**Data Analysis and Essay Practice Questions Ecology**

**1.** Explain how energy and nutrients enter, move through, and exit a food chain in an ecosystem.

(Total 8 marks)

**2.** Describe the causes and effects of the increased greenhouse effect.

(Total 6 marks)

**3.** A coral polyp is a marine organism, characterized by a hard skeleton. Coral reefs are colonies of numerous individual polyps. Coral polyps often form close associations with tiny plants such as algae. The algae, which live within the tissues of the polyp, give the coral its unique colour. The algae receive nutrients from their host and provide the host with a food source in return. When coral undergoes environmental stress it expels algae from its polyps and the coral appears white. This process is called “coral bleaching”.

The graph below indicates the number of coral reef areas showing bleaching over a 20-year period off the coast of Australia. The arrows indicate the occurrence of El Niño, an event that brings effects such as an increase in water temperature around the coral.

[Source: adapted from M Spalding, K Teleki, and T Spencer, (1999), *Climate Change and Coral Bleachin*g,
UNEP World Conservation Monitoring Centre, www.unep-wcmc.org/climate/climate%20report.htm,
reprinted with permission of the authors]

(a) Outline the trend in the number of coral reef areas showing bleaching over the period 1979 to 1998.

 (2)

(b) Discuss the effect of El Niño on the incidence of coral bleaching.

 (3)

(c) Scientists suggest that El Niño may be increasing in frequency. Suggest the impact that this might have on coral bleaching. (1)

*Sargassum*, a variety of brown algae that exists as a floating canopy above coral, was studied to determine its impact on the rate of coral bleaching. The graph below shows the percentage of bleached corals on two reefs, Goold Island and Great Palm Island, with the *Sargassum* canopy left intact and with the *Sargassum* canopy removed.

[Source: J Jompa and L McCook, (1998), *Seaweeds save the reef?! Sargassum canopy decreases coral bleaching on inshore reefs,* www.aims.gov.au/pages/research/seaweed/seaweed-canopy01.html, reprinted with the permission of the Australian Institute of Marine Science]

(d) Identify the percentage of corals bleached near Great Palm Island when *Sargassum* is left intact.

 (1)

(e) Compare the effect of *Sargassum* removal on the amount of coral bleaching at the **two** locations.

 (2)

(f) With reference to the effects of El Niño and *Sargassum* removal, suggest **two** abiotic factors which might contribute to coral bleaching.

1. .........................................................................................................................

2. .........................................................................................................................

(2)

(g) Suggest, giving a reason, how **one** human impact might increase the degree of coral bleaching. (2)

(Total 13 marks)

**4.** (a) Describe the use of *ex situ* conservation measures.

 (3)

(b) (i) Define the term *niche*.

 (1)

(ii) Explain the niche concept using a named organism.

 (4)

(Total 8 marks)

**5.** The energy flow diagram below for a temperate ecosystem has been divided into two parts. One part shows autotrophic use of energy and the other shows the heterotrophic use of energy. All values are kJm –2 yr–1.

(a) Calculate the net production of the autotrophs.(1)

(b) (i) Compare the percentage of heat lost through respiration by the autotrophs with the heterotrophs.(1)

(ii) Most of the heterotrophs are animals. Suggest **one** reason for the difference in heat losses between the autotrophs and animal heterotrophs.(1)

 The heterotrophic community can be divided into food webs based upon decomposers and food webs based upon herbivores. It has been shown that of the energy consumed by the heterotrophs, 99 % is consumed by the decomposer food webs.

(c) State the importance of decomposers in an ecosystem.(1)

(d) Deduce the long-term effects of sustained pollution which kills decomposers on autotrophic productivity.(2)

(Total 6 marks)

**6.** Discuss, giving named examples, the difficulties of placing organisms in higher trophic levels.(Total 4 marks)

**7.** In communities, groups of populations live together and interact with each other. Outline the importance of plants to populations of other organisms in a community.(Total 6 marks)

**8.** The Kluane boreal forest ecosystem project was a large scale ten year experimental manipulation of food and predators on arctic ground squirrel population (*Spermophilusparryii plesius*).

 Three areas were set up:

  a food addition area
 a predator exclusion area
 a food addition area enclosed within a predator exclusion area.

 The areas were monitored from 1986 to 1996. In spring 1996 all fences were dismantled and food addition was stopped.

 As a further experiment, spring and summer mark-recapture population estimates of the squirrels were conducted from spring 1996 to spring 1998. The results for these two years are shown below. The areas are labelled according to the conditions imposed during the previous ten years.

[Source: Karels *et al., Nature*, (2000), **408**, Pages 460–463)]

(a) State the squirrel population in the food addition plus predator exclusion area in spring 1996.(1)

(b) Describe the effect of ending food addition on the squirrel population.(2)

(c) Scientists believed that the number of ground squirrels in the boreal forests was limited by an interaction between food and predators that acted primarily through changes in reproduction. Using the data, discuss this hypothesis.(3)

(Total 6 marks)

**9.** Explain the reasons for the sizes of animal populations within communities changing and the reasons for them remaining constant.(Total 8 marks)

**10.** Describe with the aid of a diagram the phases of a sigmoid population growth curve. (Total 4 marks)

**11.** (a) Define the term *random sample*.(1)

(b) Draw and label a graph showing the sigmoid (S-shaped) population growth curve. (3)

(c) The masses of two different populations of sparrows (*Passer domesticus*) are shown in the table below.

|  |  |
| --- | --- |
| **Population 1:mass of birds / g** | **Population 2:mass of birds / g** |
| 24.5 | 26.9 |
| 25.0 | 23.2 |
| 24.0 | 23.6 |
| 25.0 | 31.0 |
| 24.5 | 27.9 |
| 24.8 | 28.3 |

(i) Calculate the mean value of the mass of birds for population 1.(1)

(ii) With reference to the data shown, explain what is meant by the term *standard deviation*. No calculation is expected. (2)

(Total 7 marks)

**12.** Ecosystems require an input of energy, water and nutrients to maintain themselves. Nutrients may be reused through recycling within ecosystems.

 Nutrient cycling within an ecosystem has been studied in many biomes. One factor studied is the mean residence time (MRT), which is the amount of time needed for one cycle of decomposition (from absorption by organism to release after death). The table below gives the mean residence time for certain nutrients in four different biomes. In addition, the plant productivity is also shown. (Plant productivity gives an indication of the quantity of biomass potentially available to consumers.)

|  |  |
| --- | --- |
|  | **Mean residence time / years** |
| **Biome** | **Carbon** | **Nitrogen** | **Phosphorus** | **Potassium** | **Calcium** | **Magnesium** | **Plant productivity /g Cm**–2 **yr**–1 |
| Sub-arctic forest | 353.0 | 230.0 | 324.0 | 94.0 | 149.0 | 455.0 | 360 |
| Temperate forest | 4.0 | 5.5 | 5.8 | 1.3 | 3.0 | 3.4 | 540 |
| Chaparral | 3.8 | 4.2 | 3.6 | 1.4 | 5.0 | 2.8 | 270 |
| Tropical rainforest | 0.4 | 2.0 | 1.6 | 0.7 | 1.5 | 1.1 | 900 |

[Source: W H Schlesinger (1991), in M Bush, *Ecology of a Changing* *Planet* (1997), Prentice Hall, page 67]

(a) (i) State which nutrient shows the shortest mean residence time in a temperate forest.(1)

(ii) Identify the biome in which potassium has the longest mean residence time.(1)

(b) Compare the mean residence time for nutrients in the temperate forest and chaparral.(2)

(c) Evaluate the relationship between the mean residence time and plant productivity for the different biomes.(2)

(d) Suggest **one** reason for the difference in mean residence time of nutrients in the tropical rainforest and the sub-arctic forest.(1)

(e) Define the term *ecosystem*.(1)

 In addition to nutrients, other atmospheric elements may also enter the ecosystem. Radioactive cesium-137 was released into the atmosphere by atomic bomb tests in 1961. The cesium-137 was deposited in the soil and on to plants. The graph shows the amount of radioactivity found in the tissues of lichens (an alga and a fungus growing together), caribou (a member of the deer family) and the Inuit (people of Alaska and Northern Canada) in the Anaktuvuk Pass of Alaska.

[Source: W G Henson, “Cesium-137 in Alaska Lichens, Caribou and Inuit.” *Health Physics*, (1967), **13**,
pages 383–389, Pergamon Press; reproduced with permission from the Health Physics Society]

(f) Describe the level of cesium-137 in the Inuit from 1962 through to 1965.(2)

(g) The three organisms form a food chain. Deduce the trophic level of

(i) lichens. ...............................................................................................................

(ii) the Inuit. ...............................................................................................................

(2)

(h) Suggest a reason for the difference in the amount of cesium-137 found in lichens, caribou and the Inuit.(1)

(Total 13 marks)

**13.** Outline ways in which leaves take part in the carbon cycle in ecosystems, apart from photosynthesis.(Total 4 marks)

**14.** The total solar energy received by a grassland is 5 × l05 kJ m–2 y–1. The net production of the grassland is 5 × 102 kJ m–2 y–1 and its gross production is 6 × l02 kJ m–2 y–1. The total energy passed on to primary consumers is 60 kJ m–2 y–1. Only 10 % of this energy is passed on to the secondary consumers.

(a) Calculate the energy lost by plant respiration.

(2)

(b) Construct a pyramid of energy for this grassland.(3)

(Total 5 marks)

**15.** (a) Define the term *net production*.(1)

(b) Complete the diagram of the nitrogen cycle by naming the organisms involved in processes A, B and C below.

(3)

(Total 4 marks)

**16.** Outline the roles of bacteria in the nitrogen cycle. (Total 6 marks)

**17.** Compare the roles of *Rhizobium* and *Pseudomonas denitrificans* in the nitrogen cycle.(Total 3 marks)

**18.** (a) Draw a labelled diagram of the nitrogen cycle(3)

(b) State **two** fuels that can be produced from biomass.(2)

(Total 5 marks)