Evolution

Question Paper 1

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Selection and evolution
Sub Topic	Evolution
Booklet	Theory
Paper Type	Question Paper 1

Time Allowed : **60 minutes**

Score : **/ 50**

Percentage : **/100**

Grade Boundaries:

A*	A	B	C	D	E	U
>85%	'77.5%	70%	62.5%	57.5%	45%	<45%

1 The Death Valley region of Nevada in the USA used to have an extensive lake system. Approximately 20 000 years ago the lakes started to dry up and now consist of isolated small pools. Four different species of the desert pupfish have been found living in these pools. Evidence indicates that over 20 000 years ago there was only one species of pupfish living in the lake system.

Fig. 8.1 shows a desert pupfish.

Fig. 8.1

(a) Explain how the change from an extensive lake system to just a few pools could have resulted in the evolution of four new species of desert pupfish.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....

..... [5]

(b) State how environmental factors can act as stabilising forces of natural selection in an isolated pool, after the initial evolution of a new species of desert pupfish.

.....

.....

.....

..... [2]

(c) Suggest what may happen to the desert pupfish if water levels rise and the pools once more form an extensive lake system.

.....

.....

.....

.....

.....

.....

.....

..... [3]

[Total: 10]

2 The fruitfly, *Drosophila*, has many different species. Three of these species, *Drosophila pseudoobscura*, *D. persimilis* and *D. miranda*, are thought to be closely related.

Samples of these three species were collected from the western United States of America. Fig. 5.1 shows where these species naturally occur.

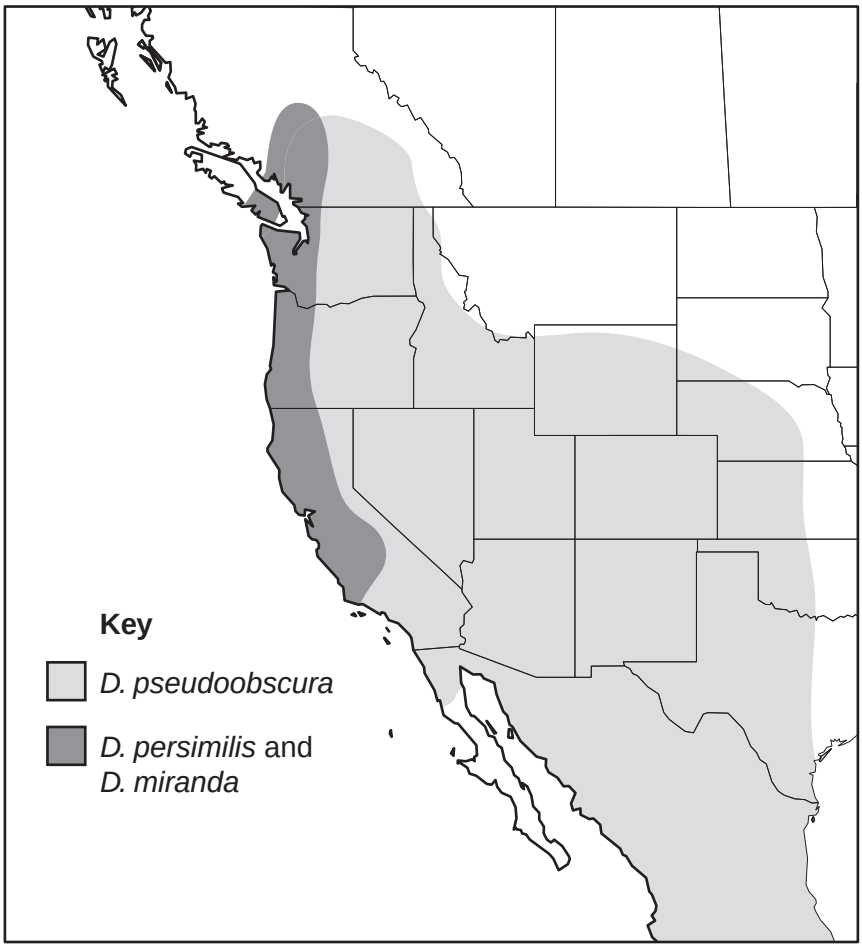

Fig. 5.1

The base sequences of four regions of DNA of each species were sequenced. The divergence of these base sequences in *D. pseudoobscura* and *D. persimilis* from the sequences in *D. miranda* was calculated. The results are shown in Table 5.1.

Table 5.1

DNA region	*Drosophila* species	percentage divergence of base sequence from that of *D. miranda*
1	*pseudoobscura*	2.5
	persimilis	2.4
2	*pseudoobscura*	8.1
	persimilis	7.3
3	*pseudoobscura*	2.1
	persimilis	1.7
4	*pseudoobscura*	1.9
	persimilis	1.7

(a) With reference to Table 5.1, describe the evidence that *D. miranda* may be more closely related to *D. persimilis* than to *D. pseudoobscura*.

.....

.....

.....

..... [2]

(b) Suggest why there is more divergence in some regions of DNA than in others.

.....

.....

.....

..... [2]

(c) The area where *D. pseudoobscura* is found is separated from the areas where the other two species are found by a high range of mountains.

Explain how the species *D. pseudoobscura* could have evolved from a population of *D. miranda.*

.....

.....

.....

.....

.....

.....

.....

..... [4]

[Total: 8]

3 **(a)** Explain what is meant by *artificial selection.*

.....

.....

.....

.....

.....

.....

.....

.....[4]

(b) In a plant breeding programme, corn, *Zea mays*, was bred in an attempt to produce a high yield of protein in the grain.

The results of this programme are shown in Fig. 8.1.

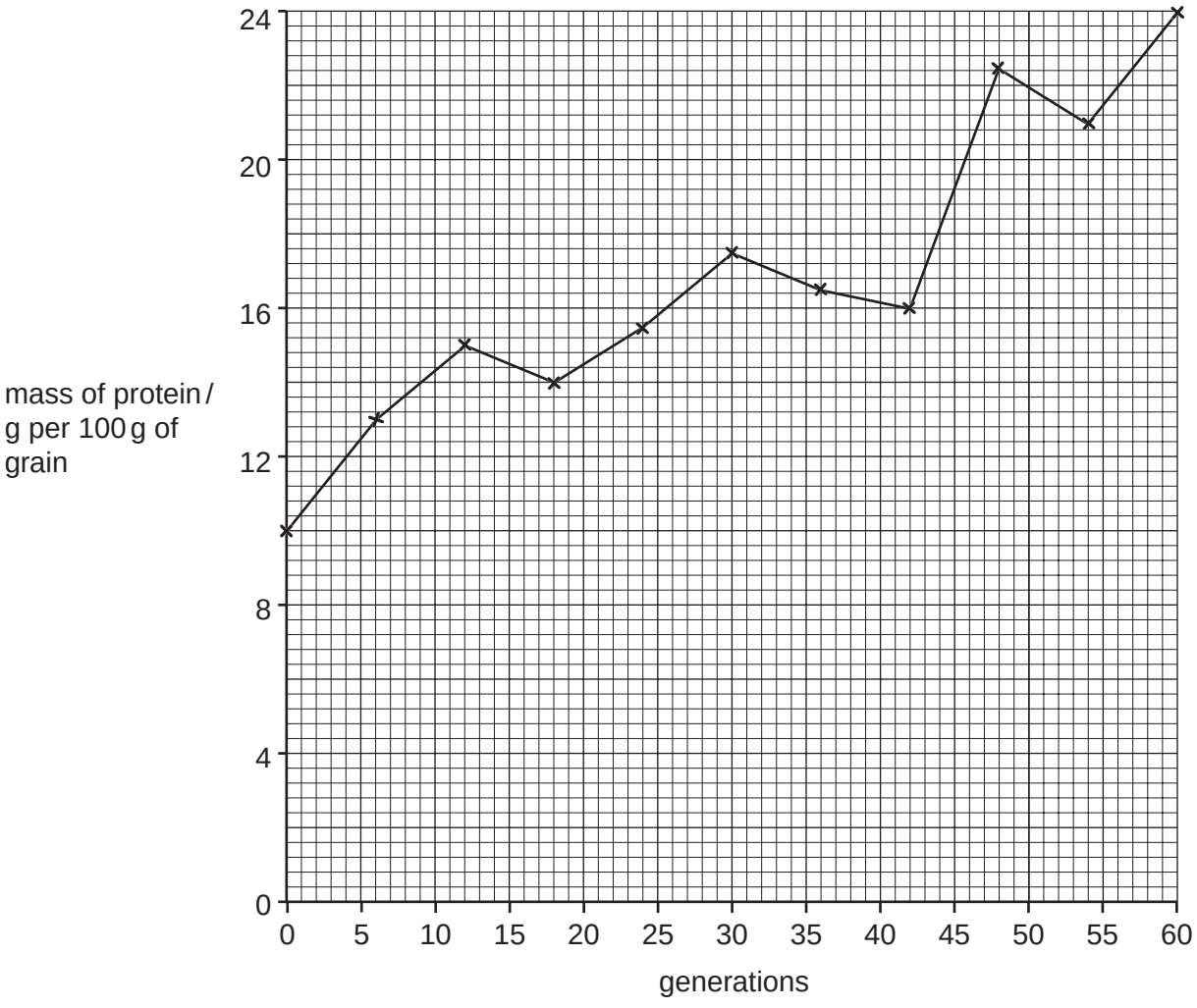

Fig. 8.1

(i) With reference to Fig. 8.1, calculate the percentage increase in grain protein by the end of the experiment.

Show your working.

Answer .....% [2]

(ii) Suggest why the protein yield does not increase steadily in each generation.

.....

.....

.....

.....[2]

[Total: 8]

4 The evolutionary origin of the four-legged amphibians (such as frogs and toads) from fish has been the subject of much debate for many years.

Among living fish, the rarely-caught coelacanth and the lungfish are thought to be most closely related to these amphibians.

Samples of blood were taken from two coelacanths that were captured recently near Comoros.

The amino acid sequences of the α and β chains of coelacanth and lungfish haemoglobin were compared with the known sequences of amphibian adults and their aquatic larvae (tadpoles). Organisms with more matches in the amino acid sequence of a polypeptide chain share a more recent common ancestor than those with fewer matches.

The comparisons with three species of amphibians, *Xenopus laevis (Xl), X. tropicana (Xt) and Rana catesbeiana (Rc)* are shown in Table 2.1.

Table 2.1

		percentage of matches of amino acid sequence					
		species of amphibian adults			**species of amphibian larvae (tadpoles)**		
	fish species	*Xl*	*Xt*	*Rc*	*Xl*	*Xt*	*Rc*
α chains	coelacanth	42.0	47.5	no data	45.4	42.6	48.2
	lungfish	40.4	42.1	no data	40.7	39.0	37.9
β chains	coelacanth	42.1	43.2	40.7	52.1	52.1	58.2
	lungfish	44.1	45.9	41.4	47.3	45.9	48.6

(a) (i) Explain whether or not the information in Table 2.1 supports the suggestion that coelacanths and amphibians share a more recent common ancestor than do lungfish and amphibians.

.....

.....

.....

.....

.....

.....

.....

.....

.....

.....[4]

(ii) Suggest why adults and tadpoles of the same species of amphibian have different amino acid sequences in their haemoglobin.

.....

.....

.....

.....

.....

..... [2]

(b) Coelacanth haemoglobin has a very high affinity for oxygen, suggesting that coelacanths, which have been captured at depths of between 200 m and 400 m, live in water that has a low concentration of oxygen.

Explain how an environmental factor, such as the low concentration of oxygen in deep water, can act:

(i) as a stabilising force in natural selection

.....

.....

.....

.....

.....

..... [3]

(ii) as an evolutionary force in natural selection.

.....

.....

.....

.....

.....

..... [3]

(c) Explain the role of isolating mechanisms in the evolution of new species.

.....

.....

.....

.....

.....

.....[3]

[Total: 15]

.

5 The Ethiopian wolf, *Canis simensis*, is a member of the Canidae family of carnivores.

Fig. 1.1 shows an Ethiopian wolf.

Fig. 1.1

(a) Ethiopian wolves evolved from an ancestor similar to the grey wolf that crossed into Northern Africa from Europe about 100 000 years ago.

They live in the alpine grasslands and heathlands at, or above, 3000 m altitude in Ethiopia.

State the most likely type of speciation that led to the evolution of the Ethiopian wolf.

.....[1]

(b) A population of Ethiopian wolves is called a pack.

Heterozygosity has been found to be low in all of the packs of Ethiopian wolves that have been studied.

Suggest why the heterozygosity may be low in Ethiopian wolf packs.

.....

.....

.....

.....

.....[2]

(c) The Ethiopian wolf is classified as an endangered species by the International Union for the Conservation of Nature and Natural Resources (IUCN). It publishes an annual list of endangered species called the Red List.

Complete Table 1.1 to summarise four of the main reasons, with further explanation, as to why the Ethiopian wolf has become an endangered species.

Table 1.1

reason	explanation
	an activity that accompanies human expansion and reduces the size of the wolf habitat
rabies, a lethal viral disease of wolves	
	a human activity to control wolves, considered to be pests
	the result of wolves breeding with domestic dogs

[4]

(d) According to the Red List, the number of endangered mammal species in 2007 was 349 and in 2008 was 448.

Calculate the percentage increase in endangered mammal species between 2007 and 2008.

Give your answer to the **nearest whole number.**

Show your working.

answer .....% [2]

[Total: 9]