



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
January 2012

Centre Number

71	
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Candidate Number

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Biology

Assessment Unit AS 1

assessing

Molecules and Cells

[AB111]



AB111

WEDNESDAY 11 JANUARY, MORNING

TIME

1 hour 30 minutes.

INSTRUCTIONS TO CANDIDATES

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

Write your answers in the spaces provided in this question paper.

There is an extra lined page at the end of the paper if required.

Answer **all nine** questions.

You are provided with **Photograph 1.5** for use with Question 5 in this paper.

Do not write your answers on this photograph.

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 down the right-hand side of pages 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**, and awarded a maximum of 2 marks.

For Examiner's use only

Question Number	Marks
1	
2	
3	
4	
5	
6	
7	
8	
9	

Total Marks	
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Section A

Examiner Only	
Marks	Remark

1 Identify the word or phrase that is described by each of the following statements.

- Carbohydrates which, when heated with Benedict's reagent, cause the formation of a brick-red precipitate.

- A cell which has two homologous copies of each chromosome.

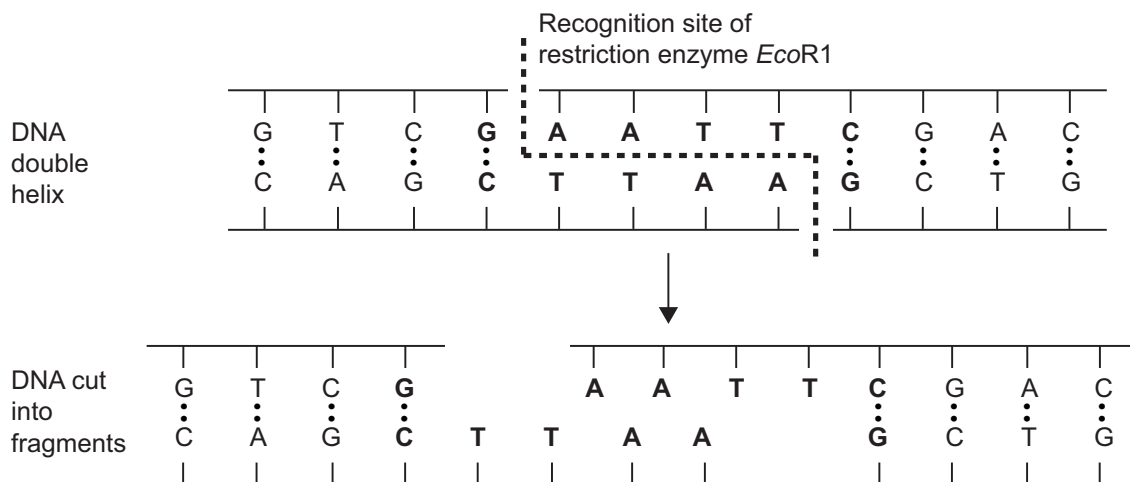
- A short strand of fluorescently labelled DNA, with a known order of bases, used to locate a specific sequence of nucleotides within a DNA molecule.

- A fatty acid chain which contains a number of double-bonded carbon atoms along its length.

- The enzyme used by HIV to synthesise viral DNA from RNA.

[5]

- 2 The restriction enzyme *EcoR1* recognises a specific sequence of bases in DNA and cuts the DNA at that site. This is shown in the diagram below.



- (a) (i) Name the type of bond which is broken between the bases **A** and **T**.

_____ [1]

- (ii) State the type of reaction which occurs when the DNA backbone is broken between the nucleotides containing **A** and **G**.

_____ [1]

When a particular bacteriophage DNA is exposed to *EcoR1*, 6 fragments of DNA are obtained.

Another restriction enzyme called *HindIII* works in a similar way to *EcoR1* but acts on a different recognition site. *HindIII* produces 8 fragments of DNA from the same bacteriophage.

- (b) (i) Determine the number of *EcoR1* recognition sites on the bacteriophage DNA.

_____ [1]

- (ii) Assuming that the recognition sites of the two enzymes do not overlap on the bacteriophage DNA, determine the number of fragments produced if both *EcoR1* and *HindIII* were used together. (Show your working.)

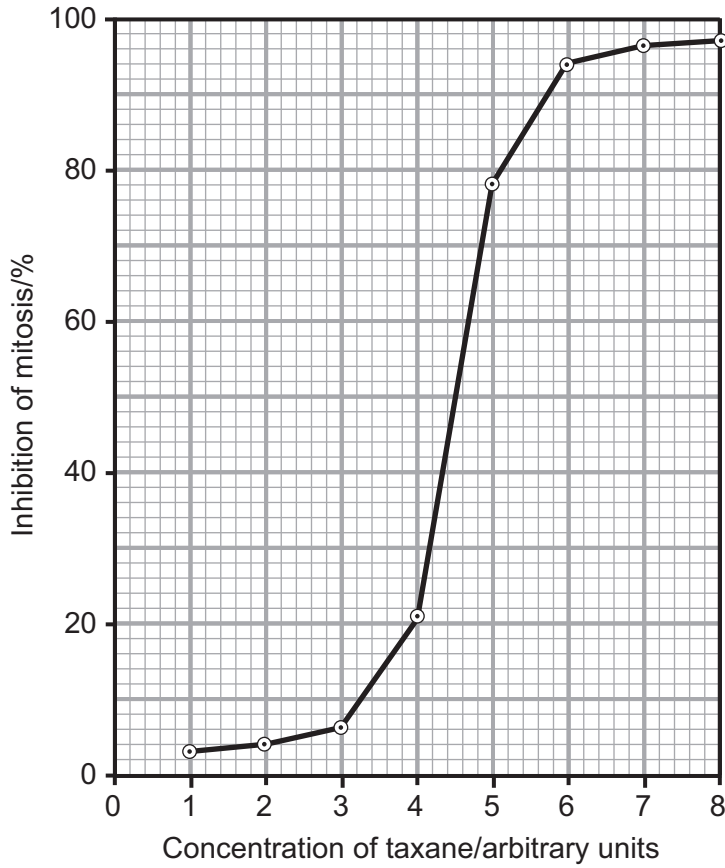
Answer _____ [1]

Examiner Only

Marks	Remark

3 Yew trees have been used as a source of a group of drugs called taxanes. Taxanes interfere with the normal functioning of the microtubules in the cell, and so inhibit mitosis. They are used to treat certain types of cancer since they prevent cell division and therefore reduce tumour growth.

The effect of various concentrations of a taxane drug on percentage inhibition of mitosis is shown in the graph below.



(a) Describe, as fully as possible, the effect of increasing taxane concentration on the % inhibition of mitosis.

[3]

Examiner Only	
Marks	Remark

- (b) Cells which have been treated with taxanes begin mitotic division, but cannot complete it. Suggest which phase of mitosis is prevented by taxanes, and give a reason for your answer.

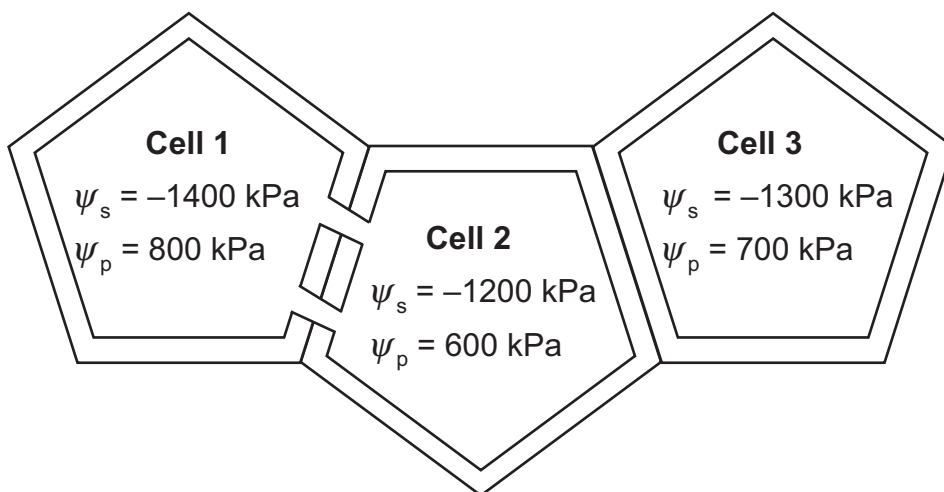
Phase of mitosis _____

Reason _____

_____ [2]

Examiner Only	
Marks	Remark

- 4 (a) The diagram below represents 3 adjacent plant cells. The solute potential (ψ_s) and pressure potential (ψ_p) for each cell are indicated.



- (i) State the name of the strands of cytoplasm which interconnect cells 1 and 2.

_____ [1]

- (ii) Describe and explain the net flow of water between cells 2 and 3.

 _____ [2]

- (b) Osmosis involves the movement of water through a selectively permeable membrane. Describe the pathway by which water molecules move through the cell-surface membrane and contrast this with the movement of small hydrophilic molecules such as glucose.

 _____ [2]

Examiner Only

Marks Remark

5 (a) **Photograph 1.5** is a colour-enhanced, transmission electron micrograph of part of a mammalian pancreas cell. This cell produces large amounts of protein.

(i) Identify the structures labelled **A** to **D**.

A _____

B _____

C _____

D _____

[4]

(ii) The actual width of the organelle along the line **XY** is 2µm. Calculate the magnification of the photograph. (Show your working.)

Answer _____ [3]

(iii) Identify **two** pieces of evidence from the photograph which indicate that there is a high level of protein production and secretion from this cell.

• evidence for protein production _____

• evidence for protein secretion _____

_____ [2]

(b) In cells of the liver, excess glucose is converted into glycogen. Glycogen deposits in the liver are a means of storing glucose for future use in the body.

Identify **one** structural property of the glycogen molecule, and state how this relates to its role as an effective storage compound of glucose.

Property _____

Role _____

_____ [2]

Examiner Only

Marks Remark

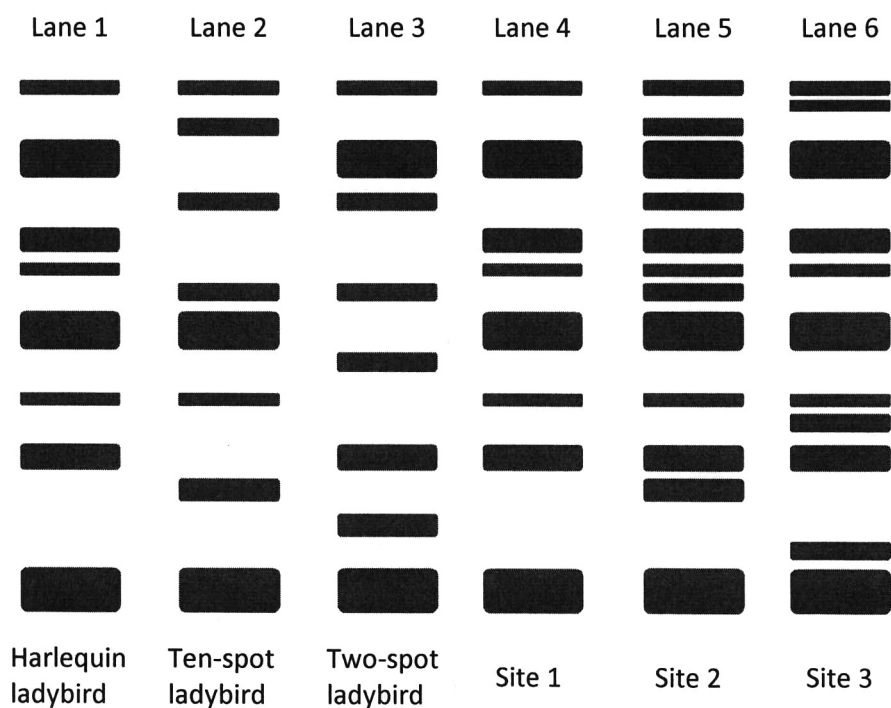
Examiner Only	
Marks	Remark

6 The harlequin ladybird (*Harmonia axyridis*) was first recorded in the UK in 2004 and has since spread widely over the South East of England. It may prey on smaller ladybirds, such as the ten-spot and two-spot ladybirds, populations of which have subsequently declined. The techniques of PCR and gel electrophoresis have been used to analyse DNA extracted from the gut of harlequin ladybirds to determine which other ladybird species have been preyed upon.

(a) Suggest why PCR is a necessary technique in investigations such as that outlined above.

[2]

(b) DNA samples from each of the three ladybird species were cut using restriction endonucleases and the resulting fragments were separated by gel electrophoresis. The diagram below shows the DNA profile of each species in the first 3 lanes. The next 3 lanes contained DNA extracted from the guts of 8 harlequin ladybirds trapped at each of 3 sites in SE England. The extract from the gut will contain DNA from the prey of the harlequin ladybird along with its own DNA.



- (i) Researchers identified site 2 as a location where harlequin ladybirds were preying on the ten-spot ladybird, but not the two-spot ladybird. Use the DNA profiles to outline the evidence supporting this conclusion.

[2]

- (ii) With respect to the prey of the harlequin ladybird, suggest an interpretation for the DNA profiles from site 1 and site 3.

Site 1

Site 3

[2]

Examiner Only	
Marks	Remark

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- 7 An oxidase enzyme found in apples is responsible for the flesh of the fruit discolouring and turning brown when it is exposed to air. This is because the enzyme oxidises chemicals called phenols which occur in the apple, eventually forming dark coloured products. Many recipes involving cut or crushed apple suggest adding an acid fruit juice, like lemon juice, to the pieces of apple to stop them from going brown.

An investigation was carried out to determine the effectiveness of various substances in preventing discolouration. Apple extract was used as the source of the enzyme and catechol, one of the natural phenols in apple tissue, was used as the substrate. When a solution of catechol is oxidised, an orange colour develops. The more active the enzyme, the more intense the colour.

The method used was as follows:

1. Using measuring cylinders add 4 cm^3 of apple extract and 1 cm^3 of distilled water to a clean test tube.
2. Add 10 cm^3 of 0.1 M catechol solution to the test tube, and shake thoroughly.
3. After 5 minutes decant some of the liquid into a clean cuvette.
4. Using a colorimeter, with a blue filter, measure the % transmission through the mixture.
5. Repeat steps 1–4 with fresh solutions, but replace the distilled water with 1 cm^3 of decolourised lemon juice.
6. Repeat step 5, but replace the lemon juice with 1 cm^3 of decolourised orange juice.

- (a) (i) Suggest how this procedure could be altered to improve its accuracy.

_____ [1]

- (ii) Blue and orange are at opposite ends of the light spectrum. Explain precisely why a blue filter was chosen for use in the colorimeter when measuring the intensity of orange colouration.

_____ [1]

Examiner Only

Marks Remark

In addition to the fruit juices mentioned in the procedure, two enzyme inhibitors, PHBA and phenylthiourea, were also investigated. The results of the investigation are shown below.

Test substance	% transmission through solution after 5 minutes
Distilled water	27
Lemon juice	90
Orange juice	74
PHBA	99
Phenylthiourea	92

(b) (i) Using the most appropriate graphical technique, plot the above data. (Use the graph paper opposite.) [4]

(ii) Lemon juice has a pH of 2.4 and orange juice has a pH of 3.5. Using this information and the information in the graph, describe and explain how the results for these two substances differ.

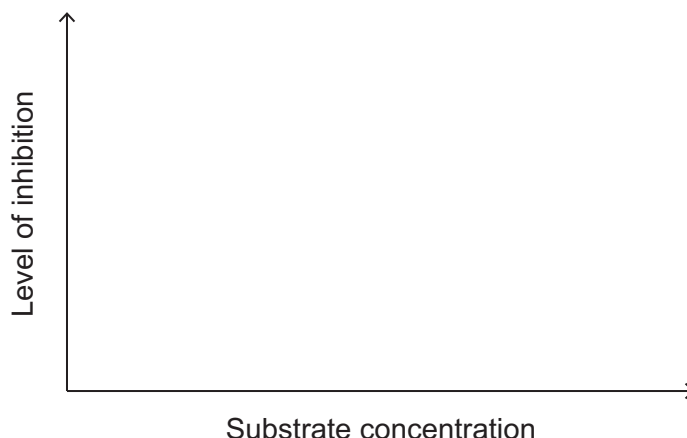
[3]

(c) Phenylthiourea is structurally dissimilar to catechol and is known to bind to the oxidase enzyme at a copper atom, which is not located at the active site.

(i) State the type of inhibition carried out by phenylthiourea.

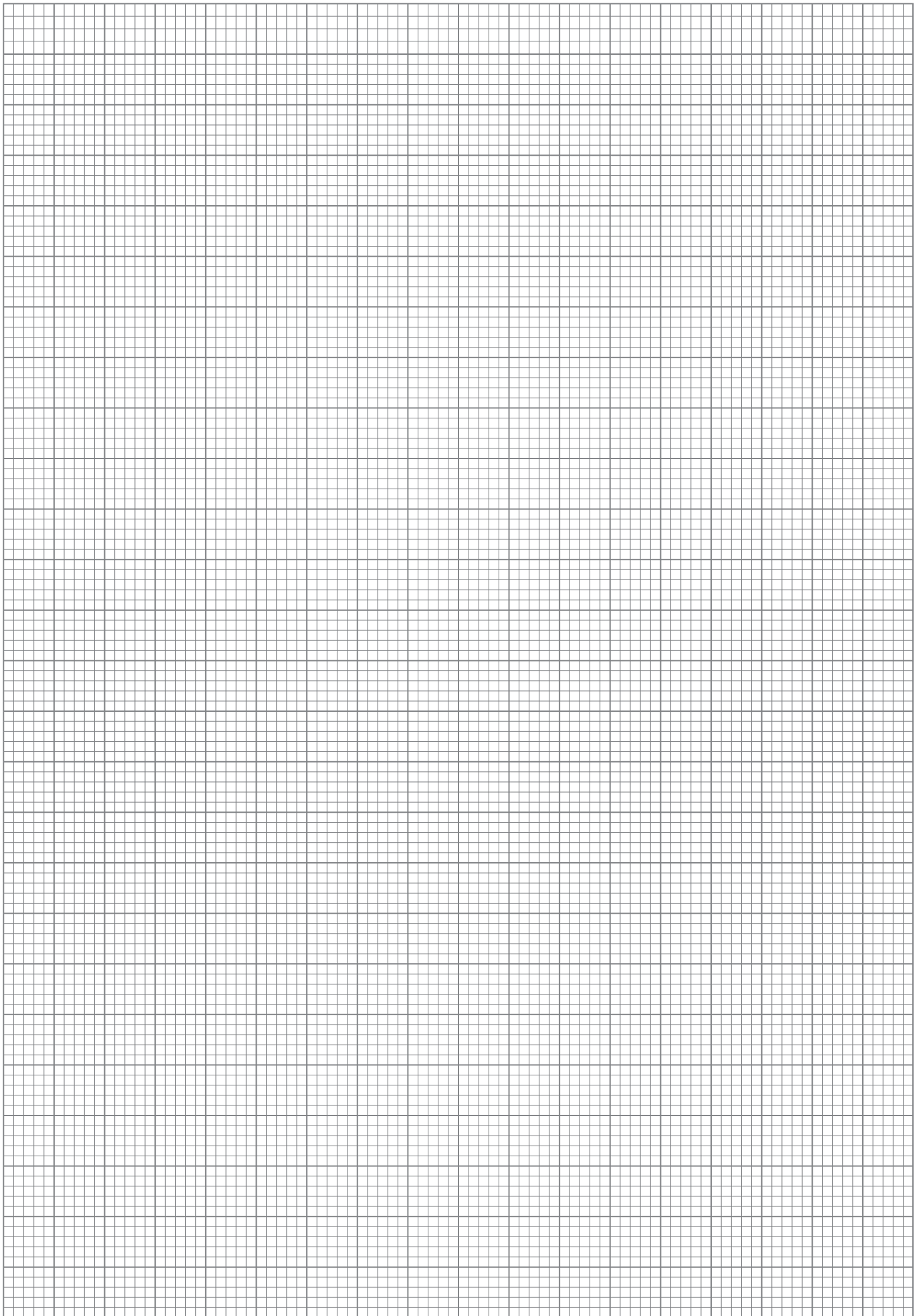
[1]

(ii) On the axes below, sketch a line to show how the level of inhibition by phenylthiourea is affected by substrate concentration.



[1]

Examiner Only	
Marks	Remark



8 Haemoglobin is a protein which has a role in transporting oxygen around the body. It consists of four connected polypeptide chains, each of which contains a non-protein haem group, the site at which oxygen is known to bind. Some sections of the polypeptide chains are coiled into alpha-helices, and there is further folding of these chains to form a compact globular molecule.

Myoglobin is a different protein which also contains a haem group, but it consists of only one polypeptide chain containing 153 amino acid residues. A myoglobin molecule is very similar in structure to a polypeptide chain in haemoglobin, with alpha-helices and an overall globular shape.

(a) (i) Complete the grid below by placing a tick (✓) or cross (X) in the appropriate cell.

Do not leave any boxes blank.

	Haemoglobin	Myoglobin
Has a secondary structure		
Has a quaternary structure		
Is a conjugated protein		

[3]

(ii) Name **two** types of bonds which may contribute to the tertiary structure of a protein.

1. _____

2. _____

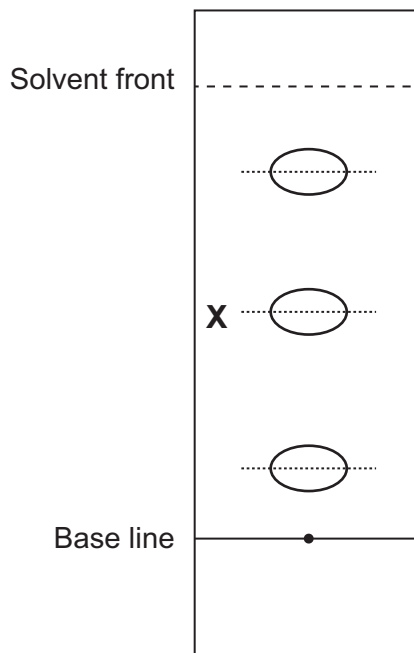
[2]

Examiner Only

Marks Remark

(c) A diagrammatic representation of a developed chromatogram is shown below. For the sake of clarity only 3 spots are shown. The dotted line through each spot indicates its mid-point, which is used to measure the distance it has travelled.

Amino acid	R_f value
alanine	0.38
arginine	0.20
asparagine	0.50
glutamic acid	0.30
leucine	0.73
lysine	0.14
valine	0.61



Using the table of R_f values shown above, identify amino acid **X** on the chromatogram. (Show your working.)

Amino acid **X** _____ [3]

Examiner Only	
Marks	Remark

Section B

Quality of written communication is awarded a maximum of 2 marks in this section.

- 9 In complex organisms, cells are organised into tissues which are then organised into organs. The ileum is an example of an organ. Describe the structure and function of the different tissue layers in the ileum and, where appropriate, their constituent cells. [13]

Quality of written communication [2]

Examiner Only	
Marks	Remark

Lined area for student responses.

Examiner Only

Marks Remark

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THIS IS THE END OF THE QUESTION PAPER

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Photograph 1.5 (for use with Question 5)

