Candidate Name	Centre Number					Candidate Number				
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AS BIOLOGY

UNIT 1
Basic Biochemistry and Cell Organisation

SPECIMEN PAPER

1 hour 30 minutes

80 marks

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**13**	
3.	**7**	
4.	**12**	
5.	**8**	
6.	**9**	
7.	**14**	
8.	**9**	
Total	**80**	

ADDITIONAL MATERIALS

In addition to this examination paper, you will require a calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen. Do not use correction fluid.
Write your name, centre number and candidate number in the spaces at the top of this page.
Answer **all** questions.
Write your answers in the spaces provided in this booklet.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.
The assessment of the quality of extended response (QER) will take place in question 8.

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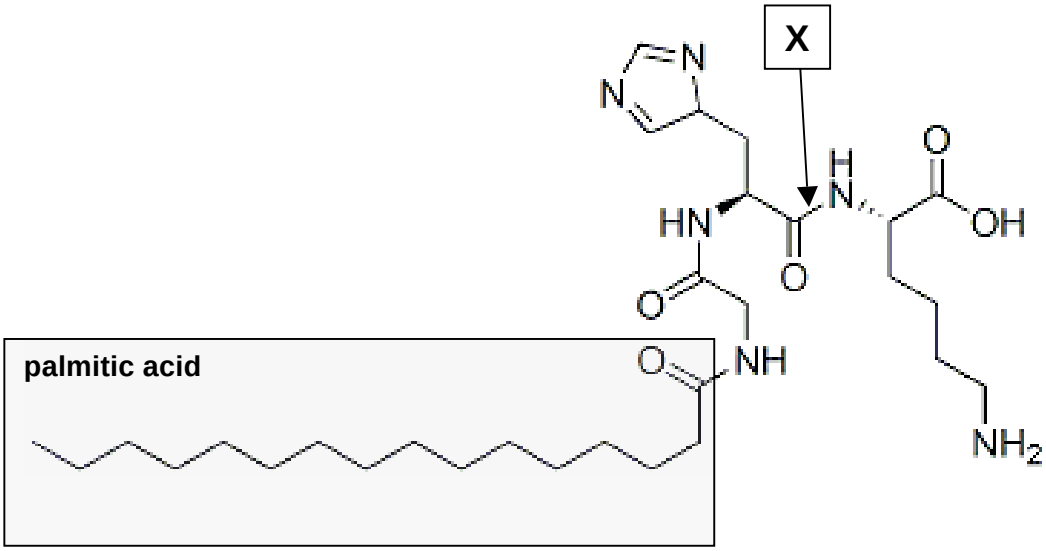
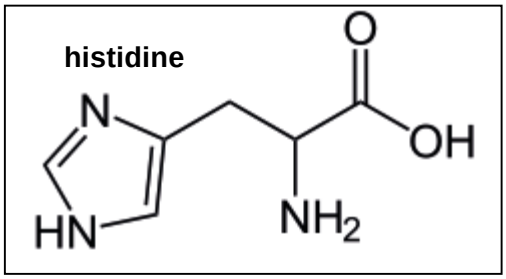
Answer **all** questions

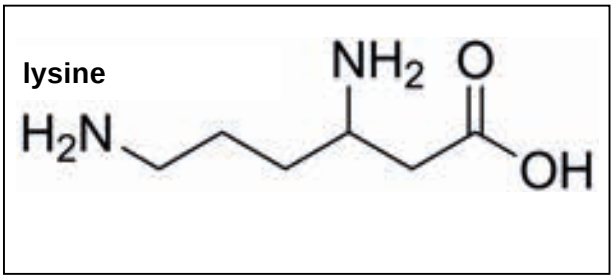
1. Palmitoyl tripeptide-1 is made of three amino acids bonded to a molecule of palmitic acid, a component of one form of a triglyceride. It is used in anti-ageing creams to stimulate collagen repair in skin.

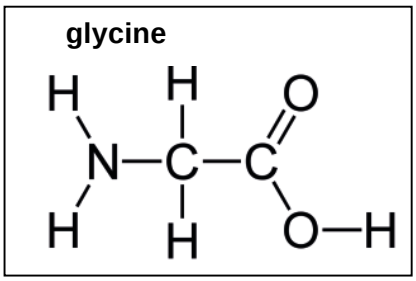
The diagram below shows the structure of palmitoyl tripeptide-1.



The structural formulae of the amino acids present in this tripeptide are shown below.







(a) (i) Name the bond labelled **X** on the diagram. [1]

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(ii) Use the diagrams of the individual amino acids to identify the primary structure of this tripeptide. [2]

palmitic acid – ……. - ……. -……

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(iii) The molecule is claimed to be better at penetrating skin due to it having hydrophilic and hydrophobic properties. Name the part of the molecule which is hydrophobic. [1]

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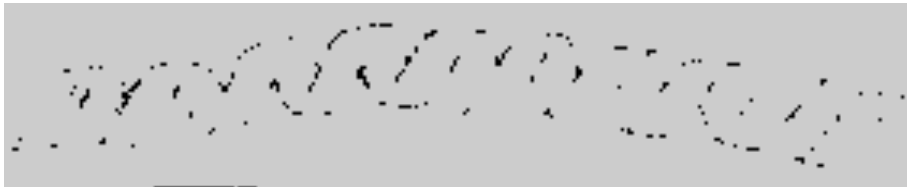
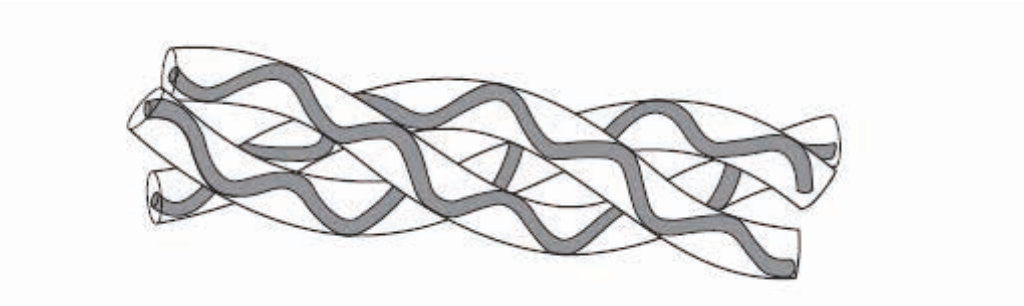
(b) Collagen is one of the main structural proteins found in skin and contains over 30% glycine. Each collagen molecule contains about 1000 amino acids. The fully functional protein is composed of three molecules of collagen and is called tropocollagen. The diagram below shows part of a single collagen molecule and a tropocollagen molecule.

collagen



tropocollagen



(i) Using the diagrams above, explain why collagen is said to have a secondary structure but tropocollagen has a quaternary structure. [3]

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(ii) Describe how the level of protein structure shown in the collagen diagram above would be different if the protein had a tertiary structure. [1]

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2. In 1961 a group of scientists demonstrated that the genetic code for a protein contained within DNA uses a triplet code of three bases for each amino acid.

(a) (i) How many different types of amino acid are used in protein synthesis? [1]

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(ii) Explain why there must be three bases in each code. [2]

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(b) The table shows some of the base sequences of mRNA together with their corresponding amino acids.

mRNA triplet	*Amino acid*
UUU	phenyl alanine
CUC	leucine
AUG	methionine
UAU	tyrosine
CGU	arginine
GAU	aspartic acid
GUU	valine
GAA	glutamic acid
AGU	serine
ACC	threonine
ACA	serine
GAC	aspartic acid
UAG	stop code

A section of mRNA produced in the nucleus of a cell is shown below.

A U G G U U G A A G A U G U U G A C

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(i) Using the information given in the table write out the sequence of amino acids for which the section of mRNA codes. [2]

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(ii) Write the base sequence for the DNA template from which the strand of mRNA was produced. [2]

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(iii) Describe the process occurring in the nucleus that gives rise to this strand of mRNA. [4]

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(c) During DNA replication a mutation occurred in the sequence of bases from which the mRNA was produced. The mutated DNA resulted in an mRNA molecule with the following base sequence.

AUG GUA GAA GAC GUU GAC

Explain why this mutation would have no effect on the protein that could be synthesised from this mRNA molecule. [2]

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3. The scientists Devulapalle and Mooser carried out experiments using the enzyme glucosyl transferase that catalyses the polymerisation of glucose molecules from dietary sucrose. Polymers of glucose form part of the plaque on teeth that can lead to dental disease.

(a) (i) Name two theories that can explain how glucosyl transferase can combine with its substrate, sucrose. [1]

..... and .....

(ii) Explain why the rate of a chemical reaction is increased by the glucosyl transferase when acting as a biological catalyst. [1]

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Devulapalle and Mooser showed that the presence of iron (II) sulphate affected the activity of glucosyl transferase. Some of their results are shown in the table below.

Iron II sulphate concentration (mM)	*glucosyl transferase activity (labelled product µmoles)*
0.0	60.0
1.0	25.2
2.0	12.0
3.0	5.2
4.0	2.4
5.0	1.6
6.0	1.2

(b) They concluded that iron (II) sulphate was acting as an enzyme inhibitor. Further investigations showed that the effect of iron (II) sulphate was reduced at higher concentrations of sucrose.
Explain how iron (II) sulphate could inhibit glucosyl transferase. [4]

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(c) Suggest a possible use of Devulapalle and Mooser's findings. [1]

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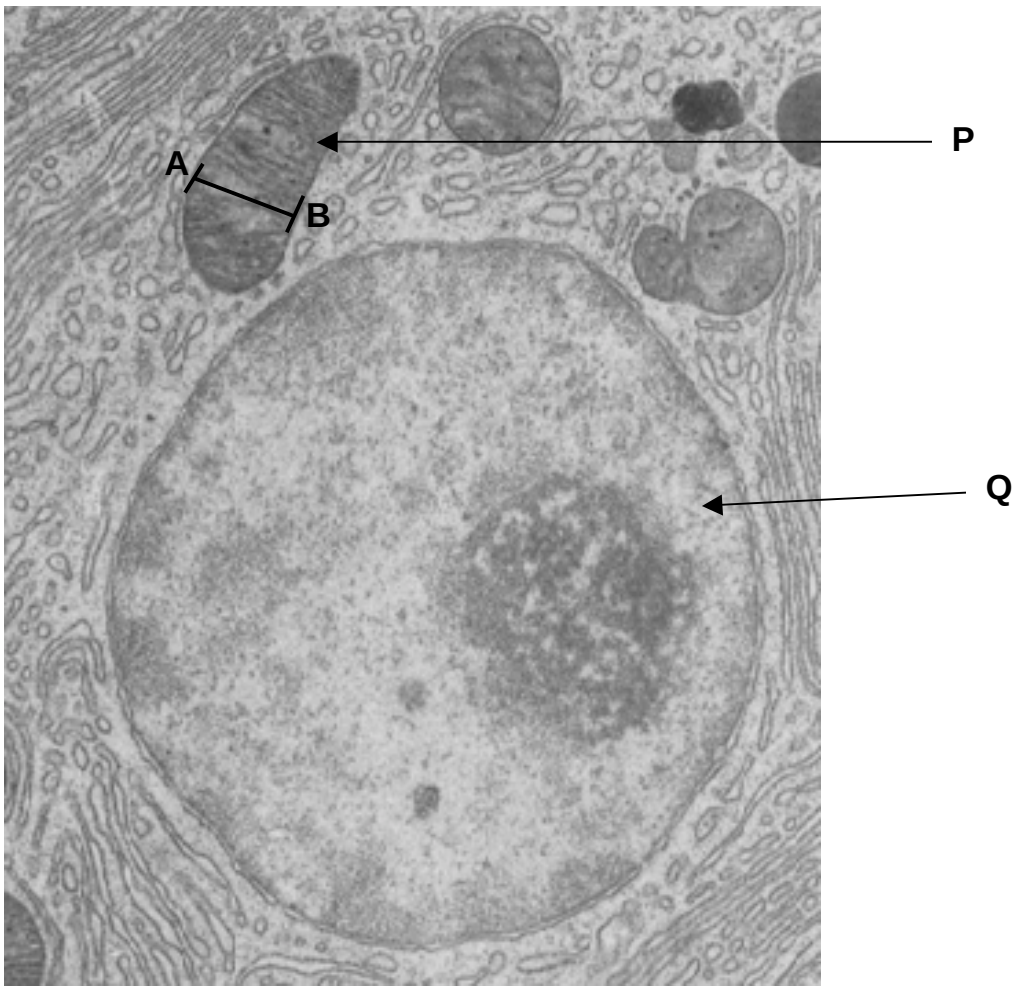
4. The electron micrograph below shows a section through a eukaryote cell.



(a) The organelles labelled **P** and **Q** are both surrounded by double membranes. Identify these organelles and describe **one** difference between them. [2]

P …… **Q** ……

Difference: ……..……..

……...

(b) The magnification of the image above is x 32 500. Calculate the actual width of the organelle in micrometres between points **A** and **B**. Give your answer to three significant figures and show your working. [3]

Answer ……..

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(c) The surface area of the organelle shown can be estimated by using the formula:

surface area = 2πr (l + r)

where:	length (l) of the organelle	=	9.8 µm,
	π	=	3.14
	average diameter	=	1.2 µm.

(i) Estimate the surface area of the organelle shown.
Show your working. [3]

Answer …….. μm^2

(ii) The surface area of a spherical organelle with the **same** volume is $23.9 \mu m^2$. Scientists have concluded from the results from experiments that there are significant advantages to the cell if these organelles have a cylindrical shape. Evaluate this statement. [4]

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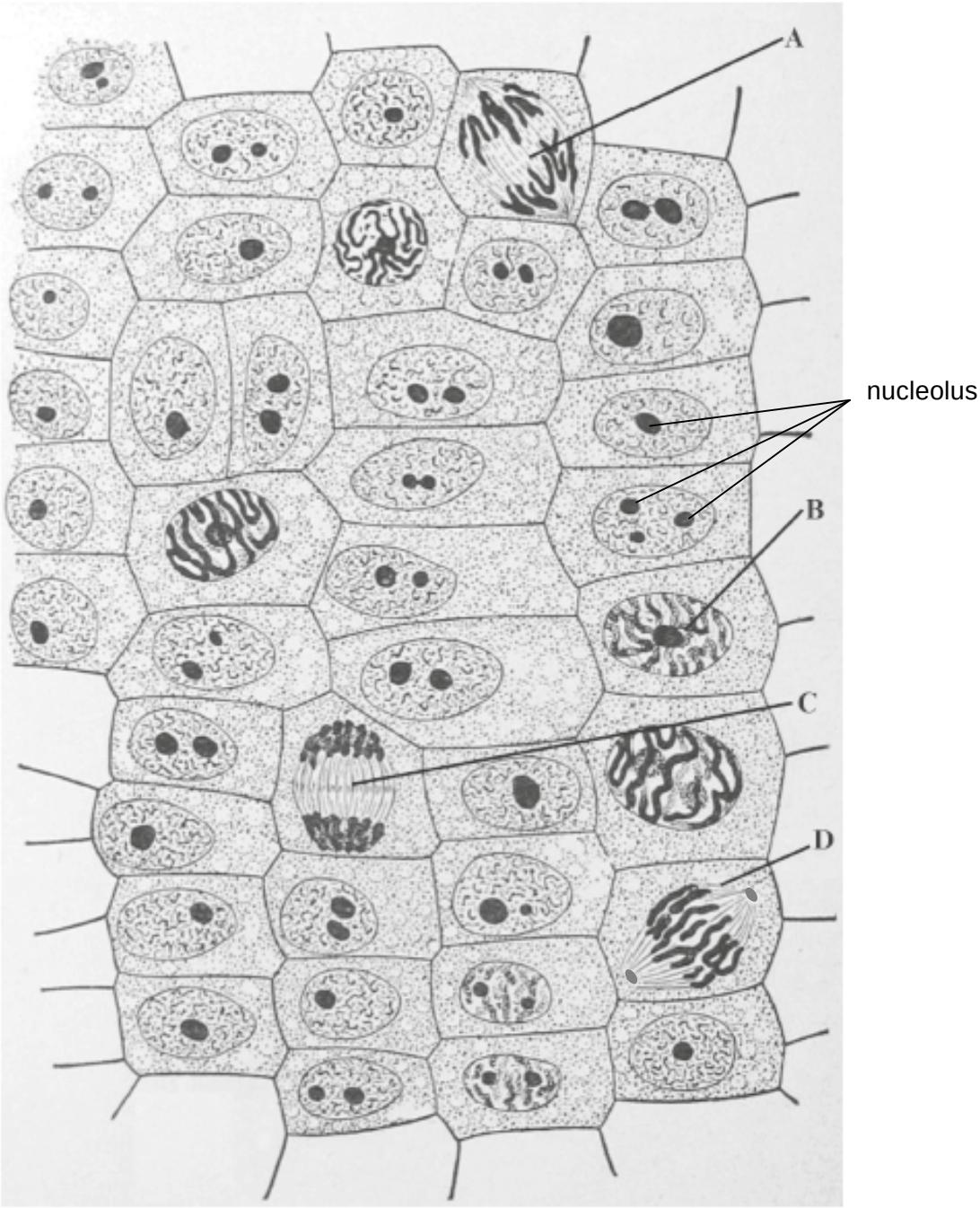
5. Growth of plants is largely limited to cell division in meristematic tissues located at the tips of roots and shoots and in the cambium of vascular bundles. The drawing below was made from a sample of meristematic plant tissue showing dividing cells.



(a) Name the type of cell division taking place and identify from the diagram above the stages of cell division shown labelled **A** to **D**. [4]

Type of cell division: .....

Stages: **A** ……

B ……

C ……

D ……

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(b) One stage of the cell cycle shown on the diagram is present in greater numbers than the others.

(i) Name this stage and explain what this suggests about the relative length of this stage? [2]

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(ii) Describe how you could improve your confidence in your conclusion. [2]

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6. A student carried out an experiment to investigate the effect of temperature on cell membranes. Using a borer, equal sized pieces of beetroot were cut, washed, and blotted with a paper towel. Each piece was placed into a test tube containing 25 cm^3 of 70 % ethanol (an organic solvent) and incubated at 15 ^oC. A red pigment called betacyanin found in the vacuoles of the beetroot cells began to leak out into the ethanol turning it red. The experiment was repeated at 30 ^oC and 45 ^oC and the time taken for the ethanol to turn red was recorded below.

Temperature (^oC)	**Time taken for the ethanol to turn red (s)**			
	Trial 1	**Trial 2**	**Trial 3**	**Mean**
15	450	427	466	447.7
30	322	299	367	329.3
45	170	99	215	161.3

(a) Calculate the percentage decrease in mean time taken for the ethanol to turn red between 15 and 30 ^oC. [2]

Answer ……..

(b) Using your knowledge of the structure of cell membranes, explain why ethanol causes the pigment to leak out of the beetroot cells. [2]

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(c) What conclusions could be drawn from this experiment regarding the effect of temperature on cell membranes? [3]

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(d) Comment on the validity of your conclusion. [2]

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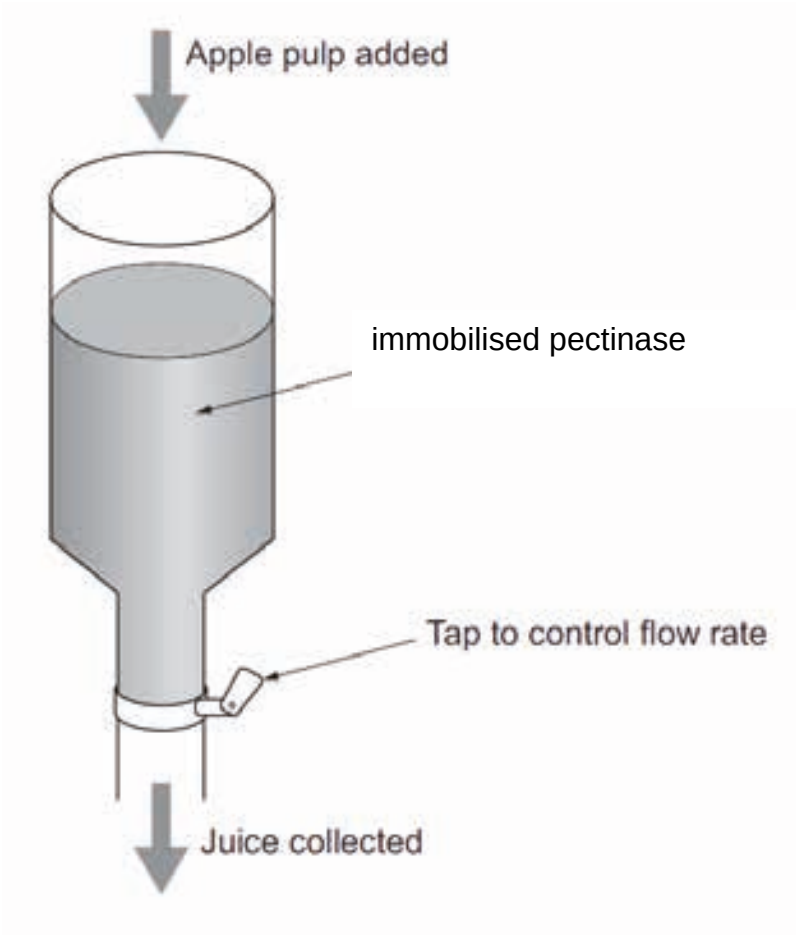
7. Pectin is a structural polysaccharide found in plant cell walls and in the middle lamella between cells, where it acts to bind cells together. Pectinases are enzymes that are used routinely in industry to increase the volume and clarity of fruit juice extracted from apples. The enzyme is immobilised and then placed inside a column. Apple pulp is added at the top, and juice is collected at the bottom. The process is shown in the diagram below.



(a) Explain why reducing the flow rate of material through the column would result in increased juice collected. [2]

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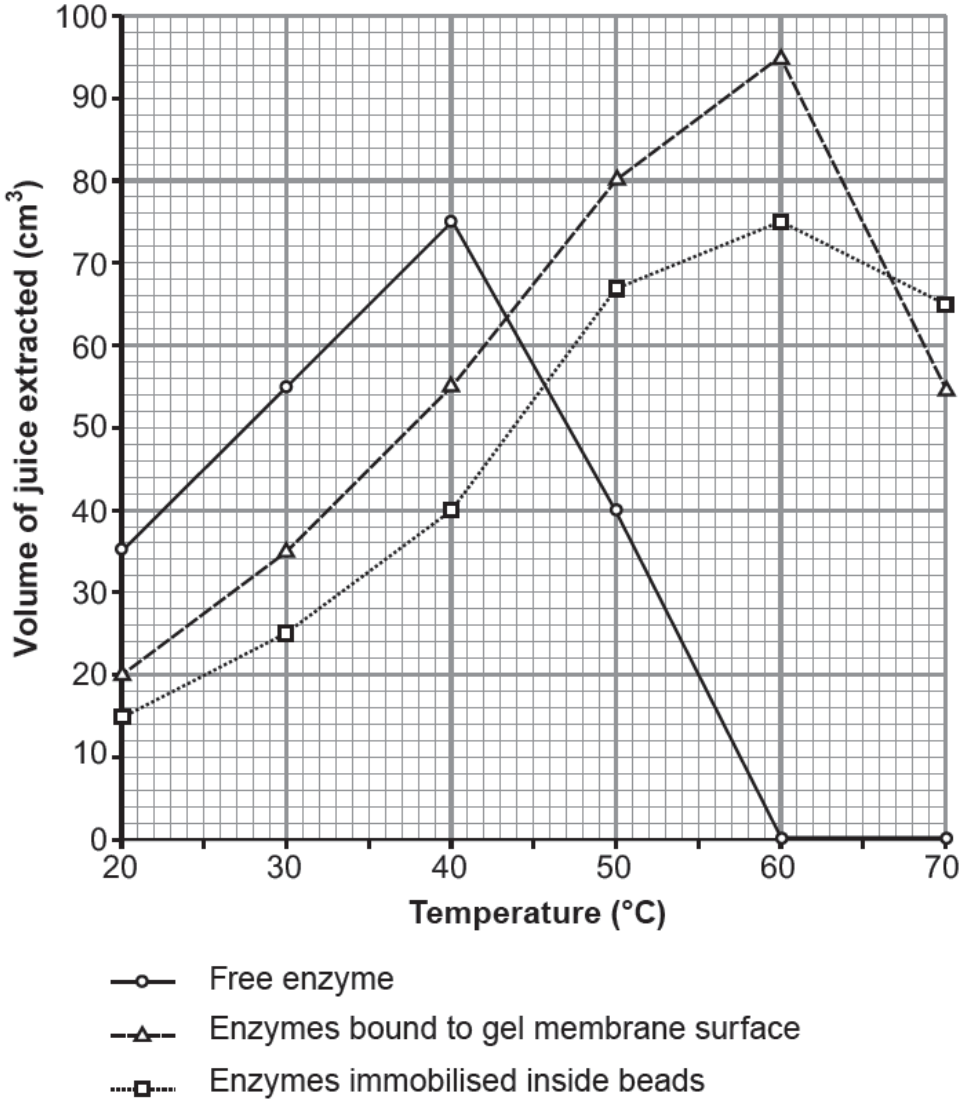
(b) The extraction of juice at different temperatures was compared using equal volumes and concentrations of free enzyme, enzymes bound to the surface of a gel membrane and enzymes encapsulated inside alginate beads. The results are shown in the graph below.



Using the graph and your own knowledge of enzymes, answer the following questions.

(i) Describe and explain the results for the free enzymes at temperatures **above** 40°C. [4]

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(ii) Explain why a higher yield of juice was obtained when using free enzymes between temperatures of 20°C and 40°C than when using either kind of immobilised enzyme. [2]

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(iii) Explain the differences seen in the results for the enzymes bound to the gel membrane surface with those immobilised inside the beads, between temperatures of 20°C and 60°C. [2]

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(iv) A Welsh apple juice producer wishes to increase their yield of apple juice. Use the information given to outline how they could adapt the basic method shown to extract a higher volume of apple juice. Explain the recommended modifications. [4]

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8. It was once suggested that '*proteins are produced by ribosomes which translate a messenger RNA molecule produced by transcription of a single gene*'.

With reference to your knowledge and understanding of protein structure and synthesis, explain why the statement above does not **fully** describe how functional proteins are produced and secreted by eukaryotic cells.
(The quality of your extended response will be assessed in this question.) [9QER]

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