

10.2 Inheritance

Question Paper

Course	DP IB Biology
Section	10. Genetics & Evolution (HL Only)
Topic	10.2 Inheritance
Difficulty	Medium

Time allowed: 60
Score: /45
Percentage: /100

Question 1a

a)
Hair colour and eye colour are traits controlled by genes. Many people with blonde hair also have blue eyes.
Suggest a reason for this occurrence.

[1 mark]

Question 1b

b)
In the common pea plant (*Pisum sativum*), the allele **P**, for purple flowers, is dominant to the allele **p**, for white flowers. The allele **I**, for inflated seed pods, is dominant to the allele **i**, for constricted seed pods. Two pea plants, heterozygous for both characteristics are crossed.

State the possible genotypes of the offspring by completing the Punnett Square table below.

		Gametes from parent 2			
Gametes from parent 1					

[4 marks]

Question 1c

c)
The result of this genetic cross was 112 seeds being produced by the parent plants.

Calculate the expected number of offspring that would have white flowers and constricted seed pods.

[2 marks]

Question 2a

a)

The gene for body colour and antennal shape in the fruit fly (*Drosophila melanogaster*) are close together on the same chromosome. These genes are therefore said to be linked.

Allele **E** for a striped body is dominant over allele **e** for an ebony body. Allele **A** codes for the dominant normal antennae, whereas allele **a** codes for an aristopedia antennae. Aristopedia antennae resemble a *Drosophila* leg rather than an antennae.

A male that is heterozygous for striped body and normal antennae is crossed with female that has an ebony body and aristopedia antennae.

State the possible allele combinations in the gametes of these flies. Use the correct notation in your answer.

[2 marks]

Question 2b

b)

State the possible phenotypes of the offspring of this genetic cross, along with the predicted ratios of each.

[2 marks]

Question 2c

c)

Explain why it may still be possible for recombinant offspring to appear in this genetic cross, even though the genes are linked.

[2 marks]

Question 2d

d)

Describe the idea that Thomas Hunt Morgan proposed to explain the variation observed in the number of recombinants that resulted from crossing linked genes.

[2 marks]

Question 3a

a)

Describe the early events that lead scientists to discover exceptions to Mendel's predicted phenotypic ratios for dihybrid crosses.

[2 marks]

Question 3b

b)

Recombinant offspring are those that have a different allele combination to their parents.

Explain how test crosses can be used to identify recombinant individuals in offspring.

[2 marks]

Question 3c

c)

A set of identical twins were raised in similar conditions by the same parents. One of the twins fell off a swing, which left a permanent scar on his chin.

State the impact this would have on the phenotypic variation between the twins.

[1 mark]

Question 3d

d)

Shepherd's purse (*Capsella bursa*) is a flowering plant which belongs to the mustard family. Fruit shape in this plant is determined by two alleles, namely allele **T** for a triangular fruit shape, which is dominant over allele **t** for top-shaped fruit. A plant with triangular shaped fruit was crossed with a plant that has top-shaped fruit. All 30 offspring of this cross had triangular shaped fruit.

State, with a reason, whether there can be certainty that the original parent plant with triangular shaped fruit had a genotype of **TT**.

[2 marks]

Question 4a

a)

In fruit flies (*Drosophila melanogaster*) wing length and body colour are each controlled by a single gene with two alleles. Allele **L** for long wings is dominant over allele **l** for vestigial wings, while allele **G** for grey body colour is dominant over allele **g** coding for ebony body colour.

Two homozygous fruit flies were crossed, one had a grey body colour and long wings while the other had an ebony body colour and vestigial wings.

State, with a reason, the number of offspring that would display a grey body colour and vestigial wings if 350 offspring were produced from this cross.

[2 marks]

Question 4b

b)

Two fruit flies from this cross, heterozygous for both body colour and wing length, were crossed and 3 200 offspring were produced.

Calculate the expected number of offspring that would display the following phenotypes, assuming that the genes for body colour and wing length are not linked.

Phenotype	Expected number of offspring
Grey body, long wings	
Grey body, vestigial wings	
Ebony body, long wings	
Ebony body, vestigial wings	

[1 mark]

Question 4c

c)

The results for the cross were different from what was expected. Scientists decide to perform a chi-squared test to determine if the difference is significant.

Calculate the value of χ^2 by completing the following table:

Phenotype of offspring	Observed (O)	Expected (E)	$(O - E)$	$(O - E)^2$	$\frac{(O - E)^2}{E}$
Grey body, long wings	1 650				
Grey body, vestigial wings	600				
Ebony body, long wings	690				
Ebony body, vestigial wings	260				
$\Sigma \frac{(O - E)^2}{E} =$					

[2 marks]

Question 4d

d)

The table shows values for χ^2 at different levels of probability and for different degrees of freedom.

Degrees of freedom	Probability, p				
	0.2	0.1	0.05	0.02	0.01
1	1.64	2.71	3.84	5.41	6.64
2	3.22	4.61	5.99	7.82	9.21
3	4.64	6.25	7.82	9.84	11.35
4	5.99	7.78	9.49	11.67	13.28
5	7.29	9.24	11.07	13.39	15.09

State the conclusion the scientists should make about the significance of their results and explain your answer.

[3 marks]

Question 5a

One mark is available for clarity of communication throughout this question.

a)

Contrast continuous and discontinuous variation.

[7 marks]

Question 5b

b)

Explain the use of a chi-squared test on data from a dihybrid cross.

[4 marks]**Question 5c**

c)

Describe sex linkage and autosomal linkage in genes.

[4 marks]



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