Pearson Edexcel

Additional Assessment Materials Summer 2021

Pearson Edexcel GCSE in Biology (1BI0) Foundation

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- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.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

2 Figure 2 shows part of a DNA molecule.

Figure 2

(a) (i) What is the shape of a DNA molecule?

(1)

- ☒ **A** single helix
- ☒ **B** double helix
- ☒ **C** complementary helix
- ☒ **D** triple helix

(ii) Which molecules are present in the DNA backbone?

(1)

- ☒ **A** sugars and phosphates
- ☐ **B** amino acids and bases
- ☐ **C** sugars and bases
- ☐ **D** amino acids and phosphates

(iii) State the type of bond that joins the bases together in the DNA molecule.

(1)

hydrogen

(b) DNA can be extracted from fruit.

Describe how cells are broken down to release DNA.

(2)

- homogenise cells
- mix cells with a detergent solution so the cell membrane undergoes lysis

(c) In 2003, scientists finished sequencing the 3 billion base pairs in the human genome.

State **two** benefits that the Human Genome Project could have for medicine.

(2)

1 locate genes associated with diseases

2 treat genetic disorders

3 Gregor Mendel investigated genetic inheritance using pea plants.

Figure 3 shows some of the equipment used in this investigation.

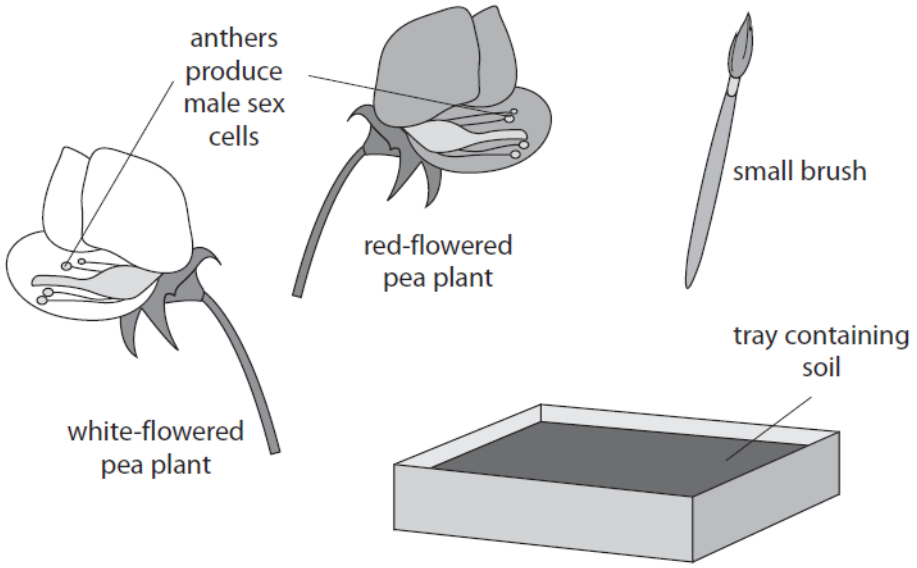

Figure 3

(a) (i) Gregor Mendel crossed red-flowered pea plants with white-flowered pea plants.

Describe how this equipment could be used to do this cross and discover the flower colour of the new pea plants produced.

(3)

- remove pollen from one plant using a brush
- transfer pollen to other plant
- collect the seeds
- grow seeds in soil

(ii) Describe how to make sure that the results obtained from this investigation are not anomalous.

(2)

- repeat
- compare results
- if all results are the same then they are not anomalous

(b) In a different investigation, Mendel crossed pea plants that produced yellow seeds (AA) with pea plants that produced green seeds (aa).
The dominant allele is shown as A.

The Punnett square shows the genotypes of the offspring from this cross.

	A	A
a	Aa	Aa
a	Aa	Aa

Explain a conclusion that can be made from the results of this cross.

(2)

- all offspring are the same (same genotype)
- as dominant allele present in genotype of offspring so heterozygous
- proves that both parents are homozygous

(c) Mendel did his investigations in the 19th century.

State **one** reason why Mendel could not fully explain the results of his investigations.

(1)

chromosomes and alleles not known at the time

1 (a) Figure 1 shows a pea plant with flowers.

Figure 1

(i) Name the type of reproduction involving flowers.

(1)

asexual

(ii) What is the advantage of reproduction involving flowers?

(1)

☒ **A** all the offspring are identical

☐ **B** there is variation in the offspring

☐ **C** there is no fertilisation

☐ **D** all the offspring grow faster

(b) The seeds produced by this pea plant can be round or wrinkled.

The allele for round seeds (R) is dominant to the allele for wrinkled seeds (r).

(i) A homozygous dominant round seeded plant was crossed with a homozygous recessive wrinkled seeded plant.

Complete the Punnett square to show the genotypes of the offspring.

(1)

	r	r
R	Rr	Rr
R	Rr	Rr

(ii) State the percentage of the offspring that will produce round seeds.

(1)

percentage = 100 %

(iii) Which scientist discovered the basis of genetic inheritance by crossing pea plants?

(1)

- ☐ **A** Charles Darwin
- ☐ **B** Alfred Wallace
- ☐ **C** Louis Leakey
- ☒ **D** Gregor Mendel

(c) The blood group of a person is determined by their genotype.

Describe how a person inherits the blood group AB.

(2)

- one parent possesses an allele of A and the other parent possesses an allele of B
- when crossed, there will be a combination of A and B to give AB for one of offspring

6aiii-iv

(iii) Complete the Punnett square to show how gender is inherited.

(2)

		male gametes	
		X	Y
female gametes	X	XX	XY
	X	XX	XY

(iv) State the probability that a child will be male.

(1)

50%.

8 (a) James Watson and Francis Crick built a model that showed that DNA has a double helix structure.

(i) Which statement about DNA is correct?

(1)

☒ **A** each pair of bases is joined by hydrogen bonds

☐ **B** phosphate groups are joined by hydrogen bonds

☐ **C** nucleotides consist of a sugar and a phosphate group only

☐ **D** bases are joined to phosphate molecules

(ii) Figure 13 shows the percentage of each base in human DNA.

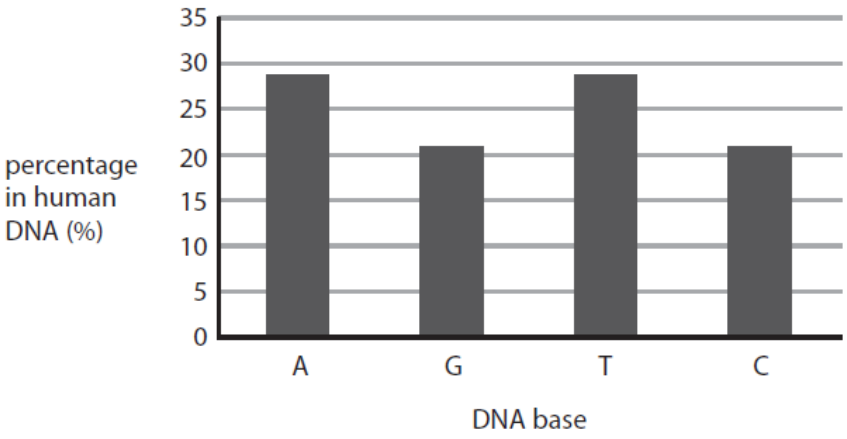

Figure 13

Describe how this data provides evidence for base pairing in DNA.

(2)

- equal percentage of A & T 29% each and G & C 21% each means A only pairs up with T and G only pairs up with C by base pairing rules
- sum of all percentages is 100%.

(b) 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)

$\frac{0.0062ng}{2} = 0.0031ng$

$0.0031ng = 3.1pg$

3.1 picograms

(c) A student used the method shown in Figure 14 to compare the mass of DNA extracted from strawberry fruit cells and from kiwi fruit cells.

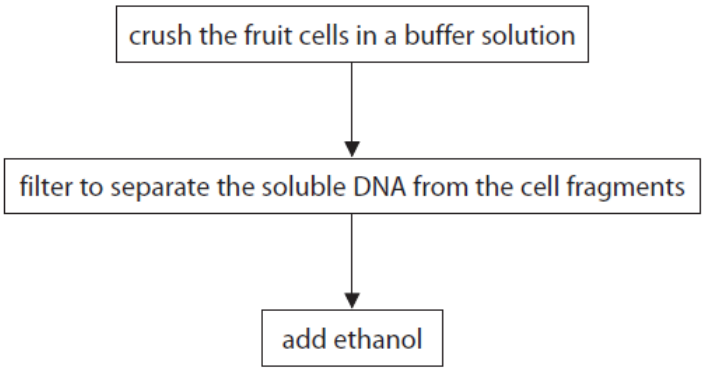

Figure 14

(i) State why ethanol is used.

(1)

to allow DNA to precipitate

(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 same volume & concentration of ethanol

2 same surface area of fruit cells after crushed

(iii) The student repeated the experiment.

Give **one** reason why.

(1)

to increase the reliability by calculating the mean and to identify any anomalies

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

Compare the outcomes of mitosis and meiosis.

(3)

mitosis:
2 daughter cells, genetically identical daughter cells, diploid cells produced

meiosis:
4 daughter cells, genetically different daughter cells, haploid cells produced

5.

(b) The body cells of chickens have 78 chromosomes in their nuclei.

(i) State the number of chromosomes found in each sex cell of a chicken.

(1)

39

(ii) Name the type of cell division which produces sex cells.

(1)

meiosis

(c) (i) What is the correct definition of a genome?

(1)

- ☒ **A** all the cells of an organism
- ☒ **B** all the enzymes of an organism
- ☒ **C** all the genetic material of an organism
- ☒ **D** all the cytoplasm of an organism

(ii) A new project called the Earth BioGenome Project aims to discover the sequence of bases in the DNA for all plants and animals.

State **two** benefits of discovering the sequence of bases for all plants and animals.

(2)

1 genes relating to diseases can be discovered early

2 DNA used for finding cure or treatment to diseases

9c.

*(c) DNA is found in the nucleus of cells.

Describe the structure of DNA and how it can be extracted from plant cells.

(6)

- double helix protects weak hydrogen bonds and thus very stable, storing genetic information
- sugar-phosphate backbone gives strength and protects more chemically reactive organic bases
- weak hydrogen bonds only joining 2 separate strands allows chains to split during DNA replication
- many hydrogen bonds together to link base pairs (A&T, C&G) to give molecule stability
- complementary base pairing, enabling DNA to be replicated
- ① crush plant tissue and homogenise it
  ② mix homogenised cells with a detergent solution
  ③ filter mixture using funnel
  ④ add ethanol to filtrate to precipitate DNA

10 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 16.

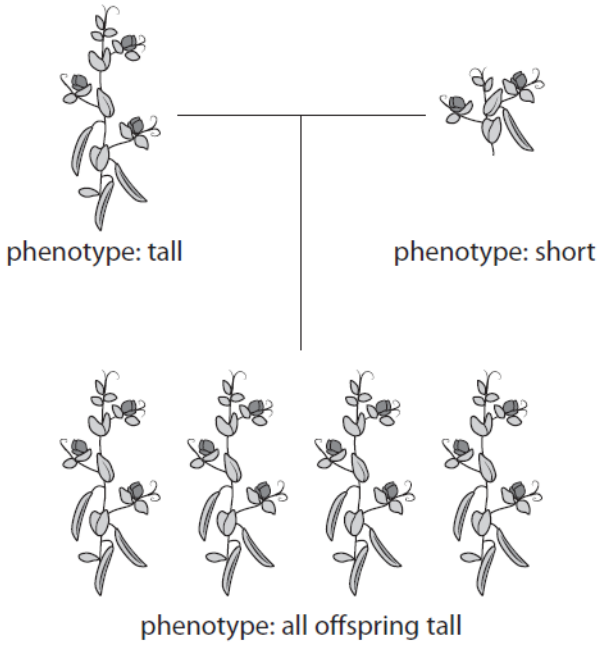

Figure 16

(i) Explain why the offspring are all tall.

(2)

- genotype of tall parent was homozygous dominant
- all offspring would have one tall dominant allele inherited from tall plant so would be 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 warm temperature is the optimal temperature for enzymes involved in growth

2 closed so it provides optimal CO_2 concentration and other conditions constantly for photosynthesis in maximum rate for growth

(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)

	A	a
A	AA	Aa
a	Aa	aa

percentage probability of green-coloured peas = 25 %

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

(2)

- provides genetic variation
- widen gene pool so not all susceptible to same weakness and pathogens

(c) Peas contain small amounts of fat.

Describe a test to identify fat.

(2)

- add ethanol to test tube with fat sample
- pour solution into new test tube and add water
- white emulsion indicates presence of fat

TOTAL = 59 MARKS