**Evolution and Classification Journal Questions (Class Set)**

**1.** The bones of many modern birds and the fossils of bird ancestors have been compared. The body shape and how bird ancestors might have flown have been studied. This indicates that small predatory dinosaurs which lived on the ground evolved into birds with some flying capabilities. These then evolved into modern birds. The cladogram shows part of bird evolution and the drawings show anatomical structures linking birds to dinosaurs with hollow bones.



[Source: Kevin padian and luis M Chiappe, (February 1998) *Scientific American*, pages 28-37]

(a) Identify which bird ancestor appears most closely related to dinosaurs.

(1)

(b) Compare the flight capabilities and hand and wrist structure of *Velociraptor* and *Columba.*(3)

(c) Identify the **two** types of evidence for evolution shown by the data.(2)

(Total 6 marks)

**2.** Researchers carried out a study on 3760 children born in a London hospital over a period of 12 years. Data was collected on the childrens' mass at birth and their mortality rate. The purpose of the study was to determine how natural selection acts on mass at birth. The chart shows the frequency of babies of each mass at birth. The line superimposed on the bar chart indicates the percentage mortality rate (the children that did not survive for more than 4 weeks).



[Source: W H Dowderswell, (1984) *Evolution, A Modern Synthesis*, Heinemann Educational Books, page 101]

(a) Identify the mode value for mass at birth.(1)

(b) Identify the optimum mass at birth for survival.(1)

(c) Outline the relationship between mass at birth and mortality.(2)

(d) Explain how this data supports natural selection.(2)

(e) Suggest **one** environmental factor that could cause a low mass at birth.

(1)

**3.** In starfish larvae (*Dendraster excentricus*) there is a correlation between food availability, the diameter of the tentacle and early development to the adult stage.

 Larvae were placed in tanks with high food availability (shown by o) and low food availability (shown by -). The "clearance rate" (shown in Graph 1) is a direct indication of how quickly food can be digested and used for growth. In Graph 2, the juvenile tentacle diameter is an indication of the larval development. This graph shows a sample of larvae of the same age. The greater the tentacle diameter the further advanced the larva is in its development to an adult. When larvae were placed in a high food availability tank, 68 % changed into the adult stage. When larvae were placed in a low food availability tank, only 42 % changed into the adult stage after 10 days.



[Source: Walsberg and Wolf, *Journal of Experimental Biology*, (1995), **198**, pages 213–219. Reproduced by permission of The Company of Biologists Ltd]

(a) State the relationship between low food availability and tentacle diameter of larvae.(1)

(b) (i) Compare low and high food availability larvae with respect to larval age up to 10 days.(2)

 (ii) Suggest a reason for the increased percentage of larvae changing into adults in a high food availability tank.(1)

(c) Discuss the selective advantages of larvae having a large tentacle diameter.(2)

(Total 6 marks) (Total 7 marks)

**4.** Marine iguanas (*Amblyrhynchus cristatus*) are found on the Galapagos islands of Genovesa and Santa Fe. Marine iguanas are unique among lizards in that they feed on algae in the intertidal zone. Between feeding they lie in the sun to warm themselves. Male iguanas establish territories on the rocks where females lie. Males provide no parental care of offspring while females guard the nest for a few days. Females mate once and use up 20 % of their body mass in reproduction, while males try to mate more than once and do not use up much of their body mass.

 The graphs below show the lengths of males and females on the two different islands, sample size (N) is indicated for each graph.



[Source: Freeman and Herron, *Evolutionary Analysis*, (2000), 2nd edition, page 296]

(a) (i) State the most frequent range of body sizes of males on Santa Fe and males on Genovesa. (1)

(ii) Suggest **one** reason for the difference in size between male marine iguanas on Santa Fe and Genovesa.(1)

(b) Compare the body size of males and females.(2)

(c) Explain, using the theory of natural selection, the significance of size in males and females. (2) (Total 6 marks)

4.

**5.** Explain **two** examples of evolution in response to environmental change.(Total 8 marks)

**6.** The mosquito (*Wyeomyia smithii*) uses daylength as a guide to either continue development of its larvae or to begin hibernation. This response to daylength is genetically controlled. Longer daylengths maintain development whereas shorter daylengths induce hibernation. In the northern regions of the northern hemisphere, even though daylengths are longer, winter arrives earlier than in regions closer to the equator. The following data is from an experiment to determine if *W. smithii* has adapted to later onsets of winter as a consequence of global warming. In 1972 and 1996, larvae were collected at various locations in the United States at latitudes 30–50° North. The larvae were examined to determine what daylength induced hibernation. Each circle on the following graph represents one larval population.



[Source: Bradshaw and Holzapfel, *Proceedings of the National Academy of Science of USA,*(2001),
**98** (25), pages 14509–14511]

(a) Outline the relationship between daylength and latitude for the larval populations in 1972.(1)

(b) Compare the data of 1972 with 1996.(2)

(c) Explain how the data illustrates an evolutionary response to a longer growing season due to a later onset of winter.(2)

(Total 5 marks)

1. The water snake (*Nerodia sipedon*) lives on the mainland surrounding Lake Erie and on the islands in the lake. The snakes vary in their appearance from banded through intermediate to unbanded. Recent research has shown that snakes from the mainland migrate to the islands every year. Mark-recapture studies on the islands indicate that young snakes which are unbanded have a higher rate of survival on the islands than do banded snakes. However, banded snakes have a higher rate of survival than unbanded snakes on the mainland.

 Five different populations were studied and the frequency of banded, intermediate, and unbanded snakes were determined for the two mainland areas (Ontario and Ohio) and the islands of Lake Erie.

 The histograms below show the variation in colour pattern within and between populations. Category A snakes are unbanded, category B and C snakes are intermediate, category D snakes are strongly banded.



[Source: S Freeman and J C Herron, *Evolutionary Analysis*, (2002), 2nd edition, Prentice Hall, pages 159–160]

(a) (i) State the percentage of unbanded snakes found on Middle and Pelee islands.(1)

(ii) Calculate the number of strongly banded snakes found on the Ohio mainland.(1)

(b) Compare the percentages of unbanded and strongly banded snakes on the mainland areas to the percentages on the islands.(3)

(c) Suggest, giving reasons, how the maintenance of the banded/unbanded polymorphism is maintained in the island populations.(2)

(Total 7 marks)

**8.** Explain evolution of a species by natural selection in response to environmental change.

(Total 7 marks)

**9.** A comparison was made of the base sequences of genes coding for the same four proteins found in three different mammals: the cow, sheep and pig. The graph below shows the differences in base sequence expressed as a percentage.



[Source: U Goodenough, (1978), *Genetics*, 2nd edition, Holt, Rinehart and Winston, page 759]

(a) Identify a protein that is identical in all three mammals.(1)

(b) Calculate the difference in the percentage of base substitutions for the hemoglobin
**-chain and fibrinopeptides when comparing the cow with sheep.(1)

(c) Deduce, giving a reason, whether the ancestors of pigs or sheep diverged more recently from those of cows.(1)

(d) Explain how the variations in these molecules can indicate the evolutionary history of these groups of mammals.(2)

(Total 5 marks)

**10.** The World Health Organisation (WHO) published a report on multi-drug resistant tuberculosis (MDR TB). MDR TB is defined as disease caused by strains oi *Mycobacterium tuberculosis* resistant to the two most important anti-TB drugs. It is largely a man-made phenomenon. The chart shows the cure and detection rate of tuberculosis (including MDR TB) in 26 countries, and a target zone defined by the WHO.



[Source: WHO Report, (1998), *Global Tuberculosis Control*, page 23]

(a) Identify the country outside the target zone with

(i) the lowest TB cure rate. ......................................................................................

(ii) the highest TB cure rate. ......................................................................................

(1)

(b) Calculate the percentage of **all** cases of TB in Benin that are cured.(1)

(c) Suggest **two** reasons why countries should aim to be in the target zone.(2)

(d) Explain how resistance to anti-TB drugs may have developed in *M. tuberculosis*.(3)

(Total 7 marks)

**11.** Explain several lines of evidence for evolution, with examples.   (6 marks)

**12.** Plants are classified together in a kingdom. Other organisms are classified in other kingdoms. Outline the value of classifying organisms.

(Total 4 marks)

**13.** Plants are a diverse group of eukaryotic organisms. Describe the different characteristics of the bryophyta, filicinophyta, coniferophyta and angiospermophyta. **(9 marks)**

**14.**       A collection of four animal specimens is observed and a dichotomous key is applied. Which specimen is an arthropod?

1.       Non-segmented body .........................................   go to 2
Segmented body .................................................  go to 3

2.       Body is not symmetrical .....................................  specimen A
Body is symmetrical ...........................................  specimen B

3.       Jointed appendages present ................................  specimen C
Jointed appendages absent .................................   specimen D

A.      Specimen A

B.      Specimen B

C.      Specimen C

D.      Specimen D (Total 1 mark)

**15.** Explain the concept of natural classification and its advantages. (4 marks)