

Variation

Question Paper 3

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Selection and evolution
Sub Topic	Variation
Booklet	Theory
Paper Type	Question Paper 3

Time Allowed : 27 minutes

Score : / 22

Percentage : /100

Grade Boundaries:

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

1 (a) Explain, with one example, how a mutation may affect the phenotype of an organism.

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A mutation of the gene for the β polypeptide chain of haemoglobin can result in sickle cell anaemia, a lethal or near lethal condition.
Only people who are homozygous for this allele have sickle cell anaemia.
All haemoglobin is affected in people who have sickle cell anaemia.
At low oxygen levels red blood cells are distorted (sickle shape) which leads to blockage of capillaries and the destruction of many red blood cells by phagocytosis leading to severe anaemia.

Fig. 4.1 shows the distribution of malaria and the sickle cell allele.

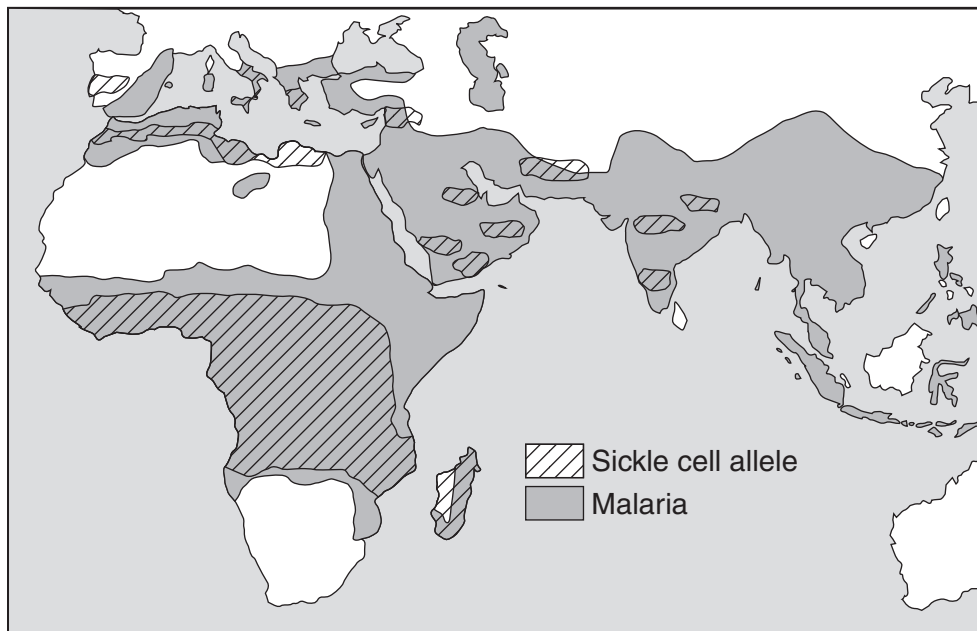


Fig. 4.1

(b) Explain why the sickle cell allele occurs at such high frequencies in some areas.

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[Total: 8]

- (c) Scientists synthesised woolly mammoth haemoglobin in order to investigate whether or not the different haemoglobin was part of the mammoth’s adaptation to a cold climate.

The affinity of haemoglobin for oxygen is affected by the changes in temperature that can occur in mammals, for example in active muscle tissue or close to the skin surface.

It is advantageous for Arctic mammals to have haemoglobin whose affinity for oxygen is only slightly affected by changes in temperature. This is often achieved by using substances called ‘red cell effectors’, which bind to haemoglobin.

Fig. 2.1 compares the effect of temperature on the affinity for oxygen of woolly mammoth and Asian elephant haemoglobin, with and without red cell effectors.

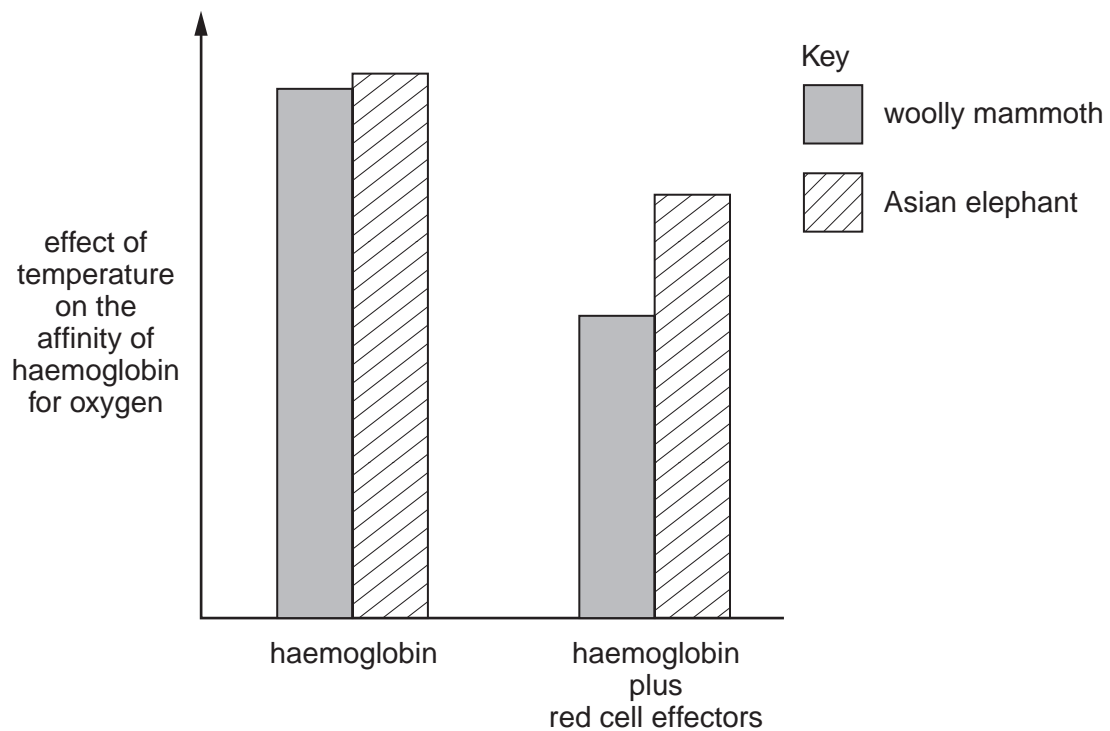


Fig. 2.1

- (i) Suggest why it is advantageous for Arctic mammals to have haemoglobin whose affinity for oxygen is only slightly affected by changes in temperature.

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- (ii) Explain whether or not Fig. 2.1 provides evidence that woolly mammoth haemoglobin is better adapted for a cold climate than Asian elephant haemoglobin.

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[Total: 14]