



Additional Assessment Materials
Summer 2021

Pearson Edexcel GCE (Biology A)

Resource Set Topic 3: Voice of the Genome.

Question Paper

(Public release version)

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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- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.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 At the start of fertilisation, many sperm cells will surround the ovum.

(a) Fertilisation begins with the acrosome reaction.

(i) Which of the following describes the acrosome reaction?

(1)

- A the ovum releases enzymes that digest the egg cell membrane
- B the ovum releases enzymes that digest the zona pellucida
- C the sperm cell releases enzymes that digest the egg cell membrane
- D the sperm cell releases enzymes that digest the zona pellucida

(ii) Which of the following statements describes the genetic content of a sperm cell?

(1)

	Each sperm cell will contain	Different sperm cells will contain
<input type="checkbox"/> A	one copy of each gene	different alleles of some genes
<input type="checkbox"/> B	one copy of each gene	the same alleles for all genes
<input type="checkbox"/> C	two copies of each gene	different alleles of some genes
<input type="checkbox"/> D	two copies of each gene	the same alleles for all genes

(b) Describe the events of fertilisation that occur after the acrosome reaction.

(3)

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(Total for Question 1 = 5 marks)

(ii) Cells in people with these diseases produce incorrectly folded enzyme molecules.

Explain why enzymes that are incorrectly folded cannot carry out their function.

(3)

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(Total for Question 1 = 7 marks)

2 Lupus is a genetic condition that has various symptoms.

There are several different genes involved in the development of the disease. The symptoms that develop vary depending on genetic and environmental factors.

Stress and exposure to chemicals in the environment can influence the development of lupus.

(a) (i) What is the term that refers to the pattern of inheritance where a single characteristic is determined by more than one gene?

(1)

A epigenetic

B monogenic

C polygenic

D sex-linked

(ii) Which of the following is another environmental factor that could affect the development of lupus?

(1)

A age

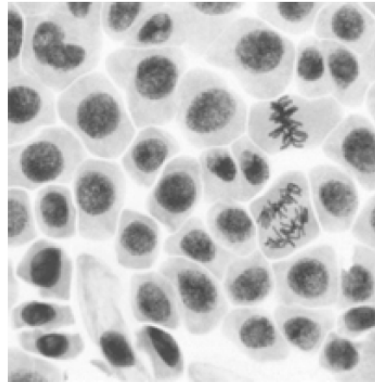
B diet

C gender

D height

5 Cell division can be affected by various chemicals. The effects of these chemicals can be studied by observing tissues.

(a) The photograph shows onion root cells undergoing mitosis.



(i) Draw a line labelled **M** to one cell at metaphase and a line labelled **A** to one cell at anaphase.

(2)

(ii) The rate at which cells are dividing can be determined by calculating the mitotic index.

The mitotic index is the percentage of cells in a sample undergoing mitosis.

The table shows the number of cells at different stages of the cell cycle in one sample.

Stage	Number of cells
Interphase	462
Prophase	23
Metaphase	24
Anaphase	4
Telophase	16

Calculate the mitotic index for the sample of cells shown in the table.

(2)

Answer %

4 Sperm cells have adaptations for their function as male gametes.

(a) Describe how the acrosome is involved in the digestion of the zona pellucida.

(2)

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(b) A sperm cell must reach the egg cell membrane for fertilisation to occur.

The surface area of an egg cell with a diameter of $120\ \mu\text{m}$ was calculated using the formula $4\pi r^2$.

Which of the following is the correct surface area of this egg cell to two significant figures?

(1)

- A $45\,000\ \mu\text{m}^2$
- B $180\,000\ \mu\text{m}^2$
- C $570\,000\ \mu\text{m}^2$
- D $2\,300\,000\ \mu\text{m}^2$

(c) Polyspermy occurs when more than one sperm cell enters the egg.

This is usually prevented by the hardening of the zona pellucida shortly after the arrival of the first sperm cell.

In an investigation, the effects of varying sperm cell concentrations on the fertilisation of eggs was measured. This was repeated using egg cells with the zona pellucida removed.

The table shows the results of these investigations.

Sperm cell concentration / $\times 10^3 \text{ cm}^{-3}$	Zona pellucida intact		Zona pellucida removed	
	Percentage fertilisation (%)	Percentage polyspermy (%)	Percentage fertilisation (%)	Percentage polyspermy (%)
50	84	3	94	3
100	99	17	95	33
200	99	18	98	52

(i) In the investigation using egg cells without a zona pellucida, 15 egg cells were used for each sperm cell concentration.

Calculate how many of these egg cells were entered by more than one sperm cell when the sperm cell concentration was $100 \times 10^3 \text{ cm}^{-3}$.

(2)

Answer.....

(ii) Deduce the effect of sperm cell concentration on the chance of polyspermy when the zona pellucida is removed.

(1)

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