Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

AS
BIOLOGY

Paper 1

Thursday 26 May 2016 Afternoon Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a ruler with millimetre measurements
- a calculator.

Instructions
- Use black ink or black ball-point pen.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- All work must be shown.
- Do all rough work in this book. Cross through any work you do not want to be marked.

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 75.

Do not write outside the box

Answer **all** questions in the spaces provided.

0 1 . 1 **Table 1** shows features of a bacterium and the human immunodeficiency virus (HIV) particle.

Complete **Table 1** by putting a tick (✓) where a feature is present.

[2 marks]

Table 1

Feature	**Bacterium**	**Human immunodeficiency virus (HIV) particle**
RNA		
Cell wall		
Enzyme molecules		
Capsid		

0 1 . 2 When HIV infects a human cell, the following events occur.

- A single-stranded length of HIV DNA is made.
- The human cell then makes a complementary strand to the HIV DNA.

The complementary strand is made in the same way as a new complementary strand is made during semi-conservative replication of human DNA.

Describe how the complementary strand of HIV DNA is made.

[3 marks]

Do not write outside the box

0 1 . 3 Contrast the structures of DNA and mRNA molecules to give **three** differences.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

Turn over for the next question

Do not write outside the box

0 2 . 1 Describe the difference between the structure of a triglyceride molecule and the structure of a phospholipid molecule.

[1 mark]

0 2 . 2 Describe how you would test for the presence of a lipid in a sample of food.

[2 marks]

0 2 . 3 Animal fats contain triglycerides with a high proportion of saturated fatty acids. If people have too much fat in their diet, absorption of the products of fat digestion can increase the risk of obesity. To help people lose weight, fat substitutes can be used to replace triglycerides in food.

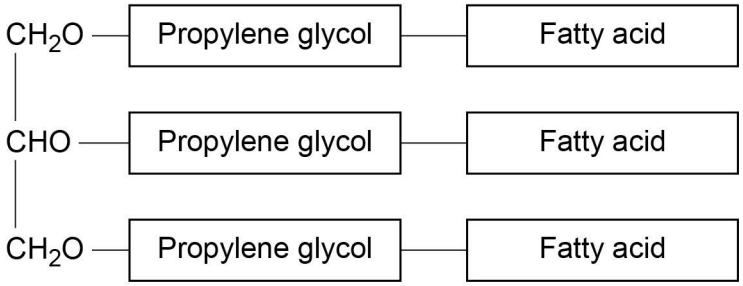
Describe how a saturated fatty acid is different from an unsaturated fatty acid.

[1 mark]

Do not write outside the box

Figure 1 shows the structure of a fat substitute.

Figure 1



0 2 . 4 This fat substitute **cannot** be digested in the gut by lipase.

Suggest why.

[2 marks]

0 2 . 5 This fat substitute is a lipid. Despite being a lipid, it cannot cross the cell-surface membranes of cells lining the gut.

Suggest why it **cannot** cross cell-surface membranes.

[1 mark]

Do not write outside the box

0 3 Cells constantly hydrolyse ATP to provide energy.

0 3 . 1 Describe how ATP is resynthesised in cells.

[2 marks]

0 3 . 2 Give **two** ways in which the hydrolysis of ATP is used in cells.

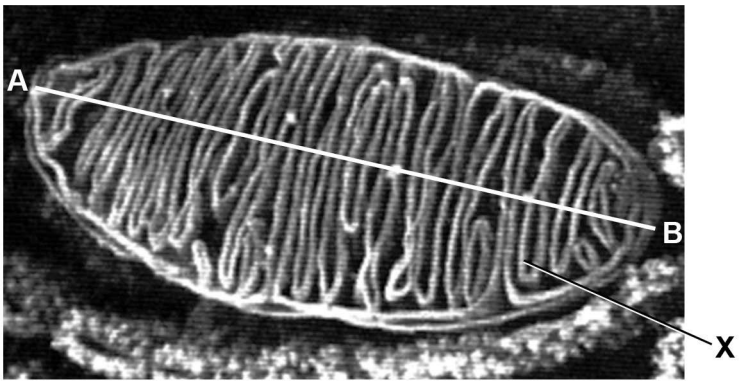
[2 marks]

1 _____

2 _____

0 3 . 3 **Figure 2** is a photograph (micrograph) of a mitochondrion taken using a scanning electron microscope.

Figure 2



What is the evidence from **Figure 2** that a scanning electron microscope was used to take this photograph?

[1 mark]

Do not write outside the box

0 3 . 4 Name the part of the mitochondrion labelled **X** in **Figure 2**.

[1 mark]

_____

0 3 . 5 The actual length of the mitochondrion between points **A** and **B** in **Figure 2** is 4 μm.

What is the magnification of the mitochondrion in **Figure 2**?

Show your working.

[2 marks]

Magnification _____

Turn over for the next question

Do not write outside the box

0 4 . 1 The letters **P**, **Q**, **R**, **S** and **T** represent ways substances can move across membranes.

- **P** – diffusion through the phospholipid bilayer
- **Q** – facilitated diffusion
- **R** – active transport
- **S** – co-transport
- **T** – osmosis

For each of the following examples of transport across membranes, select the letter that represents the way in which the substance moves across the membrane.

Write the appropriate letter in each box provided.

[3 marks]

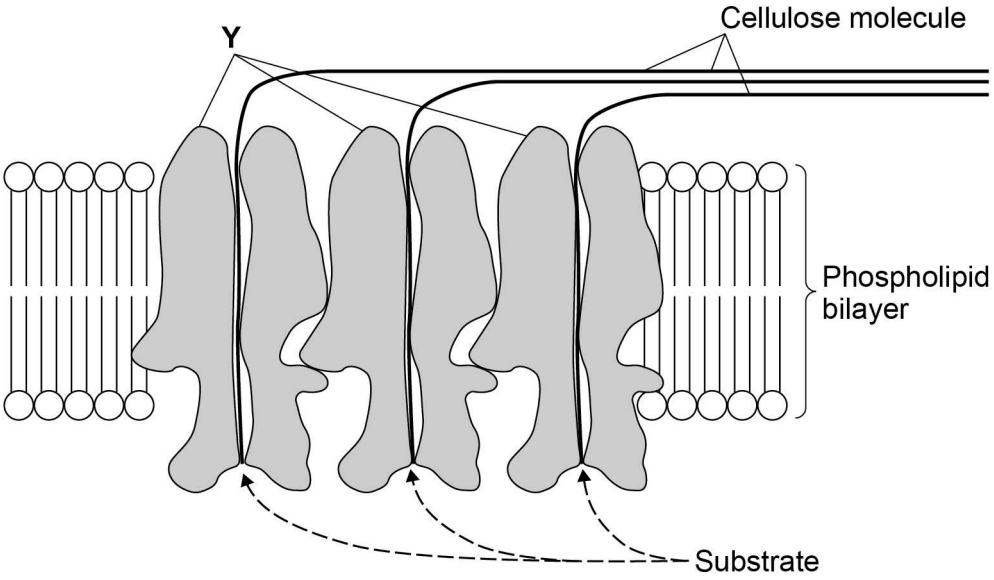
Transport through a channel protein ☐

Transport of small, non-polar molecules ☐

Transport of glucose with sodium ions ☐

Figure 3 shows how a plant cell produces its cell wall.

Figure 3



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0 4 . 2 **Y** is a protein. One function of **Y** is to transport cellulose molecules across the phospholipid bilayer.

Using information from **Figure 3**, describe the other function of **Y**.

[2 marks]

0 4 . 3 What is the evidence in **Figure 3** that the phospholipid bilayer shown is part of the cell-surface membrane?

[1 mark]

0 4 . 4 In the cell wall, bonds hold the cellulose molecules together side by side.

Tick (✓) **one** box that describes the type of bond that holds the cellulose molecules together side by side.

[1 mark]

Ester ☐

Hydrogen ☐

Ionic ☐

Peptide ☐

Do not write outside the box

0 5 Scientists investigated the hydrolysis of sucrose in growing plant cells by an enzyme called SPS.

0 5 . 1 Name the products of the hydrolysis of sucrose.

[2 marks]

1 _____

2 _____

0 5 . 2 The scientists grew plant cells in a culture for 12 days. At the start, there were only a few cells in the culture. Each day, they determined the mass of sucrose hydrolysed by SPS in the plant cells in **1 hour**.

Table 2 shows their results.

Table 2

Day	Mass of sucrose hydrolysed by SPS in 1 hour / µg	Rate of hydrolysis of sucrose by SPS
0	0.07	
2	0.09	
4	0.11	
6	0.15	
8	0.20	
10	0.24	
12	0.24	

For each day, calculate the rate **per minute** of the reaction catalysed by SPS. Record the rates in standard form and plot a suitable graph of your processed data.

[3 marks]

Do not write outside the box

0 5 . 3 What can you conclude about the growth of the plant cells from these data? Explain how you reached your conclusions.

[3 marks]

Do not write outside the box

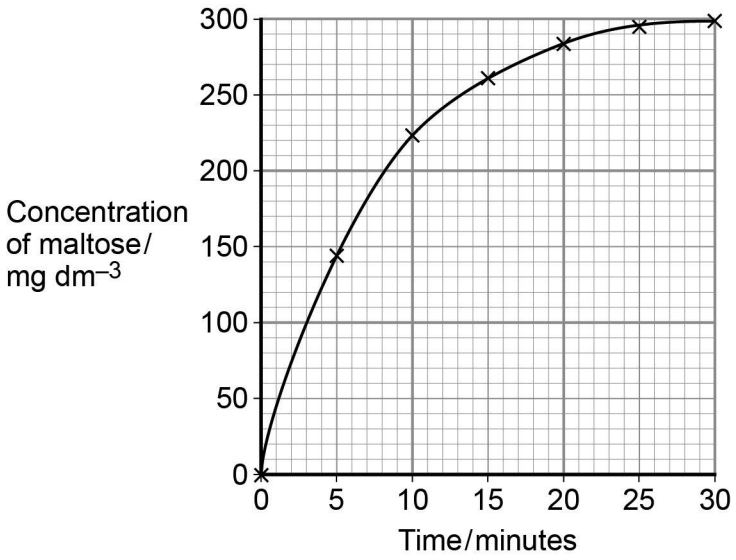
0 6 . 1 Describe the induced-fit model of enzyme action.

[2 marks]

0 6 . 2 A scientist investigated the hydrolysis of starch.
He added amylase to a suspension of starch and measured the concentration of maltose in the reaction mixture at regular intervals.

His results are shown in **Figure 4**.

Figure 4



Determine the rate of the reaction **at** 10 minutes.
Show how you obtained your answer.

[2 marks]

Rate of reaction _____ mg dm^{-3} min^{-1}

Do not write outside the box

0 6 . 3 Explain the results shown in **Figure 4**.

[2 marks]

0 6 . 4 A quantitative Benedict's test produces a colour whose intensity depends on the concentration of reducing sugar in a solution. A colorimeter can be used to measure the intensity of this colour.

The scientist used quantitative Benedict's tests to produce a calibration curve of colorimeter reading against concentration of maltose.

Describe how the scientist would have produced the calibration curve and used it to obtain the results in **Figure 4**.

Do **not** include details of how to perform a Benedict's test in your answer.

[3 marks]

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0 7 . 1 Human papilloma virus (HPV) is the main cause of cervical cancer. A vaccine has been developed to protect girls and women from HPV.

Describe how giving this vaccine leads to production of antibody against HPV.

[4 marks]

Do not write outside the box

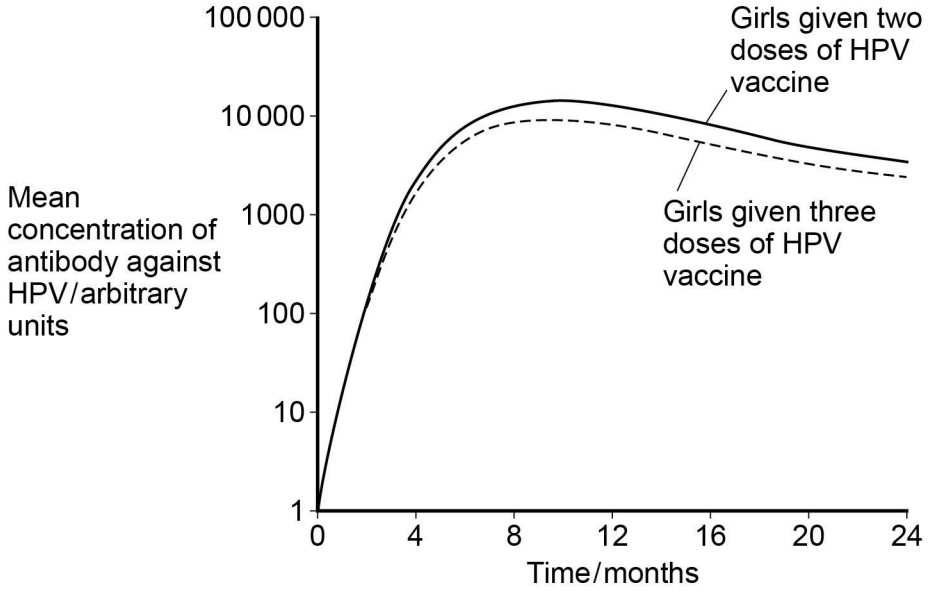
0 7 . 2 Doctors investigated whether it was better to give two or three doses of the HPV vaccine. They determined the mean concentration of antibody against HPV in blood samples from girls who were given either two or three doses of the vaccine.

- Girls given two doses received an initial vaccination, followed by a second at 6 months.
- Girls given three doses received an initial vaccination, followed by a second at 1 month and a third at 6 months.

The doctors measured the concentration of antibody each month.

The results are shown in **Figure 5**.

Figure 5



What do these results suggest about whether it is better to give two or three doses of the vaccine? Give reasons for your answer.

[2 marks]

Question 7 continues on the next page

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0 7 . 3 The doctors carried out a statistical test to determine whether the antibody concentrations were significantly different in girls given two doses of the vaccine, compared with those given three doses. They determined the mean concentrations of antibody 9 months after the first dose of vaccine.

What statistical test should the doctors have used? Give the reason for your choice.

[1 mark]

Test _____

Reason _____

_____

0 7 . 4 There is genetic diversity within HPV.

Give **two** ways doctors could use base sequences to compare different types of HPV.

[2 marks]

1 _____

_____

2 _____

_____

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0 8 . 1 The letters **A**, **B**, **C**, **D** and **E** represent stages in mitosis.

- **A** – anaphase
- **B** – interphase
- **C** – metaphase
- **D** – prophase
- **E** – telophase

Write **one** of the letters, **A** to **E**, in the box to complete the following statement.

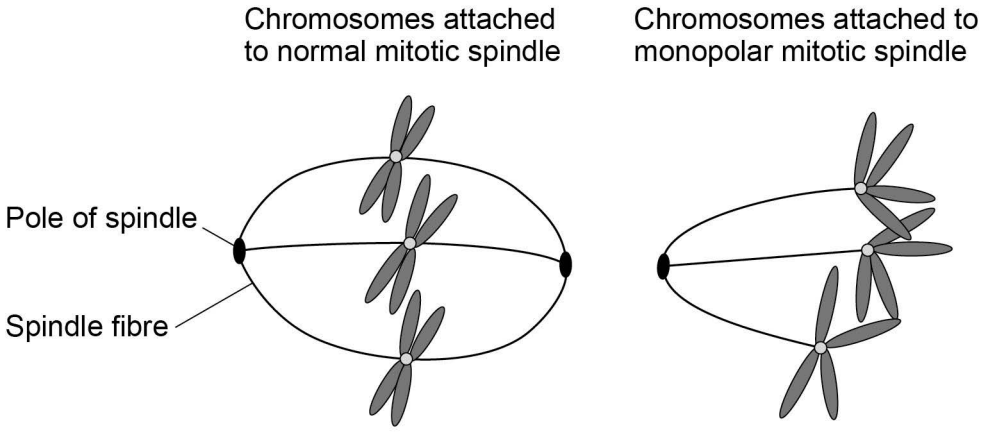
[1 mark]

Chromosomes line up on the equator of the mitotic spindle in ☐

0 8 . 2 Scientists looking for treatments for cancer are investigating the use of substances called kinesin inhibitors (KI). These inhibitors prevent successful mitosis. Some kinesin inhibitors cause the development of a monopolar spindle in mitosis.

Figure 6 shows chromosomes attached to a normal mitotic spindle and to a monopolar mitotic spindle.

Figure 6



Suggest why the development of a monopolar mitotic spindle would prevent successful mitosis.

[2 marks]

Do not write outside the box

0 8 . 3 Scientists investigated the effect of different concentrations of a kinesin inhibitor (KI) on mitosis of human bone-cancer cells grown in a culture.

Table 3 shows the scientists' results.

Table 3

Concentration of kinesin inhibitor / nmol dm^{-3}	Percentage of dividing human bone-cancer cells showing a monopolar mitotic spindle
0	0
1	0
10	8
100	93
1000	100
10 000	100

A student who saw these results concluded that in any future trials of this kinesin inhibitor with people, a concentration of 100 nmol dm^{-3} would be most appropriate to use.

Do these data support the student's conclusion? Give reasons for your answer.

[4 marks]

Do not write outside the box

0 8 . 4 At the start of their investigation, the scientists made a solution of kinesin inhibitor (KI) with a concentration of 10 000 nmol dm^{-3}. They used this to make the other concentrations by a series of dilutions with water.

Describe how they made 100 cm^3 of 1000 nmol dm^{-3} solution of kinesin inhibitor.

[2 marks]

Turn over for the next question

Do not write outside the box

0 9 Read the following passage.

Alzheimer's disease leads to dementia. This involves small β-amyloid proteins binding together to form structures called plaques in the brain.

Nerve cells in the brain produce a large protein called amyloid-precursor protein that has a complex shape. This protein is the substrate of two different enzymes, α-secretase and β-secretase. These enzymes are normally produced in the brain. One product of the reaction catalysed by β-secretase is a smaller protein that can lead to β-amyloid protein formation. Many people with Alzheimer's disease have mutations that decrease α-secretase production, or increase β-secretase production.

One possible type of drug for treating Alzheimer's disease is a competitive inhibitor of β-secretase. When some of these types of drugs were trialled on patients, the trials had to be stopped because some patients developed serious side effects.

Use information from the passage and your own knowledge to answer the following questions.

0 9 . 1 Suggest how amyloid-precursor protein can be the substrate of two different enzymes, α-secretase and β-secretase (lines 3–5).

[2 marks]

0 9 . 2 One product of the reaction catalysed by β-secretase is a smaller protein (lines 6–7).

Describe what happens in the hydrolysis reaction that produces the smaller protein from amyloid-precursor protein.

[2 marks]

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0 9 . 3 Many people with Alzheimer's disease have mutations that decrease α-secretase production, or increase β-secretase production (lines 8–9).

Use the information provided to explain how these mutations can lead to Alzheimer's disease.

[3 marks]

0 9 . 4 One possible type of drug for treating Alzheimer's disease is a competitive inhibitor of β-secretase (lines 10–11).

Explain how this type of drug could prevent Alzheimer's disease becoming worse.

[2 marks]

0 9 . 5 When some of these types of drugs were trialled on patients, the trials were stopped because some patients developed serious side effects (lines 11–13).

Using the information provided, suggest why some patients developed serious side effects.

[1 mark]

END OF QUESTIONS

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