Passage of information from parent to offspring

Question Paper 3

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 3

Time Allowed : **56 minutes**

Score : **/ 46**

Percentage : **/100**

Grade Boundaries:

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

1 Colour blindness is a condition characterised by the inability of the brain to perceive certain colours accurately.

- The most common form is termed red-green colour blindness (RGC).
- RGC results from a recessive allele.
- 0.6% of females worldwide have RGC.
- 8.0% of males worldwide have RGC.

Fig. 6.1 shows the occurrence of RGC in one family.

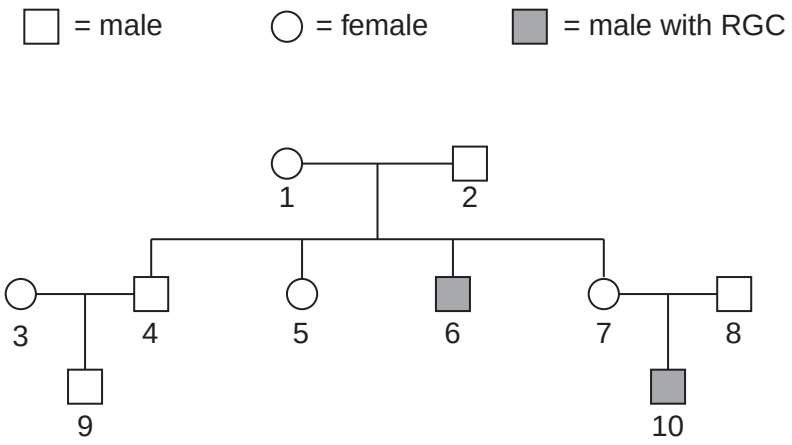

Fig. 6.1

(a) Explain the meaning of the terms *allele* and *recessive*.

allele .....

.....[1]

recessive .....

.....[1]

(b) Explain why females are less likely than males to have RGC.

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.....[2]

(c) With reference to Fig. 6.1, and using the symbols **R** for the dominant allele and **r** for the recessive allele, state the genotypes of the individuals **1**, **4**, **6** and **7**.

1 .....

4 .....

6 .....

7 ..... [4]

[Total: 8]

2 **(a)** Sometimes a gene has more than two alleles, termed *multiple alleles*.
The ABO blood group system in humans is controlled by a gene with three alleles, I^A, I^B and I^o. Alleles I^A and I^B are codominant and I^o is recessive to both.

The blood group **AB** is the result of codominance.

Explain what is meant by *codominance*.

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.....[3]

(b) In humans, a gene that codes for the production of a protein, called factor VIII, is located on the X chromosome. The dominant allele for this gene produces factor VIII, but the recessive allele does not produce factor VIII.

A person who is unable to make factor VIII has haemophilia in which the blood fails to clot properly.

Explain why a man with haemophilia cannot pass haemophilia to his son but may pass haemophilia to his grandson.

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.....[3]

(c) A gene for feather colour in chickens is carried on an autosome. This gene has two alleles, black (C^B) and splashed-white (C^W). When a male chicken with black feathers is mated with a female chicken with splashed-white feathers, all the offspring have blue feathers. This also occurs when a male chicken with splashed-white feathers is crossed with a female with black feathers.

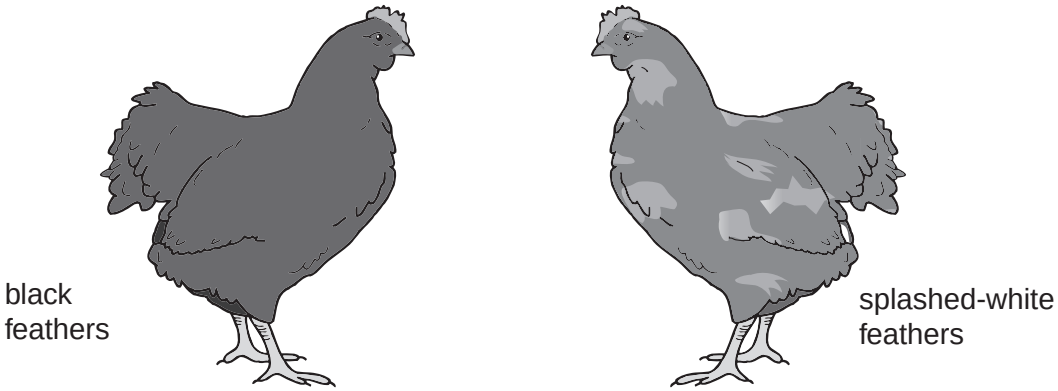

Fig. 7.1

Another gene may cause stripes on feathers (barred feathers). This gene is carried on the X chromosome. The allele for barred feathers (X^A) is dominant to the allele for non-barred feathers (X^a).

In chickens the male is homogametic and has two X chromosomes while the female is heterogametic and has one X chromosome and one Y chromosome.

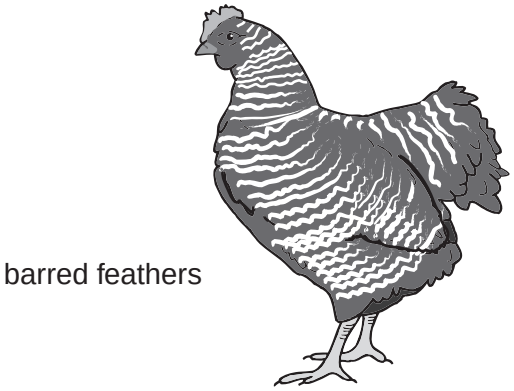

Fig. 7.2

(i) A male chicken with black, non-barred feathers was crossed with a female chicken with splashed-white, barred feathers. All the offspring had blue feathers, but the males were barred and the females were non-barred.

Using the symbols given above draw a genetic diagram to show this cross.

parents' phenotype	male, black, non-barred feathers.	female, splashed-white, barred feathers.
genotype		
gametes		
offspring genotypes		
phenotypes	male, blue, barred feathers.	female, blue, non-barred feathers.

[5]

(ii) Explain how a farmer could use a breeding programme to find out the genotype of a male chicken with blue, barred feathers.

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.....[3]

[Total: 14]

3 Coat colour in cats is determined by a sex-linked gene with two alleles, black and orange. When black cats are mated with orange cats, the female offspring are always tortoiseshell, their coats show black and orange patches of various sizes, while the male offspring have the same coat colour as their mothers.

(a) Using the symbols $\mathbf{X^B}$ for black and $\mathbf{X^O}$ for orange, draw genetic diagrams to account for both these crosses.

black female X orange male

orange female X black male

(b) List the genotypes and their phenotypes of the offspring that may result from mating a tortoiseshell female with a black male.

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(c) Suggest an explanation for the tortoiseshell coat in terms of the activity of the X chromosomes.

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[Total: 9]

4 Phenylketonuria (PKU) is a genetic disease which results in a raised concentration of the amino acid phenylalanine in the blood. If left untreated in a newborn baby, it can lead to brain damage. For this reason, babies may be tested for PKU soon after birth.

Usually, excess phenylalanine is converted to the amino acid tyrosine by the enzyme phenylalanine hydroxylase (PAH). PKU can be the result of a recessive mutation of the gene coding for PAH.

(a) Explain what is meant by a *recessive mutation*.

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(b) Using appropriate symbols, complete the diagram below to show how two parents who do not have PKU can have children with, or without, PKU.

key to symbols

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parental phenotypes without PKU

parental genotypes

gametes

offspring genotypes

offspring phenotypes

[3]

(c) PKU can be caused when a short length of the RNA produced during transcription of the gene coding for PAH is lost.

Suggest what effect this would have on the protein that is subsequently produced.

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[Total: 8]

5 **(a)** Huntington's disease (HD) is an inherited disease of the central nervous system. The symptoms of HD usually develop in adulthood and include uncontrollable muscular movements, short-term memory loss and changes in mood.

HD is caused by a dominant allele of the *huntingtin* gene on chromosome 4.

Explain what is meant by the terms *allele* and *dominant.*

allele .....

.....

dominant .....

.....[2]

(b) The dominant allele of the *huntingtin* gene contains many repeats of a triplet sequence of nucleotides, CAG. The age at which symptoms of HD first appear is linked with the number of CAG repeats.

This is shown in Fig. 1.1.

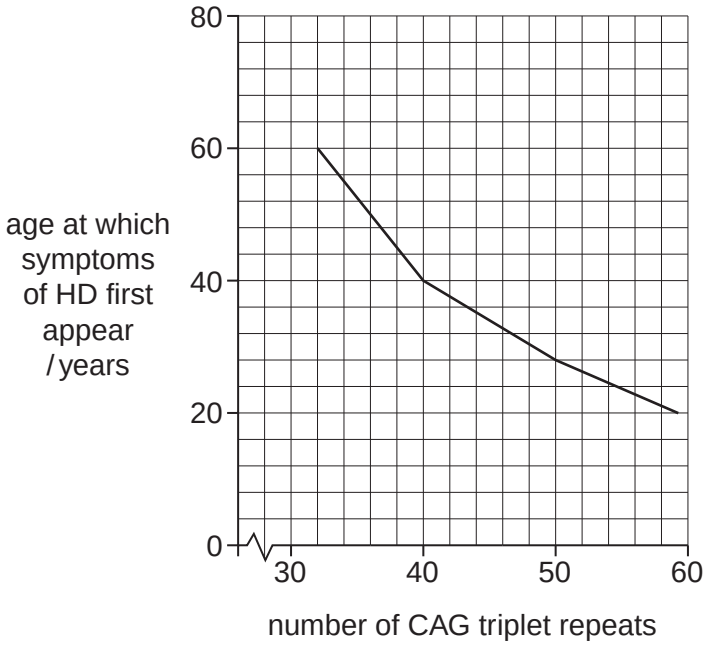

Fig. 1.1

Describe the pattern shown in Fig. 1.1.

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.....[2]

(c) A blood test to detect the dominant allele is available for people at risk of HD.

Suggest why some people at risk of HD may decide **not** to take the blood test.

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[Total: 7]