



**General Certificate of Education**

**Environmental Science 5441**

**ESC3      The Biosphere**

**Mark Scheme**

*2008 examination – January series*

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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; 2  
light needed for photosynthesis/reduced photosynthesis/reduced growth;
- (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] 1  
 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**