Patterns of Inheritance Question Paper 1

Level	A Level
Subject	Biology
Exam Board	OCR
Module	Genetics, evolution and ecosystems
Торіс	Patterns of inheritance
Booklet	Question Paper 1

Time allow	ed:	49 minute	es			
Score:		/36				
Percentage:		/100	/100			
Grade Bour	ndaries:					
A*	А	В	С	D	E	
>69%	56%	50%	42%	34%	26%	

Selection pressure can affect homozygous individuals. The effect can be investigated using a model gene pool.

A large gene pool is necessary to ensure that

- A genetic drift can occur if frequency is higher.
- **B** homozygous individuals are present in high frequency.
- C the effect of chance variations in gene frequencies are minimised.
- **D** Hardy–Weinberg equilibrium is achieved.

[Total: 1]

<u>CHEMISTRY ONLINE</u> — TUITION —

Four different eye pigments in the fruit fly, *Drosophila melanogaster*, are made from the amino acid tryptophan. A simplified metabolic pathway of pigment production is shown in Fig. 2.1.

Three different gene loci control the pathway. Each locus has two alleles. These alleles are **V** or **v**, **C** or **c** and **B** or **b**, as shown in Fig. 2.1.





(a) (i) Using the information in Fig. 2.1, deduce the phenotypes of flies with the following genotypes:

	genetypee.		[3]
	genotype	phenotype	
	VvCcBb		
	VVCCBB		
	VvccBB		
(ii)	State the term that is app	blied to this type of gene interaction.	[1]

(iii) Explain how the products coded for by the genes interact to give the different pigments.

[3]

(b) A mutation in another gene at another locus in *Drosophila* gives rise to white-eyed flies. The red eye allele of this gene (**R**) is known to be dominant to the white eye allele (**r**).

A student crossed a red-eyed fly with a white-eyed fly, expecting to get an F1 generation of red-eyed flies. In fact, the results were as shown in Table 2.1.

phenotype of fly	number of offspring
red-eyed female	27
red-eyed male	0
white-eyed female	0
white-eyed male	23

Table 2.1	
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(i) The student first suggested that the reason for there being red-eyed and white-eyed flies in the offspring was that the red-eyed parent was heterozygous.

Explain why this **cannot** be the correct explanation for the results shown in Table 2.1.

[2]

(ii) In *Drosophila*, the males are the heterogametic sex, possessing two different sex chromosomes, X and Y.

Draw a genetic diagram to show how the results shown in Table 2.1 could have been produced. [3]

Parental genotypes	TOTAL	TT TATT
Gametes		

F₁ genotypes

(iii) The chi-squared (χ^2) test can be used to analyse the results in Table 2.1. The expected ratio of red-eyed females to white-eyed males is 1:1.

Use Table 2.2 to calculate a value for chi-squared (χ^2).

$$\chi^{2}=\Sigma \quad \frac{(O-E)^{2}}{E} \qquad df = n-1 \qquad \qquad \Sigma = \text{`sum of ...'} \\ df = degrees of freedom \\ n = number of classes \\ O = observed value \\ E = expected value \end{cases}$$



phenotype of fly	0	E	0 – E	(O – E) ²	$\frac{(O-E)^2}{E}$
red-eyed female					
white-eyed male					

Use your calculated value of χ^2 and the table of probabilities shown in Table 2.3 to test the significance of the difference between the observed and expected results.

State your conclusion in the space below.

degrees of		probal	bility, p	
freedom	0.90	0.50	0.10	0.05
	0.02	0.45	2.71	3.84
2	0.21	1.39	4.61	5.99

Conclusion

[Total: 16]

[4]

Question 3

Wheat is an important food crop in many European countries. Developments in farming allowed the yield of wheat produced by farms in the UK to increase rapidly in the second half of the 20th century.

Fig. 4.1 shows the increase in the yield of wheat from 1947 to 1992. The graph also shows the increase that is thought to be as a result of the development of new varieties through selective breeding.



- (b) Explain how the selective breeding that led to this increased yield could have been done. [4]
- (c) State **two** developments, other than selective breeding, that could account for the total increase in wheat yield per hectare.

[Total: 9]

[2]



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(a) Fig. 6.1 shows a number of examples of inheritance.

Α	An <i>Antirrhinum</i> plant with red flowers is crossed with one that has white flowers. All the offspring have pink flowers.

	A haemophiliac man has children with a woman who is not a haemophiliac.
В	Their daughters all carry the allele for the disease, but their sons do not
	have the disease.

	A short-haired black mouse crossed with a long-haired brown mouse			
	produces all short-haired black offspring.			
D	Mating one of these offspring with the long-haired parent produces mice in			
	the ratio of 1 short-haired black : 1 long-haired black : 1 short-haired brown :			
	1 long-haired brown.			

-	Two snails with plain shells produce 34 offspring with plain shells and 12
-	with striped shells.

Fig. 6.1

Complete the table below, by matching each of the examples **A** to **E** to the correct explanation of their pattern of inheritance.

Explanation	Letter of example
One gene with two alleles. The alleles show codominance.	NLINE
One gene with two alleles located on an autosome (gene not sex linked). One allele is dominant and the other is recessive.	
Two genes for two different characteristics on two different chromosomes.	
A sex linked gene with a dominant and a recessive allele.	
Epistasis, where two genes interact to affect one phenotypic character.	

[5]

(b) The Hardy-Weinberg principle, represented by the equations below, can be used to estimate the frequency of alleles in a population.

$$p^{2} + 2pq + q^{2} = 1$$

 $p + q = 1$

Albino rabbits have white fur as these individuals are unable to produce the pigment melanin. The ability to produce melanin is controlled by a gene with a dominant allele (B), resulting in brown fur, and a recessive allele (b), resulting in an albino.

Of the 60 rabbits in a pet shop, 45 are brown.

(i) A student decided to use the Hardy-Weinberg principle to estimate the frequencies of the alleles in this group of rabbits.

Using the Hardy-Weinberg equations, calculate the frequency of the dominant allele in this group.

Show your working.

[3]

(ii) Give two reasons why it was not appropriate to use the Hardy-Weinberg principle to estimate the frequencies of alleles in this group of rabbits in the pet shop.

[2]

[Total: 10]