Pearson Edexcel

Additional Assessment Materials
Summer 2021

Pearson Edexcel GCE in A Level Biology

Topic 8: Origins of Genetic Variation

(Public release version)

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Additional Assessment Materials, Summer 2021

General guidance to Additional Assessment Materials for use in 2021

Context

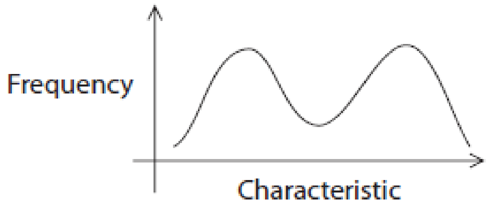
- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional Assessment Materials have been drawn from previous examination materials, namely past papers.
- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.

Purpose

- The purpose of this resource to provide qualification-specific sets/groups of questions covering the knowledge, skills and understanding relevant to this Pearson qualification.
- This document should be used in conjunction with the mapping guidance which will map content and/or skills covered within each set of questions.
- These materials are only intended to support the summer 2021 series.

1

(a) The graph shows the frequency of a characteristic found in a population of animals.



Which type of selection would create this pattern?

(1)

☒ **A** allopatric selection

☒ **B** directional selection

☒ **C** disruptive selection

☒ **D** stabilising selection

(b) The Eurasian lynx is the largest native European cat species.

It was once widespread across Europe but is now restricted to small areas of national parks.

Ex-situ and *in-situ* conservation measures were used in the 1970s to increase biodiversity.

- Lynx were bred in zoos and 10 were reintroduced into an area of protected forest where the lynx had become extinct.
- Existing wild lynx were protected in an area of forest where they had not become extinct.

In 2016 scientists estimated the population sizes and genetic biodiversity of the lynx in these two areas of forest.

They found that the population and genetic biodiversity of the lynx in the area where they had been reintroduced were much lower than in the protected area.

(i) State what is meant by the term **biodiversity**.

(1)

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(ii) Explain why, in 2016, the genetic biodiversity of the lynx population in the area where they had been reintroduced was much lower than in the protected area.

(2)

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(c) Explain the principles and issues associated with *ex-situ* conservation methods.

(4)

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2

In the fruit fly, *Drosophila*, the allele for normal wings (**N**) is dominant to the allele for vestigial (small) wings (**n**).

The allele for red eyes (**R**) is dominant to the allele for sepia eyes (**r**).

In an investigation, students crossed homozygous parent flies. Flies with normal wings and red eyes were crossed with flies with vestigial wings and sepia eyes.

All the F_1 offspring of this cross had normal wings and red eyes.

Flies from this F_1 generation were crossed and the phenotypes of their offspring (F_2 generation) were counted.

The results for the F_2 generation are shown in the table.

***Drosophila* phenotype**	**Number of *Drosophila* with each phenotype**
normal wings and red eyes	885
normal wings and sepia eyes	322
vestigial wings and red eyes	286
vestigial wings and sepia eyes	107

The students thought that the genes for wing length and eye colour were on different chromosomes.

(a) (i) State a null hypothesis for this investigation.

(1)

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(ii) A Chi squared test was carried out to test this hypothesis.

Complete the table.

(1)

Phenotype	**Expected ratio**	**Observed results (O)**	**Expected results (E)**	**(O − E)**	**$(O - E)^2$**	**$\frac{(O - E)^2}{E}$**
normal wings and red eyes	9	885	900			
normal wings and sepia eyes	3	322	300	22	484	1.61
vestigial wings and red eyes	3	286	300	−14	196	0.65
vestigial wings and sepia eyes	1	107	100	7	49	0.49

(iii) Calculate the value of Chi squared using the formula

(1)

$$\chi^2 = \sum \frac{(O - E)^2}{E}$$

Answer ....

(iv) The table shows some critical values of Chi squared at different degrees of freedom.

Degrees of freedom	p value				
	0.900	**0.500**	**0.100**	**0.050**	**0.010**
1	0.016	0.455	2.706	3.841	6.635
2	0.211	1.386	4.605	5.991	9.210
3	0.584	2.366	6.251	7.815	11.345
4	1.064	3.357	7.779	9.488	13.277

Use this table to comment on the results of the investigation.

(3)

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*(b) In *Drosophila*, the allele for grey bodies (**G**) is dominant to the allele for black bodies (**g**).

In a second investigation, students crossed homozygous parent flies. Flies with normal wings and grey bodies were crossed with flies with vestigial wings and black bodies.

All the F_1 offspring had normal wings and grey bodies.

Flies from this F_1 generation were crossed and the phenotypes of their offspring (F_2 generation) were counted.

The results are shown in the table.

***Drosophila* phenotype**	**Number of *Drosophila* with each phenotype**
normal wings and grey body	1105
normal wings and black body	85
vestigial wings and grey body	72
vestigial wings and black body	338

Explain the results of this second investigation.

(6)

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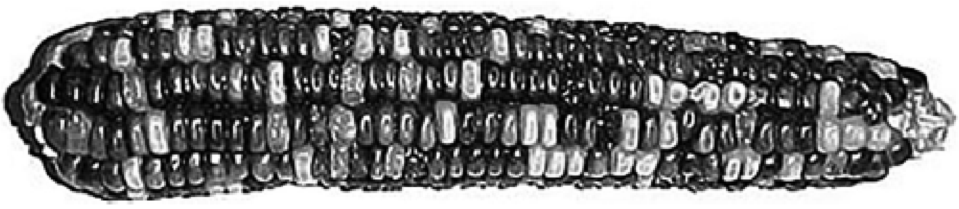
3

The photograph shows a maize cob with smooth, wrinkled and different coloured grains.



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The shape and colour of maize grains are controlled by two unlinked genes.

The allele for smooth seeds (A) is dominant to the allele for wrinkled seeds (a).

The allele for purple seeds (B) is dominant to the allele for yellow seeds (b).

(a) State all the possible genotypes of a smooth, purple grain.

(1)

(b) Two maize plants, grown from grains that were both wrinkled and purple, were cross-pollinated.

In the F_1 generation, some grains were wrinkled and purple and some were wrinkled and yellow.

Which of the following shows the genotypes of the parent plants?

(1)

☒ **A** AaBb × AaBb

☒ **B** aaBB × aaBB

☒ **C** AABb × AABB

☒ **D** aaBb × aaBb

(c) A student cross-pollinated a maize plant grown from a smooth, purple grain (heterozygous for both pairs of alleles) with a maize plant grown from a wrinkled, yellow grain.

Using a genetic diagram, determine the probability that this cross will produce grains that are wrinkled and purple.

(4)

Answer ....

4

Cystic fibrosis is a recessive inherited condition where the cells in the lungs produce sticky mucus. This mucus builds up in the airways, causing breathlessness and chest infections.

People with cystic fibrosis often need treatments such as physiotherapy and antibiotics.

(a) The incidence of babies born with cystic fibrosis in Australia is 1 in 2500.

Use the Hardy Weinberg equation, $p^2 + 2pq + q^2 = 1$, to calculate the percentage of Australians who are carriers of cystic fibrosis.

(4)

Answer .... %

(b) A woman is a carrier of the cystic fibrosis allele. Her partner does not have cystic fibrosis and is not a carrier.

Use a genetic cross to determine the probability of this woman producing a child who is also a carrier.

(4)

Probability ....

5

Some health disorders, such as sickle cell anaemia, have a genetic basis.

People who are at risk of these disorders can be identified using genetic tests.

Hospital managers need to predict the future cost of treating people with health disorders.

It has been claimed that the Hardy-Weinberg equation ($p + q = 1$ or $p^2 + 2pq + q^2 = 1$) could be used to predict the number of people who would need treatment for health disorders.

Discuss the validity of this claim.

(9)

TOTAL FOR TEST = 43 MARKS