Please check the examination details below before entering your candidate information

Candidate surname	Other names

Pearson Edexcel Level 3 GCE

Centre Number | Candidate Number

Tuesday 19 May 2020

Afternoon (Time: 1 hour 30 minutes) | Paper Reference **8BI0/01**

Biology B

Advanced Subsidiary
Paper 1: Core Cellular Biology and Microbiology

You must have:
Calculator, HB pencil, ruler

Total Marks

Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Show your working in any calculation questions and include units in your answer where appropriate.
- Answer the questions in the spaces provided – *there may be more space than you need.*
- You may use a scientific calculator.
- In question(s) marked with an **asterisk** (*), marks will be awarded for your ability to structure your answer logically showing how the points that you make are related or follow on from each other where appropriate.

Information

- The total mark for this paper is 80.
- The marks for **each** question are shown in brackets – *use this as a guide as to how much time to spend on each question.*

Advice

- Read each question carefully before you start to answer it.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over

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P 6 2 3 0 4 A 0 1 2 8

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Answer ALL questions.

Some questions must be answered with a cross in a box ☒. If you change your mind about an answer, put a line through the box ☒ and then mark your new answer with a cross ☒.

1 Short sequences of nucleotides are being developed as potential drugs.

They act by binding to selected sites on DNA or RNA molecules and prevent the synthesis of a specific protein associated with a disease.

Two types of drug to treat genetic disorders are:

- antisense drugs, which are RNA nucleotides that bind to mRNA
- triplex drugs, which are DNA nucleotides that bind to DNA forming a three-stranded helix.

(a) (i) The type of bonds that hold the two strands of a DNA molecule together in a double helix are

(1)

☐ **A** glycosidic bonds

☐ **B** hydrogen bonds

☐ **C** phosphodiester bonds

☐ **D** peptide bonds

(ii) Antisense drugs inhibit protein synthesis by interfering with

(1)

☐ **A** protein folding

☐ **B** replication

☐ **C** transcription

☐ **D** translation

(iii) Triplex drugs inhibit protein synthesis by interfering with

(1)

☐ **A** protein folding

☐ **B** replication

☐ **C** transcription

☐ **D** translation

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(b) The table shows the sequence of bases in part of an mRNA molecule.

Complete the table to show the base sequence of **each** of the following:

(i) the corresponding coding strand of DNA that produced this mRNA sequence

(1)

(ii) the base sequence of an antisense drug that will bind to this mRNA.

(1)

Base sequence on the DNA coding strand												
Base sequence on mRNA	C	A	U	G	C	A	U	A	U	C	G	G
Base sequence of antisense drug												

(iii) State the number of amino acids that would be coded for by the part of mRNA shown in this table.

(1)

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(c) Which of the following statements is true for the total number of bases in a double-stranded DNA molecule?

(1)

☒ **A** $\frac{A + T}{C + G} = 1$

☒ **B** $\frac{A}{T} = \frac{C}{G}$

☒ **C** $A \times T = C \times G$

☒ **D** $\frac{A}{C} = \frac{G}{T}$

(Total for Question 1 = 7 marks)

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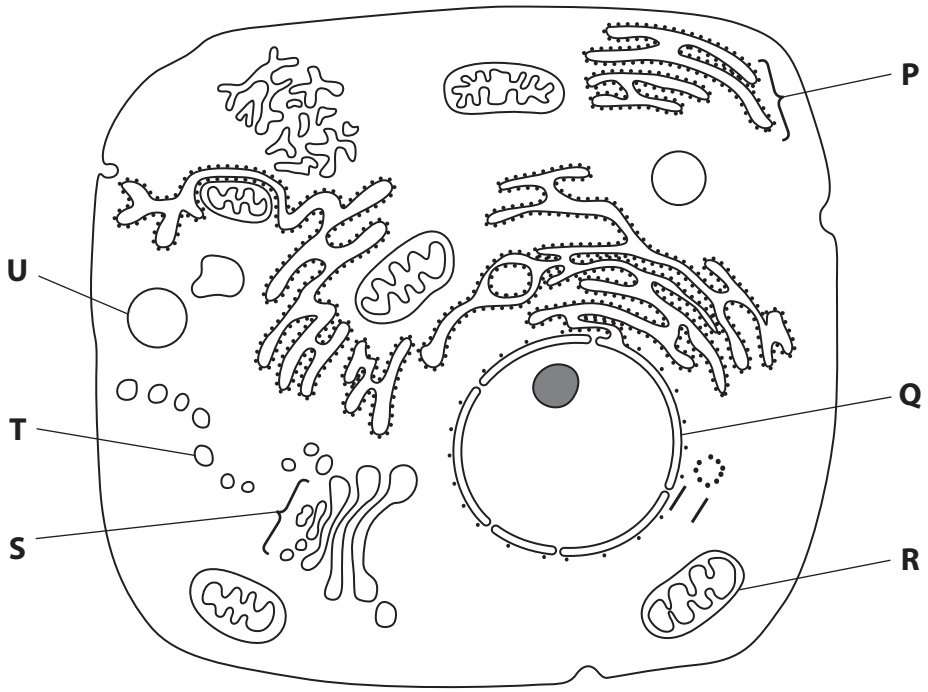
2 The diagram shows the ultrastructure of an animal cell.



Magnification ×9000

(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)

Answer .....

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

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(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**
☒ **A**	✓	×	✓	✓	✓	✓
☒ **B**	×	✓	✓	✓	×	✓
☒ **C**	✓	×	×	✓	✓	✓
☒ **D**	✓	✓	✓	×	✓	×

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(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.

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(Total for Question 2 = 10 marks)

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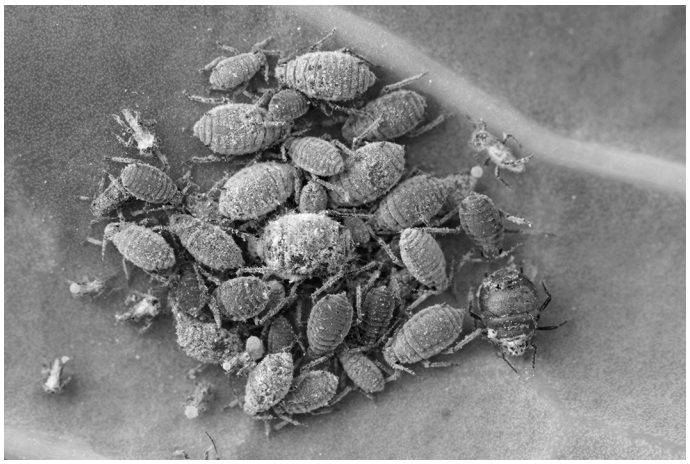
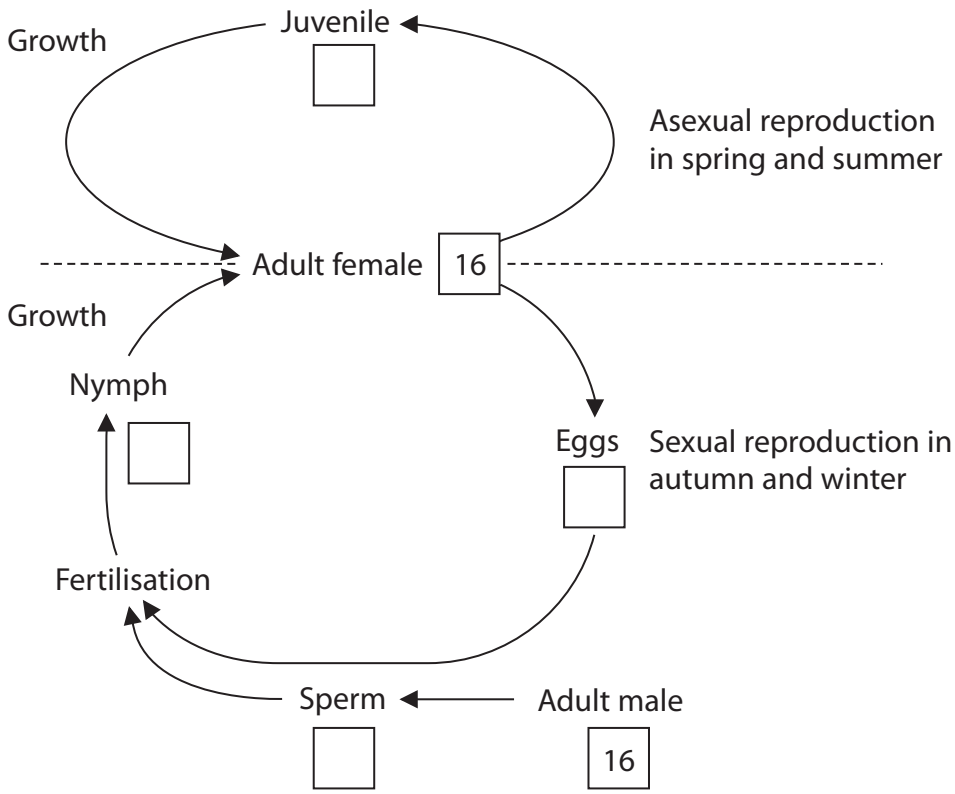
3 Adult female cabbage aphids (*Brevicoryne brassicae*) undergo either asexual reproduction or sexual reproduction depending on the time of year.

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)

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(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			

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(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

(Total for Question 3 = 10 marks)

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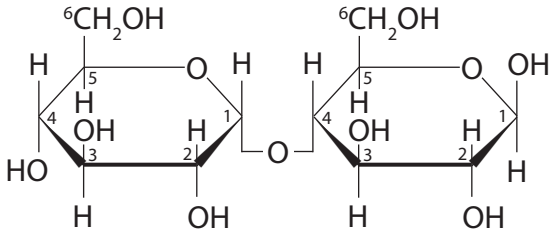
4 Enzymes are involved in a wide range of metabolic reactions.

(a) The diagram represents the structure of a maltose molecule.



Draw a diagram to show the hydrolysis of maltose.

(3)

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(b) Catalase is an enzyme found in potato cells.

It catalyses the breakdown of hydrogen peroxide.

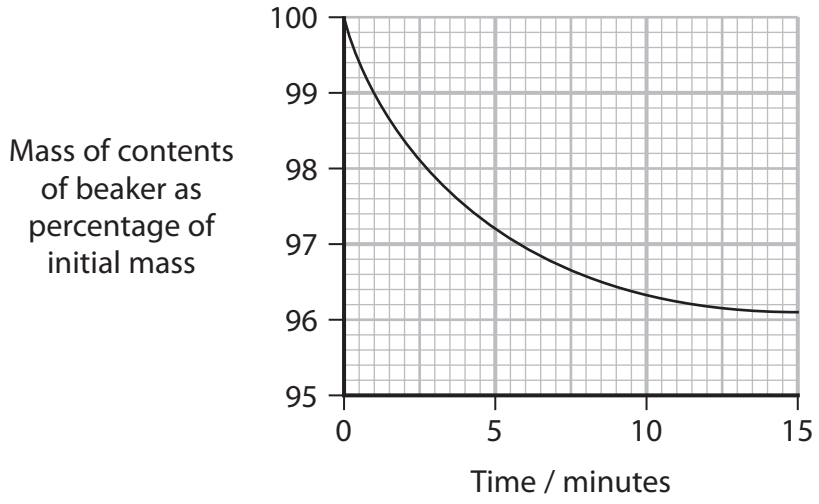
$$\text{hydrogen peroxide} \xrightarrow{\text{catalase}} \text{water + oxygen}$$

In an investigation, cylinders of potato were cut with a cork borer.

The cylinders were then sliced into discs with the same thickness and put into a small beaker containing 50 cm^3 of hydrogen peroxide.

The mass of the beaker and its contents was recorded over a period of 15 minutes.

The graph shows the results of the experiment.



Explain the relationship shown in the graph.

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(c) Explain how a gene mutation can prevent the production of catalase in potato cells.

(3)

(Total for Question 4 = 10 marks)

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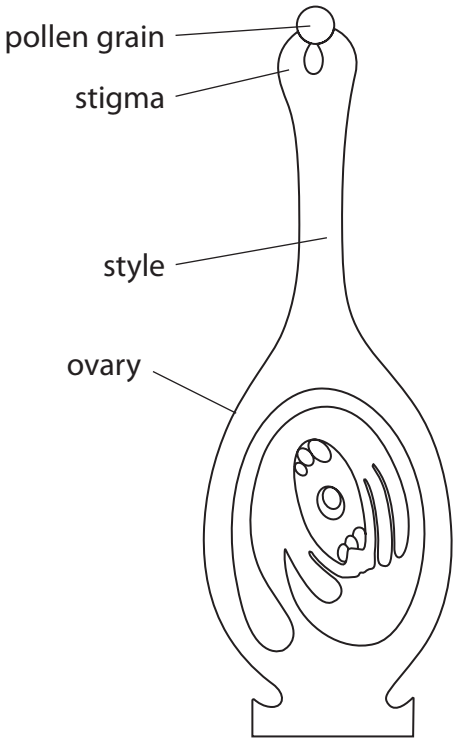
5 The diagram illustrates part of a flowering plant when pollination has just taken place.



(a) Describe the role of enzymes in the growth of the pollen tube.

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(b) The styles of some plants secrete RNAase enzymes when pollen from the same flower germinates on the stigma.

Explain how these RNAase enzymes affect the growth of the pollen tube.

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(c) Explain the role of double fertilisation in flowering plants.

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(Total for Question 5 = 10 marks)

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

(a) Describe the process of spermatogenesis.

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

This contains a mean concentration of 17 000 sperm mm^{-3}.

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

Give your answer in standard form.

(2)

Answer .....

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(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}.

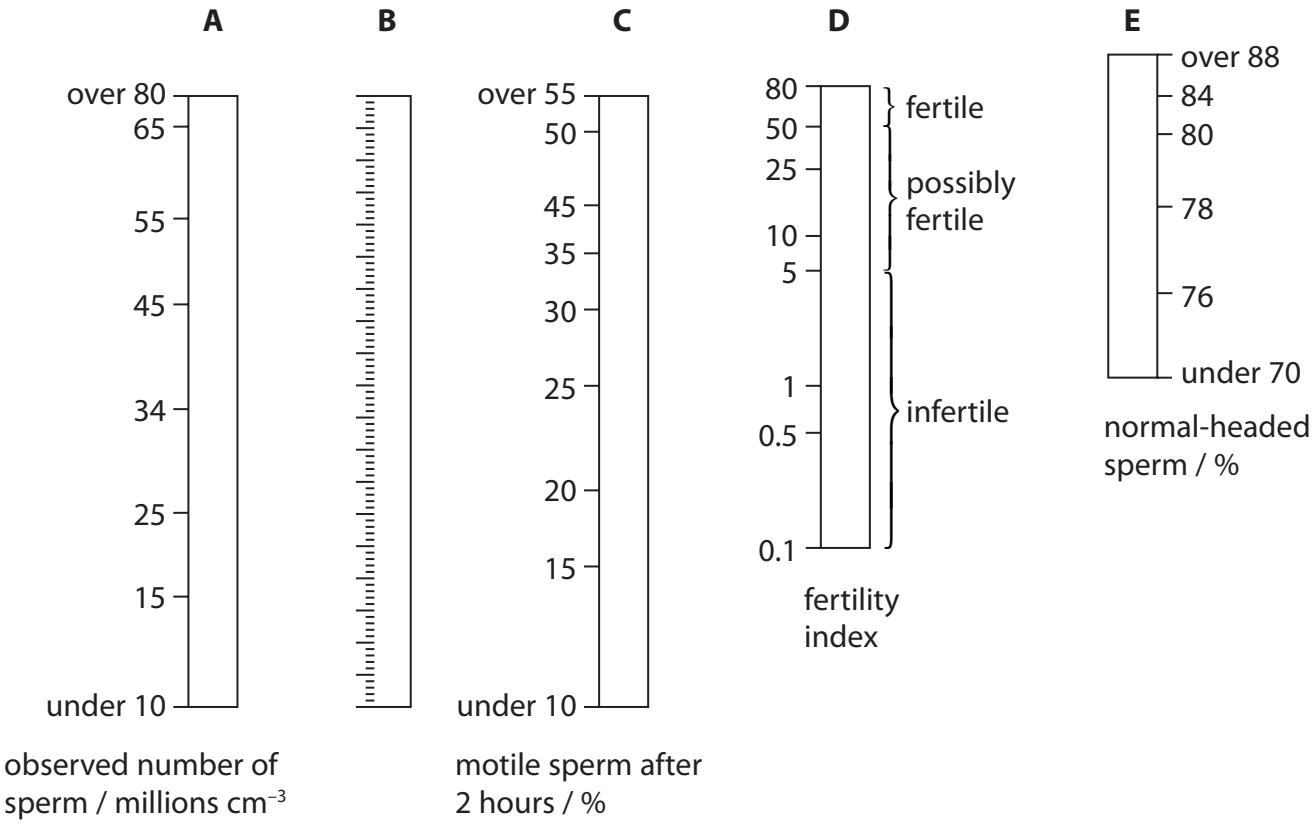
(1)

Answer .....

(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.



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(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 .....

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

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(Total for Question 6 = 10 marks)

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7 *Streptococcus pneumoniae* is a bacterium that causes pneumonia.

(a) When *Streptococcus pneumoniae* is grown on a culture plate, the bacterial cells produce:

- either smooth, shiny colonies (S-strain)
- or rough colonies (R-strain).

The S-strain bacteria produce a smooth capsule but the R-strain bacteria do not.

(i) Explain why the R-strain bacteria are not able to produce the capsule present in the S-strain bacteria.

(2)

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(ii) In an investigation, mice were injected with either the S-strain or the R-strain.

The results are shown in the table.

Strain of *Streptococcus pneumoniae* injected into mice	**Injected mice**
S-strain	died
R-strain	lived

The S-strain bacteria were then killed by heating them.

Mice were then injected with either heat killed S-strain bacteria or a mixture of heat killed S-strain bacteria and live R-strain bacteria.

The results are shown in the table.

Strain of *Streptococcus pneumoniae* injected into mice	**Injected mice**
S-strain (heat killed)	lived
S-strain (heat killed) and R-strain (live)	died

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Analyse the data to explain why the mice died when they were injected with a mixture of heat killed S-strain and live R-strain bacteria.

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(b) In another investigation, heat killed S-strain bacteria were treated with **one** type of enzyme:

- protein digesting enzymes (proteases)
- RNA-digesting enzymes (RNAases)
- DNA digesting enzymes (DNAases)
- lipid digesting enzymes (lipases).

Each type of enzyme treated S-strain bacteria was then mixed with live R-strain bacteria and injected into mice.

Complete the table to predict whether the mouse lives or dies.

Write **dead** OR **alive** in the spaces in the table.

(3)

Enzyme used to treat the heat killed S-strain bacteria	**Mouse injected with live R-strain and enzyme treated S-strain [dead or alive]**
protease	
RNAase	dead
DNAase	
lipase	

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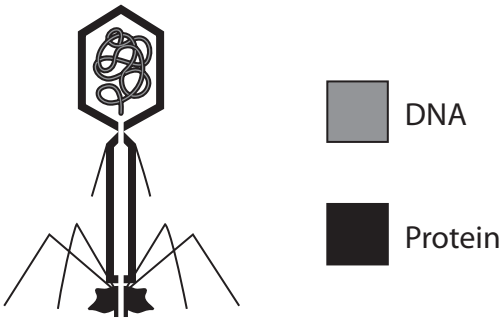
(c) Another investigation used radioactively labelled phages.

Phages are viruses that consist of DNA contained within a protein head.



Phages inject their DNA into a host bacterial cell, but leave the protein heads (called phage ghosts) on the outside of the infected cell.

Two different types of phage were developed by growing the phages in cultures of bacteria in two separate media.

Medium (**A**) contained radioactive phosphorus (^{32}P).

Medium (**B**) contained radioactive sulfur (^{35}S).

Type A phage had DNA that included the ^{32}P.

Type B phage had proteins that included the ^{35}S.

(i) State why radioactive carbon, nitrogen or oxygen were not used in this experiment.

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(ii) Separate cultures of the bacteria *E. coli* were infected with either type A or type B phage.

After infection the empty phage heads (phage ghosts) were separated from the bacterial cells.

Each was tested for radioactivity.

Complete the table to show where radioactivity was present (**Y**) or absent (**N**).

(1)

Phage type (label)	Bacterial cells	Phage ghosts
A (^{32}P)		
B (^{35}S)		

(Total for Question 7 = 10 marks)

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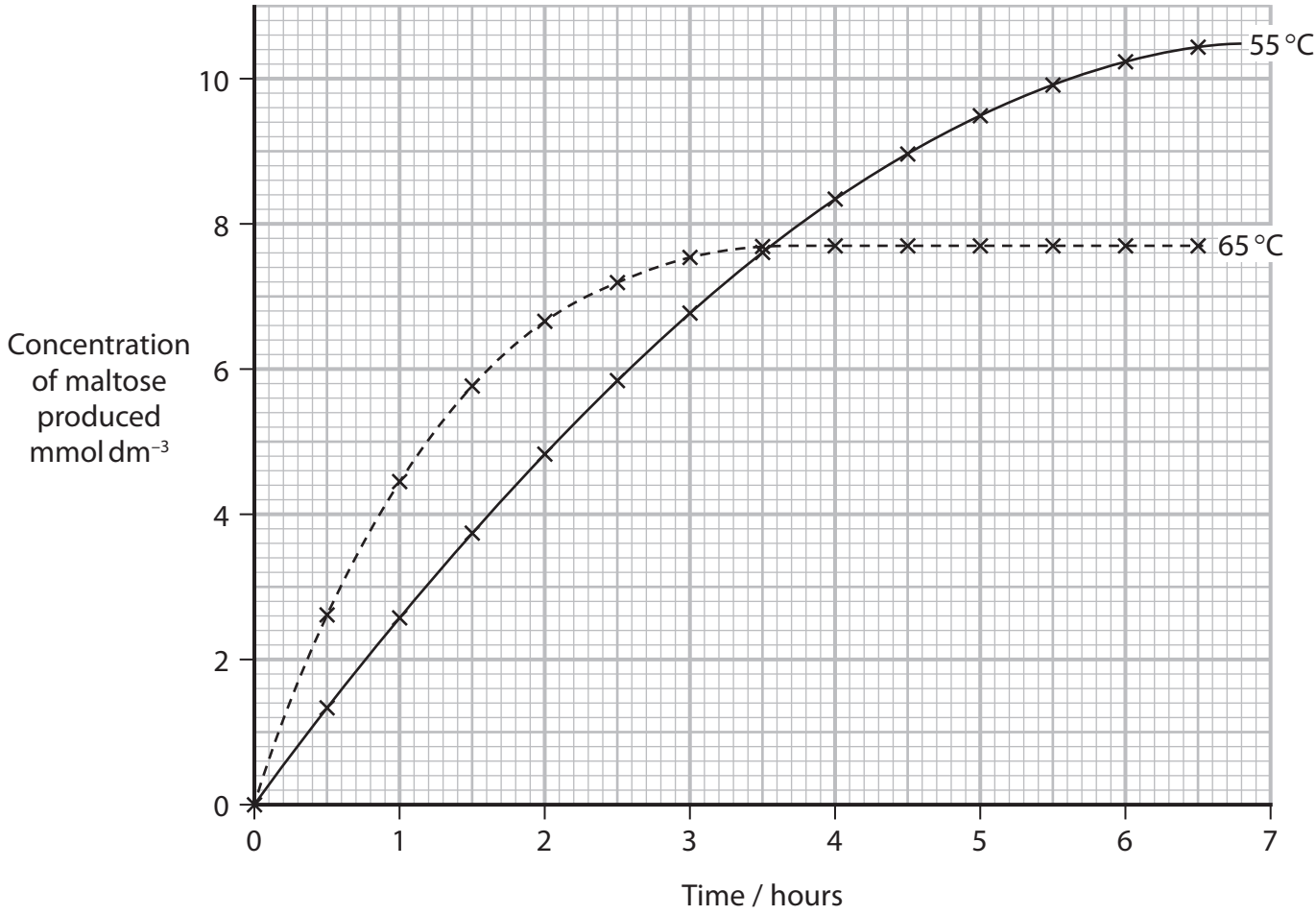
8 The graph shows the results of an experiment investigating the effect of temperature on the hydrolysis of starch using the enzyme amylase.



(a) Calculate the initial rate of reaction at 55 °C in mmol dm^{-3} min^{-1}.

(2)

Answer .....

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(b) Explain the difference between the two curves from 4 and 6 hours.

(2)

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(c) In this experiment:

- two beakers were prepared containing 1 cm^3 of amylase and 100 cm^3 of starch solution at room temperature
- these beakers were then placed in the water baths at two different temperatures, 55 °C and 65 °C
- every 30 minutes a sample of the mixture was extracted and the concentration of maltose was measured.

(i) Analyse the information to explain why the initial rate of this reaction was faster at 65 °C than it was at 55 °C.

(3)

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*(d) Evaluate the method used in this investigation and suggest improvements.

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TOTAL FOR PAPER = 80 MARKS

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