



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2024

Centre Number

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Candidate Number

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Biology

Assessment Unit AS 1

assessing

Molecules and Cells

MV24

[SBY11]

FRIDAY 10 MAY, AFTERNOON

Time

1 hour 30 minutes, plus your additional time allowance.

Instructions to Candidates

Write your Centre Number and Candidate Number in the spaces provided at the top of this page.

You must answer the questions in the spaces provided.

Do not write on blank pages.

Complete in black ink only.

Answer **all seven** questions.

Information for Candidates

The total mark for this paper is 75.

Section A carries 60 marks. Section B carries 15 marks.

Figures in brackets printed at the end of each question indicate the marks awarded to each question or part question.

You are reminded of the need for good English and clear presentation in your answers.

Use accurate scientific terminology in all answers.

You should spend approximately **20 minutes** on Section B.

You are expected to answer Section B in continuous prose.

Quality of written communication will be assessed in Section B.

Section A

1 Proteins are polymers of amino acids. Several types of bonds are involved in their structure, which contribute to the overall shape of a protein.

(a) The table below shows bonds which may be present in the primary, secondary and tertiary structures of proteins.

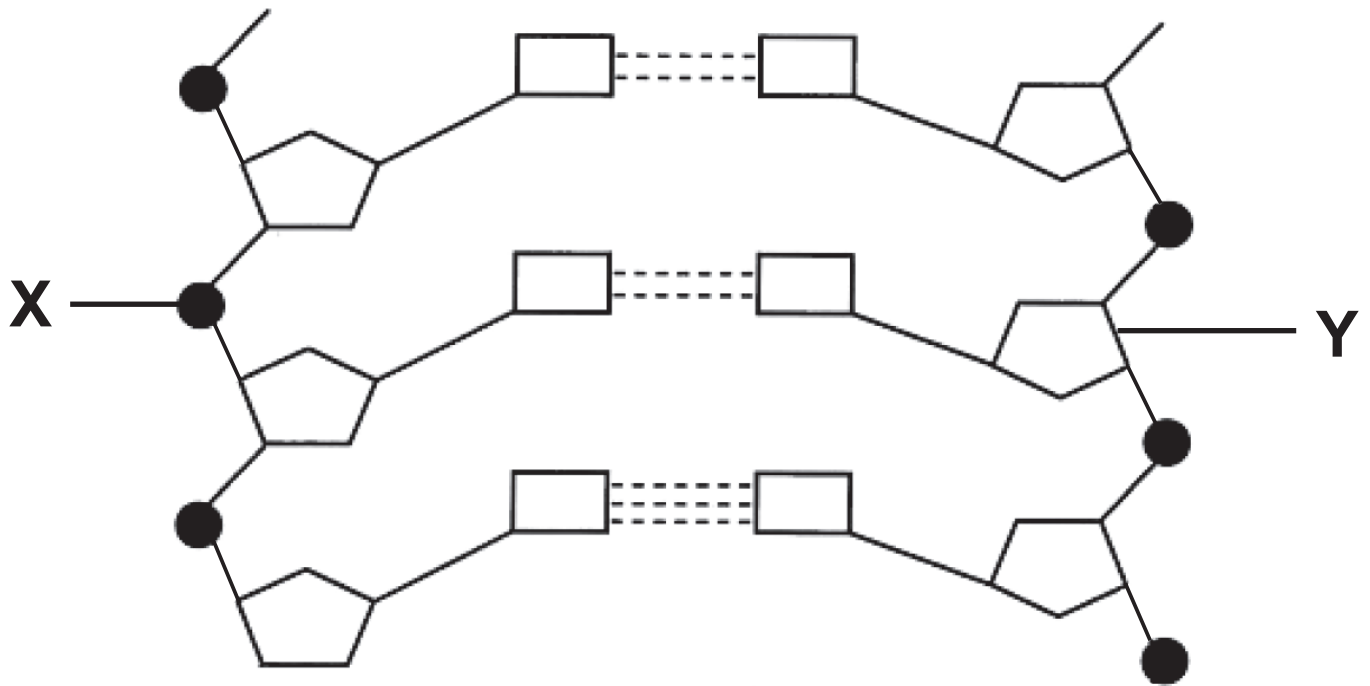
Complete the table by adding a tick (✓) if the bond is present or a cross (X) if the bond is not present. Do not leave any boxes blank. [3 marks]

Protein structure	Type of bond			
	Hydrogen	Peptide	Ionic	Disulfide
Primary	X			
Secondary	✓			
Tertiary	✓			

(b) Enzymes are proteins with a particular shape.

Explain the importance of shape to enzyme function. [2 marks]

2 The diagram below represents part of a DNA molecule.



(a) Name the components labelled X and Y.
[2 marks]

X _____

Y _____

(b) Several enzymes catalyse the replication of DNA.

Name the enzyme which 'unzips' the DNA molecule during DNA replication and describe how it does this.

[2 marks]

(c) (i) The table below shows the percentages of some of the bases in the DNA of two organisms.

Complete the table. [2 marks]

	Percentage of bases in DNA			
Organism	Adenine	Cytosine	Guanine	Thymine
Sea urchin	33	17		
Human				22

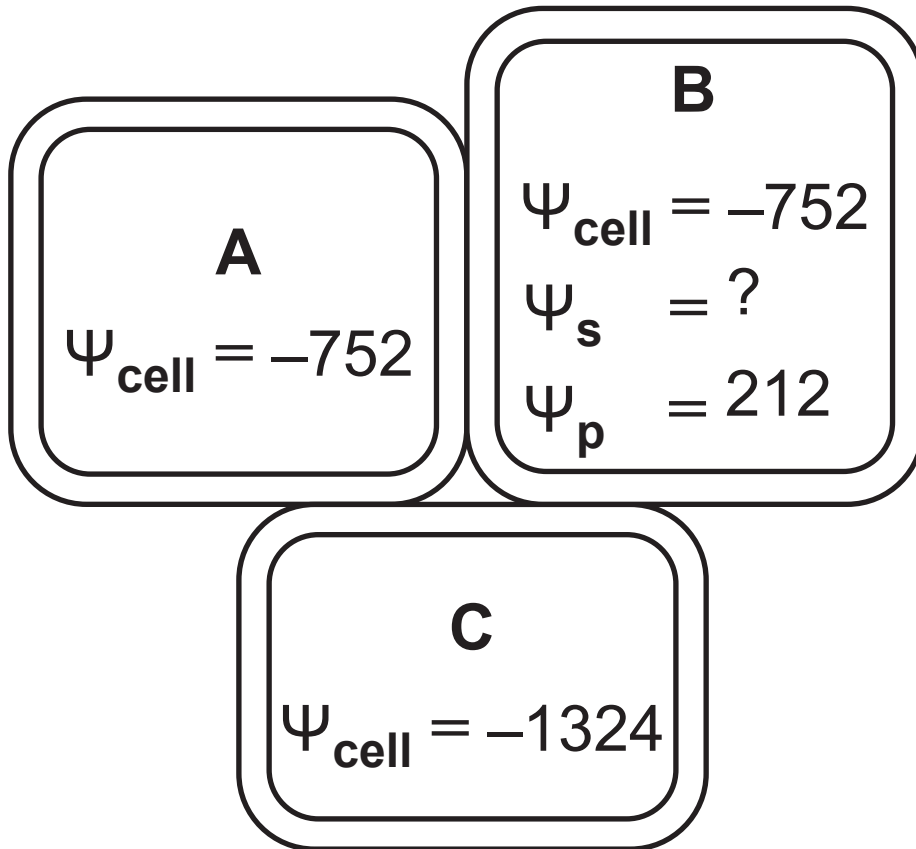
The genetic material from a virus was analysed in the same way and found to contain bases in the following percentages.

Adenine	Cytosine	Guanine	Uracil
24	32	23	21

It was concluded that the viral genetic material was RNA.

(ii) State the evidence from the table that supports this conclusion. [2 marks]

- 3 Three plant cells (**A**, **B** and **C**) are represented in the diagram below. Values (kPa) relating to their water potential have been included.



- (a) Calculate the solute potential (Ψ_{s}) of cell **B**. [2 marks]

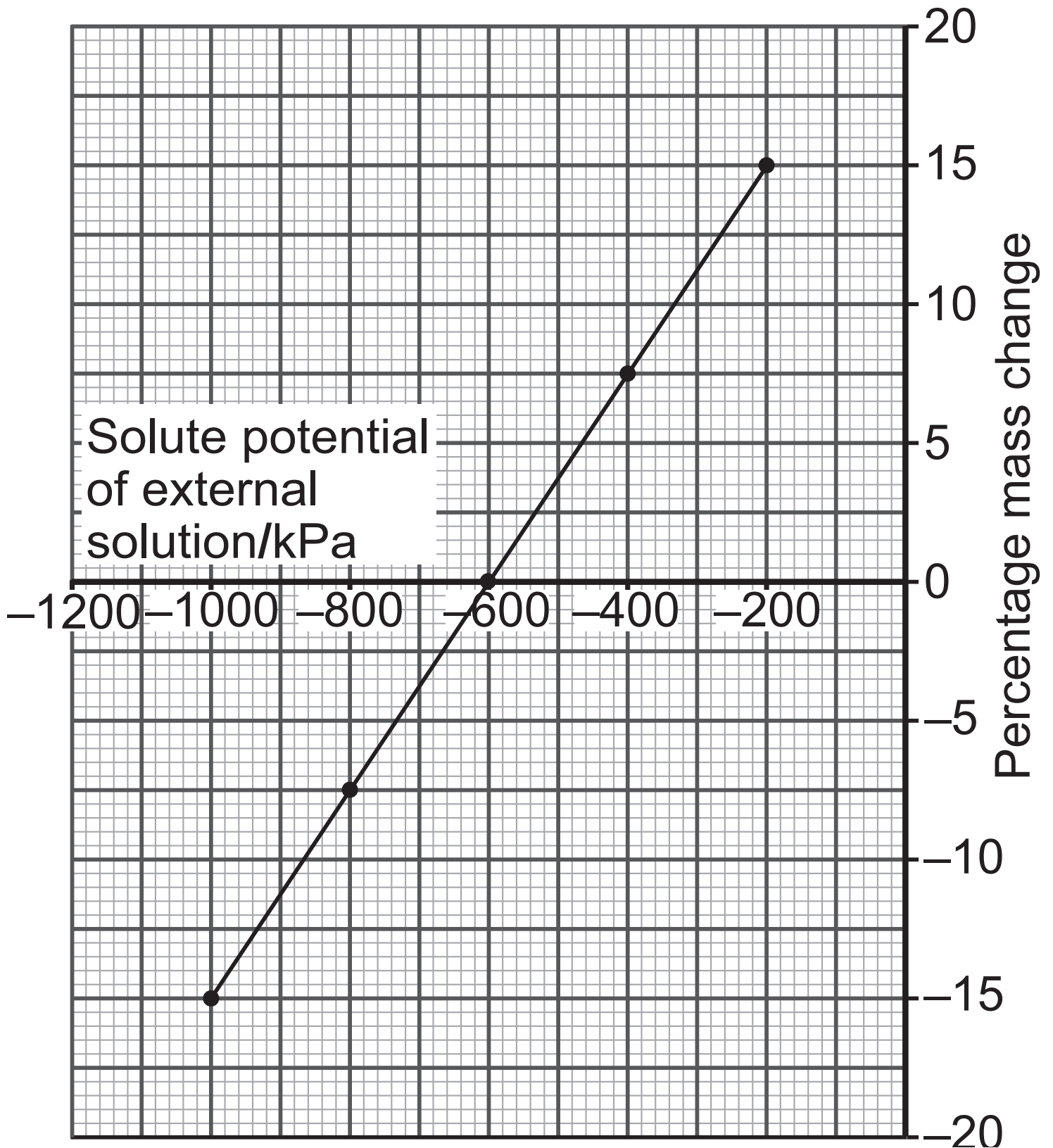
(Show your working.)

_____ kPa

(b) Add arrows to the diagram opposite to show the net movement of water between the cells. [2 marks]

(c) Describe and explain the change that occurs when an animal cell is placed in a hypertonic (concentrated) salt solution. [2 marks]

(d) The graph below shows the percentage mass change of pieces of sweet potato tissue after immersion in five external solutions with different solute potentials.



(i) Identify the trend shown by the results in the graph. [1 mark]

(ii) Sweet potatoes store carbohydrate as sugar, whereas standard white potatoes store carbohydrate as starch.

Suggest and explain how this affects the solute potential of standard white potatoes. [2 marks]

(e) (i) Explain why the solute potential of a cell is always less than zero.
[1 mark]

(ii) State the value of the pressure potential (Ψ_p) for a cell at the point of incipient plasmolysis. [1 mark]

_____ kPa

4 The cell cycle is a sequence of events that involves interphase, mitosis and cytokinesis.

There are checkpoints within the cell cycle to ensure that the previous stages have been completed correctly.

The first checkpoint is at the end of the G_1 phase of the cell cycle.

(a) Describe **two** features of a cell which are checked before moving from G_1 into S phase. [2 marks]

1. _____

2. _____

(b) If the cell cycle is not correctly regulated via checkpoints, then cancer can result from uncontrolled cell division.

Fluorouracil is a cancer (chemotherapy) treatment. It acts by preventing the synthesis of nucleotides containing thymine.

(i) Using the information provided, explain how fluorouracil stops cell division. [2 marks]

Many cancers are caused by mutations in genes which control the cell cycle. A gene called BRCA1 codes for a protein which helps repair damaged DNA at the G₁ checkpoint.

(ii) Suggest the effect of a mutation in the BRCA1 gene. [1 mark]

Inhibition of enzymes can also be used in cancer treatments.

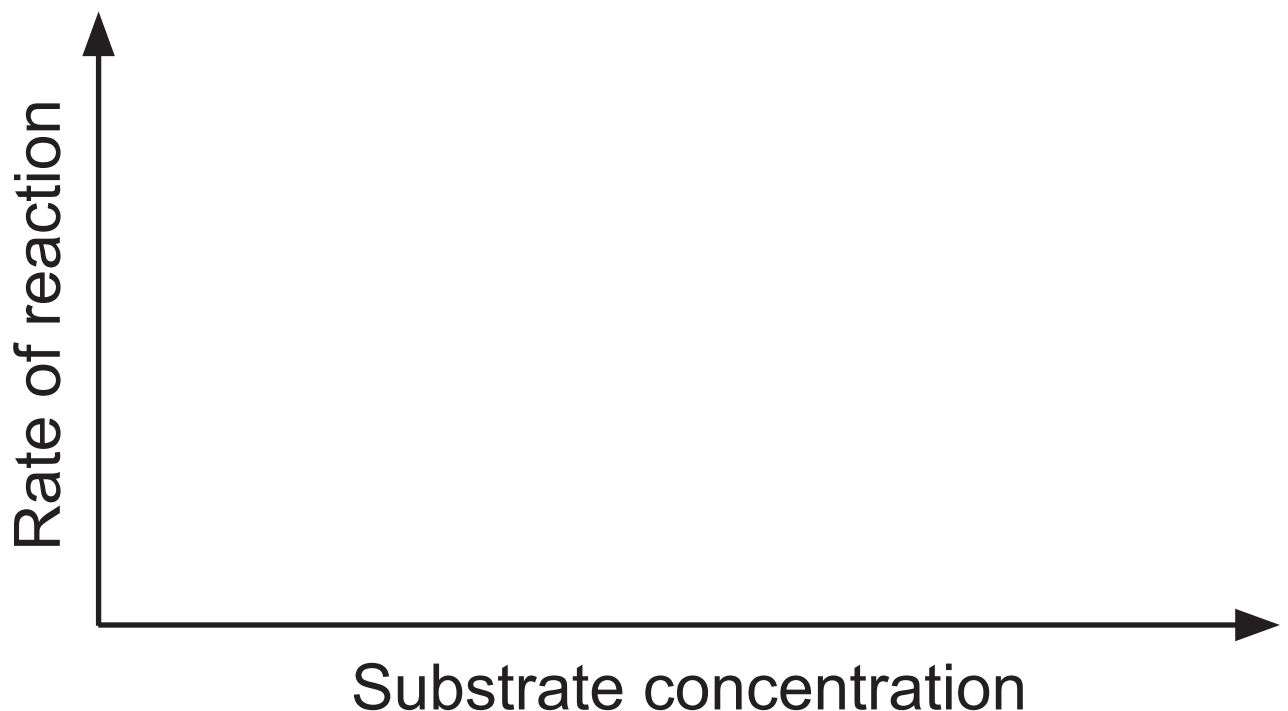
(iii) Describe and explain **two** ways in which enzymes can be inhibited.
[4 marks]

1. _____

2. _____

5 (a) Several factors, including substrate concentration and pH, affect enzyme activity.

(i) On the axes below, sketch a line to show the effect of increasing substrate concentration on the rate of an enzyme-controlled reaction.
[1 mark]



(ii) Enzymes have an optimum pH at which they work most efficiently. Enzyme activity is reduced at other pH values. Explain the effect of non-optimum pH conditions on the rate of enzyme activity. [3 marks]

(b) Enzyme immobilisation can allow enzymes to work effectively at a wider range of pH values, by making the enzyme involved more stable.

(i) Describe immobilisation by **adsorption** and suggest how this technique makes the enzyme more stable. [2 marks]

(ii) State **two** other advantages of enzyme immobilisation. [2 marks]

1. _____

2. _____

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(c) Immobilised enzymes are frequently used in industry due to their increased stability.

An enzyme which converts glucose to ethanol can be immobilised for use in the biofuel industry. In this way, ethanol produced from plant products can be used as a fuel.

Researchers investigated different methods of enzyme immobilisation and different sources of glucose, to determine their effect on ethanol production.

The results are summarised below.

Source of glucose	Method of immobilisation	Ethanol production/ grams per litre per hour
Sugar molasses	Cross-linkage	6.50
Cane molasses	Cross-linkage	1.92
Sugar cane bagasse	Adsorption	0.43
Blackstrap molasses	Adsorption	1.85
Sorghum juice	Adsorption	1.37
Cornmeal	Entrapment	0.34
Wheat straw	Entrapment	0.38

- (i) Sugar cane bagasse and blackstrap molasses are both used with adsorption as an immobilisation method in the production of ethanol.

Calculate the difference in ethanol production from these two sources over a 24-hour period. Give your answer to one decimal place.
[3 marks]

(Show your working.)

_____ grams per litre

(ii) The data shown was used to help identify the most appropriate source of glucose to achieve greatest ethanol production.

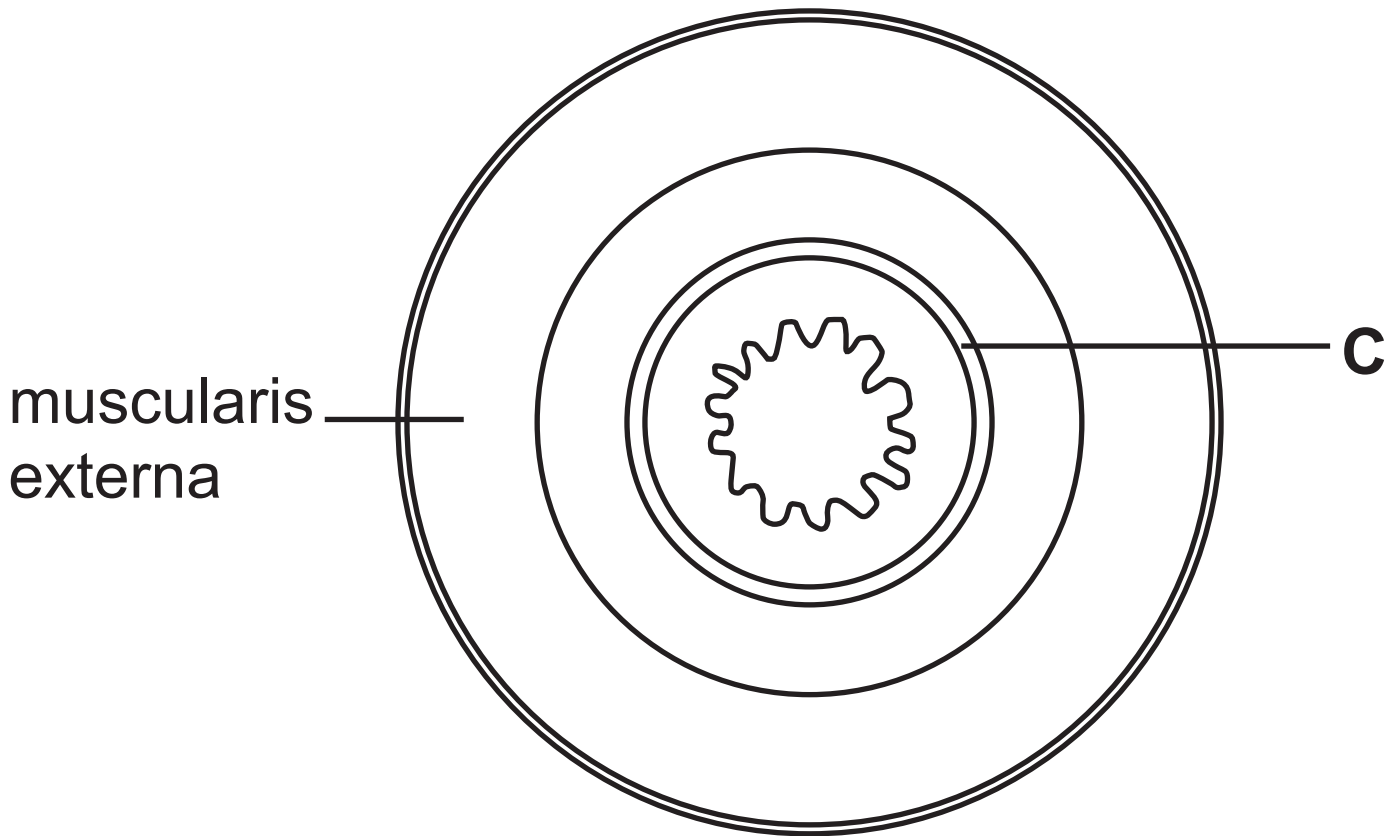
Suggest why it is not valid to use only the information in the table to identify the most appropriate source of glucose. [1 mark]

(iii) Comment on the ethanol production from cornmeal and wheat straw in comparison with the other sources, and suggest an explanation. [2 marks]

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(Questions continue overleaf)

6 The human ileum consists of tissue layers with different functions. The tissue layers of the ileum are represented in the diagram below.

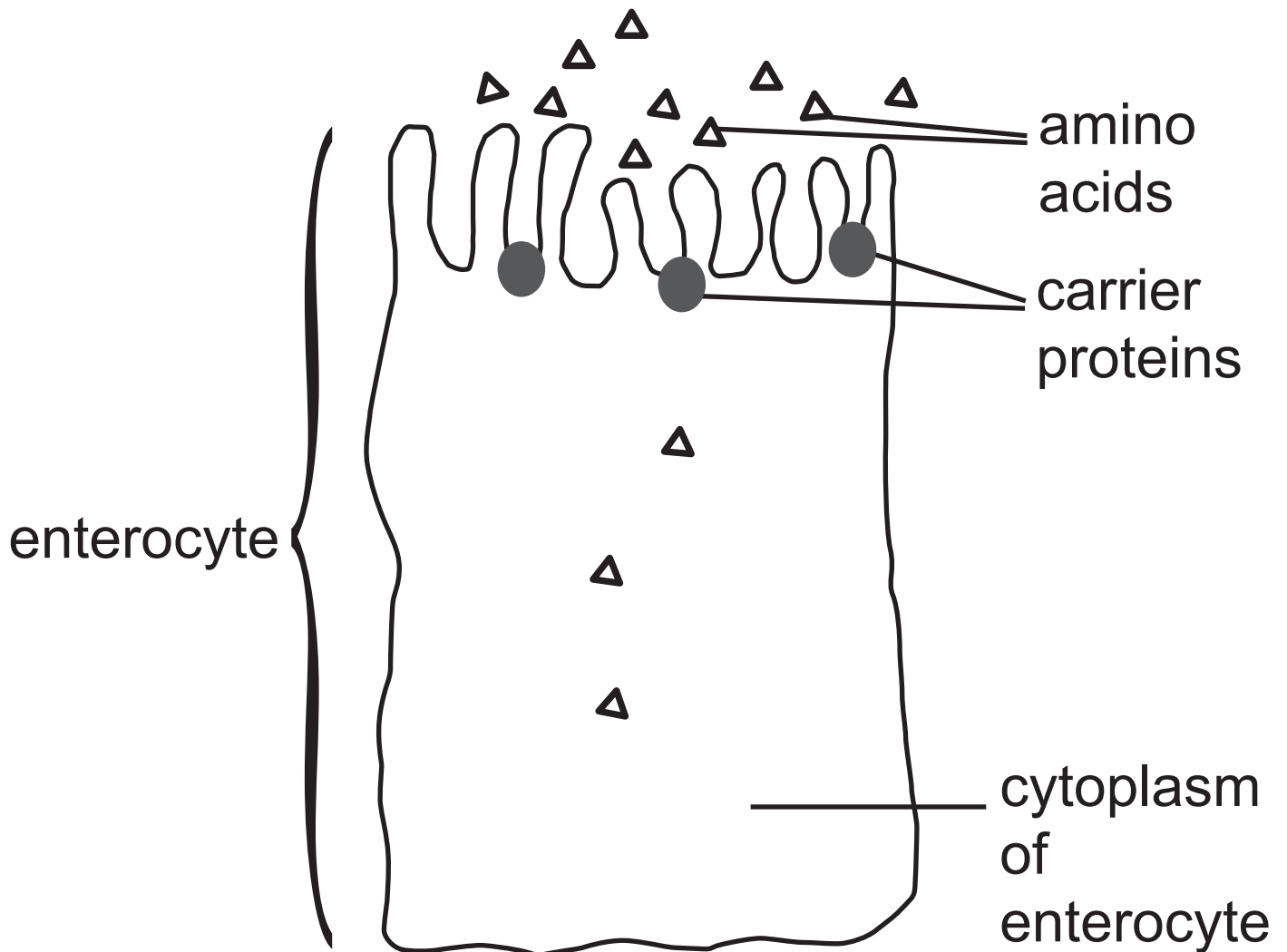


(a) Describe and explain the function of layer C. [2 marks]

A type of columnar epithelial cell, called an enterocyte, is specialised for the absorption of nutrients from the ileum.

(b) Name the tissue layer in which enterocytes would be located.
[1 mark]

(c) Products of digestion are absorbed into the bloodstream via the enterocytes. Amino acids are products of protein digestion. Following a protein-rich meal, amino acids are present in a relatively high concentration in the ileum. The diagram below summarises the movement of amino acids into an enterocyte.



- (i) Using the information provided and your knowledge, identify the mechanism by which amino acids enter the enterocyte. [2 marks]

Explain your answer fully.

(ii) Some medical conditions can change the shape of the carrier proteins shown.

Describe and explain the effect this would have on the absorption of amino acids. [2 marks]

During the absorption of food products, sodium ions also enter the enterocytes. These ions must then be removed from the enterocyte and returned to the lumen. They are present in a higher concentration in the lumen than in the enterocyte.

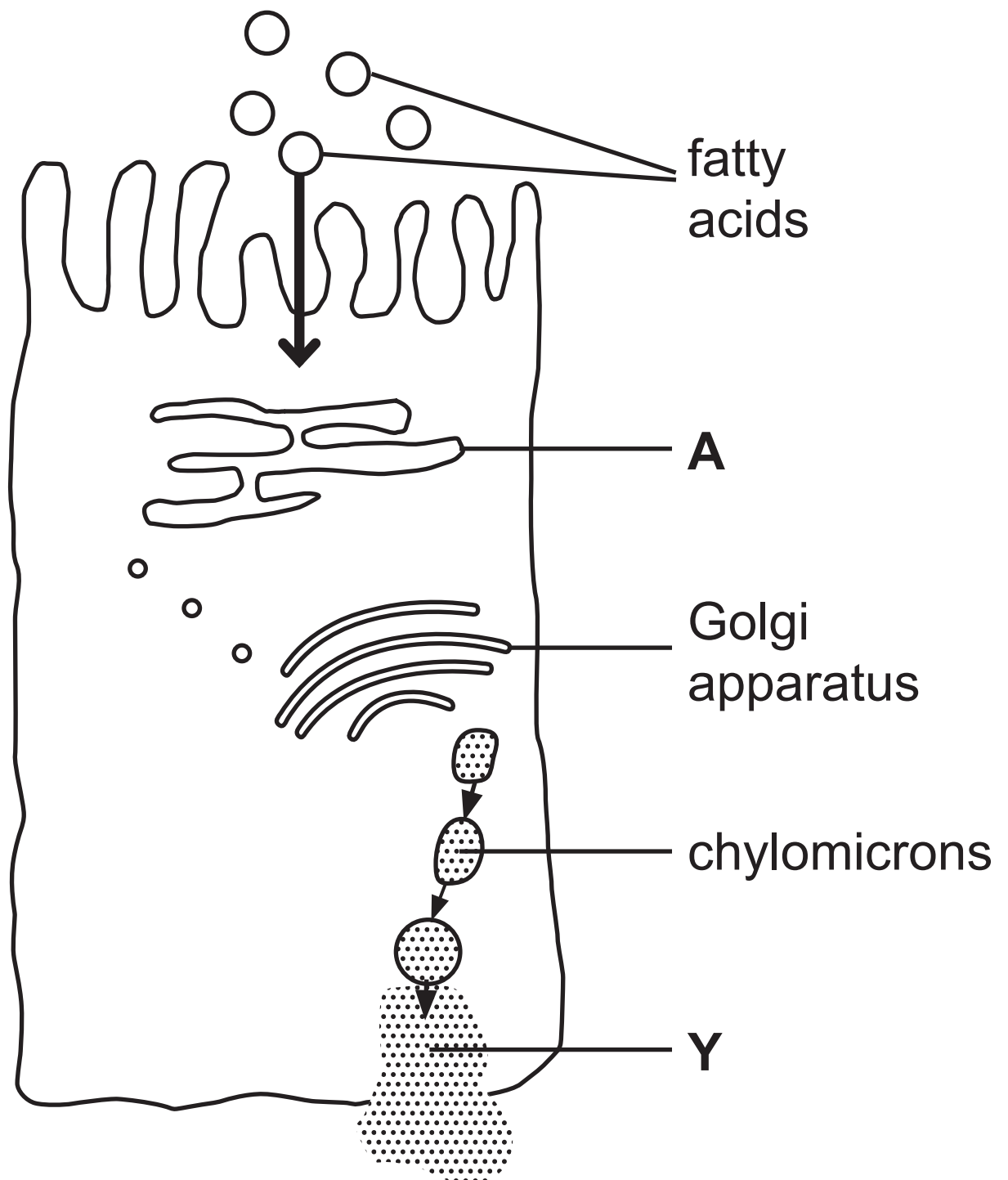
(iii) Identify the mechanism by which sodium ions are removed from the enterocyte. [1 mark]

(d) Fatty acids are a product of fat digestion. They are absorbed into a lacteal, rather than the bloodstream.

(i) Suggest an advantage of absorbing fatty acids into lacteals and not the bloodstream. [1 mark]

The diagram below summarises the absorption of fatty acids through an enterocyte.

For export out of the enterocyte, fatty acids combine with protein to form structures called chylomicrons.



(ii) Using the diagram, identify and describe the mechanism by which chylomicrons leave the enterocyte, as shown at **Y**. [2 marks]

Before the fatty acids combine with protein, they are modified while passing through the structure labelled **A** in the diagram.

(iii) Identify **A** and explain its function. [2 marks]

Section B

Quality of written communication will be assessed in this section.

7 Eukaryotic cells contain membrane-bound organelles.

State the function of the following organelles in eukaryotic cells and explain how their structure relates to their function.

[15 marks]

Mitochondria

Chloroplasts

Rough endoplasmic reticulum

Golgi apparatus

Nucleus

SOURCES

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For Examiner's use only	
Question Number	Marks
1	
2	
3	
4	
5	
6	
7	

Total Marks	
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Examiner Number

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