



MARKSCHEME

May 1999

ENVIRONMENTAL SYSTEMS

Standard Level

Paper 2

SECTION A

1. (a) (i) (9 El Niño events in 50 years)
Frequency 1 in 5.5 years / 2 in 10 / 9 in 50 (*any ratio acceptable*)
[1 mark].
(Accept 4.5–6 as an estimate is required in question.) *max [1 mark]*
- (ii) *Accept any reasonable answer, e.g.:*
Duration of ice cover on Lake Mendota varied between 1938 and 1988 [1 mark];
from about 50 to 126 days [1 mark];
shorter duration of ice cover sometimes coincided with El Niño events [1 mark]/ some El Niño events reduce duration of ice cover while others have little effect [1 mark]/ may be a trend towards reduced duration of ice cover between 1938 and 1988 [1 mark].
Also allow: fluctuations become more marked with time [1 mark] *max [3 marks]*
- (iii) *Accept any two reasonable hypotheses. May be global or local but do require a causal relationship. (Increased duration of ice cover on lake causes El Niño is not acceptable.)*
E.g. global:
Changes in weather patterns/severity of winters are due to El Niño events. [1 mark]/
Days of duration of ice cover on Lake Mendota is decreasing on average, due to global warming. [1 mark]/
E.g. local:
El Niño events increase winter temperatures in Wisconsin, North America. [1 mark]/
Changes in growth of vegetation around the lake result in variations in temperature so duration of ice cover changes. [1 mark]. *max [2 marks]*
- (iv) *Relate evidence to one of the hypotheses in (iii). Accept any one of e.g.: (must be consistent)*
temperatures at different locations over past years [1 mark]/
duration of ice cover on other lakes [1 mark]/
levels of carbon dioxide/greenhouse gases in the atmosphere over past years [1 mark]/
vegetation surveys/tree height surveys over time [1 mark]. *max [1 mark]*

- (b) (i) Allow for candidates countin all peaks or just major peaks.
10 years (± 3) [1 mark] max [1 mark]
- (ii) Hares are the primary food source of the lynx so, if numbers fall, so do lynx numbers as the food source is reduced [1 mark]; fewer offspring produced because less food [1 mark]; but after a time lag [1 mark]/predator : prey relationship [1 mark] max [2 marks]
- (iii) *Any reasonable suggestions, e.g.:*
- severe winters [1 mark]/
 - hare population numbers increase rapidly when lynx numbers are low, followed by intense intraspecific competition for food, then mass starvation [1 mark]/ similar in lynx [1 mark]/
 - density dependent factor e.g. epidemic [1 mark]/
 - hares are r-strategists – reproduce quickly [1 mark]/
 - hares overshoot carrying capacity [1 mark]
- hunting of hare/lynx max [2 marks]
- (iv) *Any reasonable suggestions, e.g.:*
- trapping of animals [1 mark]/
 - pelts counted if lynx/hare caught [1 mark]/
 - aerial surveys [1 mark]/
 - observation by residents [1 mark]/
 - sampling of known areas [1 mark]/
 - large pitfall traps
- (Allow [0 marks] for one suggestion, [1 mark] for two and [2 marks] for three suggestions or up to [1 mark] for one detailed suggestion.) max [2 marks]
- (c) (i) tropical estuary [1 mark] max [1 mark]
- (ii) because the graph is discontinuous [1 mark] max [1 mark]
- (iii) low productivity but area is larger than that of other ecosystems [1 mark] max [1 mark]
(quantitative difference not required for the mark.)
- (iv) *Allow reasonable interpretation of graph. Marks should be awarded for any correct step in the 3 required below. Allow for ECF if necessary.*
- TRF $2200 \times 10^9 \times 16$ [1 mark] / $= 35\,200 \times 10^9$ [1 mark] g yr⁻¹
[1 mark];
continental shelf =
 $600 \times 26 \times 10^9$ [1 mark] = $15\,600 \times 10^9$ [1 mark] g yr⁻¹ [1 mark];
- TRF more productive as high temperature/precipitation/insolation [1 mark]. max [3 marks]

Total [20 marks]

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. |

2. (a) *Any three of:*
particulates; PM₁₀ from diesel engines;
CFCs; halons; nitrous (or nitrogen) oxides
carbon dioxide; methane; any other greenhouse gas;
industrial smoke;
volcanic emissions;
sulphur dioxide

max /3 marks/

Explanations: *[3 × 3 marks]*

particulates / PM₁₀ – form haze over cities/industrial areas/ photochemical smog *[1 mark]*; absorb solar radiation so reduce amount reaching surface of earth *[1 mark]*; decrease crop growth as less light for photosynthesis *[1 mark]*

CFCs/halons/methane – ozone depletion in stratosphere *[1 mark]*; increased solar radiation in form of UV light *[1 mark]*; may cause mutations in crop plants exposed to higher UV levels/no effect on rate of photosynthesis/crop growth *[1 mark]*

Carbon dioxide/methane/other greenhouse gases – enhanced greenhouse effect/global warming *[1 mark]*; increased absorption of UV radiation in the atmosphere *[1 mark]*; increased temperature so increased rate of photosynthesis so more crop growth *[1 mark]*

volcanic emissions – high in sulphur dioxide, high levels of smoke, causing haze *[1 mark]*; reduces solar radiation reaching earth's surface *[1 mark]*; reduces photosynthesis, less crop growth *[1 mark]*

sulphur dioxide – if candidates produce an argument which is reasonable, allow up to 3 marks but they must state some deflection of UV radiation in the atmosphere. If the argument is based on acid deposition but links this to decreased plant growth through stomatal blockage, so decreased rate of photosynthesis (*allow up to 2 marks*)

If candidates list *e.g.* three greenhouse gases to discuss the same effects, allow up to 6/9 marks for valid arguments.

max /9 marks/

- (b) Particles/gases are transferred by convection currents [1 mark]; in the atmosphere [1 mark];
 convection cells and brief explanation [1 mark];
 brief description of e.g. Hadley cells, Rossby waves, cyclones as distributing mechanisms [1 mark]. (Ferrel cells, polar cells, tricellular model are not on the syllabus, but should be credited if mentioned.)
 wind currents [1 mark];
 rain washes particles out of the atmosphere [1 mark].

max [5 marks]

EDI max [3 marks]

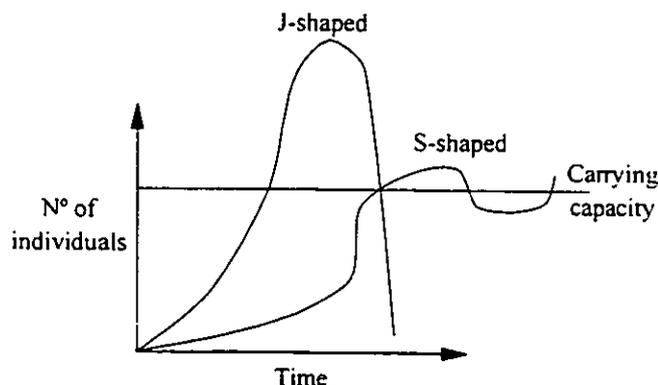
Total [20 marks]

- 3. (a) For all parts of this question, reduce section marks by [1 mark] if named species are not given.
 Environments are stable or unstable [1 mark];
 Spp. in unstable environments are opportunists [1 mark];
 rapid reproduction, large numbers of progeny with minimal care, fast growth rates [1 mark];
 survival rates are low but resource and competition overwhelmed by numbers [1 mark];
 e.g. named examples of pioneer colonisers [1 mark];
 in stable environments, K-selection is more successful [1 mark];
 few young with considerable parental care, slow development, high survival rate [1 mark];
 maximises efficiency of exploitation of resources [1 mark];
 in succession, pioneers are r-selected species and climax species are K-selected [1 mark].

max [6 marks]

- (b) r-selection leads to a population growth in a 'J' shape [1 mark];
 rapid growth, overshoot of carrying capacity then collapse (boom and bust) [1 mark];
 K-selection gives 'S'-shaped curve that then fluctuates around carrying capacity [1 mark];
 Some spp. can adapt strategy to the environment and adopt r or K selection [1 mark];

Graph [1 mark]



max [4 marks]

- (c) Density-dependent factors (DDFs) cause a higher percentage of the population to die as population size increases **[1 mark]**
 e.g. as numbers increase, pressure on food increases, so increased mortality, especially amongst young so lower reproductive rate **[1 mark]**.
 or increased crowding – including disease spread – including mortality – more so if density higher **[1 mark]**;
 DDFs are always biotic e.g. competition, predator numbers **[1 mark]**.
(some ecologists say that weather may be a DDF – climate school)
[1 mark]
 affect all species and are usually associated with stable environments **[1 mark]**;
 e.g. any example, such as (DDF): lemmings' mass migrations when population density reaches an unsustainable level. Lemmings are more aggressive and will try to cross barriers – in the sea they will drown **[1 mark]**
 Density-independent factors (DIFs) cause constant mortality rate whatever the size of the population **[1 mark]**
 May be abiotic (e.g. winter cold) or biotic **[1 mark]**/
 Usually in unstable environments **[1 mark]**;

max [7 marks]

EDI *max [3 marks]*

Total [20 marks]

4. (a) Allow **[1 mark]** for naming three classes
 Renewable/perpetual, replenishable, non-renewable **[1 mark]**
 Allow **[1 mark]** for three correct examples
 (e.g. wood, groundwater, fossil fuels) **[1 mark]**
 Allow up to 2 x 3 marks for relevant discussion of the classes.
 Any reasonable statements, e.g.
 renewable e.g. organisms/ecosystems/forests are self-sustaining with input of solar radiation **[1 mark]**;
 can be sustainably used if sustainable yields are calculated **[1 mark]**/
 exploit without depleting natural capital (stock) **[1 mark]**/
 just take annual gain in biomass/energy **[1 mark]**;
 replenishable – e.g. ozone layer/ground water **[1 mark]**/
 are non-living but also rely on solar radiation for renewal **[1 mark]**;
 sustainable use depends on time scale and amount extracted **[1 mark]**/
 aquifers can refill by natural drainage but humans may extract more than is replaced **[1 mark]**;
 non-renewable – e.g. fossil fuels/minerals **[1 mark]**/
 any use turns natural capital (stock/resource) into natural income (yield/crop/income) but liquidates the capital **[1 mark]**;
 Cannot use non-renewable natural capital sustainably, can only extend use by efficiencies or recycling **[1 mark]**;

max [8 marks]

- (b) Carrying capacity = the maximum number or 'load' of a species that can be sustainably supported by a given environment *[1 mark]*:
sustainable / without permanent damage to the environment *[1 mark]*:
Carrying capacity may not be a suitable term to apply to human populations as they can use technology to increase it *[1 mark]*:
But global materials are finite so it is often moving resources from one area to another *[1 mark]*

global human population can only increase carrying capacity to a limit set by natural capacity and income *[1 mark]*.

Increase by: (accept any three reasonable responses, e.g.):

max [4 marks]

- import food/goods/energy from outside *[1 mark]*
- substitute a manufactured good for a natural one that may run out *[1 mark]*
- substitute high energy foods (meat) for more energy efficient foods (cereals/vegetables) *[1 mark]*
- trade with other regions/countries for scarce goods in exchange for surplus *[1 mark]*
- continue economic growth *[1 mark]*

decrease the size of their ecological footprints *[1 mark]*.

max [3 marks]

- (c) Accept any reasonable comments, up to 2 marks, e.g.:

- increased use of renewable forms of energy *[1 mark]*
- more recycling of materials *[1 mark]*
- increased energy/resource use efficiency *[1 mark]*.
- run out of fossil fuels / non-renewable resources *[1 mark]*

max [2 marks]

EDI *max [3 marks]*

Total [20 marks]