Passage of information from parent to offspring

Question Paper 6

Level	International A Level
Subject	Biology
Exam Board	CIE
Topic	Inherited change
Sub Topic	Passage of information from parent to offspring
Booklet	Theory
Paper Type	Question Paper 6

Time Allowed : **39 minutes**

Score : **/ 32**

Percentage : **/100**

Grade Boundaries:

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

1 Fig. 4.1 shows four generations of a family in which some members of the family suffer from sickle cell anaemia.

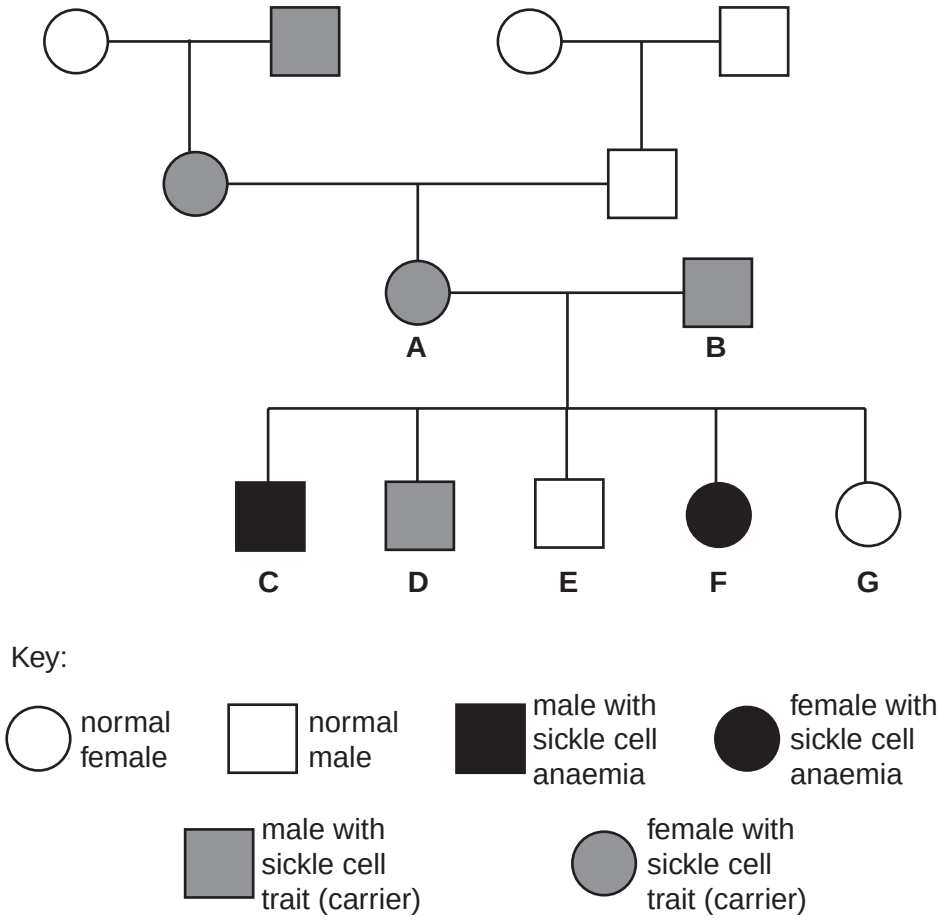

Fig. 4.1

(a) Using the symbols $\mathbf{H^N}$ for the allele for normal haemoglobin and $\mathbf{H^S}$ for the allele for sickle cell haemoglobin, state the genotypes of the following individuals.

A .....

C .....

[1]

(b) Draw a genetic diagram to show the probability of the parents **A** and **B** producing another child with sickle cell anaemia.

[4]

[Total : 5]

2 Resistance to the widely used poison warfarin is now extremely common in rats. Warfarin interacts with vitamin K to prevent its normal functions in the blood clotting mechanism. Normal rats fed on warfarin suffer a fatal haemorrhage. Resistant rats apparently do not use vitamin K in the same way and maintain normal blood clotting times, even when they have eaten large amounts of warfarin. Warfarin resistance in rats is determined by a single dominant allele. Animals carrying the allele for resistance need large quantities of vitamin K.

genotype	resistance to warfarin	quantities of vitamin K required
homozygous recessive	not resistant (susceptible)	normal
heterozygous	resistant	slightly higher
homozygous dominant	resistant	extremely large

When warfarin is used continually the percentage of resistant rats remains at about 50% of the total rat population.

(a) Using the symbols **R** for the allele that confers warfarin resistance and **r** for the allele that produces no resistance, draw a genetic diagram to explain how resistant rats can produce warfarin susceptible offspring.

[4]

(b) Suggest why homozygous dominant rats are unlikely to survive in the wild.

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.....[1]

(c) Describe how natural selection operates to maintain the proportion of resistant rats at about 50% of the total population.

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.....[3]

(d) Explain, with an example, how a mutation that results in the substitution of a single base may affect the phenotype of an organism.

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.....[3]

[Total : 11]

3 Scallops, which are bivalve molluscs, are important commercially throughout the world. The marine bay scallop, *Agropecten irradians*, has three distinct shell colours, yellow, orange and black. The shell colour is controlled by a gene with three alleles, yellow, S^y, orange, S^o, and black, S^b.
Scallops are hermaphrodite and are able to fertilise themselves to produce offspring.
Single mature adult specimens of yellow, orange and black scallops were collected and kept in separate tanks of seawater until they produced young. The young were then scored for shell colour. The results were as follows.

yellow scallop – 25 yellow and 8 black
orange scallop – 31 orange and 9 black
black scallop – 27 black

(a) Explain the results from the orange and black scallops, using the symbols given.

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[6]

(b) Orange scallops are more valued for human consumption.

Describe how a marine biologist could produce a pure-breeding line of orange scallops for commercial exploitation using the offspring from the single orange scallop.

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.....[2]

[Total : 8]

4 The fruit fly, *Drosophila melanogaster*, has many phenotypic variations and has been used in experiments to demonstrate the principles of inheritance.

(a) The majority of fruit flies have red eyes but there is a variant with white eyes.

Fig. 7.1 shows the red-eyed and white-eyed variants of the fruit fly.

Fig. 7.1

The gene for eye colour is located on the X chromosome.

Using suitable symbols, draw a genetic diagram to show the possible offspring of a cross between a heterozygous red-eyed female fruit fly with a white-eyed male fruit fly.

key to symbols:

.....

.....

parental phenotypes	red-eyed female	white-eyed male
parental genotypes		
gametes		
offspring genotypes		
offspring phenotypes		

[5]

(b) One of the genes controlling the clotting of blood in humans is also located on the X chromosome. A rare variation of the gene, a recessive allele for haemophilia, can lead to a condition where the blood fails to clot properly.

(i) State why a man who has haemophilia is unable to pass the condition on to his son.

.....

..... [1]

(ii) Queen Victoria of Great Britain in the 19th century was a carrier of haemophilia, but did not have the condition.

State the term used to describe the genotype of a carrier.

..... [1]

(iii) Neither of Queen Victoria's parents carried the allele for haemophilia.

Suggest how Queen Victoria could have become a carrier.

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..... [1]

[Total: 8]