



Rewarding Learning

ADVANCED SUBSIDIARY (AS)
General Certificate of Education
2019

Centre Number

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Candidate Number

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Biology

Assessment Unit AS 1

assessing

Molecules and Cells

MV18

[SBY11]

TUESDAY 21 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 seven** 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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(Questions start overleaf)

Section A

- 1 (a) The table below describes some events during meiosis. State the name of each stage and identify the division of meiosis involved. [6 marks]

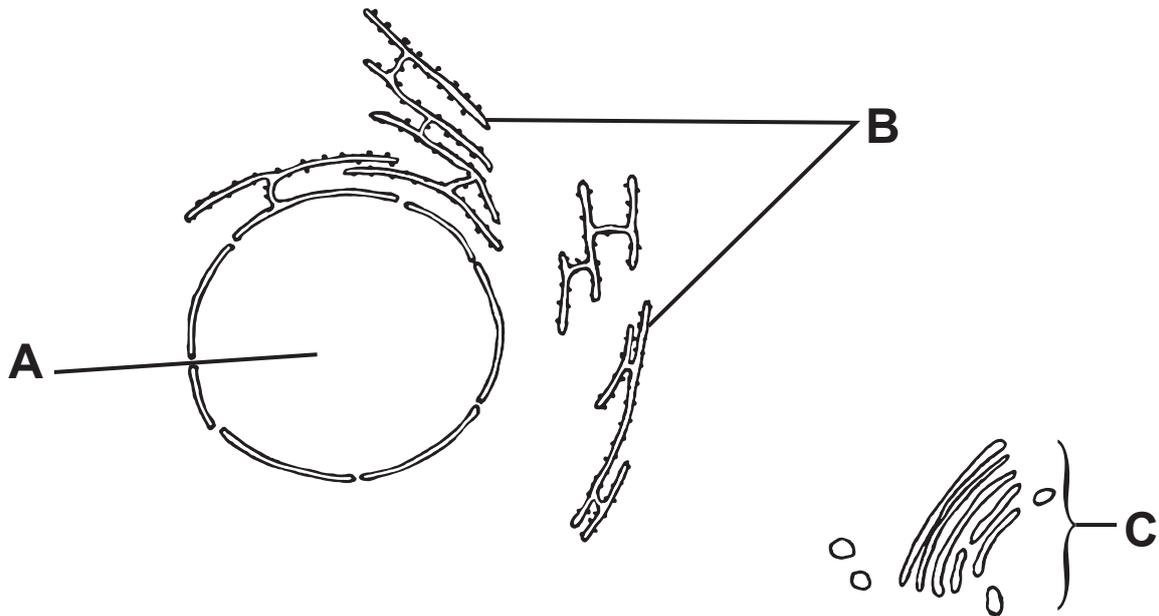
Description	Stage of meiosis	Division
Microtubules of spindle contract, pulling chromosomes to opposite poles of the cell		
Single chromosomes align along the cell equator		
Chiasmata occur between bivalents		

- (b) State **two** differences between meiosis and mitosis. [2 marks]

1. _____

2. _____

2 The diagram below represents part of the ultrastructure of a mammalian liver cell.



(a) The structures labelled **A**, **B** and **C** play a role in the production of a protein by the cell.

Describe the **role** of each structure in protein production. [3 marks]

A _____

B _____

C _____

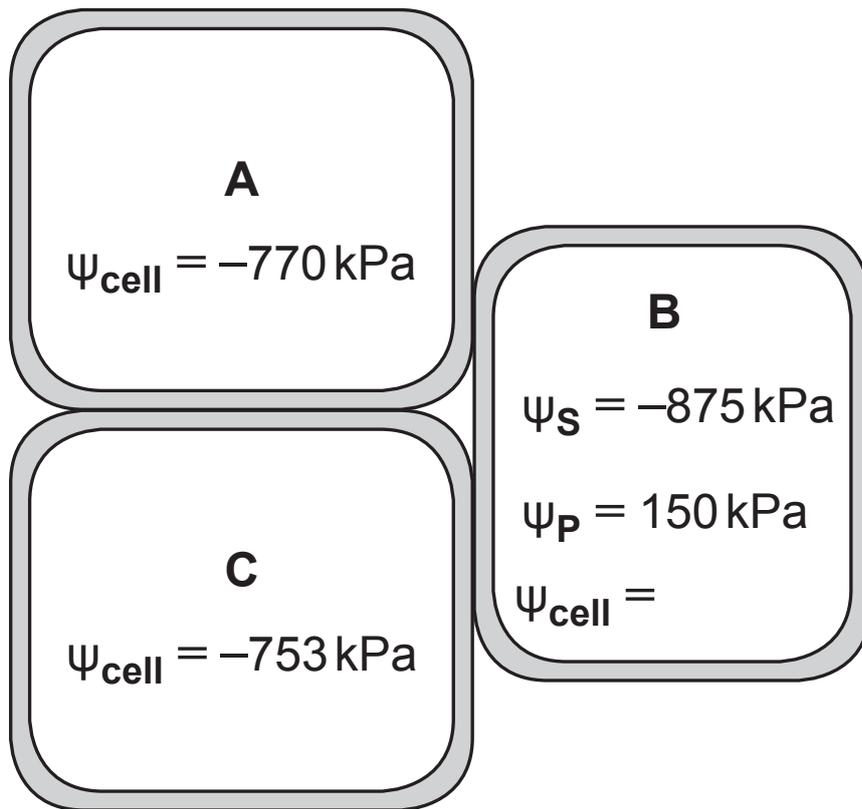
(b) All cells possess a plasma (cell surface) membrane. In addition, eukaryotic cells contain membrane systems and membrane-bound organelles.

An investigation was carried out to determine the percentages of different types of membranes which were found in mammalian liver and pancreas cells. The results are shown in the table below.

Type of membrane	Percentage of total cell membrane/%	
	Liver cells	Pancreas cells
Plasma	2	5
Rough ER	35	60
Smooth ER	16	0.5
Golgi apparatus	7	10
Secretory vesicle	0	3

Both liver and pancreas cells produce relatively large amounts of protein. Proteins produced in a cell may be used within the cell or released from the cell for use elsewhere.

- 3 Three plant cells (**A**, **B** and **C**) are represented in the diagram below, along with values relating to their water potentials.



- (a) Calculate ψ_{cell} for **B** and use arrows to show the direction of water movement between the three cells.
[2 marks]

(Show your working.)

(b) Movement of water may also occur between red blood cells and the plasma that surrounds them.

In terms of water potential, describe and explain the effect on red blood cells if the surrounding plasma becomes too dilute. [2 marks]

(c) One function of mammalian kidneys is the regulation of the water potential of the blood. If the kidneys are not functioning correctly, dialysis may be needed. This involves blood passing through a dialysis machine, where it flows in close proximity to a liquid referred to as dialysis fluid. The blood and the dialysis fluid are separated by a semi-permeable membrane.

The table below shows the concentrations of some of the substances present in the blood plasma entering the dialysis machine and in the dialysis fluid at the start of dialysis.

Substance	Concentration/mg dl⁻¹	
	Blood plasma	Dialysis fluid
sodium	2520	2520
chloride	1800	1800
urea	30	0
creatine	5	0
glucose	100	100

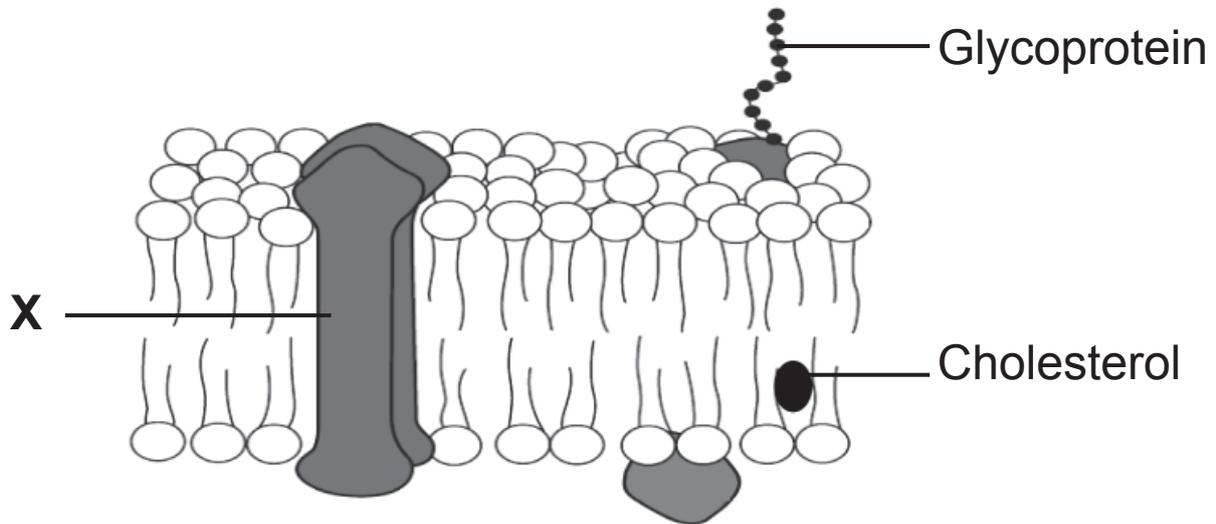
(i) Determine which substance will show the greatest rate of diffusion from blood plasma to dialysis fluid.
[1 mark]

- (ii)** Explain why it is necessary to ensure that the concentration of glucose in the dialysis fluid is the same as that in the blood plasma. [2 marks]

The composition of the dialysis fluid leaving the machine is monitored during treatment. Occasionally a red colouration appears in the dialysis fluid.

- (iii)** Suggest an explanation for the appearance of this red colouration in the dialysis fluid. [2 marks]

- 4 The diagram below represents the fluid mosaic model of membrane structure.



- (a) (i) Molecule **X** is a protein involved in the transport of water-soluble substances across the membrane. Identify molecule **X** and explain why this type of molecule is necessary in the transport of water-soluble substances. [3 marks]

(ii) State the function of cholesterol in the membrane.
[1 mark]

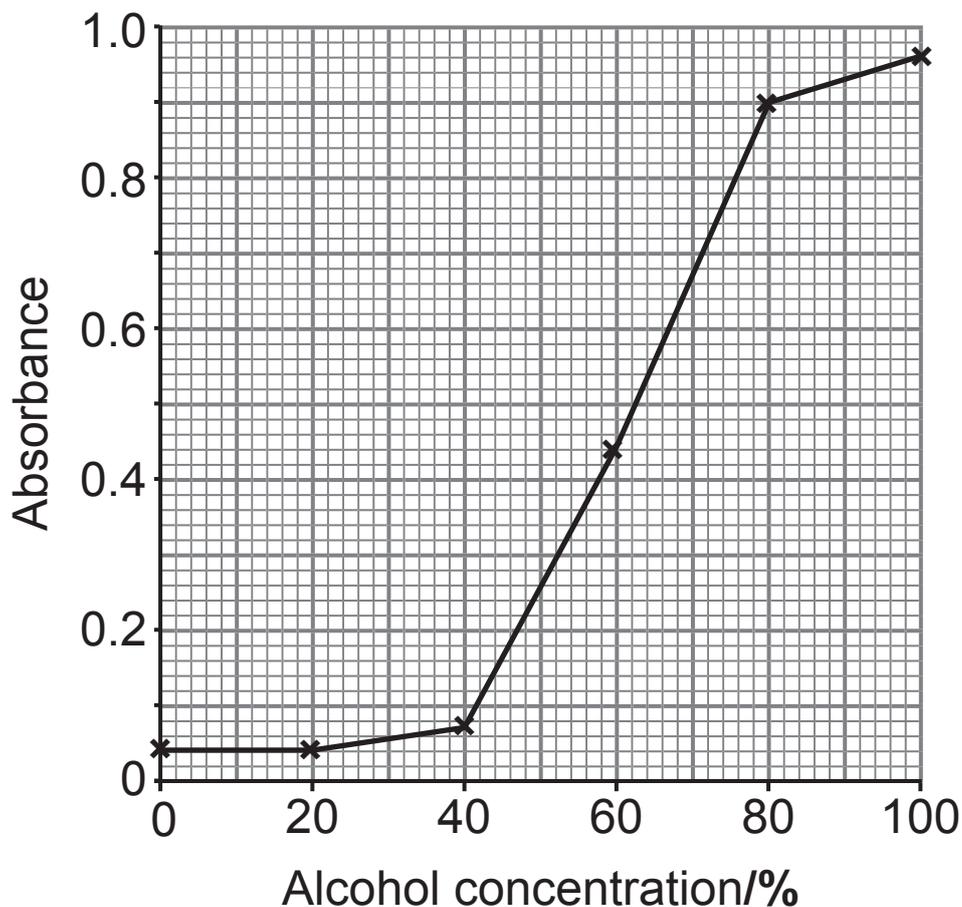
In prokaryotic membranes, the fatty acids in phospholipids are unsaturated, whereas they are saturated in eukaryotic membranes.

(b) Explain precisely the difference between saturated and unsaturated fatty acids. [1 mark]

(c) Hand sanitisers containing alcohol can be used to destroy bacteria (prokaryotes) on the skin. However, at very high concentrations, alcohol can have a drying effect which may damage the skin.

An investigation was carried out into the effect of alcohol concentrations on membrane permeability. Beetroot tissue was used rather than prokaryotes, since the release of a red pigment from beetroot cells can be a measure of membrane permeability.

Sections of beetroot tissue were placed in different concentrations of alcohol and the absorbance of the surrounding solution was measured using a colorimeter. The results are shown in the graph below.



- (i) Calculate the percentage increase in absorbance when alcohol concentration was increased from 80% to 100%. [2 marks]

(Show your working.)

- (ii) Describe and suggest an explanation for the trend shown by the data in the graph. [3 marks]

(iii) Using the information provided, and assuming prokaryotic membranes are similarly affected by alcohol, suggest why many brands of hand sanitiser have an alcohol concentration of approximately 70%.
[2 marks]

5 (a) The use of enzymes is important in biotechnology. To maximise the efficiency of enzymes they are often immobilised. Describe the immobilisation techniques below. [3 marks]

- Adsorption

- Encapsulation

- Cross-linkage

(b) State and explain one **disadvantage** of enzyme immobilisation. [2 marks]

Disadvantage _____

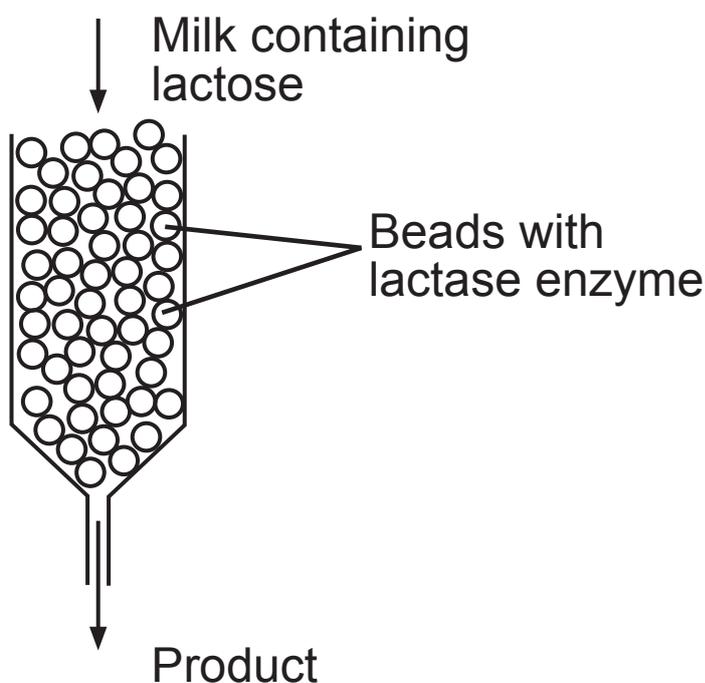
Explanation _____

Lactose intolerance is a common digestive problem in which the body is unable to digest lactose, a sugar mainly found in milk and other dairy products.

The enzyme lactase breaks down lactose into two sugars, glucose and galactose, which are easily absorbed into the bloodstream.

People with lactose intolerance don't produce enough lactase. The result is that lactose stays in the digestive system and is fermented by bacteria. Symptoms of lactose intolerance include stomach cramps and bloating.

One method of easing these symptoms is to use lactose-free milk. This milk has been treated with lactase to remove most of the lactose present. This is done in an industrial reactor using immobilised enzymes. The diagram below illustrates how this is carried out.



(c) (i) State **one** advantage of the lactase enzyme being immobilised during this process. [1 mark]

(ii) The process of removing lactose from milk is carried out at relatively low temperatures such as 5°C. Suggest **one** advantage and **one** disadvantage of using this temperature. [2 marks]

Advantage _____

Disadvantage _____

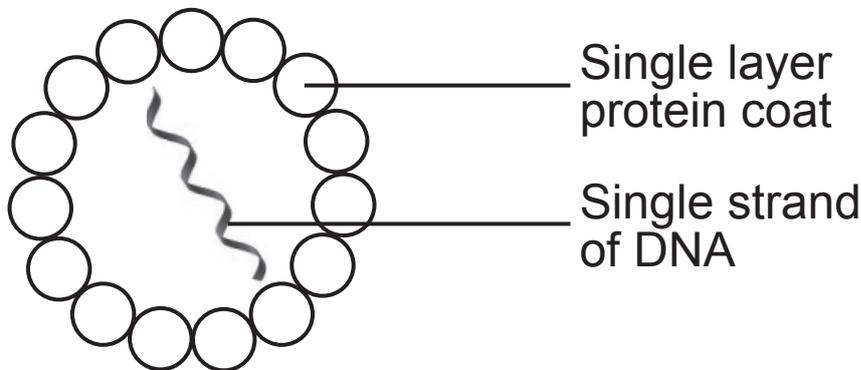
(iii) Suggest why it may be necessary at this temperature to pass the milk through the reactor several times. [2 marks]

(iv) It has been claimed that lactose-free milk tastes sweeter than untreated milk. Suggest an explanation for this. [1 mark]

(d) Babies born prematurely (before the 37th week of pregnancy) sometimes have a temporary lactose intolerance and may need to take lactose-free formula milk. Suggest a reason for this temporary intolerance. [1 mark]

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- 6 Canine parvovirus (CPV-2) is a virus that mainly affects dogs. Infection is caused by eating material containing the CPV-2 virus. The structure of the virus is represented below.



- (a) HIV is a virus which affects humans. Using the diagram of the CPV-2 virus and your knowledge, describe two structural **differences** between CPV-2 and HIV.

[2 marks]

1. _____

2. _____

- (b) CPV-2 enters cells by endocytosis.

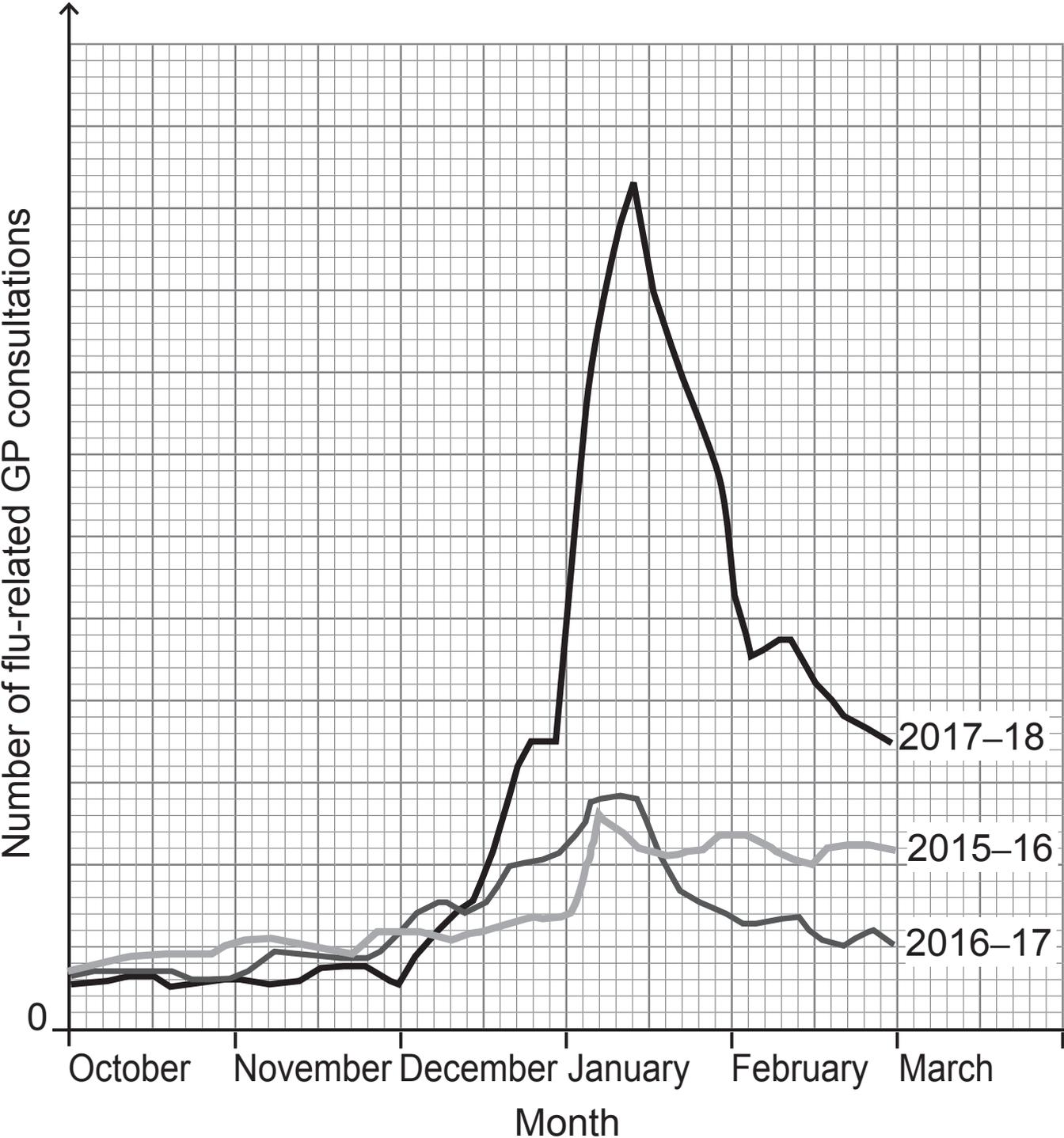
- (i) Describe the process of endocytosis. [2 marks]

In order to replicate, the viral DNA must enter the nucleus. Once this has happened the normal semi-conservative DNA replication mechanism of the host cell is used. This allows many copies of the viral DNA to be made.

(ii) Outline how copies of the viral DNA are produced by semi-conservative replication. [2 marks]

(c) CPV-2 usually targets actively dividing cells and, in infected dogs, the mucosa of the ileum suffers significant damage. Suggest which cells of the mucosa are affected and explain the consequences of damage to these cells. [2 marks]

Every week during 'flu season' the Public Health Agency for Northern Ireland produces data relating to GP consultations for the flu virus. The graph below shows this data for three years (2015–2018) from the beginning of October until the end of February.



SOURCES

Q6(c)..... © Public Health Agency <https://www.publichealth.hscni.net>

For Examiner's use only	
Question Number	Marks
1	
2	
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Total Marks	
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Examiner Number

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