
carbon emission trading;
more use of public transport;   *[5 max]*
Accept any other reasonable points.

Expression of ideas [3 max]

Total [20]