Surname	Centre Number	Candidate Number
First name(s)		2

GCE AS

B400U10-1

S24-B400U10-1

MONDAY, 13 MAY 2024 – MORNING

BIOLOGY – AS component 1
Basic Biochemistry and Cell Organisation

1 hour 30 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**9**	
3.	**21**	
4.	**14**	
5.	**14**	
6.	**9**	
Total	**75**	

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ADDITIONAL MATERIALS

A calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

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. If you run out of space, use the additional page(s) at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of quality of extended response (QER) will take place in question **6**.

The quality of written communication will affect the awarding of marks.

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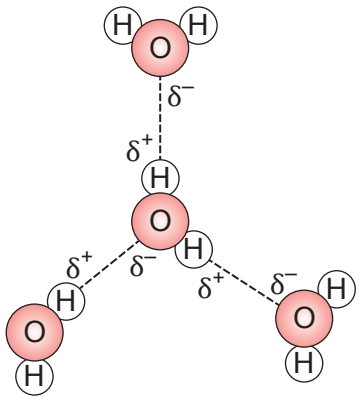
Answer **all** questions.

1. Water is a polar molecule with a slightly uneven distribution of charge. This allows bonds to form between water molecules. **Image 1** shows the structure of water.

Image 1



(a) (i) State the name of the bond which forms between two water molecules. Explain why this bond forms. [2]

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(ii) Transport of water in plants relies on some of the properties of water and the bonds between the water molecules.

State **two** properties of water which allow the transpiration stream to work in plants. [2]

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(iii) Water moving into the plants at the roots exerts root pressure.
Explain how root pressure contributes to the movement of water through the plant. [2]

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(b) Complete the table to describe the advantages of the following properties of water to living organisms. [2]

Property of water	Advantage to living organisms
Takes a large amount of energy to raise its temperature.	....
Takes a large amount of energy for it to evaporate.	....

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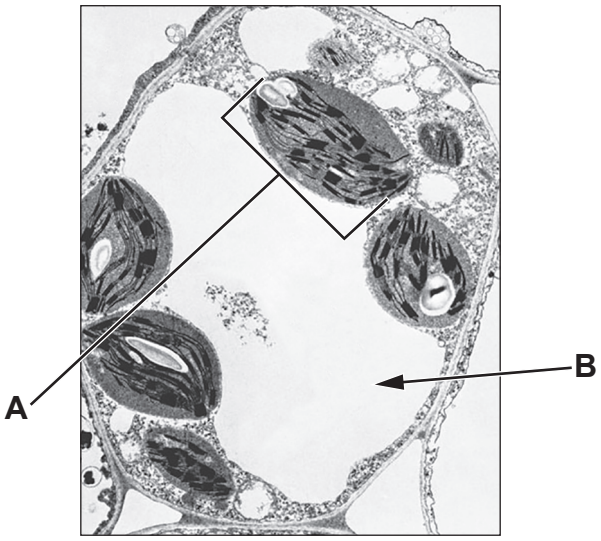
2. **Image 2.1** shows an electron micrograph of a eukaryotic cell.

Image 2.1



(a) (i) Identify the structures labelled **A** and **B** in **Image 2.1**. [1]

A .....

B .....

(ii) Using your answer to (a)(i), determine the Kingdom to which this cell belongs. [1]

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(iii) **Image 2.1** shows some internal features of structure **A**.
Suggest why these would not be visible if the cell had been viewed with a light microscope. [1]

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(b) Multicellular organisms have specialised cells which aggregate together into tissues, organs and then organ systems.

(i) State the difference between a tissue and an organ. [1]

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(ii) Give an example of **one** tissue and **one** organ from a flowering plant. [2]

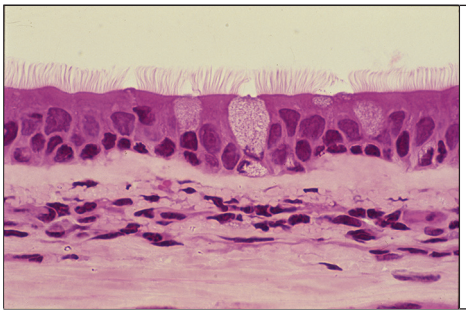
Tissue: .....

Organ: .....

(iii) **Images 2.2A**, **2.2B** and **2.2C** show photomicrographs of three different types of human tissue.

Identify the tissues shown in **Images 2.2A, 2.2B** and **2.2C** and give their function in the body. [3]

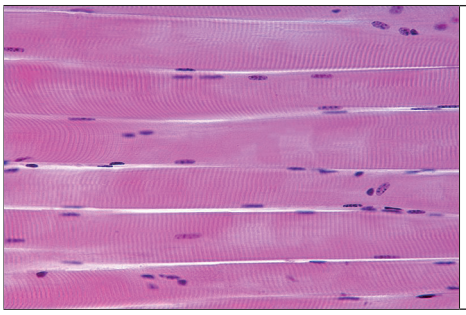
Image 2.2A



Tissue: .....

Function: .....

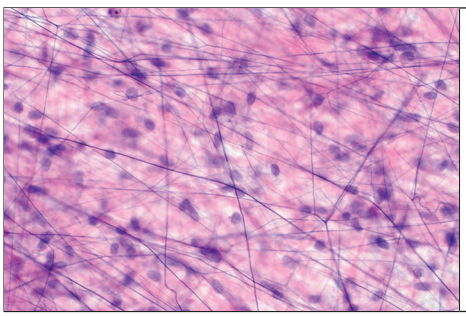
Image 2.2B



Tissue: .....

Function: .....

Image 2.2C



Tissue: .....

Function: .....

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3. Cellulose is a polysaccharide found in the cell wall of plants. Its structure makes the cell wall strong.

(a) (i) State which isomer of glucose is present in cellulose. [1]

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(ii) Describe how the arrangement of the glucose molecules gives strength to the cell wall. [3]

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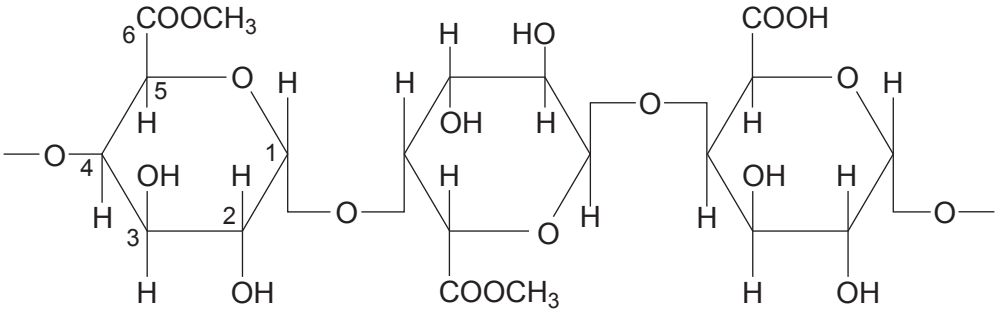
Cellulose fibres in the plant cell wall are held together by another polysaccharide called pectin. **Image 3.1** shows part of the structure of pectin.

Image 3.1



(iii) Using **Image 3.1** and your knowledge of polysaccharides:

I. State the reaction involved in the formation of both cellulose and pectin. [1]

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II. Give **one** similarity and **one** difference between the structure of cellulose and pectin. [2]

Similarity: .....

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Difference: .....

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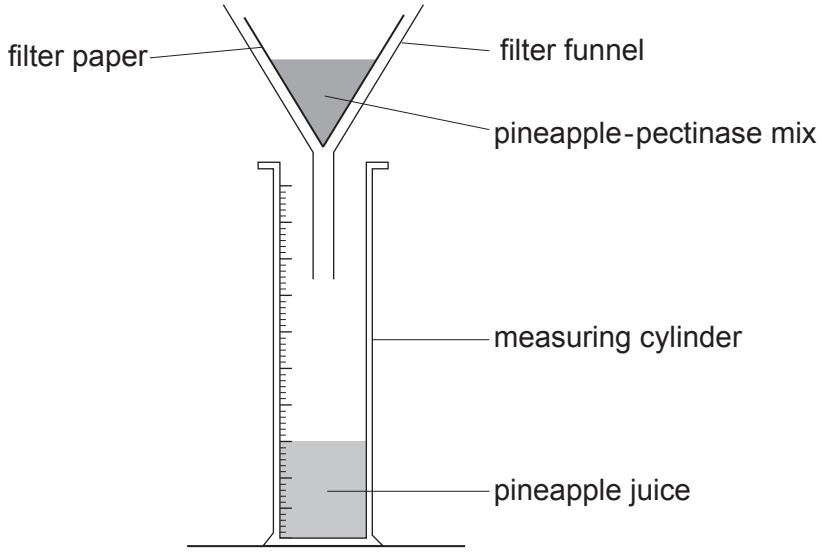
(b) In the production of pineapple juice, pineapple pulp can be treated with pectinase, an enzyme which breaks down pectin in the cell wall. This releases more juice from the cells.

An investigation was carried out to show the effect of the concentration of pectinase on the breakdown of pectin. A brief method is given below. Some of the apparatus is shown in **Image 3.2**.

- Pineapple tissue was mashed to form a pulp.
- 5 cm^3 of 0.2% pectinase was added to the pulp and stirred for 10 seconds.
- The pineapple-pectinase mix was placed in a water bath at 25 °C for 1 hour.
- The mixture was then filtered and the volume of juice recorded.
- The experiment was repeated with a range of pectinase concentrations.

Image 3.2



(i) State the independent and dependent variables in this experiment. [1]

Independent variable: .....

Dependent variable: .....

(ii) Suggest **two** variables which were **not** controlled. [2]

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(iii) Explain **one** reason why the volume of juice collected may be lower than expected using the filtration method shown in **Image 3.2**. [1]

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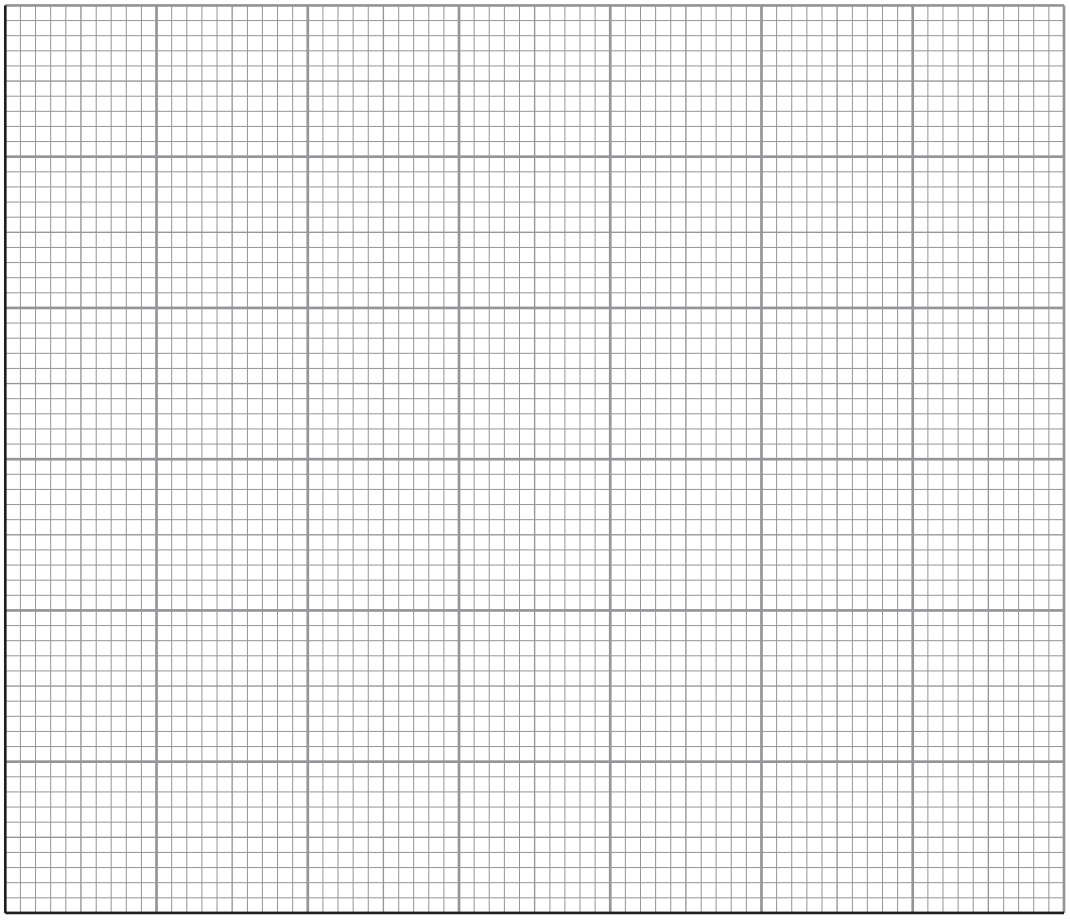
(c) **Table 3.3** shows the volume of juice recorded using a range of pectinase concentrations.

Table 3.3

Concentration of pectinase / %	Volume of juice / cm^3
0.2	0.5
0.4	1.2
0.6	2.4
0.8	2.5
1.0	2.8
1.2	2.8
1.4	2.8

(i) Plot the data in **Table 3.3** on **Graph 3.4**. [4]

Graph 3.4



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(ii) Use **Graph 3.4** to describe and explain the effect of increasing the concentration of pectinase. [4]

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(d) The pectinase and pineapple mixture was placed in a water bath at the optimum temperature for the enzyme. If incubation temperature was less than the optimum, the volume of juice extracted would have changed.

Suggest how the volume of juice extracted would have changed. Explain your answer. [2]

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4. (a) **Images 4.1A**, **4.1B** and **4.1C** show three types of nucleotides.

Image 4.1A

ATP

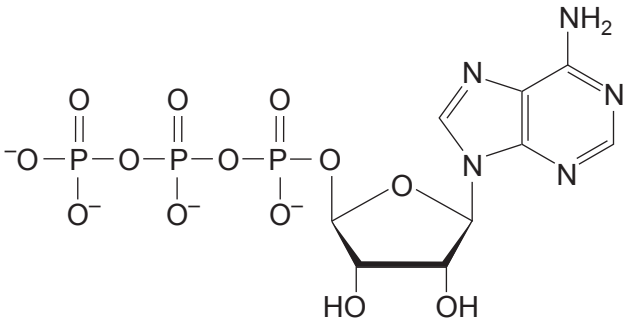


Image 4.1B

NAD

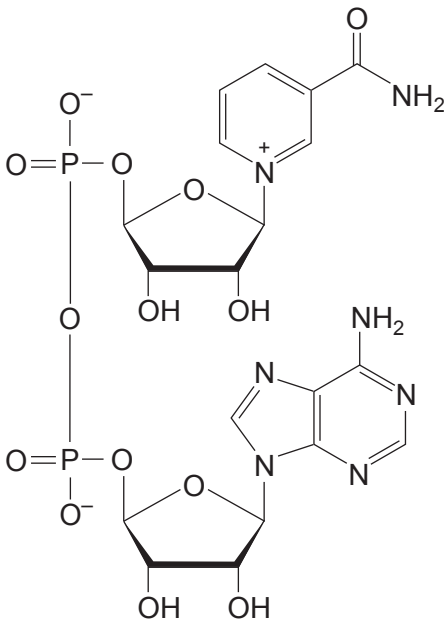
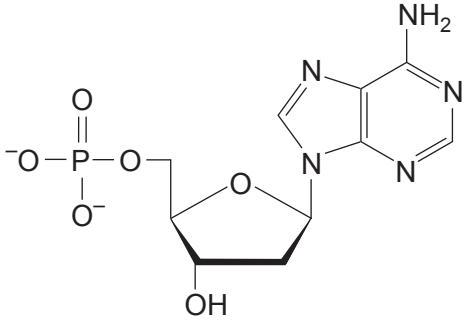


Image 4.1C

DNA



(i) Using **Images 4.1A**, **4.1B** and **4.1C**, state **one** similarity between all the molecules shown and **two** differences in structure between **ATP** and **NAD**. [3]

Similarity: .....

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Difference 1: .....

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Difference 2: .....

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(ii) Explain why ATP is a suitable 'energy currency' in all living organisms. [3]

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Question continued overleaf

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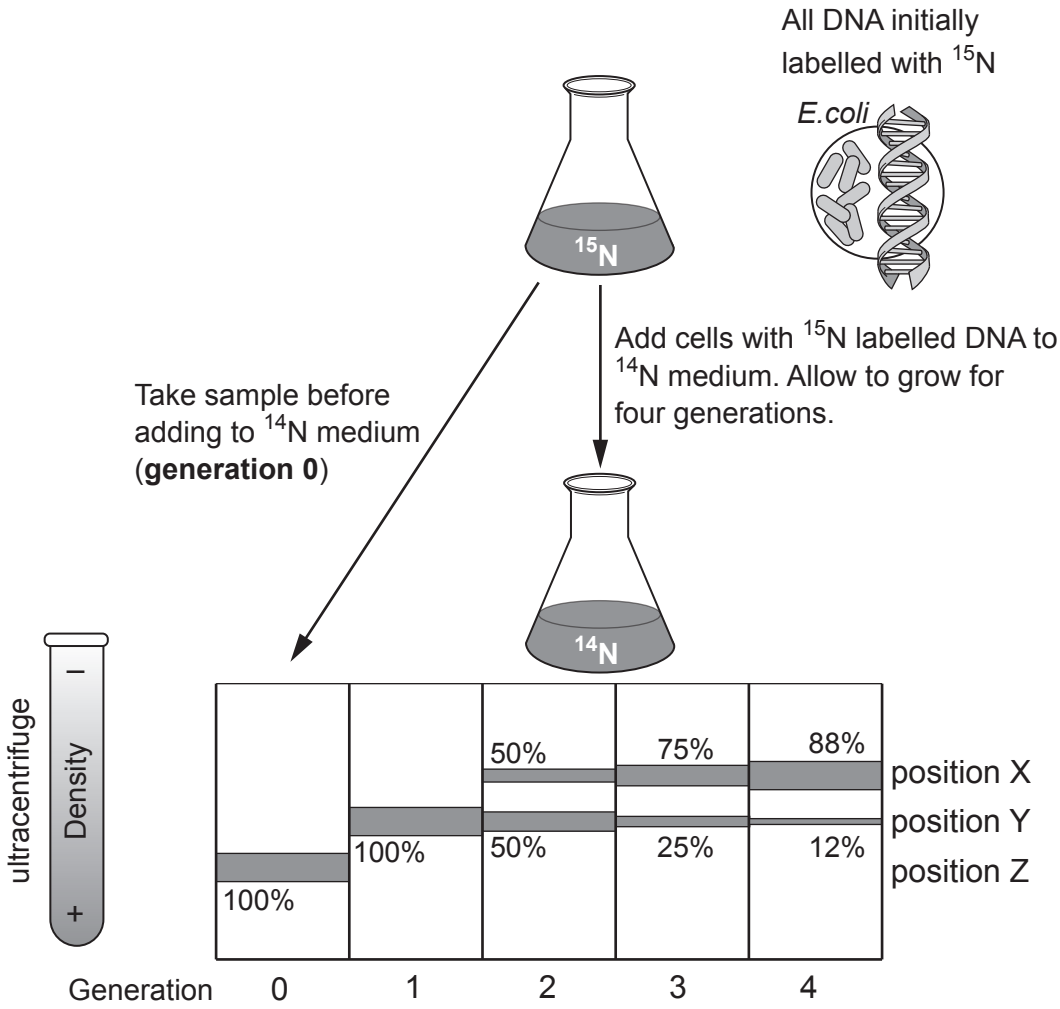
(b) DNA is a very stable molecule which is passed on from generation to generation. Watson and Crick proposed that DNA must be replicated semi-conservatively. Experiments by Meselson and Stahl supported their theory. **Image 4.2** shows the Meselson and Stahl experiment and results. A sample of DNA was taken from each generation of cells and analysed using density gradient centrifugation.

The figures in **Image 4.2** show the percentage of DNA at each position after centrifugation.

Image 4.2



(i) The ^{14}N would be incorporated into the newly synthesised DNA.

State into which part of a DNA nucleotide the ^{14}N would be incorporated. [1]

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(ii) Suggest why the **generation 0** sample was taken before the ^{15}N labelled cells were added to the ^{14}N culture medium. [1]

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(iii) Use your own knowledge and the information in **Image 4.2** to explain how the results for the following generations support the theory of semi-conservative replication.

I. **Generation 1** [2]

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II. **Generations 2–3** [3]

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(iv) Suggest why the percentage of DNA found at position **Y** in **generation 1** has reduced from 100% to 12% by **generation 4**. [1]

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5. (a) An investigation was carried out on the effect of surface area on osmosis. A brief method is shown below:

- Four cylinders were taken from the cortex of a carrot using a 15 mm diameter cork borer and each cut to 40 mm in length.
- The initial mass of each cylinder was recorded.
- Each cylinder was cut into a different number of equal length pieces to increase the surface area.
- The cylinder pieces were placed in a sucrose solution of 0.1 M and left for 24 hours.
- The final mass of the cylinder pieces was recorded.

The volumes and surface areas for each cylinder are shown in **Table 5.1**.

Table 5.1

Cylinder	Number of pieces	Radius / mm	Length of each piece / mm	Total surface area / mm^2	Volume / mm^3	Surface area: Volume ratio
A	1	7.5	40	2237	7068	0.32 : 1
B	2	7.5	20	2591	7068	0.37 : 1
C	4	7.5	10	3297	7068	0.47 : 1
D	8	7.5	5	.....	7068	..... :1

(i) Complete **Table 5.1** for cylinder **D** by:

I. Calculating the total surface area. [2]

Use the formula $n(2\pi rh + 2\ \pi r^2)$
Where n = number of pieces
r = radius
h = length of each piece

Use π = 3.14

Space for working

II. Calculating the surface area to volume ratio. [1]

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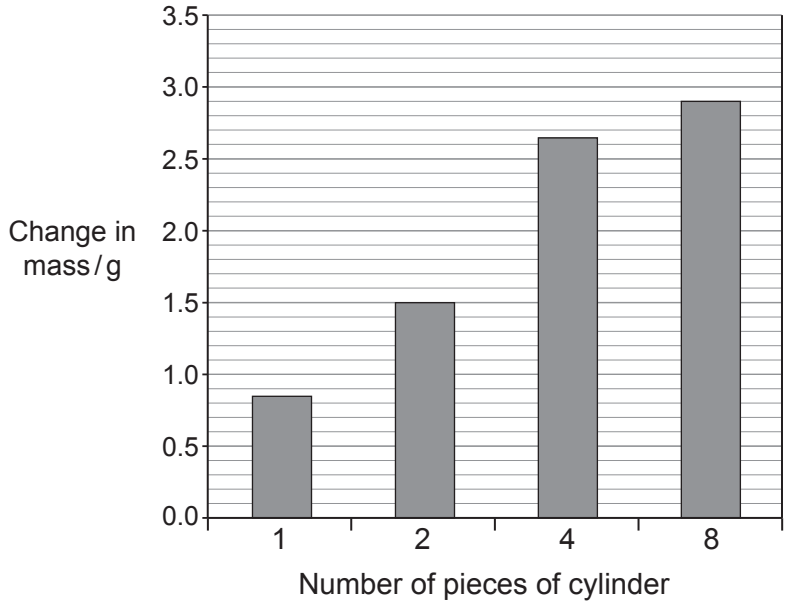
The results of the experiment are shown in **Graph 5.2**.

Graph 5.2



(ii) Use your knowledge of osmosis, **Table 5.1** and **Graph 5.2**.

Describe and explain how the number of pieces of cylinder affects the change in mass of the carrot. [5]

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(iii) When the number of pieces was increased to 16, the change in mass remained the same as for 8 pieces. Suggest an explanation for this. [1]

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(b) (i) The steps below show part of a method that could be used to find the water potential of the carrot tissue.

- Prepare six cylinders of carrot, each measuring 40 mm in length.
- Record the initial mass of each cylinder.
- Place one cylinder into one of a range of sucrose solutions (0.0 M, 0.2 M, 0.4 M, 0.6 M, 0.8 M or 1.0 M).
- Leave for 24 hours.
- Carefully dry each cylinder and record the final mass of each cylinder.

Complete the method above by stating the final steps which would be required to find the water potential of the carrot tissue. [2]

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(ii) Older carrots convert sugars to starch.

Suggest what would happen to the water potential of carrot tissue if older carrots were used in the method in (b)(i). Explain your answer. [3]

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6. Cells of the airway in humans secrete mucus. The thickness of this mucus is regulated by the movement of chloride ions through an intrinsic membrane protein called CFTR. This protein is coded for by the CFTR gene.

Cystic fibrosis is a condition where the movement of chloride ions is reduced, resulting in thicker mucus. The condition can be caused by mutations in the CFTR gene. One mutation causes the deletion of a single amino acid from the protein.

Use your knowledge of the genetic code and protein synthesis to explain how a mutation in the CFTR gene could cause a deletion of an amino acid.

Describe how this deletion could affect the structure of the CFTR protein.

Suggest how this deletion could affect the function of the CFTR protein. [9 QER]

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END OF PAPER

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