



**General Certificate of Education**

**Environmental Science 5441**

**ESC3      The Biosphere**

**Mark Scheme**

*2008 examination – January series*

Mark schemes are prepared by the Principal Examiner and considered, together with the relevant questions, by a panel of subject teachers. This mark scheme includes any amendments made at the standardisation meeting attended by all examiners and is the scheme which was used by them in this examination. The standardisation meeting ensures that the mark scheme covers the candidates' responses to questions and that every examiner understands and applies it in the same correct way. As preparation for the standardisation meeting each examiner analyses a number of candidates' scripts: alternative answers not already covered by the mark scheme are discussed at the meeting and legislated for. If, after this meeting, examiners encounter unusual answers which have not been discussed at the meeting they are required to refer these to the Principal Examiner.

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**Environmental Science****January 2008****ESC3****Instructions: ; = 1 mark / = alternative response A = accept R = reject****Question 1**

	<b>Letter</b>
The role of an organism in the community	<b>(E)</b>
Non-living factors, such as temperature, that affect the distribution of living organisms	<b>C</b>
All the living organisms in a defined area	<b>B</b>
The total number of a species living in a defined area	<b>F</b>
The place where an organism lives	<b>L</b>
A technique for measuring the influence of an environmental gradient on organisms	<b>I</b>

**Total marks = 5**

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**Question 2**

- (a) (i) Pioneer (species)/(primary) coloniser; 1
- (ii) (Spores) brought by animals/blown by wind/from the soil; 1  
 [A spores on pondweed]  
 [A brought by flood]
- (iii) Less light;  
 light needed for photosynthesis/reduced photosynthesis/reduced growth; 2
- (b) Sediment nutrient rich/fertile;  
 colonisers can survive initial conditions/grow on sediment;  
 colonisers die and decompose;  
 increase in nutrient content/organic matter/fertility;  
 formation of soil from sediment/roots bind soil;  
 increase in soil depth/structure/change in pH;  
 increase in water retention/water holding;  
 concept of new conditions leading to establishment of new /better adapted species;  
 resulting sequence of vegetation developing (eg grasses→shrubs→trees/  
 annuals→perennials/increase in complexity);  
 ref. to climax community/plagioclimax/deflected succession; MAX 4
- (c) Important habitat for organisms/named organisms;  
 food source for organisms/named organism/ref. to food chain;  
 [A water source for drinking]  
 species diversity reduced at climax community;  
 ref to concept of ecological stability/complexity of ecosystem; MAX 2

**Total marks = 10**

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**Question 3**

- (a) (i)  $P = C - R - U - F / C - (R + U + F)$ ; 1  
[R equations using A even if correct]
- (ii)  $91.34 - (30.51 + 0.03 + 57.06) / 91.34 - 87.60 = \underline{3.74}$ ; 1  
[A use of  $P = A - (R+U)$   
 $34.28 - (30.51 + 0.03) = 3.74$ ]
- (b) Reduces energy lost as heat/maintaining body temperature; 1  
[A reduces energy lost in movement/respiration]  
[R 'less energy lost' without reason]
- (c) Primary consumer; 1
- (d) (i) Suggested suitable sample area eg  $10\text{m} \times 10\text{m} / 100 \text{ m}^2$ /suitable percentage area;  
grid and co-ordinates;  
[A correct concept if implied in answer]  
suitable method of choosing random numbers; MAX 2  
[R 'throwing quadrats']
- (ii) Correct use of  $\sum n(n-1)/114$  ; 2  
 $5.26/5.3$ ;  
[R 5.2]
- (iii) Indicates relative abundance/measure of ecological stability; 1
- (iv) Difficult to count individuals/identify; 1  
[R hard to count/too many to count]

**Total marks = 10**

**Question 4**

- (a) (i) Moderates temperature change/temperature stability/thermal buffer; 1
- (ii) Ice floats;  
[A if implied in answer]  
prevents lakes from freezing solid/insulates water beneath/  
enables organisms to survive beneath ice/protection from land predators; 2  
[A ice provides habitat]  
[A ref to freeze-thaw creating niche/microclimate]
- (b) (i)  $2350 \pm 50$  (mm); 1
- (ii)  $-6$  to  $+4^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$  / range of  $10^{\circ}\text{C} \pm 1^{\circ}\text{C}$ ; 1
- (iii) (Hot) desert; 1
- (c) Maintains (high) biodiversity/prevents extinction/rare species;  
regulates atmospheric gases/produces oxygen;  
carbon store/reduces greenhouse effect;  
regulates water cycle;  
economic benefits - eg any 2 of:  
food/industrial products/timber/medicines;;  
maintenance of gene pool/future economic benefit (agriculture/medicines)/  
qualified scientific research/education qualified;  
prevents flooding/soil erosion;  
maintenance of culture of indigenous people;  
moral/ethical reasons; 4  
[R recreation/aesthetics/ecotourism]

**Total marks = 10**

### Question 5

- (a) Loss of habitat/fragmentation of habitat/habitat change/  
change in woodland management eg coppicing;  
shortage of food/competition for food;  
seasonal nature of foods;  
climatic factors;  
predation;  
introduced species;  
disease;  
qualified pollution/pesticides/qualified human interference; MAX 3
- (b) (i) Small gene pool/inbreeding;  
too large to keep in captivity (eg whales);  
specific food requirements;  
unknown breeding triggers/lack of knowledge of breeding requirements;  
stress of captivity;  
limited choice of mates/incompatibility with potential mates; MAX 2
- (b) (ii) Lack of food gathering skills;  
lack of immunity to disease;  
inability to recognise/avoid predators;  
inability to establish territory;  
too tame/used to human contact/dependent on humans/  
behaviour changed by captivity;  
original threat still present/original habitat destroyed/reduced;  
effect of climate change on habitat; MAX 3  
[R unable to mate]
- (c) The Wildlife and Countryside Act (1981 and 1984);  
banning damaging activities/protection of nesting sites/  
establishment of protected area/NNRs/SSSI;  
**OR**  
EU Habitats Directive; [NB 1 mark for named legislation  
creation of SACs; 1 mark for an effect of legislation]  
**OR**  
Biodiversity Action Plans;  
relevant detail;  
**OR**  
EU Birds Directive;  
creation of SPAs; 2
- [A Countryside Stewardship Scheme / Environmental Stewardship/ESA  
grants/subsidies for maintaining hedgerows/woodlands]  
[R CITES/Ramsar/set aside]

**Total marks = 10**

**Question 6**

- (a)
- 1 Suitable method/area/time for collecting sample;  
[R name of method only]
  - 2 marking in a way that does not affect behaviour/vulnerability to predation/  
does not rub off;
  - 3 left for suitable time to allow mixing/integration with remaining population;
  - 4 count number of marked and unmarked in second sample;
  - 5 apply Lincoln Index/formula for calculation/example of calculation;
  - 6 assumes no natural population change in time interval;
  - 7 repeat whole sampling process and take average;
  - 8 multiply up to area of grassland;

MAX 5

- (b) *Quality of Written Communication is assessed in this answer.*

**Abiotic:**

- 1 Named abiotic factor/rainfall/light/water supply/temperature/pH;
- 2 affects rate of photosynthesis/growth of plants;
- 3 availability of food supply;
- 4 concept of density independent factors/effect of named natural disaster;
- 5 ref to soil factors affecting burrowing;

Max 4

**Biotic:**

- 6 competition for food (at same trophic level);
- 7 competition for breeding space;
- 8 competition for mates;
- 9 predation;
- 10 disease;
- 11 concept of density dependent factors;
- 12 concept of environmental resistance;
- 13 concept of carrying capacity;
- 14 concept of biotic potential;
- 15 concept of homeostatic control/negative feedback;  
[A description eg predator-prey relationship]
- 16 human factors eg culling/hunting/pesticides;

Max 6

MAX 8

*Quality of Written Communication*

Mark	Descriptor
2	All material is logically presented in clear, scientific English and continuous prose. Technical terminology has been used effectively and accurately throughout. At least half a page of material is presented.
1	Account is logical and generally presented in clear, scientific English. Technical terminology has been used effectively and is usually accurate. Some minor errors. At least half a page of material is presented.
0	The account is generally poorly constructed and often fails to use an appropriate scientific style to express ideas.

MAX 2

**Total marks = 15**