

**Paper Reference(s) 9BI0/01**

**Pearson Edexcel Level 3 GCE**

**Biology B**

**Advanced**

**Paper 1: Advanced Biochemistry,  
Microbiology and Genetics**

**Thursday 6 June 2019 – Morning**

**Time: 1 hour 45 minutes plus your additional  
time allowance**

**INSTRUCTIONS TO CANDIDATES**

**Write your centre number, candidate number,  
surname, other names and your signature in  
the boxes below. Check that you have the  
correct question paper.**

<b>Centre No.</b>					
<b>Candidate No.</b>					
<b>Surname</b>					
<b>Other names</b>					
<b>Signature</b>					
<b>Paper Reference</b>	9	B	I	0	/ 0 1



**Y57053A**

**Pearson**

**(Turn over)**

- **Use BLACK ink or ball-point pen.**
- **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 questions 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.**

**MATERIALS REQUIRED FOR EXAMINATION**

**Calculator, HB pencil, ruler**

**ITEMS INCLUDED WITH QUESTION PAPERS**

**Nil**

**(Instructions continue on next page)**

**(Turn over)**

## **INFORMATION FOR CANDIDATES**

- **The total mark for this paper is 90.**
- **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 TO CANDIDATES**

- **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)**

**Answer ALL questions.**

**Write your answers in the spaces provided.**

**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 The nucleic acids, DNA and mRNA, are polymers.**

**(a) The table on page 5 shows some components that may be found in a molecule of these nucleic acids.**

**For each component, put ONE cross ☐ in the appropriate box, in each row, to show where these components can be found. (4 marks)**

**(Question continues on next page)**

**(Turn over)**

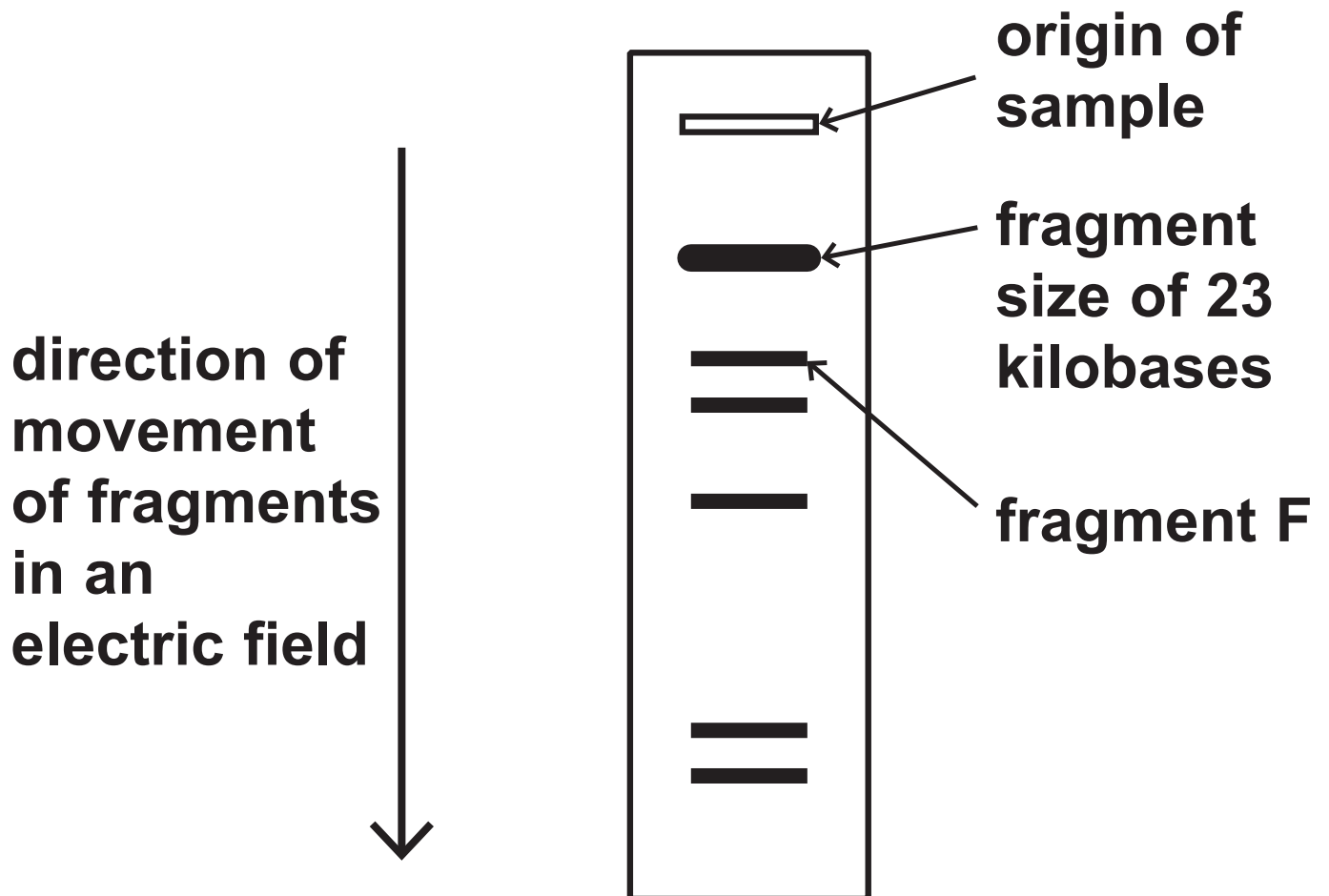
<b>Component</b>	<b>Component found in a molecule of</b>			
	<b>both DNA and mRNA</b>	<b>DNA but NOT mRNA</b>	<b>mRNA but NOT DNA</b>	<b>neither DNA nor mRNA</b>
<b>Adenine</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Hydrogen bonds</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Pentose sugar</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
<b>Uracil</b>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

**(Question continues on next page)**

**(Turn over)**

**(b) Fragments of DNA can be separated by gel electrophoresis to produce a DNA profile.**

**The diagram shows an example of a DNA profile.**



**(Question continues on next page)**

**(Turn over)**

- (i) Explain why fragments of DNA can be separated by gel electrophoresis. (2 marks)**

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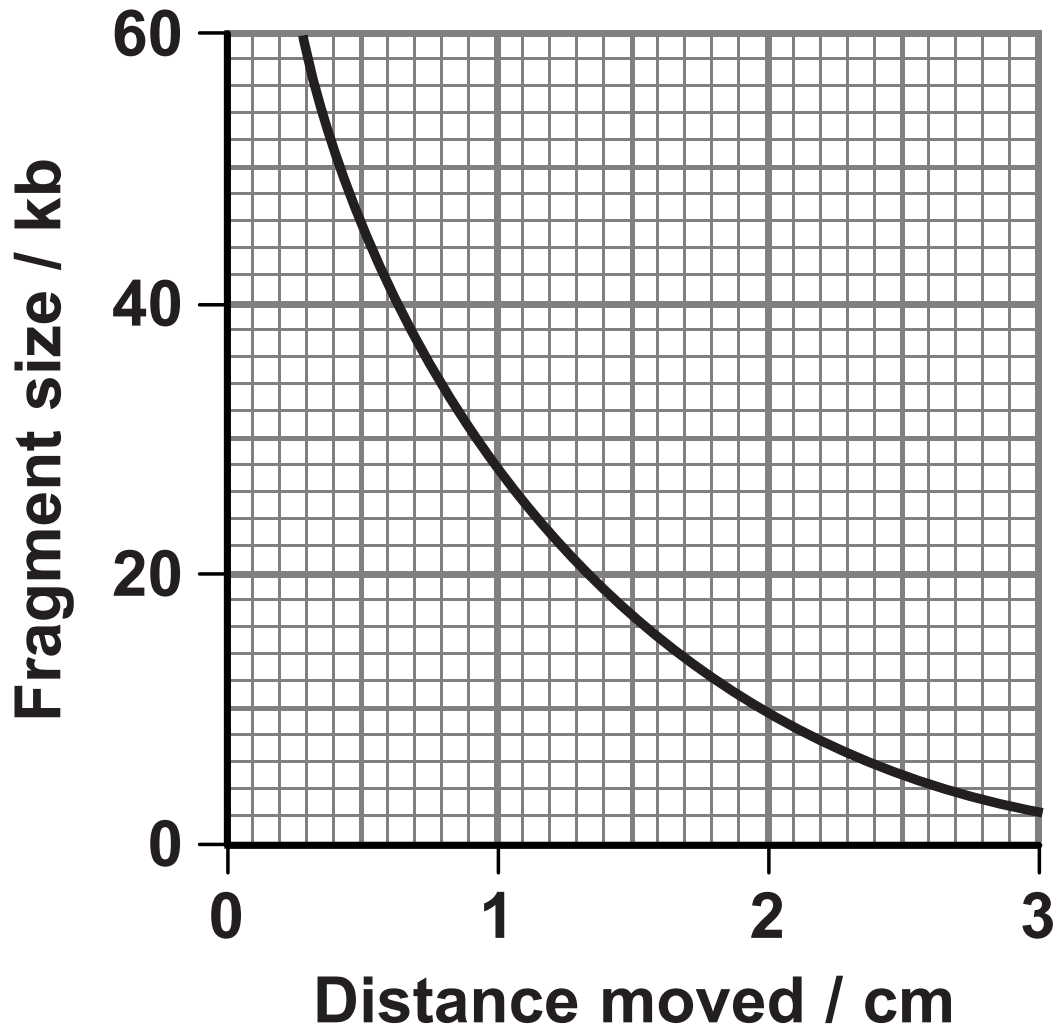
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**(Question continues on next page)**

**(Turn over)**

- (ii) The graph shows the relationship between the distance moved in a gel and the fragment size.



(Question continues on next page)

(Turn over)



**9**

**Determine the size of fragment F.  
(1 mark)**

**Answer \_\_\_\_\_ kb**

**(TOTAL FOR QUESTION 1 = 7 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**

**2 Bacteria were cultured in two different types of medium.**

**One medium contained glucose as the energy source and the other contained sucrose.**

**The same molar concentrations of glucose and sucrose were used.**

**(a) Which row of the table identifies these sugars? (1 mark)**

	<b>Glucose</b>	<b>Sucrose</b>
<input type="checkbox"/> <b>A</b>	<b>monosaccharide</b>	<b>monosaccharide</b>
<input type="checkbox"/> <b>B</b>	<b>monosaccharide</b>	<b>disaccharide</b>
<input type="checkbox"/> <b>C</b>	<b>disaccharide</b>	<b>disaccharide</b>
<input type="checkbox"/> <b>D</b>	<b>disaccharide</b>	<b>monosaccharide</b>

**(Question continues on next page)**

**(Turn over)**

**(b) Bacteria were grown in each medium for 20 hours.**

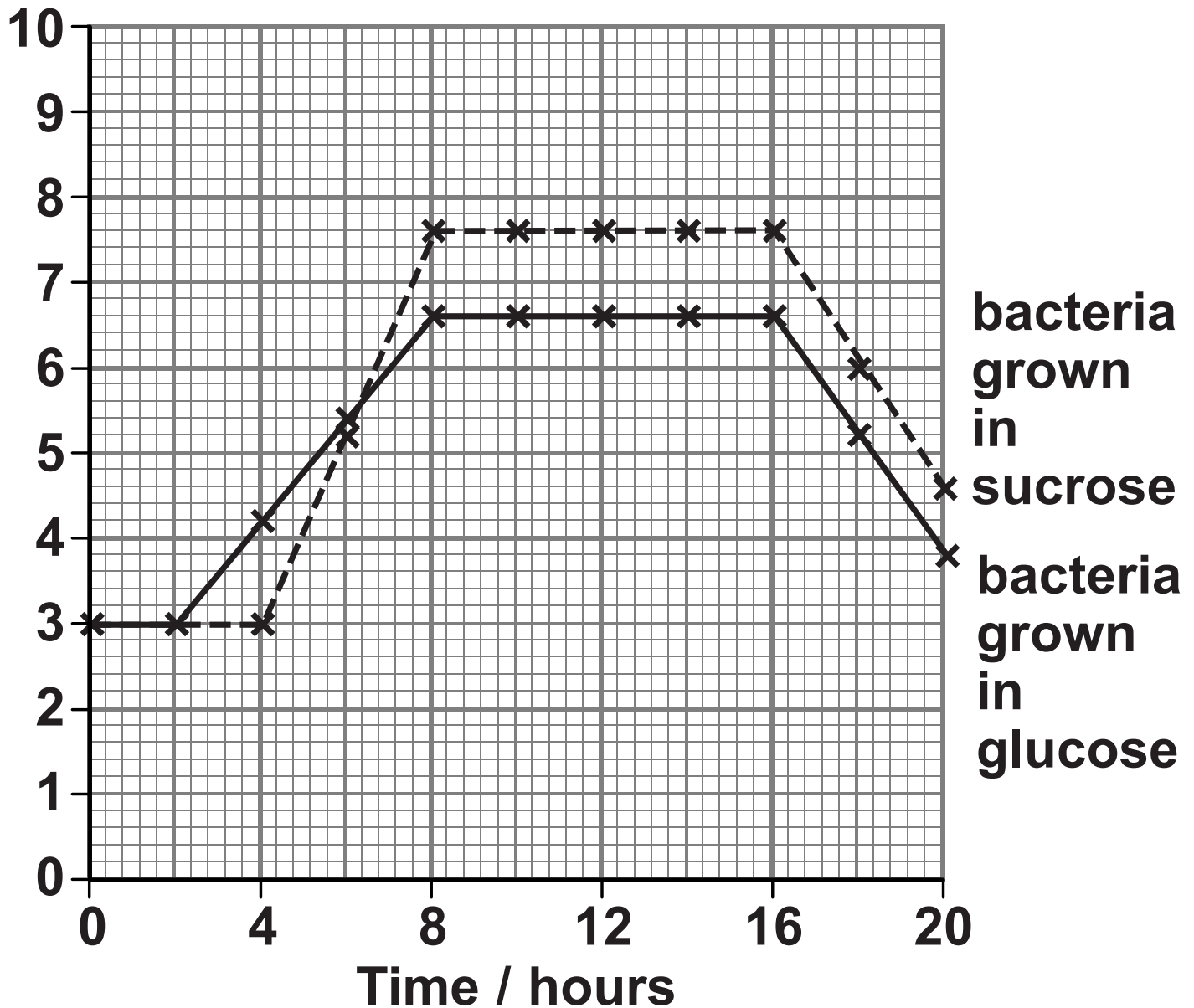
**Every two hours, the numbers of bacteria were determined using dilution plating and an optical method (turbidity).**

**(Question continues on next page)**

**(Turn over)**

The graph shows the results from the dilution plating.

Log<sub>10</sub> cell  
number per cm<sup>3</sup>



(Question continues on next page)

(Turn over)

- (i) Calculate how many times faster the bacteria in sucrose reproduce than the bacteria in glucose, during the log phase. (2 marks)

Answer \_\_\_\_\_

(Question continues on next page)

(Turn over)

- (ii) Analyse the data to explain why the growth curve for sucrose is different from the growth curve for glucose. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

- (iii) On the graph on page 12, draw a curve to show the number of bacteria grown in glucose as determined by the optical method. (1 mark)

**(TOTAL FOR QUESTION 2 = 6 MARKS)**

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**(Questions continue on next page)**

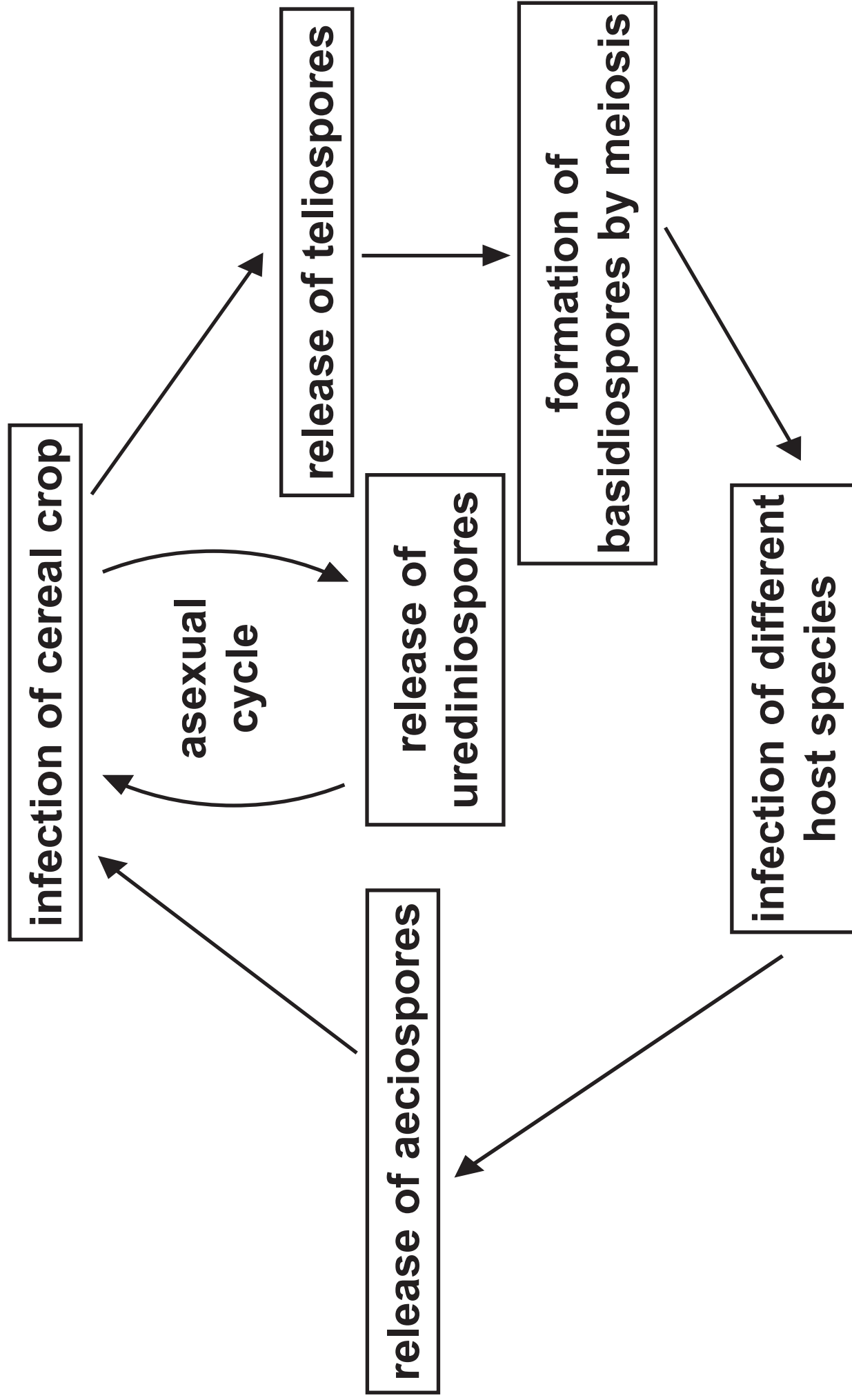
**(Turn over)**

- 3 The stem rust fungus is responsible for destroying cereal crops and reducing grain yield.**

**The diagram on page 17 shows some stages in the life cycle of the stem rust fungus.**

**(Question continues on next page)**





(Question continues on next page)

(Turn over)

**(a) Which genus does the stem rust fungus belong to? (1 mark)**

- ☐ **A Plasmodium**
- ☐ **B Puccinia**
- ☐ **C Salmonella**
- ☐ **D Staphylococcus**

**(Question continues on next page)**

**(Turn over)**

**(b) Explain how stem rust fungus results in a reduction in grain yield. (3 marks)**

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**(Continue your answer on next page)**

**(Turn over)**

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**(Turn over)**

- (c) Cereal crops have been genetically modified (GM) to produce plants that are resistant to stem rust fungus.**

**Analyse the diagram to deduce why the formation of basidiospores and urediniospores can produce a stem rust fungus to which these GM plants are no longer resistant. (3 marks)**

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**(TOTAL FOR QUESTION 3 = 7 MARKS)**

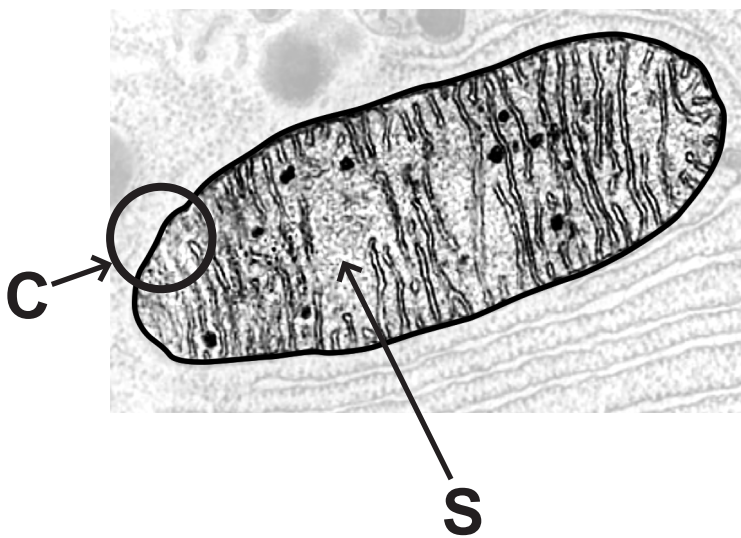
**(Questions continue on next page)**

**(Turn over)**

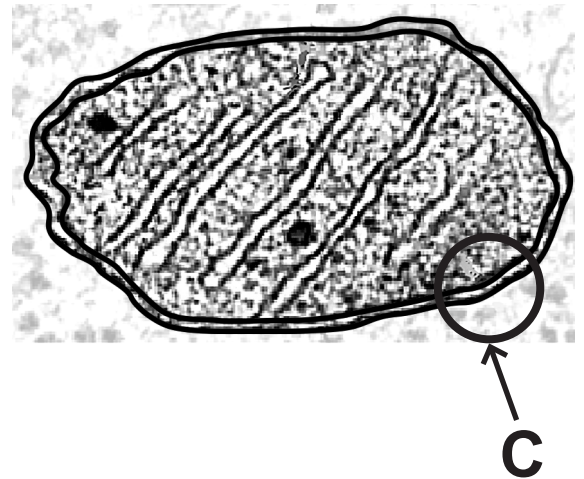
- 4 (a) Photographs P and Q are electron micrographs of mitochondria.

Each photograph was taken using a different electron microscope.

Photograph P



Photograph Q



Sourced from: <http://book.bionumbers.org/how-big-are-mitochondria/>

Source: Cellupedia

(Question continues on next page)

(Turn over)

**(i) What is the structure labelled S?  
(1 mark)**

- ☐ **A     crista**
- ☐ **B     matrix**
- ☐ **C     stroma**
- ☐ **D     thylakoid**

**(Question continues on next page)**



- (ii) Explain the difference in appearance of the parts labelled C using the two different electron microscopes. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

**\*(b) The table shows the protein : lipid ratio of the inner and outer membrane of a mitochondrion.**

<b>Membrane of mitochondrion</b>	<b>Protein : lipid ratio</b>
<b>inner</b>	<b>3:2</b>
<b>outer</b>	<b>1:1</b>

**Explain the difference in the protein : lipid ratio of the inner and outer membrane of a mitochondrion.  
(6 marks)**

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**(Continue your answer on next page)**

**(Turn over)**

**(Turn over)**

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**(TOTAL FOR QUESTION 4 = 9 MARKS)**

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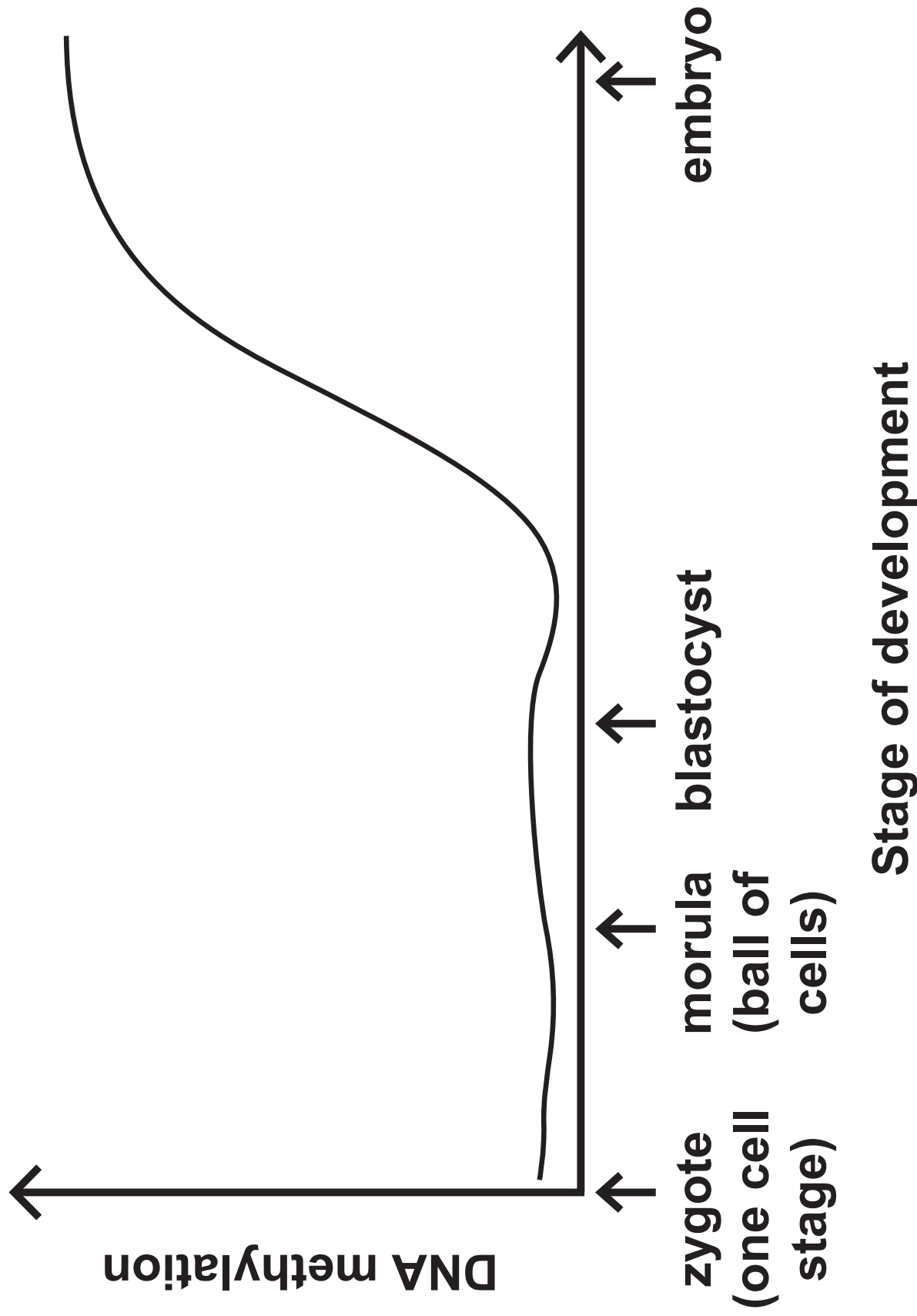
**(Questions continue on next page)**

**(Turn over)**

- 5 (a) Epigenetic modifications are involved in the development of an embryo.**

**The graph on page 30 shows the changes in DNA methylation during the development of an embryo from a zygote.**

**(Question continues on next page)**



30

(Question continues on next page)

(Turn over)

- (i) **State the meaning of the term DNA methylation. (1 mark)**

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**(Question continues on next page)**

**(Turn over)**

- (ii) Describe the differences between totipotent, pluripotent and multipotent stem cells during the development of an embryo. (3 marks)**

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**(Continue your answer on next page)**

**(Turn over)**



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**(Turn over)**

- (iii) Analyse the graph to explain why DNA methylation is involved in the development of an embryo. (2 marks)**

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**(Continue your answer on next page)**  
**(Turn over)**

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**(Turn over)**

**(b) Explain why some cells are not able to become other cell types.  
(2 marks)**

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**(Turn over)**

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**(TOTAL FOR QUESTION 5 = 8 MARKS)**

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**(Questions continue on next page)**

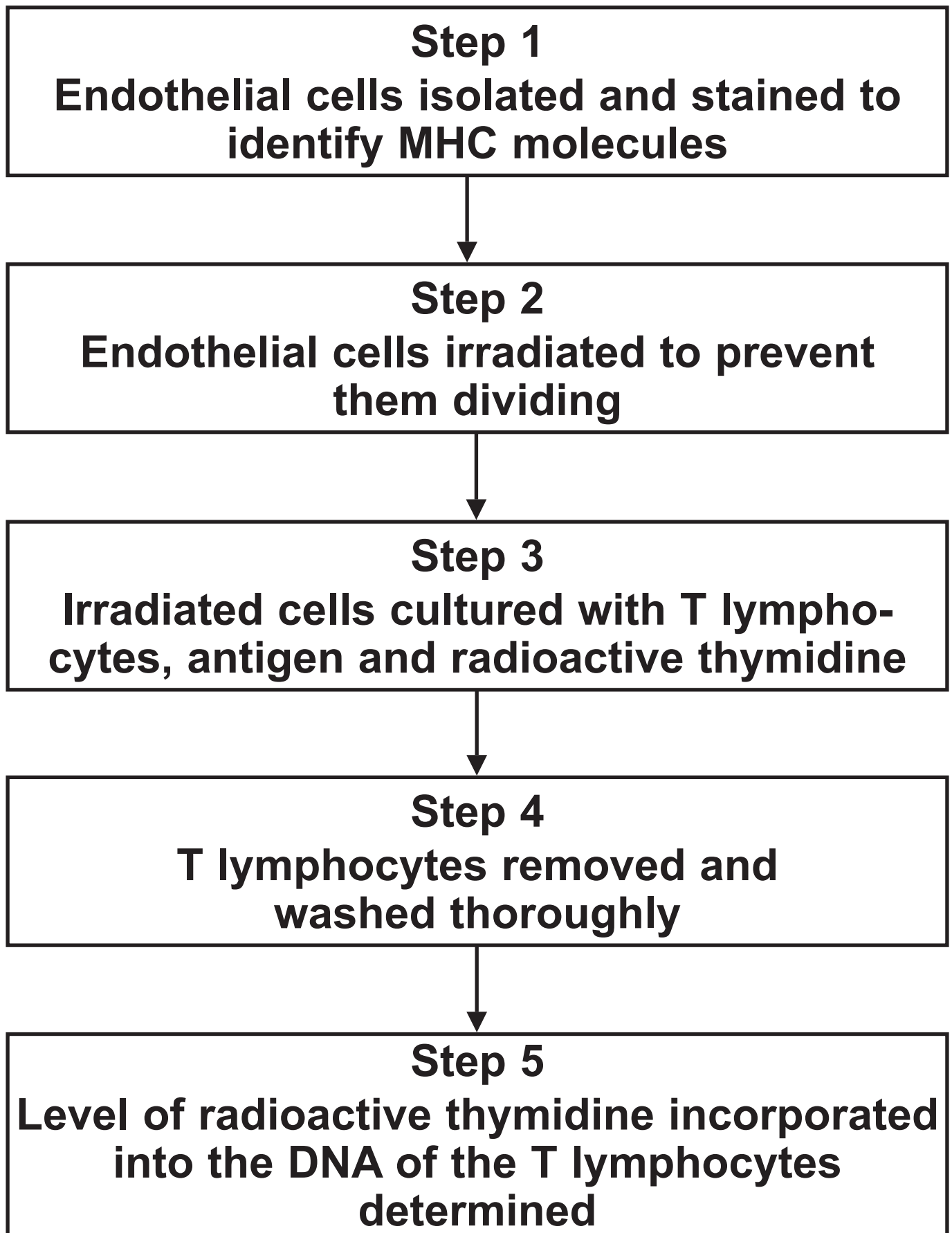
**(Turn over)**

- 6 Cell division can be measured using radioactive thymidine. This molecule is used in the synthesis of new DNA molecules.**

**A scientist investigated the ability of endothelial cells to present antigens.**

**The flow chart on page 39 shows some of the steps involved in this investigation.**

**(Question continues on next page)**



**(Question continues on next page)**

**(Turn over)**

- (a) Explain why the scientist looked for the presence of MHC molecules on the endothelial cells, in Step 1. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**



**(b) Irradiation prevents cells from dividing.**

**Explain why the endothelial cells were irradiated in Step 2, before they were cultured with T lymphocytes and antigen. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

**(c) Explain why the T lymphocytes needed to be washed thoroughly in Step 4. (2 marks)**

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**(Question continues on next page)**

**(Turn over)**

**(d) In this investigation, the ability of the endothelial cells to present four different types of antigen was assessed.**

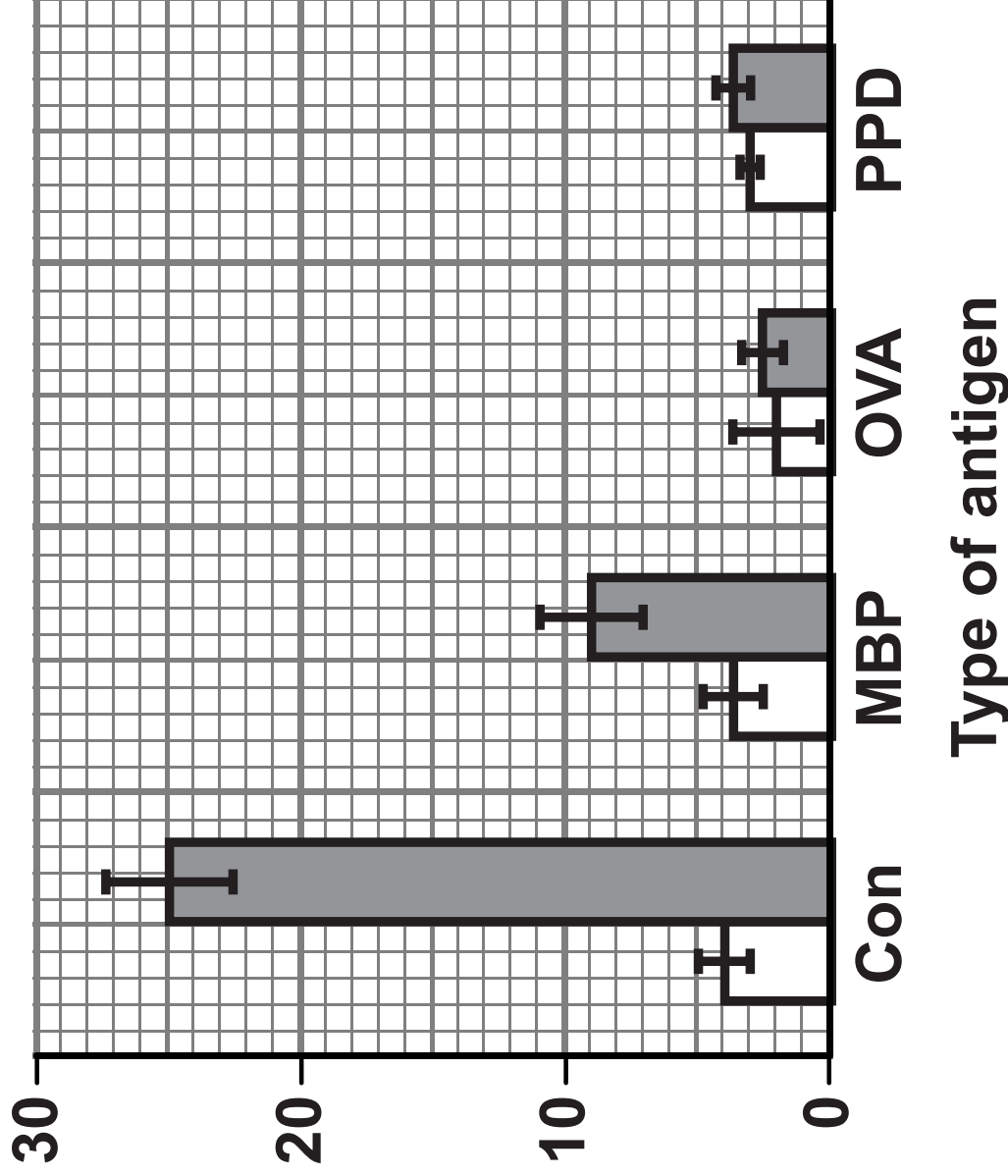
**T lymphocytes were cultured with endothelial cells and antigen.**

**This was repeated using T lymphocytes cultured with endothelial cells and no antigen.**

**The graph on page 44 shows the results of this investigation.**

**(Question continues on next page)**

Level of radioactive  
thymidine / a.u.



Key:

□ T lymphocytes  
cultured  
without antigen

■ T lymphocytes  
cultured with  
antigen

(Question continues on next page)

(Turn over)

- (i) Explain why T lymphocytes were cultured with and without the antigen. (2 marks)

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(Question continues on next page)

(Turn over)

- (ii) Analyse the data to explain the conclusions that can be drawn from this investigation. (3 marks)**

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**(Turn over)**

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**(TOTAL FOR QUESTION 6 = 11 MARKS)**

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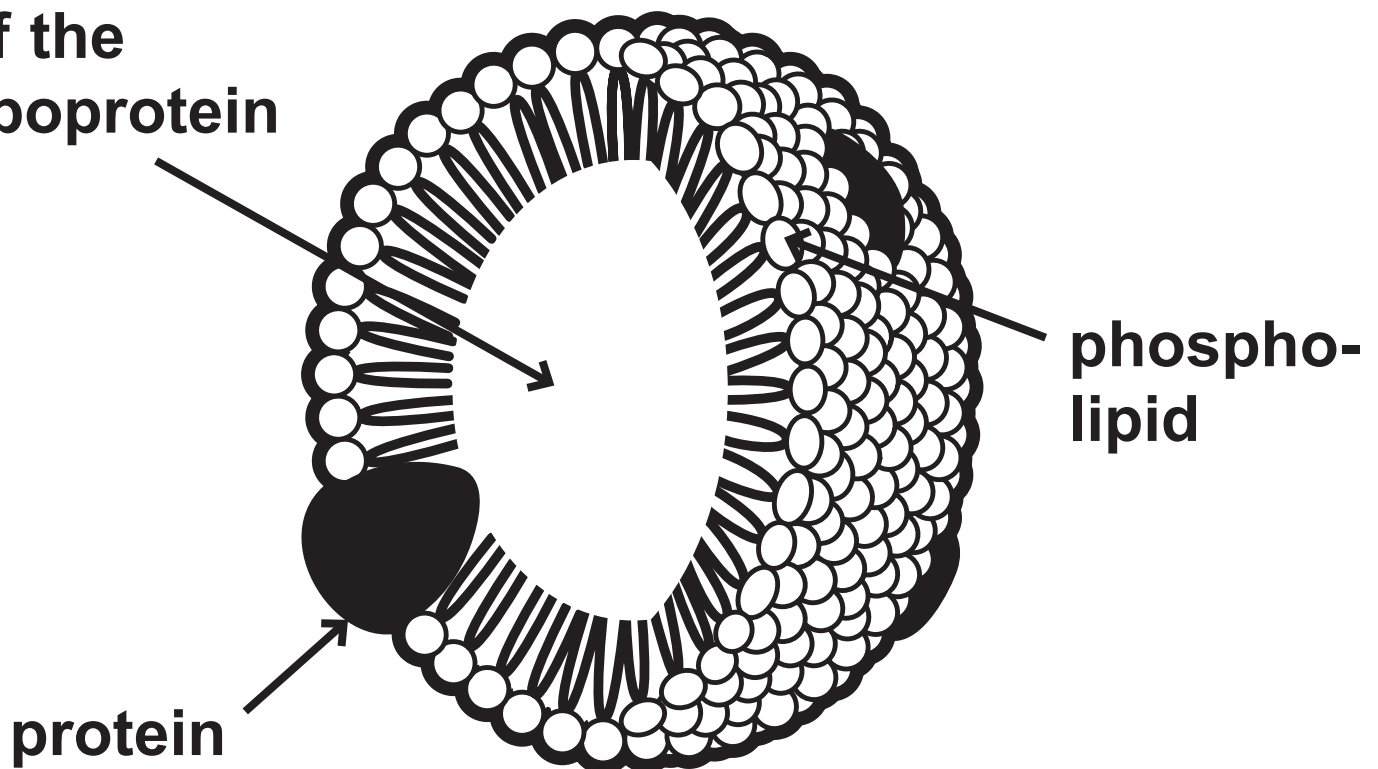
**(Questions continue on next page)**

**(Turn over)**

- 7 High density and low density lipoproteins are spherical structures that transport cholesterol and fatty acids in the bloodstream.**

**The diagram shows a lipoprotein.**

**cholesterol  
and fatty  
acids  
transported  
in the centre  
of the  
lipoprotein**



**(Question continues on next page)**

**(Turn over)**



**(a) Explain why the properties of lipoproteins enable cholesterol and fatty acids to be transported in the bloodstream. (3 marks)**

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**(Continue your answer on next page)**  
**(Turn over)**

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**(Question continues on next page)**

**(Turn over)**

**(b) The table shows some information about two types of lipoprotein, high density lipoprotein (HDL) and low density lipoprotein (LDL).**

<b>Information about lipoproteins</b>	<b>HDL</b>	<b>LDL</b>
<b>density range / g cm<sup>-3</sup></b>	<b>1·063 to 1·210</b>	<b>1·019 to 1·063</b>
<b>typical diameter / nm</b>	<b>8</b>	<b>22</b>
<b>typical volume / nm<sup>3</sup></b>	<b>268</b>	
<b>percentage of protein (%)</b>	<b>50</b>	<b>20</b>

**(Question continues on next page)**

**(Turn over)**

- (i) Complete the table to show the volume of a typical LDL using the formula:

$$\frac{4}{3} \pi r^3 \quad \text{where } \pi = 3.14$$

(2 marks)

(Question continues on next page)

(Turn over)

- (ii) Analyse the information to explain why LDLs have a lower density range than HDLs.  
(2 marks)

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(Question continues on next page)

(Turn over)

**(iii) Explain why raised levels of LDLs may increase the risk of heart disease. (4 marks)**

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**(Continue your answer on next page)**

**(Turn over)**

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**(TOTAL FOR QUESTION 7 = 11 MARKS)**

**(Questions continue on next page)**

**(Turn over)**

- 8 Genetically modified (GM) crop plants have been produced that have stomata with a wider aperture than non-modified crop plants.**

**This difference in the width of the aperture is only evident in daylight.**

**(Question continues on next page)**



The photographs show the appearance of each type of stoma in daylight.

Non-modified  
plant



guard  
cells

aperture

GM plant



outer wall of  
guard cell

inner wall of  
guard cell

10  $\mu\text{m}$

Sourced from: [http://www.aip.nagoya-u.ac.jp/en/public/research/images/Wang\\_f1.jpg](http://www.aip.nagoya-u.ac.jp/en/public/research/images/Wang_f1.jpg)

(Question continues on next page)

(Turn over)

- (a) (i) Calculate the magnification of the GM plant photograph using the scale bar.**

**Give the answer in standard form.  
(2 marks)**

**Answer \_\_\_\_\_**

**(Question continues on next page)**

**(Turn over)**

- (ii) Calculate how many times wider the aperture of the stoma of the GM plant is compared with the stoma of the non-modified plant. (1 mark)

Answer \_\_\_\_\_

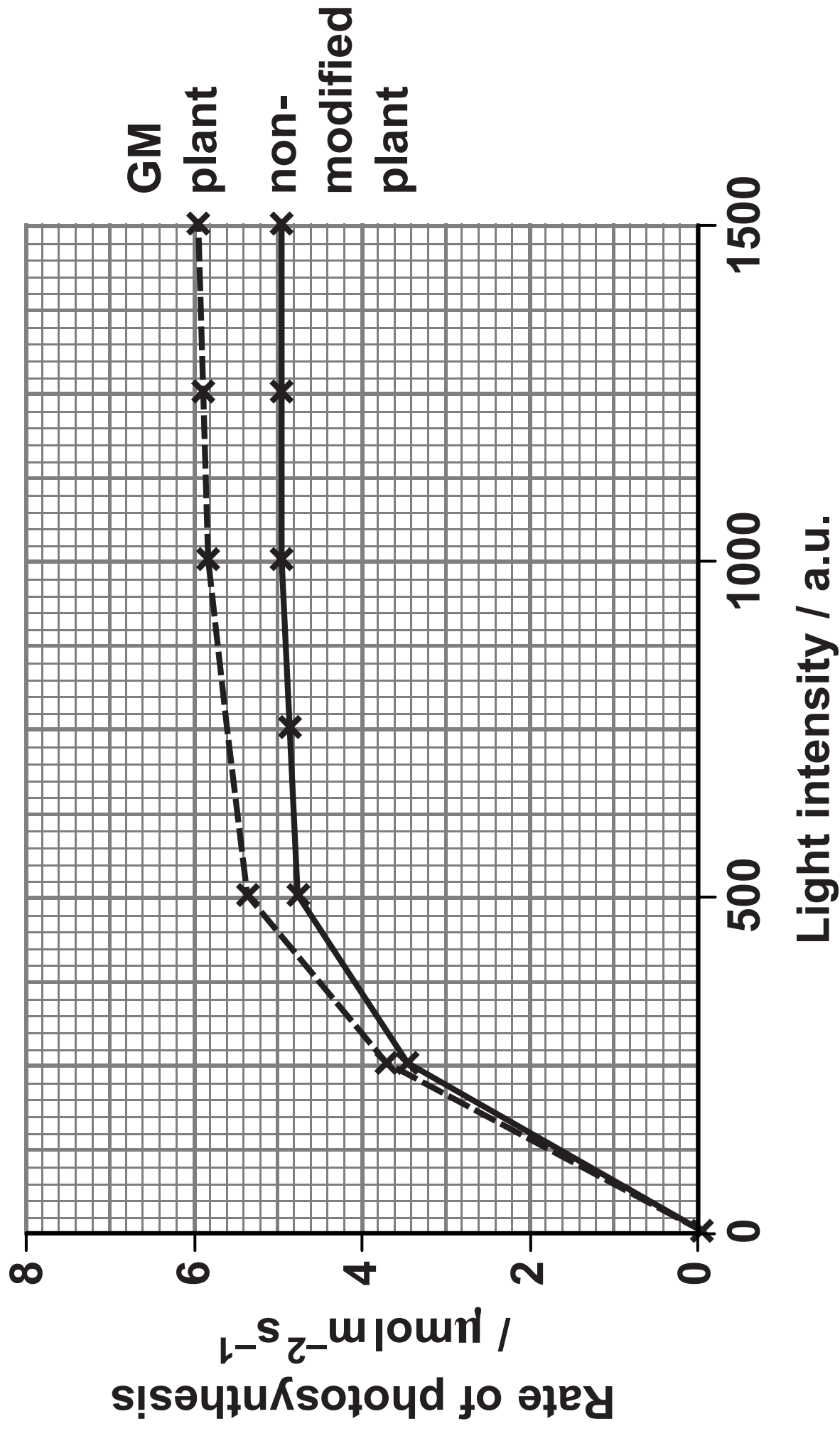
(Question continues on next page)

(Turn over)

- (b) An investigation was carried out to compare the effect of light intensity on the rate of photosynthesis in GM plants with the effect in non-modified plants.**

**The graph on page 61 shows the results of this investigation.**

**(Question continues on next page)**



(Question continues on next page)

(Turn over)

- (i) The rate of photosynthesis is expressed as  $\mu\text{mol m}^{-2} \text{s}^{-1}$ .

Describe what was measured to find the rate of photosynthesis.  
(3 marks)

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(Continue your answer on next page)

(Turn over)

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**(Question continues on next page)**

**(Turn over)**

**(ii) Explain the results of this investigation. (3 marks)**

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**(Continue your answer on next page)**

**(Turn over)**



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**(Question continues on next page)**

**(Turn over)**

**(c) Explain why the wider stomata in GM crop plants could increase their yield. (3 marks)**

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**(Continue your answer on next page)**

**(Turn over)**

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**(Question continues on next page)**

**(Turn over)**

**(d) The flow chart shows some of the steps involved in opening the aperture of a stoma.**

**Hydrogen ions actively transported out of the guard cells**



**Potassium ions diffuse into the guard cells**



**Starch broken down into malate**



**Water moves into the guard cells**



**Aperture of the stoma widens**

**(Question continues on next page)**

**(Turn over)**

**(i) What happens when hydrogen ions are actively transported out of the guard cells? (1 mark)**

- ☐ **A ADP and phosphate ions are converted into ATP by a hydrolysis reaction**
- ☐ **B ADP and phosphate ions are converted into ATP by a condensation reaction**
- ☐ **C ATP is broken down into ADP and phosphate ions by a condensation reaction**
- ☐ **D ATP is broken down into ADP and phosphate ions by a hydrolysis reaction**

**(Question continues on next page)**

**(Turn over)**

**(ii) Which of the following explains why water moves into the guard cells? (1 mark)**

- ☐ **A malate lowers the water potential of the cytoplasm**
- ☐ **B malate raises the water potential of the cytoplasm**
- ☐ **C starch lowers the water potential of the cytoplasm**
- ☐ **D starch raises the water potential of the cytoplasm**

**(Question continues on next page)**

**(Turn over)**

**(iii) Which of the following explains why the aperture of the stoma widens? (1 mark)**

- ☐ **A The guard cells become smaller and the inner wall of the guard cell is more flexible than the outer wall**
- ☐ **B The guard cells become smaller and the inner wall of the guard cell is less flexible than the outer wall**
- ☐ **C The guard cells become larger and the inner wall of the guard cell is more flexible than the outer wall**
- ☐ **D The guard cells become larger and the inner wall of the guard cell is less flexible than the outer wall**

**(TOTAL FOR QUESTION 8 = 15 MARKS)**

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**(Questions continue on next page)**

**(Turn over)**

**9 Doxorubicin (Dox) is a drug used to treat cancer.**

**(a) Cancer is caused when cells divide uncontrollably.**

**This drug works in two ways:**

- **it becomes inserted into the DNA and holds the two strands together.**
- **it binds to an enzyme that repairs DNA.**

**Explain how Dox prevents cancer cells from dividing. (5 marks)**

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**(Continue your answer on next page)**

**(Turn over)**



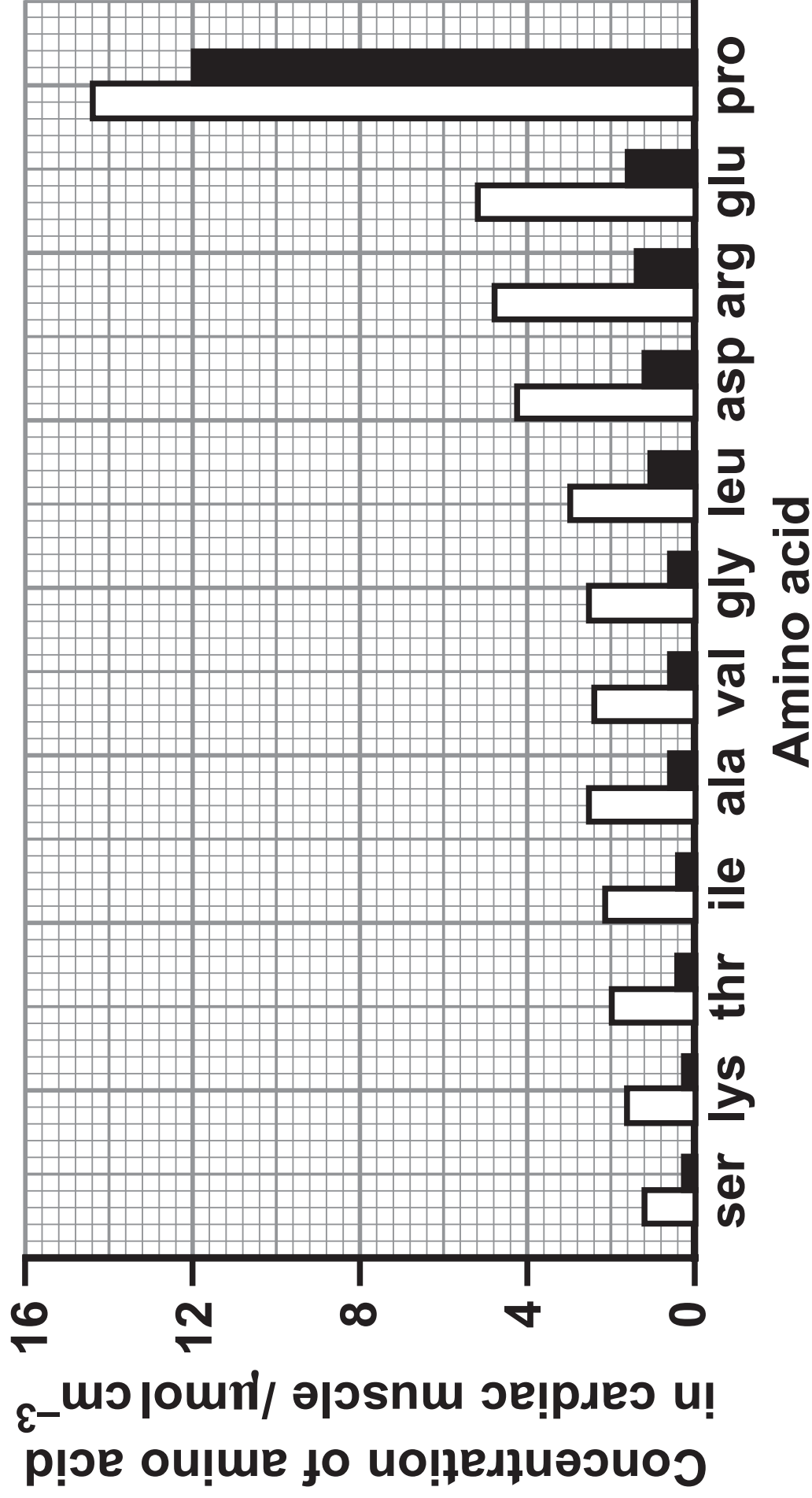
**(Turn over)**

**(b) Weakening of the cardiac muscle is one side effect of using Dox.**

**The effect of Dox on the concentration of several amino acids in cardiac muscle was investigated.**

**The graph on page 75 shows the results of this investigation.**

**(Question continues on next page)**



(Question continues on next page)

(Turn over)

**The table shows some non-polar and polar amino acids.**

Type	Amino acids
non-polar	ala, gly, ile, leu, pro, val
polar	arg, asp, glu, lys, ser, thr

- \*(i) Analyse the information to determine the effect of Dox on the concentration of these types of amino acid in cardiac muscle. (6 marks)**

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**(Continue your answer on next page)**

**(Turn over)**

**(Turn over)**

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**(Question continues on next page)**

**(Turn over)**

- (ii) Explain why a change in the concentration of amino acids results in the weakening of cardiac muscle. (2 marks)**

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**(Continue your answer on next page)**  
**(Turn over)**

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**(Question continues on next page)**

**(Turn over)**



**(iii) Explain how weakening of the cardiac muscle could affect a person. (3 marks)**

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**(Continue your answer on next page)**

**(Turn over)**

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**(TOTAL FOR QUESTION 9 = 16 MARKS)**

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**TOTAL FOR PAPER = 90 MARKS**  
**END**