

Passage of information from parent to offspring

Question Paper 2

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 2

Time Allowed : 66 minutes

Score : / 55

Percentage : /100

Grade Boundaries:

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

1 Resistance to the poison warfarin is now extremely common in rats. Warfarin inhibits an enzyme in the liver, vitamin K epoxide reductase, that is necessary for the recycling of vitamin K. This vitamin is involved in the production of substances required for blood clotting.

- Rats susceptible to warfarin die of internal bleeding.
- Rats that are homozygous for resistance to warfarin do not suffer from internal bleeding when their diet provides more than 70 µg of vitamin K per kg body mass per day.
- Heterozygous rats are resistant to warfarin when their diet provides about 10 µg of vitamin K per kg body mass per day.

(a) Using appropriate symbols, complete the genetic diagram to show how two resistant rats can produce warfarin-susceptible offspring.

key to symbols

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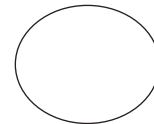
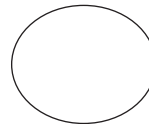
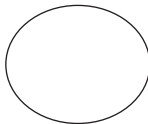
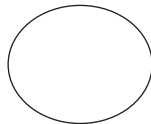
parental
phenotypes

resistant male

resistant female

parental
genotypes

gametes



offspring
genotypes

offspring
phenotypes

[3]

(b) Rats that are homozygous for warfarin resistance have a low survival rate in the wild. Suggest why this is so.

.....
 [1]

- (c) Warfarin can be safely given to humans who are at risk of unwanted blood clots. The clotting time of the blood is measured regularly and the warfarin dose is varied accordingly.

Suggest, giving a reason, the type of inhibition warfarin has on the enzyme vitamin K epoxide reductase.

type of inhibition

reason

..... [2]

- (d) The allele for warfarin resistance may have originated by a single base substitution and resulted in a modified vitamin K epoxide reductase.

Explain how a single base substitution may affect the phenotype of an organism.

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..... [3]

[Total: 9]

- 2 (a) Explain what is meant by the term *heterozygous genotype*.

heterozygous

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genotype

..... [2]

- (b) The budgerigar, *Melopsittacus undulatus*, is a small type of parrot that is native to Australia.

Fig. 7.1 shows a budgerigar.



Fig. 7.1

A budgerigar can have blue, green, yellow or white feathers.

Two genes, **A/a** and **D/d**, are involved in the inheritance of feather colour in budgerigars.

- A bird which has at least one dominant allele **A** but is homozygous for **d** has blue feathers.
- A bird which has at least one dominant allele **D** but is homozygous for **a** has yellow feathers.
- A bird with at least one dominant **A** allele **and** one dominant **D** allele has green feathers.
- A bird that is homozygous for **a** and **d** has white feathers.

- (c) Two green-feathered budgerigars, heterozygous at both gene loci, were crossed.

Draw a genetic diagram of this cross to show the probability of producing offspring with yellow feathers.

[6]

[Total: 8]

3 Maize, *Zea mays*, is a major cereal food crop. Unlike most crop plants, maize seed is produced by hybridisation between two different inbred parental strains.

(a) (i) Explain why this is done.

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..... [3]

(ii) Suggest **one** disadvantage of producing seed in this way.

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..... [1]

(b) In the light-independent stage of photosynthesis, the enzyme rubisco catalyses the combination of carbon dioxide with ribulose biphosphate, RuBP. When the carbon dioxide concentration within the leaf is very low, rubisco tends to combine oxygen, rather than carbon dioxide, with RuBP. This process is called photorespiration. It reduces carbon dioxide assimilation and therefore reduces crop yields.

Photorespiration is most likely to happen in hot, dry conditions.

(i) Suggest **why** photorespiration is most likely to take place in hot, dry conditions.

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..... [3]

- (i) Suggest an explanation for the lack of effect of carbon dioxide concentration on the rate of photosynthesis in maize plants, shown by these results.

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..... [2]

- (ii) Suggest **one** explanation for the changes in the rate of photosynthesis between 0700 hours and 1900 hours on day 1.

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..... [2]

[Total: 15]

- 4 Huntington’s Disease (HD) is a severe neurological disorder in which symptoms usually appear after the person has reached sexual maturity. Symptoms include memory loss and changes in personality and mood.

HD is caused by a gene mutation on chromosome 4 in which the triplet code CAG is repeated many times. The resulting allele is dominant.

- (a) Explain what is meant by the terms gene mutation and triplet code.

gene mutation

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triplet code

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..... [4]

- (b) A couple wish to start a family. The man does not have HD but the woman does have the disease. The woman’s father does not have the disease.

Complete the genetic diagram below to show the probability of the couple’s first child having HD.

key
Huntington allele = T
normal allele = t

<i>parental phenotypes</i>	man without HD	woman with HD
<i>parental genotypes</i>	.....	.....
<i>gametes</i>	.....	.....
<i>offspring genotypes</i>	.....
<i>offspring phenotypes</i>	.....
<i>probability of first child having HD</i>	..... [3]	

[Total: 7]

5 In humans a rare, sex-linked, recessive allele results in a change in the shape of the iris in the eye. This condition is known as cleft iris (CI).

(a) Explain what is meant by the term *sex linkage*.

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..... [2]

(b) Using suitable symbols complete the genetic diagram below.

Key to symbols

recessive allele

dominant allele

parental phenotypes male with CI X no mal female

parental phenotypes

gametes

offspring genotypes

offspring phenotypes [5]

(c) A woman who is heterozygous for CI becomes pregnant by a man with a normal iris.

State the probability that their child will have CI.

..... [1]

[Total: 8]

- 6 (a) The inheritance of coat colour in horses is complex but all horses have one of two base colours, red (chestnut) or black. The base colour is controlled in a simple monohybrid way.
- When chestnut stallions and mares are mated the foals are always chestnut.
 - When black stallions are mated with black mares, either black or chestnut foals may be produced.

Draw a genetic diagram to show how two parents with black coat colour can produce a chestnut foal **and** the probability of such an event occurring.

Choose a letter symbol to represent coat colour.

(b) Five other genes can modify the base coat colour.

One of these genes is the **C** gene. There are two alleles of this gene, **C** and **C^{CR}**.

- **C** does not affect the base coat colour.
- **C^{CR}** may modify the base coat colour.
- If a chestnut horse has at least one **C^{CR}** allele its phenotype will be palomino, which is a light cream colour.
- If a black horse has at least one **C^{CR}** allele its effect will not be noticeable in the phenotype.

Complete the genetic diagram below.

<i>parental genotype</i>	aaCC^{CR}	AaCC
<i>parental phenotype</i>	.....	.....
<i>gametes</i>	.....	.....
<i>offspring genotypes</i>	.....	.....
<i>offspring phenotypes</i>	.....	.....

[4]

[Total: 8]