Surname	Centre Number	Candidate Number
First name(s)		2

GCE AS

B400U10-1

O20-B400U10-1

MONDAY, 12 OCTOBER 2020 – 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.	**12**	
2.	**13**	
3.	**18**	
4.	**10**	
5.	**13**	
6.	**9**	
Total	**75**	

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ADDITIONAL MATERIALS

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

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen.

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 continuation 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**.

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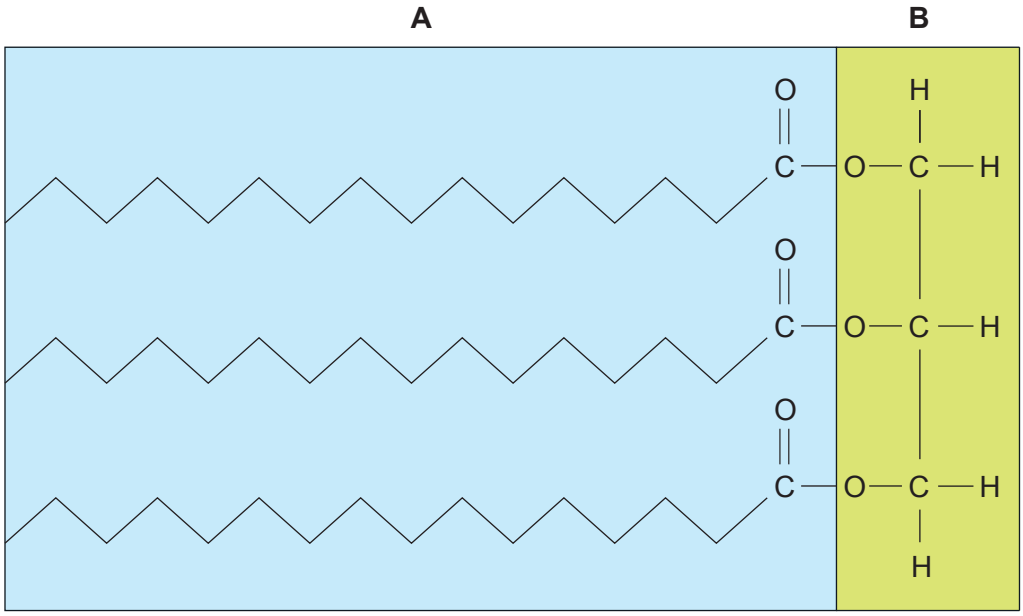
Answer **all** *questions.*

1. Triglycerides are a class of lipids which are used for long term energy storage and thermal insulation, particularly in mammals and birds. **Image 1.1** shows the structure of a molecule of triglyceride found in a mammal.

Image 1.1



(a) (i) Name the bonds in the triglyceride molecule which are hydrolysed by lipase enzymes. [1]

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(ii) Following hydrolysis of these bonds, name the molecule that would be formed from portion **B** of the molecule in the diagram. [1]

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(iii) Explain why it would be incorrect to refer to a triglyceride as a polymer. [1]

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(iv) Describe a test which could be performed to detect the presence of triglyceride in a sample. [2]

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(v) Identify the specific **type** of molecule shown in portion **A** of **image 1.1**. Explain your answer. [2]

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(vi) Explain why a diet high in this **type** of molecule could increase the risk of heart disease. [2]

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Many seeds contain large amounts of lipid as a proportion of their mass.

During germination the new plant uses the food reserves within the seed to provide it with the energy it requires for growth. This food reserve is composed mainly of carbohydrate in the form of starch and lipid in the form of triglycerides. **Table 1.2** shows the energy made available to the germinating plant when lipids and carbohydrates are respired.

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Table 1.2

Molecule metabolised	Oxygen consumption ($dm^3\ g^{-1}$)	Energy released ($kJ\,g^{-1}$)
Triglyceride	1.96	38
Carbohydrate	0.81	17

(b) With reference to the data in **table 1.2** explain the advantage to plants of using lipid as a food reserve in their seeds as opposed to carbohydrate. [3]

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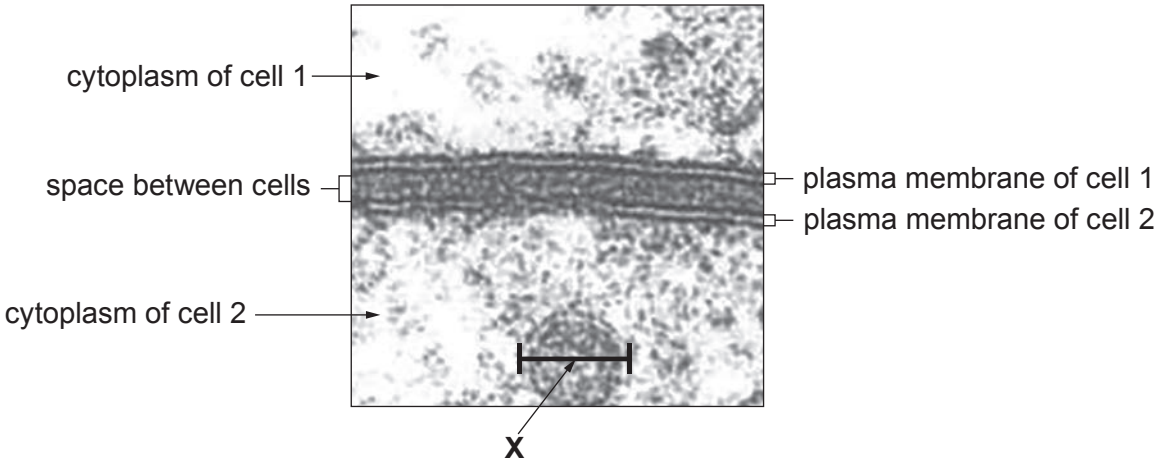
2. **Image 2.1** is an electron micrograph which shows the plasma membranes of two adjacent cells. A stain was used to make the membranes visible with the electron microscope. The stain binds to negatively charged molecules, making the membranes appear as pairs of parallel dark lines.

Image 2.1



(a) (i) Name the currently accepted model used to describe the structure of the plasma membrane. [1]

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(ii) Explain the distribution of the staining of the membranes in **image 2.1**. [3]

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(iii) The structure labelled **X** is a secretory vesicle. The magnification of the micrograph is ×34 000. Calculate the actual diameter of the secretory vesicle.
Express your answer to the nearest whole nm. [3]

Diameter = ... nm

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(b) Many single celled organisms, such as yeast, feed by using secretory vesicles to secrete digestive enzymes onto their food. The food is digested extra-cellularly and the products of digestion are absorbed into the cell.

(i) Name the mode of nutrition seen in yeast. [1]

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(ii) Describe how the secretory vesicles are produced and how the digestive enzymes are then secreted from the cell. [3]

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(iii) Suggest why enzyme-secreting cells are observed to contain large numbers of mitochondria. [2]

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3. Some bacteria produce a protease which breaks down milk protein. When the enzyme is added to milk the milk gradually becomes clear as the protein in milk is broken down.
A student investigated the effect of temperature on this protease using the following method.

- Set up five water baths in beakers using ice, hot and cold water at the following approximate temperatures; 10 °C, 20 °C, 30 °C, 40 °C, 50 °C.
- Record the actual temperature of the water baths.
- Add 10 cm^3 of milk to one test tube.
- Add 1 cm^3 of protease at pH 7 to a separate test tube.
- Place both test tubes in the first water bath for five minutes.
- Pour the milk into the protease.
- Record the time taken for the milk to become clear.
- Repeat for the other temperatures.

The results the student obtained are shown in **table 3.1**.

Table 3.1

Actual temperature of water bath / °C	Time taken for the milk to become clear / seconds			
	Trial 1	Trial 2	Trial 3	Mean
8	56	49	54	53
18	31	34	28	31
32	28	34	27	30
42	21	17	21	20
54	45	36	34	38

(a) (i) State **two** *other* variables that should have been controlled during this investigation. [2]

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(ii) Identify **two** sources of inaccuracy in this experimental method **and** describe how accuracy could be improved in each case. [4]

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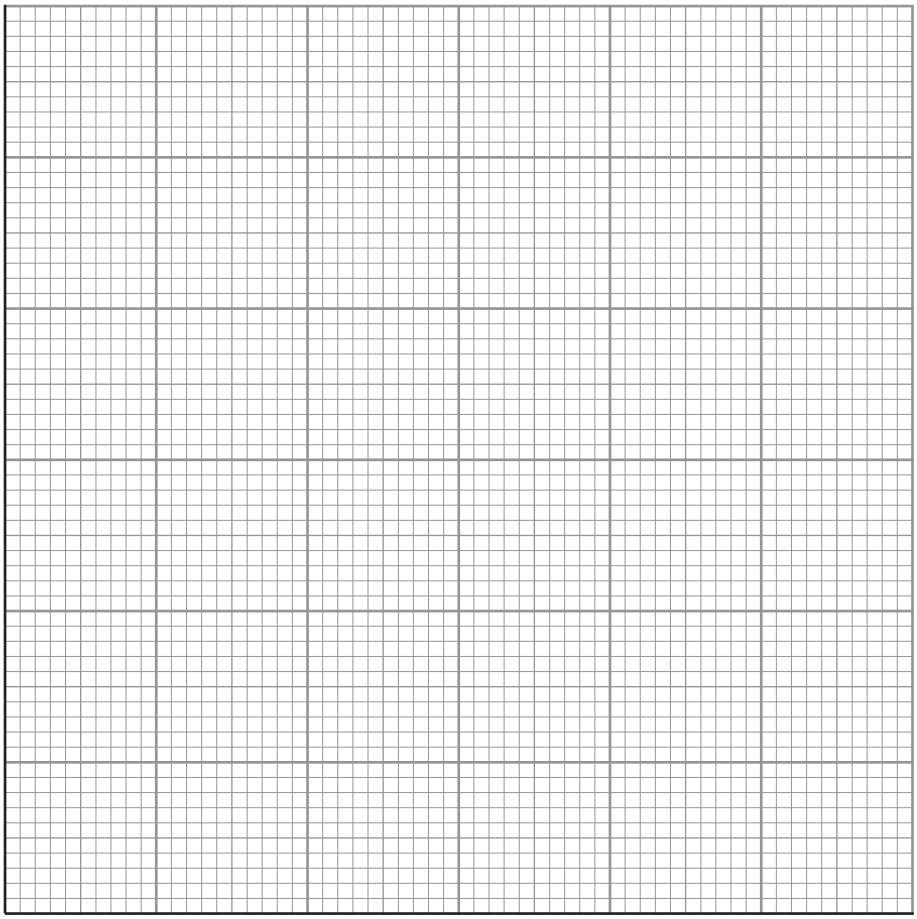
(b) (i) Plot the mean results of the investigation on the graph paper provided. [4]



(ii) Describe and explain the results of the experiment. [4]

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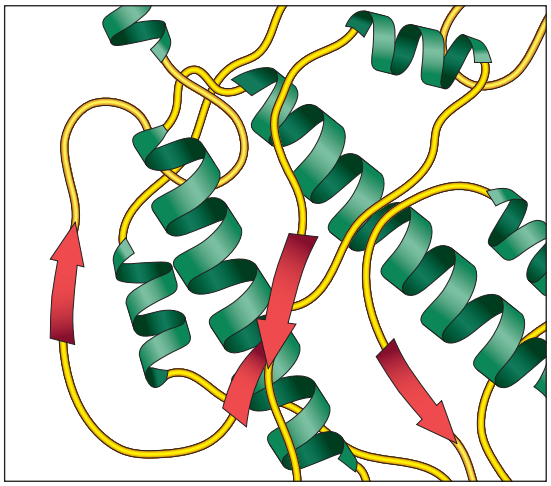
(c) **Image 3.2** shows part of the structure of the protease used in the experiment on page 6.

Image 3.2



(i) State the highest level of protein structure shown in **image 3.2** and identify the bonds that maintain the structure. [2]

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(ii) Explain how the shape of the molecule is related to its function. [2]

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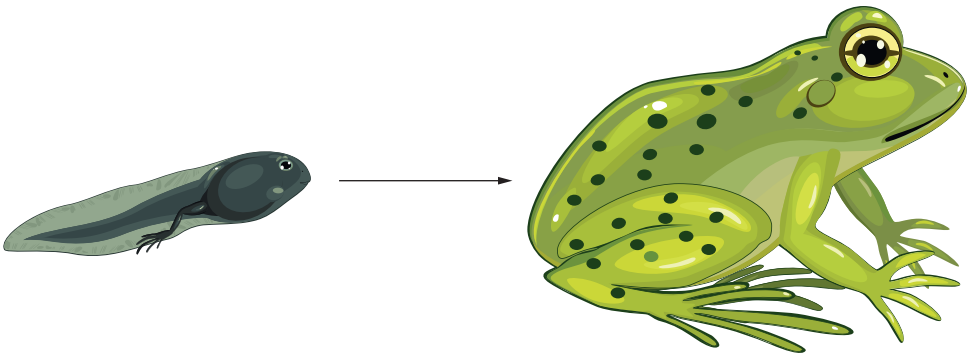
4. Programmed cell death, also known as **apoptosis**, is an important part of embryonic development. For example, in tadpoles, the cells of the tail undergo apoptosis as the tadpole develops into an adult frog. This is shown in **image 4.1**.

Image 4.1



During apoptosis, the cells in the tail break down into fragments surrounded by membranes. These membranes have signal molecules which are recognised by the tadpole's white blood cells. The cell fragments are then engulfed and destroyed.

(a) (i) Suggest the class of biological molecules to which the signal molecules belong. [1]

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(ii) Name the process by which white blood cells engulf and destroy the cell fragments. [1]

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(b) During apoptosis enzymes hydrolyse the cell's DNA into different lengths. The length of DNA molecules is measured in base pairs (bp).

(i) Name the complementary base pairs found in DNA and state the bond that joins them. [2]

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(ii) Each complete 360° turn of the double helix of DNA is 34 nm long and contains 10 base pairs. The length of a DNA fragment is 6800 nm.
Calculate the number of base pairs in this fragment. [2]

Number of base pairs = ... bp

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(iii) With reference to the hydrolysis of DNA, explain why the process of apoptosis would prevent the formation of functional proteins. [4]

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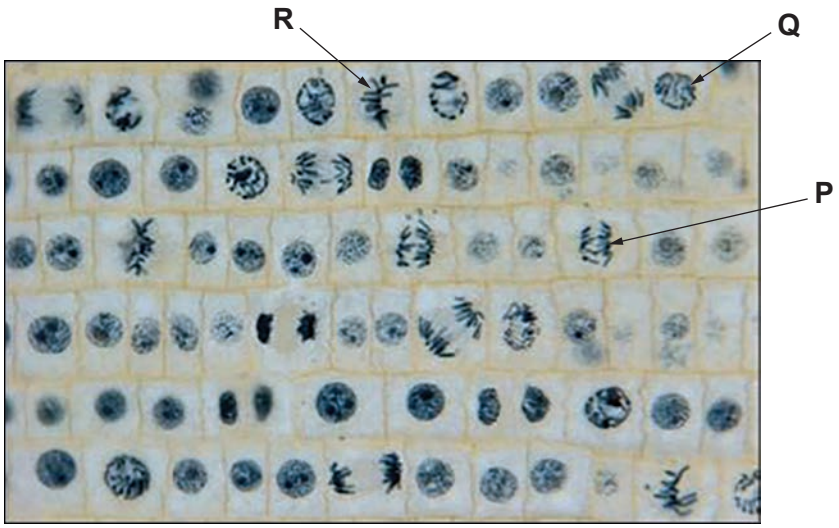
5. **Image 5.1** shows a section of onion root tip with cells at various stages in the cell cycle.

Image 5.1



(a) (i) Identify the stages of the cell cycle shown by: [1]

P .....

Q .....

R .....

(ii) Explain why the slide shown in **image 5.1** was prepared using tissue from a **root tip**. [2]

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A student counted the number of cells in each stage of the cell cycle in a section of plant tissue similar to the one shown in **image 5.1**. The results obtained are shown in **table 5.2**.

Table 5.2

Stage of cell cycle	Number of cells in each stage	Percentage cells in each stage
Q	24	21.2
R	8	7.1
P	6	5.3
S	7	6.2
T	68	60.2

(b) With reference to the data in **table 5.2**, identify which stage of the cell cycle is represented by the letter **T** in the table. Explain your answer. [2]

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A group of herbicides (weedkiller) known as the dinitroaniline herbicides were once used commonly to control weeds. Dinitroaniline works by inhibiting the formation of the spindle microtubules during cell division.

(c) (i) Identify which stage of mitosis would be affected by dinitroaniline. Explain your answer. [2]

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(ii) Suggest how the herbicide would affect the growth of a plant. [2]

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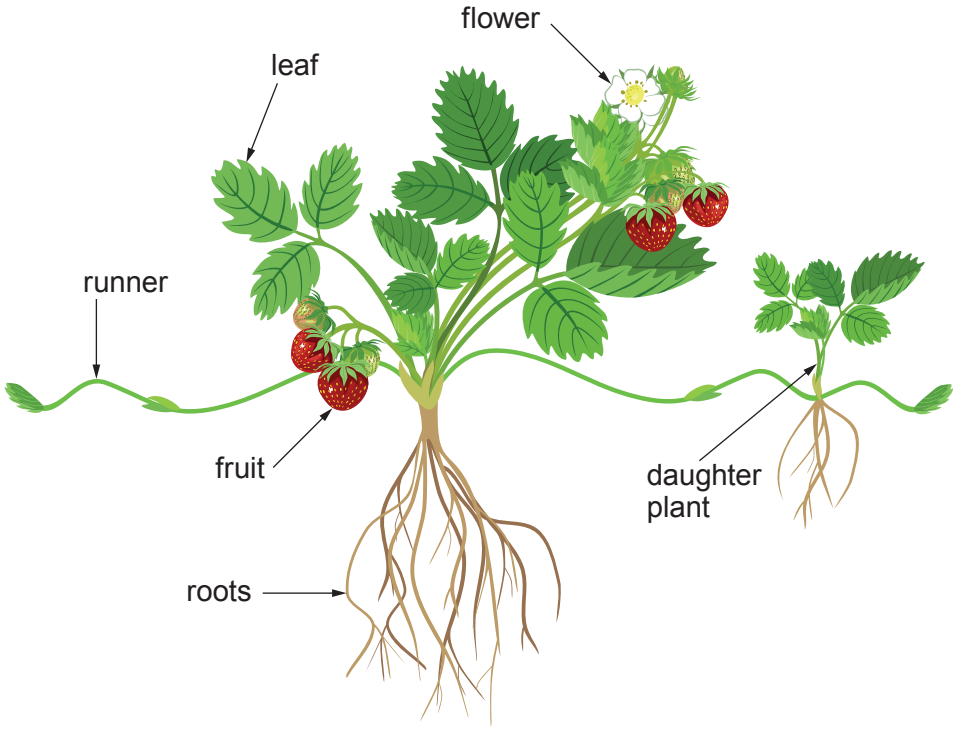
Image 5.3 shows two methods by which strawberry plants reproduce.

- Strawberry plants can reproduce using seeds.
- Another method involves a runner growing out from the parent plant and when it touches the soil a new daughter plant will grow. In this type of reproduction the daughter plants are produced entirely through mitosis.

Image 5.3



(d) The cells in the runner of the parent plant contain 8 sets of chromosomes giving a total number of 56.

(i) State how many chromosomes there would be in a root cell in the daughter plant. [1]

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(ii) When growing plants for commercial strawberry crops, growers prefer to use runners rather than seeds to produce new plants. Explain why it is an advantage to produce new plants in this way rather than using seeds. [3]

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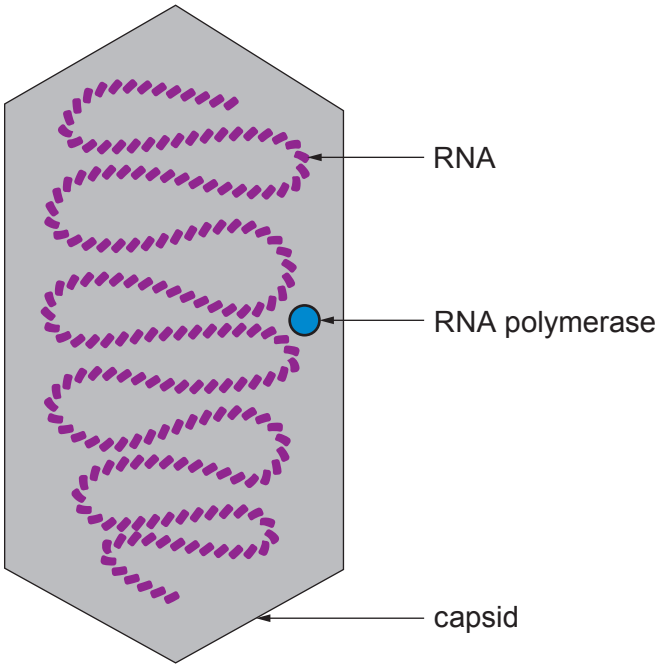
6. Viruses cause infections in many mammals including humans. The basic structure of a virus is shown in **image 6.1**.

Image 6.1



The virus must enter a host cell in order to reproduce. Once inside, the viral RNA is replicated using viral RNA polymerase enzyme. Viral RNA then acts as a code to synthesise the capsid protein using the host cell's organelles.

Compare the structure of the virus shown in **image 6.1** with the structure of a human cell. Describe and explain how the viral RNA is replicated and then used to make viral protein molecules. [9 QER]

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