



Additional Assessment Materials
Summer 2021

Pearson Edexcel GCE in AS Biology

Topic 2: Cells, Viruses and Reproduction of
Living Things

(Public release version)

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General guidance to Additional Assessment Materials for use in 2021

Context

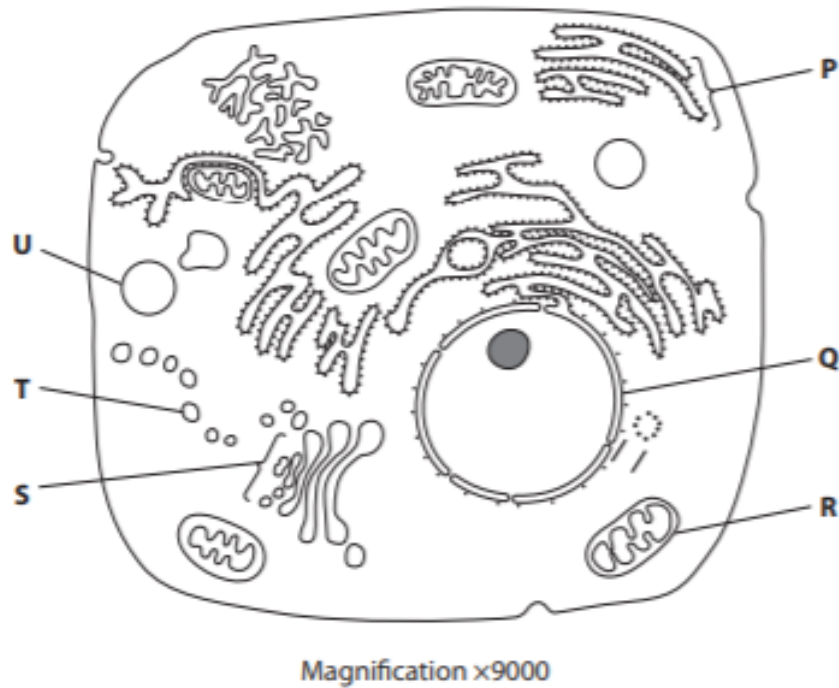
- Additional Assessment Materials are being produced for GCSE, AS and A levels (with the exception of Art and Design).
- The Additional Assessment Materials presented in this booklet are an **optional** part of the range of evidence teachers may use when deciding on a candidate's grade.
- 2021 Additional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- Additional Assessment Materials have come from past papers both published (those materials available publicly) and unpublished (those currently under padlock to our centres) presented in a different format to allow teachers to adapt them for use with candidate.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

The diagram shows the ultrastructure of an animal cell.



(a) (i) The structure labelled **R** on the diagram represents a

(1)

- A chloroplast
- B lysosome
- C mitochondrion
- D ribosome

(ii) The structure labelled **Q** on the diagram represents the

(1)

- A cell surface membrane
- B nuclear envelope
- C rough endoplasmic reticulum
- D smooth endoplasmic reticulum

(iii) Calculate the actual diameter of the structure labelled **U**.

(2)

$$\text{image size} = 0.8 \text{ cm} = 8 \text{ mm}$$

$$\text{actual size} = \frac{8}{9000} = 0.00088889 \text{ mm} \rightarrow \text{Answer } 8.9 \times 10^{-4} \text{ mm}$$

A | M

(iv) Describe how the structures labelled **P**, **S** and **T** are involved in the production and secretion of molecules from this cell.

(3)

P, the rough endoplasmic reticulum, is where translation takes place, which results in the production of proteins. These proteins are enclosed in vesicles which then travel to S, the Golgi apparatus. The Golgi apparatus modifies, sorts and packages proteins made in the rough endoplasmic reticulum and makes glycoproteins and glycolipids. These are then packaged into secretory vesicles (T), which travel to the cell surface membrane and are secreted out of the cell by exocytosis (by the vesicles fusing with the cell surface membrane).

(b) Which row in the table is correct for structures found in animal cells and prokaryotic cells?

(1)

	Nucleolus		Plasmid		Ribosome	
	Animal cell	Prokaryotic cell	Animal cell	Prokaryotic cell	Animal cell	Prokaryotic cell
<input type="checkbox"/> A	✓	✗	✓	✓	✓	✓
<input type="checkbox"/> B	✗	✓	✓	✓	✗	✓
<input checked="" type="checkbox"/> C	✓	✗	✗	✓	✓	✓
<input type="checkbox"/> D	✓	✓	✓	✗	✓	✗

(c) Explain why it is possible to see the detailed structure of a prokaryotic cell with an electron microscope but not with a light microscope.

(2)

electron microscopes have a higher magnification and resolution and so small organelles such as ribosomes can be seen

2

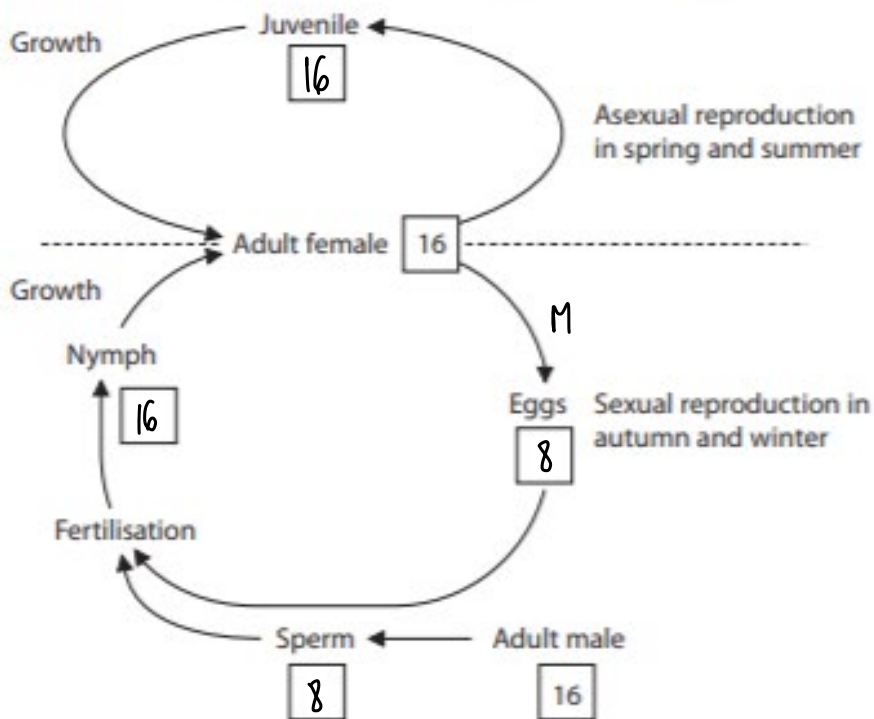
Adult female cabbage aphids (*Brevicoryne brassicae*) undergo either asexual reproduction or sexual reproduction depending on the time of year.

The photograph shows some cabbage aphids on a cabbage leaf.



Source: © Denis Crawford/Alamy Stock Photo

Some of the boxes in the diagram show the number of chromosomes present in a single cell from a particular stage of each of the alternative methods of reproduction.



(a) (i) Complete the empty boxes in the diagram to show the number of chromosomes present in a single cell at that stage of reproduction.

(2)

(ii) Label the arrows on the diagram with the letter **M** to show where meiosis takes place.

(1)

(b) Explain why a juvenile aphid is genetically identical to its parent.

(3)

a juvenile aphid is produced by mitosis (asexual reproduction) which produces two genetically identical cells from a parent cell. There is no recombination or independent assortment of chromosomes so the genetic information remains the same, and there is no genetic variation.

(c) (i) Complete the table with a ✓ or ✗ to compare the events during mitosis and meiosis. The first row in the table has been completed for you.

(3)

Event	Mitosis	Meiosis I	Meiosis II
chromosomes shorten and thicken	✓	✓	✗
homologous chromosomes pair together	✗	✓	✗
crossing over can cause genetic variation	✗	✓	✗
homologous chromosomes separate	✗	✓	✗
sister chromatids separate	✓	✗	✓

(ii) Which of the following increases the number of different alleles in a population? (1)

- A crossing over
- B gene mutation
- C independent assortment of chromosomes during nuclear division
- D random fusion of gametes

3

Male fertility can be determined by a number of different factors.

(a) Describe the process of spermatogenesis.

(4)

The diploid primordial germ cells divide several times by mitosis to form diploid spermatogonia. The spermatogonia grow without further division to form primary spermatocytes.

The primary spermatocytes undergo meiosis I to form secondary spermatocytes. The secondary spermatocytes undergo the second meiotic division to form haploid spermatids.

The spermatids then grow and differentiate to form spermatozoa (which have a flagellum, acrosome etc).

(b) The mean volume of the semen produced by a male ejaculation is 3.4 cm^3 .

This contains a mean concentration of $17000 \text{ sperm mm}^{-3}$.

Calculate the mean total number of sperm in a single ejaculation.

Give your answer in standard form.

(2)

cm^3
↓ ×1000
 mm^3

$$3.4 \text{ cm}^3 = 3400 \text{ mm}^3$$

$$\begin{aligned} \text{number of sperm} &= c \times V \\ &= 17000 \times 3400 \\ &= 57800000 \end{aligned}$$

Answer 5.78×10^7

(c) The distance from the point of ejaculation in the vagina to the upper end of the fallopian tube (where fertilisation takes place) is 19 cm.

Some sperm travel this distance in three hours.

Calculate the mean speed of these sperm in cm min^{-1} .

(1)

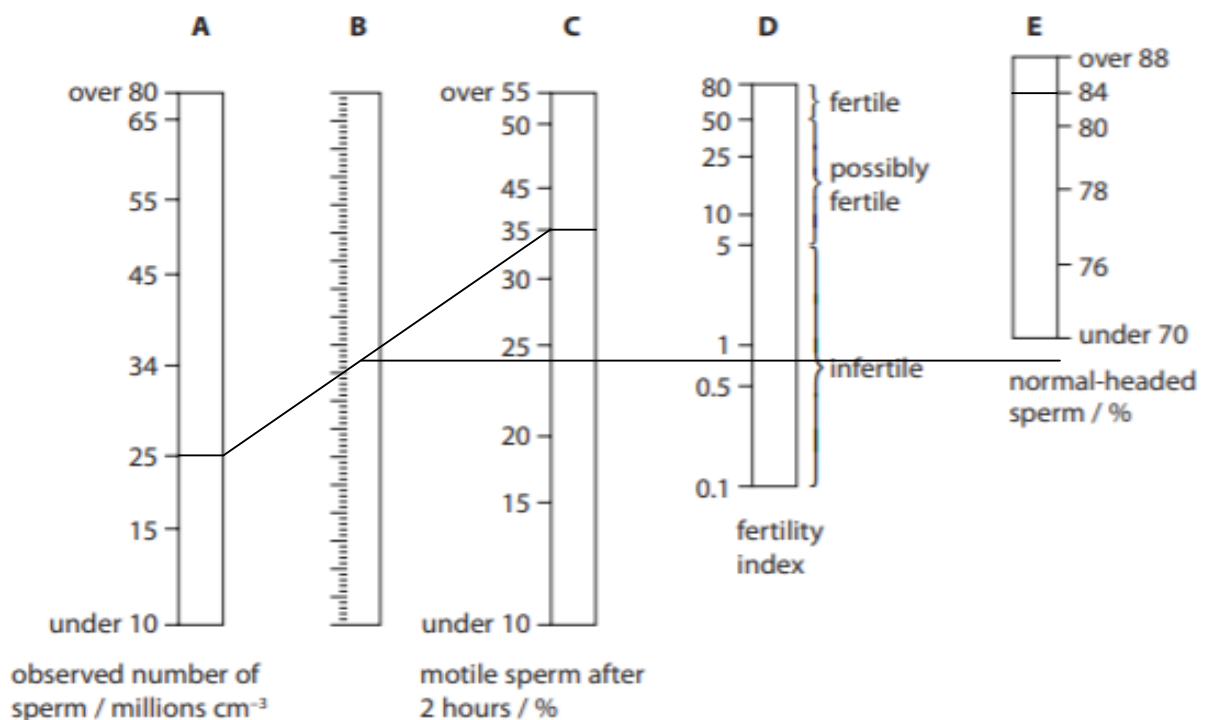
$$\frac{19}{180} = 0.10555\dots$$

Answer 0.106 cm min^{-1}

(d) Male fertility can be estimated using scales that take into account the number of sperm, their mobility and the percentage with a normal 'head'.

To calculate male fertility using these scales:

- draw a straight line between the observed number of sperm (scale A) and the percentage of sperm motile after 2 hours (scale C)
- from the intersection of this line with scale B, draw another straight line to scale E (the percentage of normal-headed sperm)
- the point where this second line crosses scale D (the fertility index), provides a relative assessment of fertility.



(i) Estimate the fertility of a man who produces a semen sample with:

- 25 million sperm per cm^3
- 35% of which are motile after 2 hours and
- 84% of which have normal heads.

(2)

Answer 0.8

(ii) Deduce why fertilisation is unlikely to occur if there are 5 million spermatozoa per cm^3 .

(1)

the fertility index would be < 0.1

In 2014 there was an Ebola virus outbreak in West Africa.

(a) Which of the following viruses contains RNA and the enzyme reverse transcriptase?

(1)

- A Ebola virus
- B human immunodeficiency virus (HIV)
- C λ (lambda) phage
- D tobacco mosaic virus

(b) Ebola virus begins its lytic cycle soon after the infection of body cells.

(i) Describe the lytic cycle of a virus.

(2)

the DNA of the virus is inserted into the cytoplasm of the host cell, and the DNA replicates independently of the host cell, using the host cell's machinery such as ribosomes and Golgi apparatus. When there is a large number of virus particles the host cell lyses and the virus particles are released.

(ii) Some doctors believe that the Ebola virus may undergo latency within body cells.

State what is meant by the term latency.

(2)

latency is the ability of a virus to lie dormant in the host organism's cells without replicating its genetic material or producing new virus particles; no symptoms are produced.

(c) An experimental drug called Zmapp was used to treat patients during this outbreak of Ebola virus.

Patients with Ebola virus were randomly split into two groups.

Both groups received standard medical treatment.

One group was also given Zmapp on days 1, 3 and 5.

Some of the patients suffered severe side effects after treatment with Zmapp and required additional medical care.

The results are shown in the table.

Day	Number of patients surviving		Number of patients with severe side effects after treatment with Zmapp on days 1, 3 and 5
	Without Zmapp	With Zmapp	
1	35	36	11
2	32	33	
3	31	31	7
4	30	29	
5	29	28	3
6	26	28	
7	23	28	
8	22	28	
9	22	28	

Analyse the data to assess the effectiveness of Zmapp to treat patients with Ebola virus.

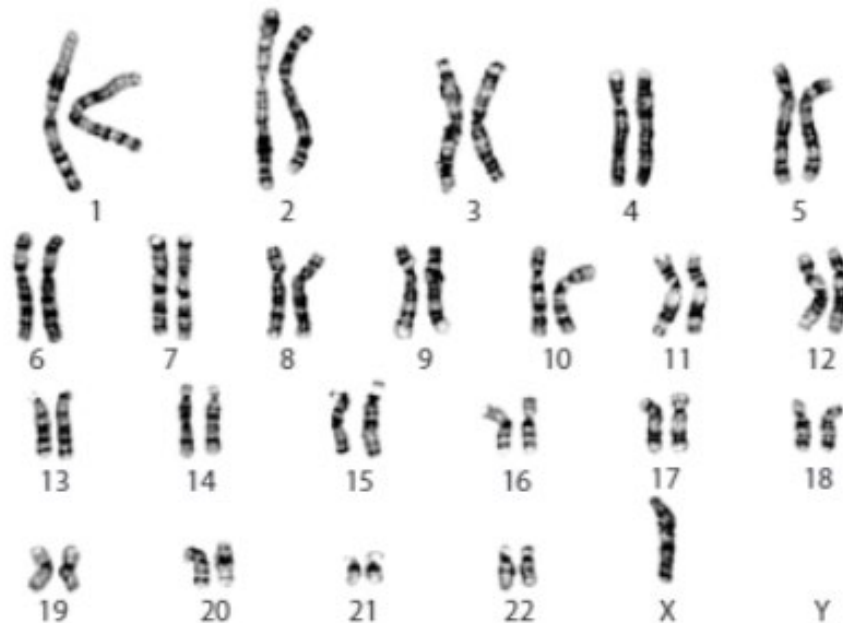
(4)

Zmapp seems to be ineffective at treating patients with Ebola virus as a total of 21 patients treated with Zmapp had severe side effects. On day 1, 30.6% of patients treated with Zmapp had severe side effects, which is a large proportion of the group. However on day 5, only 10% had severe side effects, which indicates that the reaction to Zmapp decreases with each additional dose.

5

A karyotype shows the chromosomes found in the cells of an individual.

The photograph shows a karyotype from a child with a genetic condition.



(Source: © Dept. of Clinical Cytogenetics, Addenbrookes Hospital/Science Photo Library)

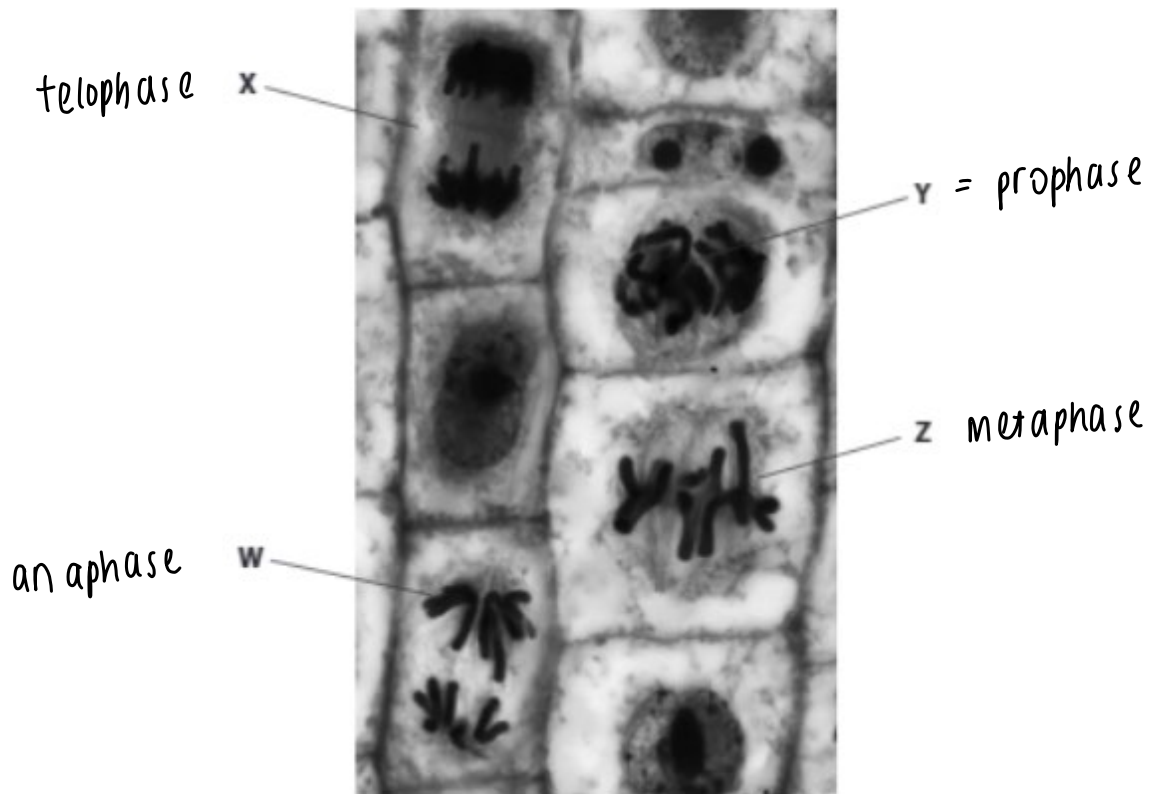
(a) (i) Which of the following identifies the genetic condition shown in the photograph? (1)

- A Down's syndrome due to monosomy
- B Down's syndrome due to polysomy
- C Turner's syndrome due to monosomy
- D Turner's syndrome due to polysomy

(ii) Which process would have caused the genetic condition shown by this karyotype? (1)

- A base insertion
- B base substitution
- C non-disjunction
- D translocation

(b) The photograph shows cells in different stages of mitosis.



(Source: © STEVE GSCHMEISSNER/Science Photo Library)

(i) Which of the following correctly identifies the stages shown in the photograph?

(1)

	W	X	Y	Z
<input checked="" type="checkbox"/> A	anaphase	telophase	prophase	metaphase
<input type="checkbox"/> B	anaphase	prophase	telophase	metaphase
<input type="checkbox"/> C	prophase	anaphase	metaphase	telophase
<input type="checkbox"/> D	telophase	metaphase	anaphase	prophase

(ii) Colchicine is a chemical that inhibits mitosis.

A student investigated the effect of colchicine on mitosis.

Two sets of genetically identical cells were grown in culture. Colchicine was added to one culture of cells but not to the other culture of cells.

Six hours after treatment, the mean percentages of cells in each stage of mitosis were determined.

The results are shown in the table.

Mitosis stage	Mean percentage of cells in stage \pm Standard Deviation	
	cells cultured without colchicine	cells cultured with colchicine
interphase	84.8 \pm 4.2	82.8 \pm 3.2
prophase	10.2 \pm 2.2	16.3 \pm 3.1
metaphase	1.8 \pm 0.4	0.8 \pm 0.2
anaphase	1.8 \pm 0.2	0.7 \pm 0.1
telophase	1.4 \pm 0.3	0.4 \pm 0.1

Analyse the data to comment on how colchicine affects mitosis.

Colchicine doesn't seem to affect interphase of mitosis as there are roughly the same % of cells in both groups in the interphase stage and the standard deviations overlap. However, there is a significantly lower number of cells in metaphase, anaphase and telophase in the group treated with colchicine, which suggests that colchicine affects the formation of spindle fibres by the centrioles which are responsible for arranging the chromosomes at the equator of the cell and then separating and moving the sister chromatids to opposite poles of the cell. There are 1% less cells in metaphase in the cultured group, 1.1% less in anaphase and 1% less in telophase. Therefore colchicine inhibits mitosis and so cells cannot divide.

(4)

TOTAL FOR TEST = 46 MARKS