



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2018

Centre Number

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Candidate Number

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Biology

Assessment Unit AS 1

assessing

Molecules and Cells

MV18

[SBY11]

THURSDAY 24 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 eight** 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.

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Section A

- 1 The process of osmosis is the movement of water from a region of higher water potential to a region of lower water potential through a selectively permeable membrane.
- (a) The diagram below represents a plant cell immersed in a solution with a water potential of -1180 kPa (Ψ_{external}). The initial solute potential (Ψ_{s}) and pressure potential (Ψ_{p}) of the cell are also shown.

$$\Psi_{\text{external}} = -1180 \text{ kPa}$$

$\Psi_{\text{s}} = -1550 \text{ kPa}$
$\Psi_{\text{p}} = 320 \text{ kPa}$

- (i) Calculate the water potential (Ψ_{cell}) of the cell.
[1 mark]

_____ kPa

- (ii) Draw an arrow **on the diagram** to show the direction of water movement. [1 mark]

(b) For each of the statements described below, indicate the net movement of water by placing a ✓ in the correct box. [3 marks]

Statement	Net movement of water		
	Into the cell	Out of the cell	No net movement
Carrot tissue does not gain or lose mass after 20 minutes in a sugar solution			
An animal cell ($\Psi_{\text{cell}} = -825 \text{ kPa}$) is immersed in a solution ($\Psi_{\text{s}} = -974 \text{ kPa}$)			
An animal cell shows evidence of crenation when immersed in a salt solution			

2 Creutzfeldt-Jakob Disease (CJD) is a neurodegenerative disorder which results in the breakdown of nerve tissue in the brain of humans.

(a) (i) State the specific type of molecule that causes CJD **and** the larger biological group to which this molecule belongs. [2 marks]

- Specific type of molecule

- Larger biological group

(ii) Name **one** similar disorder, caused by this type of molecule, which occurs in other mammals.
[1 mark]

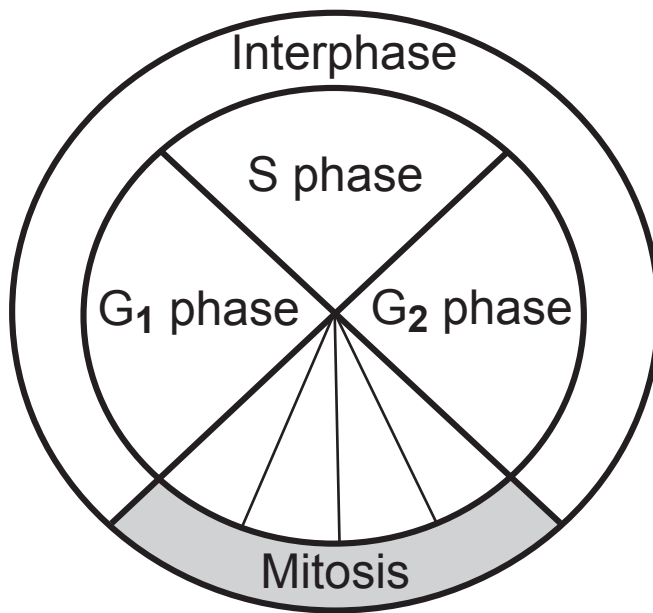
The incubation period of a disease is the time from infection to the appearance of symptoms. For CJD, this can be from 5–20 years.

(b) (i) Describe **one** way in which someone could become infected with CJD. [1 mark]

(ii) State what happens during the incubation period. [1 mark]

(c) Viruses can also cause infectious diseases. Describe how viruses differ biochemically from the molecule that causes CJD. [1 mark]

- 3 The diagram below represents the cell cycle. Mitosis is a type of nuclear division.



(a) Place an **X** on the diagram at the stage where spindle proteins are synthesised. [1 mark]

(b) (i) Name the stage of mitosis that involves the separation of chromatids. [1 mark]

(ii) Spindle fibres help to separate chromatids. Name the structure which produces spindle fibres in **animal** cells. [1 mark]

(iii) Describe how chromatid separation occurs. [1 mark]

(c) A type of cancer called Non-Hodgkin's Lymphoma (NHL) can arise as a result of uncontrolled cell division of lymphocyte cells in bone marrow. Vincristine can be used as part of a chemotherapy programme to treat NHL. Vincristine interferes with mitosis.

(i) Explain precisely how vincristine can slow down the growth of a cancerous tumour. [2 marks]

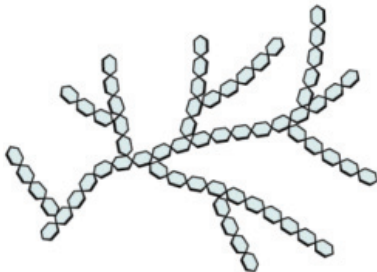
(ii) Normal cell division is a carefully controlled process, with various 'checkpoints' existing at different points in the cell cycle. For example, before a cell is able to proceed from G₁ to S phase, the cell's DNA is checked for damage. Suggest why a cell with damaged DNA is stopped from proceeding to S phase. [2 marks]

4 Each of the polysaccharides shown below is constructed from a single type of monomer.

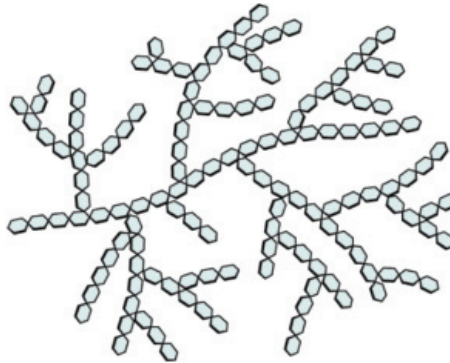


Amylose

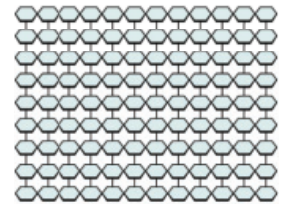
+



Amylopectin



Glycogen



Cellulose

Starch

(a) Name the type of reaction that occurs to join two monomers and the bond that is created between the monomers in these polysaccharides. [1 mark]

Reaction _____

Bond _____

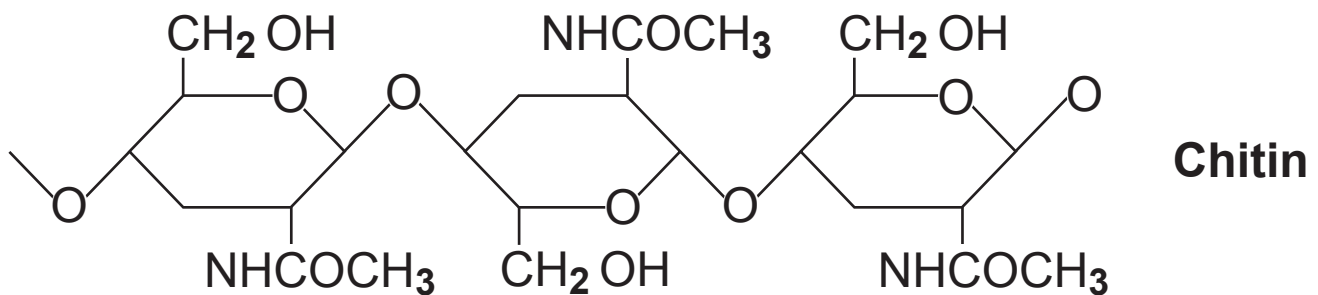
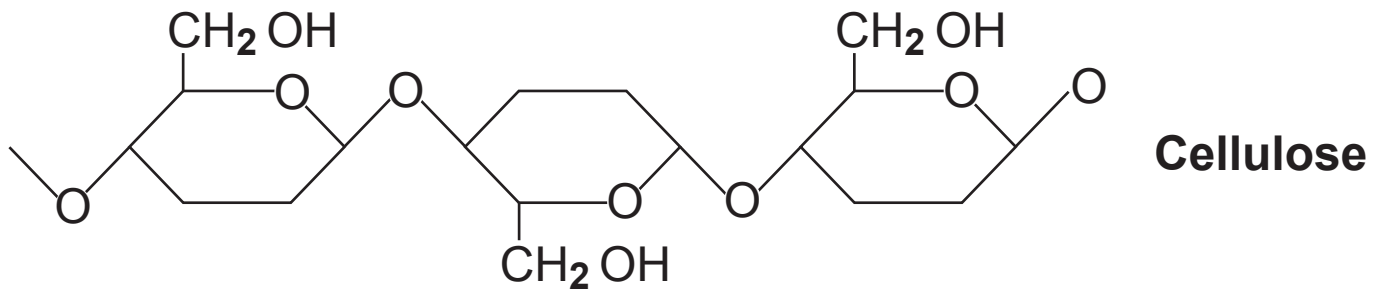
Glycogen and starch are found in animal and plant cells respectively. They have similar biochemical structures and functions.

(b) Apart from bonding, compare **and** contrast the structure and function of glycogen and starch. [4 marks]

Structure

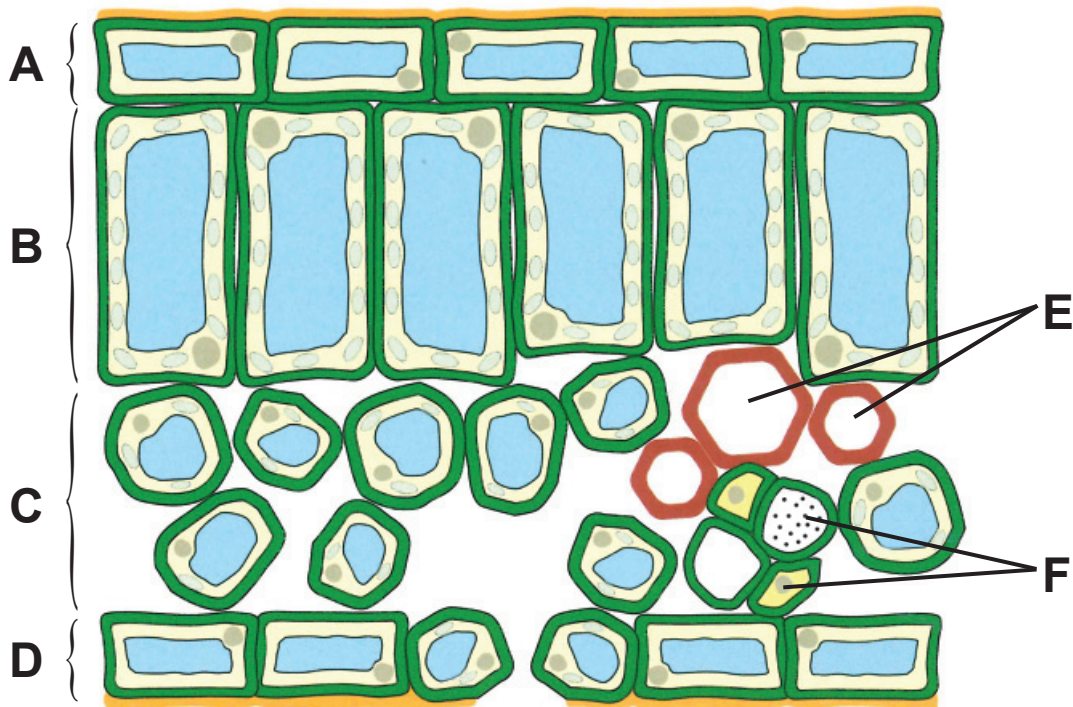
Function

The cell wall of plant cells is composed of cellulose whereas the cell wall of fungal cells contains chitin. These polymers have similar functions. Chitin can also be found in some animals, such as the shore crab (***Carcinus maenas***). The diagrams below show small sections of cellulose and chitin.



(c) Suggest a function for chitin in the shore crab and explain how its structure relates to this function.
[2 marks]

- 5 The diagram below represents a transverse section through part of a mesophytic leaf. Six of the tissues are labelled **A–F**.



- (a) (i) Using the appropriate letter from the diagram, identify the tissue which is responsible for each of the following: [3 marks]

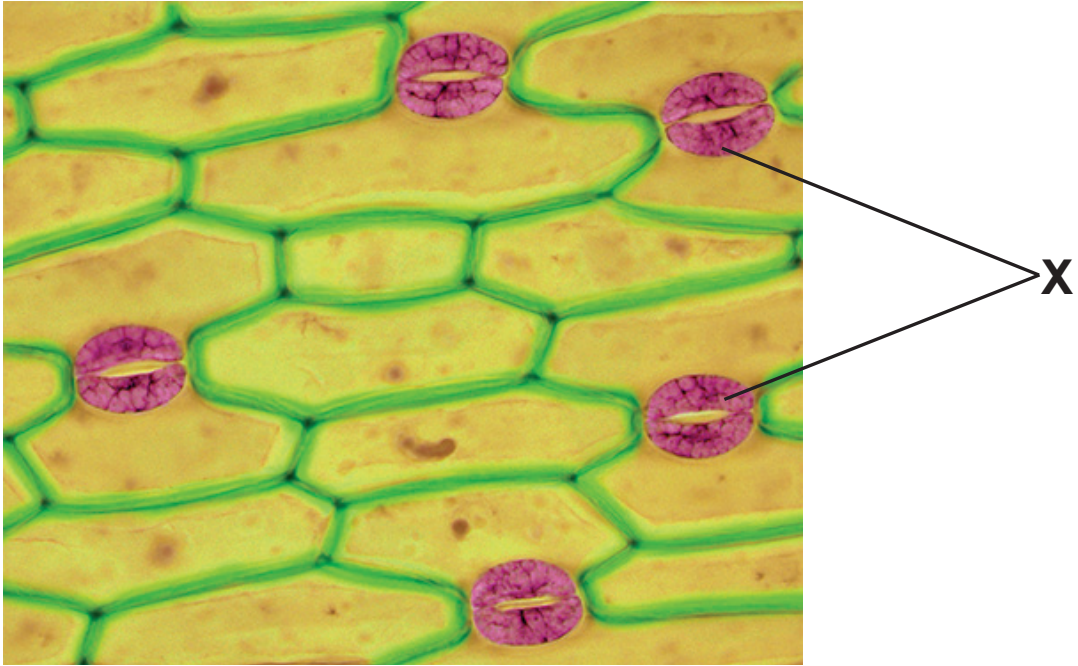
Maximum photosynthesis _____

Regulation of water loss _____

Translocation of sugars _____

(ii) Describe and explain the location of air spaces in the leaf shown. [3 marks]

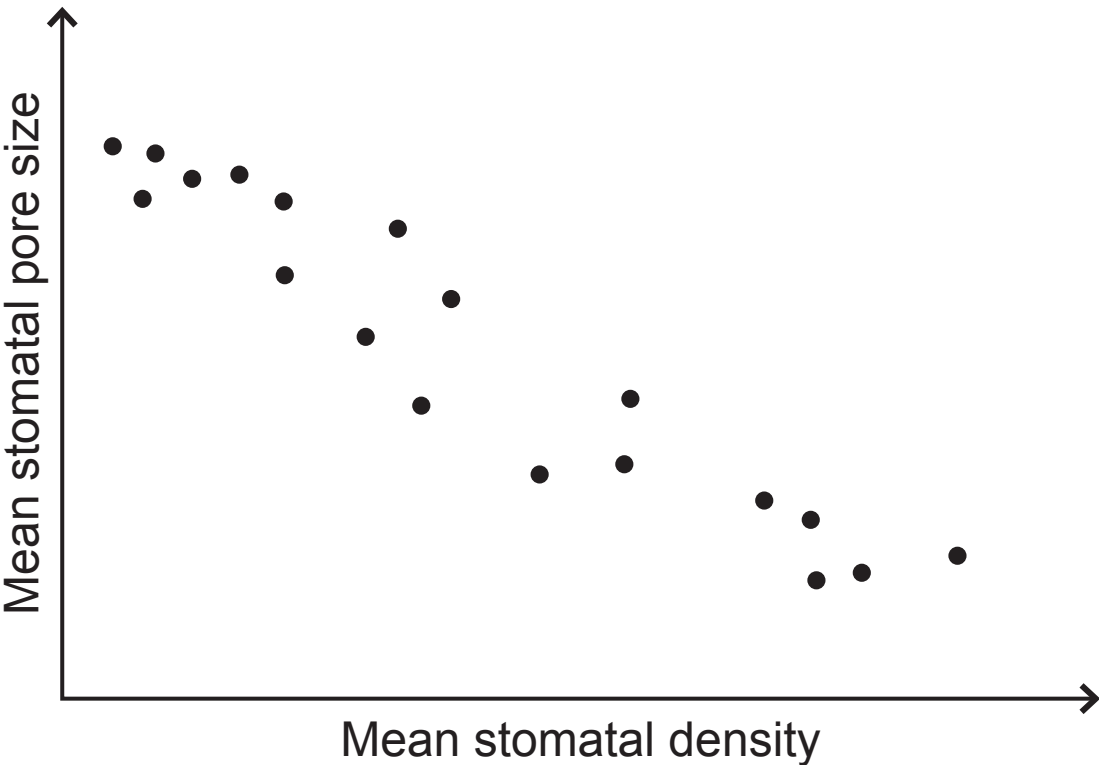
(b) The photograph below shows part of the leaf surface.



(i) Name the cells labelled **X**. [1 mark]

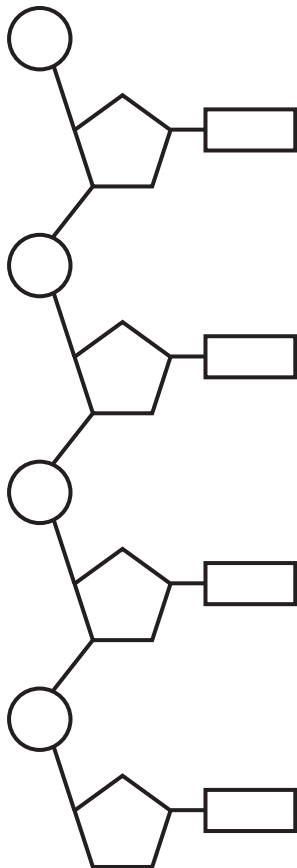
(ii) The cells labelled **X** lose water at night. Suggest the effect of this. [2 marks]

Both stomatal density and stomatal pore size influence the volume of carbon dioxide that enters a leaf. The mean stomatal density and mean stomatal pore size in different populations of paper birch trees (*Betula papyrifera*) were investigated. The results are shown below.



(c) Describe the trend shown and suggest how paper birch trees with low mean stomatal density can photosynthesise effectively. [2 marks]

6 The diagram below represents a single strand of DNA.



(a) Draw a circle around a nucleotide on the diagram.
[1 mark]

(b) DNA holds the code for protein synthesis. It is copied into a type of RNA which is able to leave the cell nucleus through nuclear pores.

Suggest why DNA is not able to leave the nucleus.
[2 marks]

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(c) The table below shows the approximate percentages of the four bases found in the DNA of five different species.

Organism	Percentage of bases in organism's DNA/%			
	Adenine	Guanine	Cytosine	Thymine
Yeast	32	18	18	32
Rat	30	20	20	30
Human	30	20	20	30
Grasshopper	30	20	20	30
E. coli		26		

(i) Complete the table above to show the expected percentage of bases that would be found in DNA from **E. coli**. [1 mark]

(ii) The values shown for human and grasshopper DNA are the same, even though the two organisms are very different. Explain how their DNA differs.

[1 mark]

(d) (i) DNA is replicated through semi-conservative replication. Explain the term 'semi-conservative replication'. [1 mark]

(ii) Name **two** of the enzymes involved in semi-conservative replication of DNA and describe the role of each. [4 marks]

1. Enzyme _____

Role _____

2. Enzyme _____

Role _____

(e) In 1958 Meselson and Stahl carried out an experiment which demonstrated that replication of DNA was semi-conservative. They cultured bacteria on agar containing ^{15}N , which is a heavy isotope of nitrogen. The bacteria were then moved to agar containing normal ^{14}N (a light isotope) and allowed to reproduce. DNA was extracted from each generation of bacteria and centrifuged. The results for bacteria cultured on ^{15}N are shown in the first diagram below.

(i) Complete the second diagram to show the distribution of DNA extracted from the **second** generation grown on ^{14}N . [1 mark]



DNA from bacteria grown on ^{15}N



DNA from bacteria grown on ^{14}N for **two** generations

(ii) Meselson and Stahl grew bacteria on ^{14}N for several more generations. Suggest and explain how the result after three generations would differ from that for two generations. [2 marks]

- 7 Hypertension (high blood pressure) is a condition which often goes undetected as it has very few obvious symptoms. If left untreated, it increases the risk of heart attack and stroke.

Adults with hypertension often have increased blood levels of a molecule called angiotensin 2. An enzyme Angiotensin Converting Enzyme (ACE) converts the molecule angiotensin 1 to angiotensin 2.



Angiotensin 2 narrows blood vessels, which in turn contributes to increased blood pressure.

- (a) With reference to the mechanism of enzyme action, describe fully how ACE converts angiotensin 1 to angiotensin 2. [3 marks]

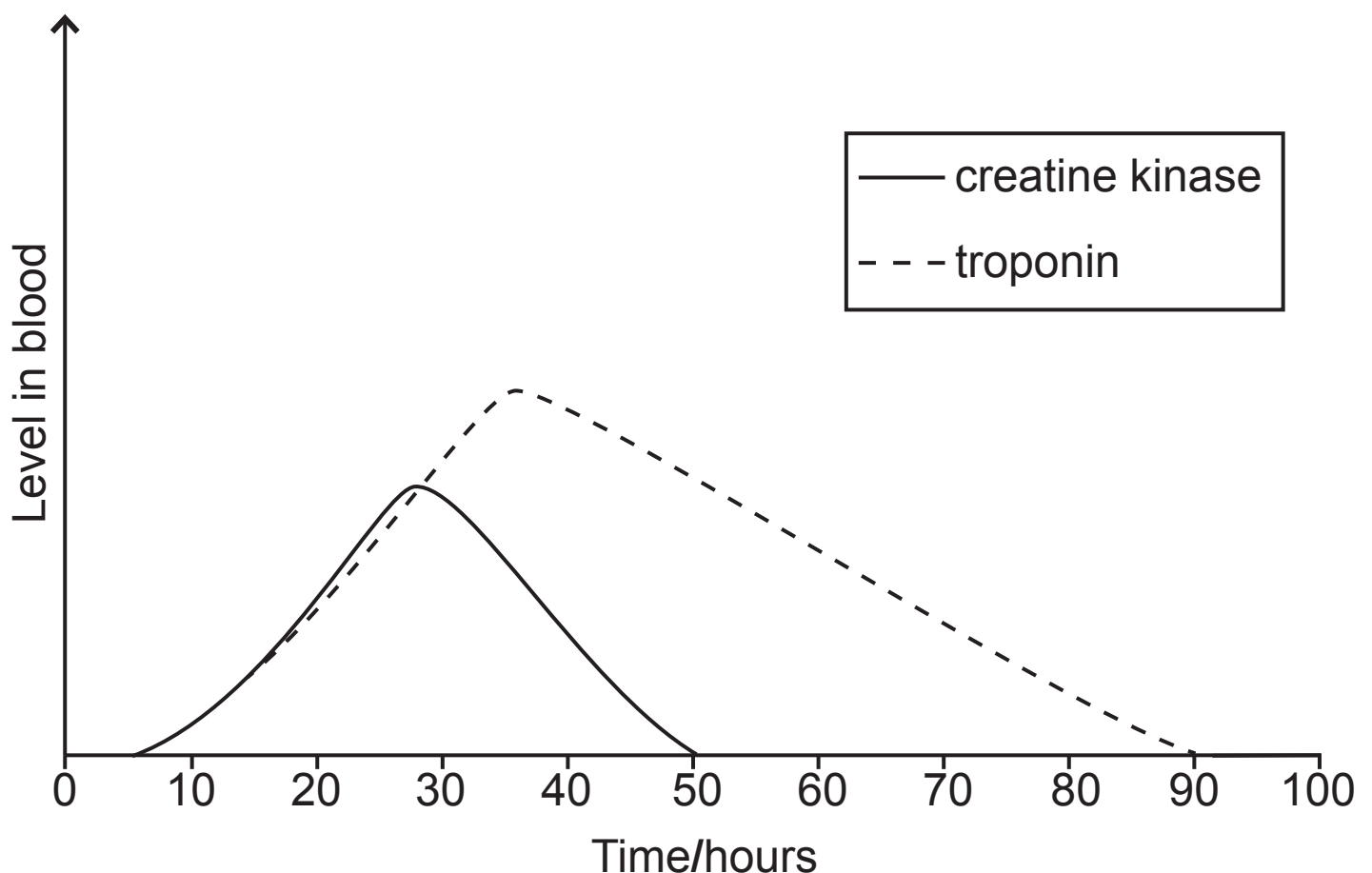
Enzyme inhibition may be used to treat hypertension. ACE inhibitors are medicines which prevent angiotensin 1 being converted into angiotensin 2.

(b) Describe and explain **two** ways in which these inhibitors may inhibit the ACE enzyme. [3 marks]

While ACE is an enzyme which can contribute to heart disease, other enzymes can act as biomarkers and are useful as indicators of health.

Two examples of biomarkers which can be used to assess heart health are the enzyme creatine kinase and another molecule called troponin. Both of these molecules are released from damaged heart muscle.

The graph below shows the levels of both of these biomarkers over a 100-hour period (96 hours = 4 days) in the blood of an individual who has suffered from chest pain.



(c) (i) Describe the differences between the trends shown in the graph for creatine kinase and troponin. [2 marks]

(ii) Using the graph, suggest **two** reasons why doctors use the troponin blood test (rather than creatine kinase) to help diagnose a heart attack. [2 marks]

Section B

Quality of written communication will be assessed in this section.

- 8** All eukaryotic cells, and some organelles, are surrounded by selectively permeable membranes. The composition of the membranes is important in controlling the movement of molecules directly across the membranes.

Substances which cannot pass directly across the membrane may be transported by endocytosis or exocytosis.

(a) Describe the structure of cell membranes and explain how their composition makes the membrane selectively permeable. [9 marks]

(b) Describe the processes of endocytosis and exocytosis. [6 marks]

SOURCES

Q4. Source: <https://cnx.org/contents/kxd8RhSc@1.9:TugP4BFc@1/Carbohydrates>
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Q5. Source: © Biology for CCEA AS level by Dr J Napier, page 120 published by Colourpoint Books, 2012. ISBN 978 1780730103

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Question Number	Marks
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Examiner Number

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