Pearson Edexcel

Additional Assessment Materials Summer 2021

Pearson Edexcel GCSE in Biology (1BI0) Higher

Resource Set Topic 3: Genetics

Questions

(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- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.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.

7.

(b) Mendel's research on pea plants showed that genetic traits are inherited.

(i) Which term is used to describe the expression of traits in an organism?

(1)

☒ **A** genotype

☑ **B** phenotype

☒ **C** allele

☒ **D** gamete

(ii) Mendel crossed pea plants that produced round seeds with pea plants that produced wrinkled seeds.

All the offspring produced round seeds.

He then crossed these offspring with each other.

Some pea plants in the next generation produced round seeds and the others produced wrinkled seeds.

Explain how this showed that some inherited traits are not expressed in an organism.

(3)

All of the offspring in the first generation are heterozygous. They have alleles for both round seeds and wrinkled seeds, but only the dominant trait, round seeds, is expressed. In the next generation, 75% of the offspring have round seeds. 25% have wrinkled seeds as they are homozygous for the recessive allele.

7.

(c) Duchenne muscular dystrophy is a recessive sex-linked genetic disorder.
This disorder causes muscle weakness.

Figure 14 shows the inheritance of Duchenne muscular dystrophy in a family.

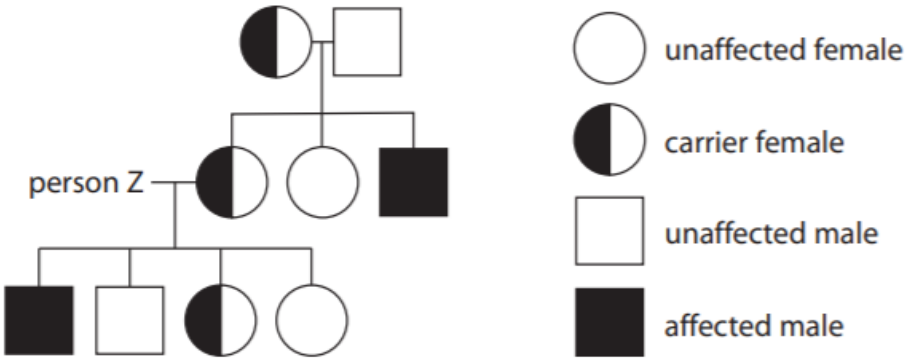

Figure 14

State and explain the phenotype of person Z.

(3)

Person Z is an unaffected carrier female. Carrier means she has one dominant allele and one recessive allele. The dominant allele masks the effect of the recessive allele thus the phenotype is same as the someone with 2 dominant alleles. However she can still pass down the recessive allele to her children.
(Person Z received the recessive allele from her mother and the dominant allele from her father)

9.

(b) Figure 17 shows the structure of a DNA nucleotide.

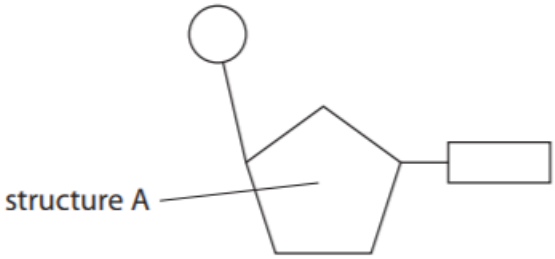

Figure 17

(i) Structure A is a

(1)

☒ **A** base

☒ **B** phosphate

☒ **C** sugar

☒ **D** polymer

*(ii) In 2003, the first complete human genome was sequenced.

The genomes of different people have small changes in the sequence of the DNA bases.

Describe how these changes in DNA sequence can affect the individuals and how sequencing a person's genome could influence their medical treatments.

(6)

Changes in the sequence of DNA bases is mutation. Different alleles for the gene are formed which give different phenotypes. Mutation leads to different amino acid being formed or key amino acid being not formed / become non-functional. Sequencing a person's genome can help to identify any genetic diseases, or if the individual have a higher risk of developing a certain disease. The individual can then take precautions to decrease the likelihood of developing the disease. Genome sequencing also allows the individual to receive personalised treatment. For example, DNA of cancer cell can be sequenced and be compared to the sequence found by Human Genome Project. This allows the scientists to work out which genes are mutated. Using this information, scientists can produce monoclonal antibodies that specifically targeted cancer cells with a specific mutation.

Moreover, sequencing human genome allows gene therapy to be used to treat diseases as well as forms personalised drugs to increase the effectiveness of the drugs.

(ii) Myxopyronin inhibits bacterial RNA polymerase.

Explain why the antibiotic myxopyronin can be used to treat bacterial infections in humans.

(4)

Myxopyronin can kill bacteria without killing human cells. By inhibiting bacterial RNA polymerase, myxopyronin prevents transcription in bacteria. Translation is also prevented so proteins cannot be synthesised. The RNA polymerase of bacteria is different to the RNA polymerase of humans.

2 (a) A scientist obtained a mass of 0.0062 nanograms of DNA from a diploid human cell.

Calculate the mass of DNA the scientist should obtain from a haploid human cell.

Give your answer in picograms.

(1 nanogram = 1000 picograms)

(2)

0.0062 nanograms = (0.0062 × 1000) picograms

= 6.2 picograms

$\frac{6.2}{2} = 3.1$

3.1 picograms

(b) A student used the method shown in Figure 3 to compare the mass of DNA extracted from strawberry fruit cells and from kiwi fruit cells.

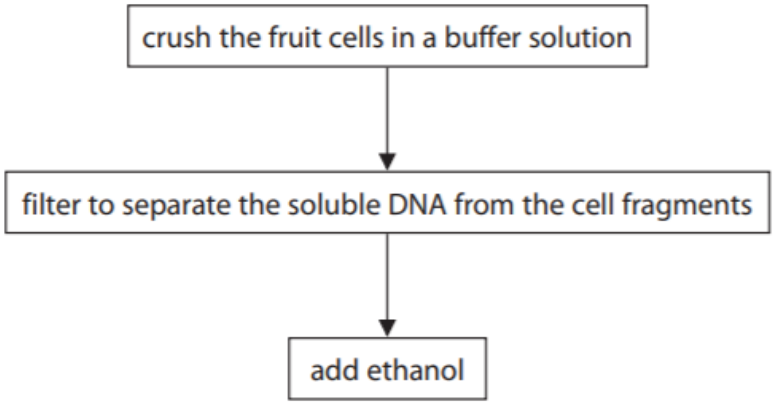

Figure 3

(i) State why ethanol is used.

(1)

DNA is insoluble in ethanol so it will be isolated from the solution

(ii) State **two** variables the student needs to control when using this method to compare the mass of DNA from these two fruits.

(2)

1 mass of fruit used

2 concentration of ethanol

(iii) The student repeated the experiment.

Give **one** reason why.

(1)

So that a mean can be calculated, which is more accurate than a single mass. It increases reliability.

(c) Mitosis and meiosis are processes that produce new cells.

Compare the outcomes of mitosis and meiosis.

(3)

In mitosis, daughter cells are genetically identical to the parent. 2 diploid daughter cells are produced. In meiosis, 4 haploid daughter cells, which are genetically different from the parent, are produced.

9 Transcription and translation are stages in the synthesis of proteins.

(a) (i) Which enzyme is involved in the process of transcription?

(1)

- ☐ **A** DNA ligase
- ☐ **B** lysozyme
- ☒ **C** RNA polymerase
- ☐ **D** restriction endonuclease

(ii) Describe how a mutation in the non-coding region of the DNA can prevent a gene being transcribed.

(2)

The mutation can be in the promotor region, preventing transcription factors from binding so transcription cannot occur.

(b) A gene coding for a protein has two alleles.

Figure 14 shows the first 5 codons of an mRNA strand for these alleles.

Allele 1 – AUG CCA CAG GAG UUC

Allele 2 – AUG CCA GAG GAG UUC

Figure 14

Allele 2 has a mutation.

Figure 15 shows the key needed to predict the translated amino acid sequence of the protein.

codon	AUG	CCA	CAG	GAG	UUC
amino acid	Met	Pro	Gln	Glu	Phe

Figure 15

Explain how the mutation in allele 2 could affect the functioning of this protein.

(3)

In allele 2, base C is mutated into G.
During translation, glu is added to the polypeptide chain instead of Gln. The two proteins have different side chains, so the structure and the shape / folding of the protein is affected. If the protein was an enzyme, it can no longer bind to its substrates becoming non-functional.

*(c) The inheritance of different alleles affects the phenotype of an individual.

A child is blood group O.

The child's mother is blood group A and the child's father is blood group B.

Explain how this child is blood group O.

Use the Punnett square and probability in your answer.

(6)

		father: I^B	father: I^O
mother	I^A	$I^A I^B$ group AB	$I^A I^O$ group A
	I^O	$I^B I^O$ group B	$I^O I^O$ group O

The allele I^O is recessive to both I^A and I^B. Both parents have a copy of the I^O allele which is passed on to the child, so the child has 2 copies of I^O and is blood group O. (25% of having a child with blood group O).

(ii) State what is meant by the term genome.

(1)

Genome is the entire genetic material of an organism.

4 Gregor Mendel used pea plants in plant breeding experiments. He discovered the basis of genetic inheritance.

(a) He cross-bred tall pea plants with short pea plants.

All the offspring were tall, as shown in Figure 4.

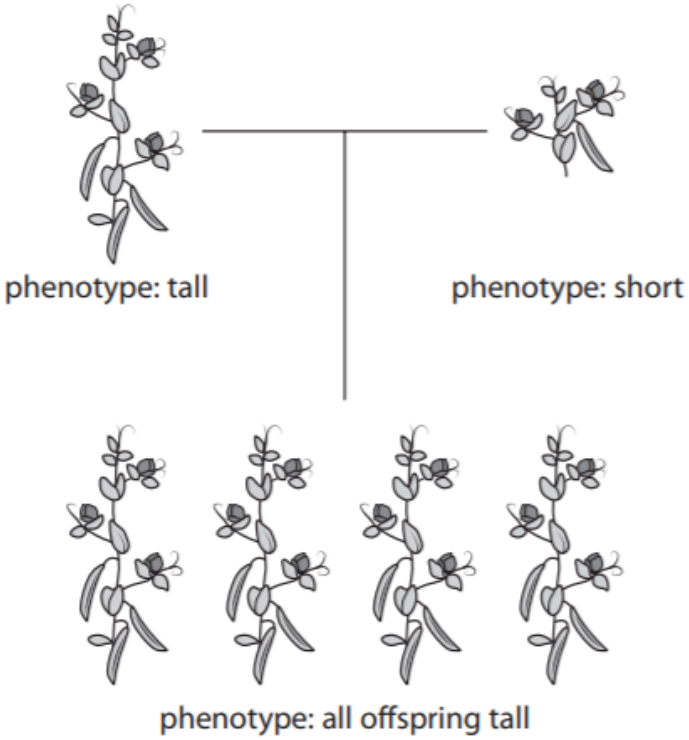

Figure 4

(i) Explain why the offspring are all tall.

(2)

Both parents are homozygous so all offspring are heterozygous.
The allele for tall pea plants is dominant, so all offspring are tall.

(ii) In this investigation, the parent pea plants were grown in a warm, closed greenhouse.

Give **two** reasons why the parent pea plants were grown in a warm, closed greenhouse.

(2)

1 the temperature is optimal for the growth of pea plants

2 suitable conditions for photosynthesis

(b) Pea plants produce different coloured peas.

The allele for yellow-coloured peas (A) is dominant to the allele for green-coloured peas (a).

Two heterozygous parent plants were used in a genetic cross.

(i) Predict, using the Punnett square, the percentage probability that this cross will have offspring that produce green-coloured peas.

(3)

parent 2

parent 1

	A	a
A	AA yellow pea	Aa yellow pea
a	Aa yellow pea	aa green pea

percentage probability of green-coloured peas = 25 %

(ii) Explain **one** advantage to pea plants of using sexual reproduction to produce offspring.

(2)

There is genetic variation in the offspring which allows better adaptations and survival of the species.

5 Figure 5 shows a great tit on a bird feeder.

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Figure 5

Scientists have found that great tits living now have longer beaks than great tits living 50 years ago.

Genetic analysis shows changes in the sequence of the bird's DNA.

(a) (i) Give the complementary strand sequence for this DNA template.

(1)

A	T	G	T	T	A	C	G	T
:	:	:	:	:	:	:	:	:
T	A	C	A	A	T	G	C	A

(ii) Which statement correctly describes a DNA molecule?

(1)

☐ **A** two strands joined together by strong bonds to form a double helix

☐ **B** two complementary bases twisted into a double helix by strong bonds

☒ **C** a double helix with strands joined by hydrogen bonds between bases

☐ **D** four complementary strands joined together with hydrogen bonds

(iii) State the term used to describe a change in the sequence of DNA bases.

(1)

mutation

10.

(b) Colour blindness affects approximately 1 in 12 men.

In a city of 2 million people, 51% are men.

(i) What is the number of men who are colour blind in the city?

(1)

☒ **A** 42500 $51\% \times 1\,000\,000 = 510\,000$

☐ **B** 85000

☐ **C** 166666 $\frac{510000}{12} = 42500$

☐ **D** 1020000

(ii) Colour blindness is a sex-linked genetic disorder caused by a recessive allele.

Colour blindness only affects 1 in 200 women.

Explain why more men than women are colour blind.

(2)

The allele is found on the X chromosome. women have 2 copies of the X chromosome but men only have 1, so women need both alleles to be recessive to be affected. Whereas men only need to inherit one recessive allele as they don't have an extra X chromosome which can mask the recessive allele.

(iii) A female without the allele for colour blindness has a baby boy.

The father is colour blind.

Explain the probability of the baby boy being colour blind.

(2)

The baby boy will not be colour blind as he will inherit the Y chromosome from his father and an X chromosome with the allele for normal vision from his mother. (so 0% of being colour blind)

10.

(c) One cause of colour blindness is a change in the DNA sequence of a gene.

This results in the production of a different protein in cone cells in the retina of the eye.

Explain how a change in the DNA sequence of a gene can result in the production of a different protein.

(4)

a nucleotide complementary to the changed base pairs with it so During transcription, the mRNA sequence is changed, resulting in a different amino acid joined in the polypeptide chain. The amino acids have different side chains, which affects the structure of the protein. The protein will have a different shape and properties.

TOTAL = 61 MARKS