AQA

Please write clearly in block capitals.

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

Surname _____

Forename(s) _____

Candidate signature _____

AS BIOLOGY

Unit 2 The variety of living organisms

Tuesday 6 June 2017 Afternoon Time allowed: 1 hour 45 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.
- You may ask for extra paper. Extra paper must be secured to this booklet.
- Do all rough work in this book. Cross through any work you do not want to be marked.

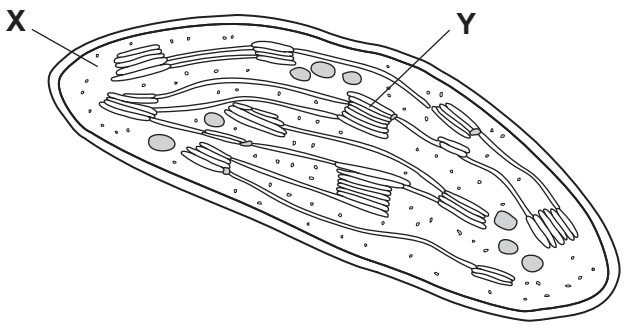
Information
- The maximum mark for this paper is 85.
- The marks for questions are shown in brackets.
- You are expected to use a calculator, where appropriate.
- Quality of Written Communication will be assessed in all answers.
- You will be marked on your ability to:
  – use good English
  – organise information clearly
  – use scientific terminology accurately.

For Examiner's Use	
Examiner's Initials	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
10	
TOTAL	

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

1 **Figure 1** shows a chloroplast as seen with an electron microscope.

Figure 1



1 (a) Name **X** and **Y**.

[2 marks]

X _____

Y _____

1 (b) Describe the function of a chloroplast.

[2 marks]

_____

_____

_____

_____

_____

1 (c) The actual maximum length of this chloroplast is 5 μm. Calculate the magnification of **Figure 1**. Show your working.

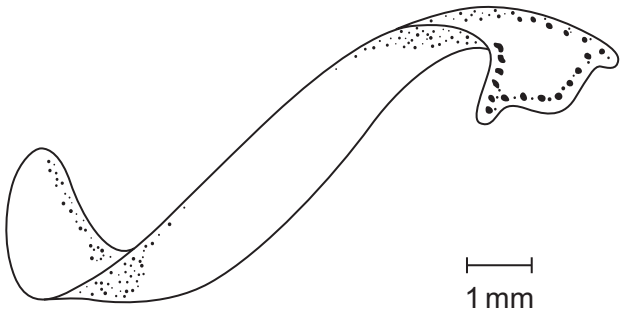
[2 marks]

Answer = _____

6

2 (a) Flatworms are small animals that live in water. They have no specialised gas exchange or circulatory systems.
Figure 2 shows one type of flatworm.

Figure 2



2 (a) (i) Name the process by which oxygen reaches the cells inside the body of this flatworm.
[1 mark]

_____

2 (a) (ii) The body of a flatworm is adapted for efficient gas exchange between the water and the cells inside the body.

Explain **two** ways the shape of the flatworm's body allows efficient gas exchange, using **Figure 2.**

[2 marks]

1 _____

_____

_____

2 _____

_____

_____

Question 2 continues on the next page

2 (b) (i) A gill is an organ. What is an organ?

[1 mark]

2 (b) (ii) Describe how oxygen in the water reaches the blood inside a fish gill.

[3 marks]

[Extra space]

7

3 (a) Explain what is meant by genetic diversity.

[1 mark]

3 (b) The willow tit is a bird. Numbers of willow tit have decreased over the past 50 years.

Explain how this decrease in numbers may affect their genetic diversity.

[2 marks]

3 (c) The willow tit can feed on the seeds produced by knapweed plants.

Describe how you could collect data from knapweed plants to investigate variation in seed length.

Do **not** include details of the apparatus you would use.

[2 marks]

5

Turn over for the next question

4 (a) What is a species?

[2 marks]

4 (b) Scientists investigated the diversity of plants in a small area within a forest. **Table 1** shows their results.

Table 1

Plant species	Number of individuals
Oak	9
Beech	5
Sycamore	7
Ash	5
Birch	43
Hazel	3
Hawthorn	3
Alder	6
Willow	4

The index of diversity can be calculated by the formula

$$d = \frac{N(N-1)}{\sum n(n-1)}$$

where

d = index of diversity
N = total number of organisms of all species
n = total number of organisms of each species

4 (b) (i) Calculate the index of diversity of plants in the forest. Use the formula on page 6. Show your working.

[2 marks]

Answer _____

4 (b) (ii) The forest was cleared to make more land available for agriculture.

After the forest was cleared, the species diversity of insects in the area decreased. Explain why.

[3 marks]

_____

_____

_____

_____

_____

_____

[Extra space] _____

_____

_____

7

5 Below is a short sequence of DNA bases.

T T T G T A T A C T A G T C T T C G T T A A T A

5 (a) (i) What is the maximum number of amino acids for which this sequence of DNA bases could code?

Tick (✓) **one** box next to the correct answer.

[1 mark]

8 ☐

9 ☐

12 ☐

24 ☐

5 (a) (ii) The number of amino acids coded for could be fewer than your answer to part **(a)(i)**.

Give **one** reason why.

[1 mark]

_____

_____

5 (b) Explain how a change in the DNA base sequence for a protein may result in a change in the structure of the protein.

[3 marks]

[Extra space]

5 (c) A piece of DNA consisted of 74 base pairs. The two strands of the DNA, strands **A** and **B**, were analysed to find the number of bases of each type that were present. Some of the results are shown in **Table 2**.

[2 marks]

Table 2

	Number of bases			
	C	G	A	T
Strand **A**	29			
Strand **B**	18		11	

Complete **Table 2** by writing in the missing values.

7

6 Organisms can be classified using a hierarchy of phylogenetic groups.

6 (a) (i) Explain what is meant by a hierarchy.

[2 marks]

6 (a) (ii) Explain what is meant by a phylogenetic group.

[1 mark]

6 (b) Cytochrome c is a protein involved in respiration. Scientists determined the amino acid sequence of human cytochrome c. They then:

- determined the amino acid sequences in cytochrome c from five other organisms
- compared these amino acid sequences with that of human cytochrome c
- recorded the number of differences in each amino acid sequence compared with human cytochrome c.

Table 3 shows their results.

Table 3

Organism	Number of differences in the amino acid sequence compared with human cytochrome c
A	1
B	12
C	12
D	15
E	43

6 (b) (i) Explain how these results suggest that organism **E** is the **least** closely related to humans.

[2 marks]

6 (b) (ii) A student who looked at these results concluded that organisms **B** and **C** are more closely related to each other than to any of the other organisms.

Suggest **one** reason why this might **not** be a valid conclusion.

[1 mark]

6 (b) (iii) Cytochrome c is more useful than haemoglobin for studying how closely related different organisms are.

Suggest **one** reason why.

[1 mark]

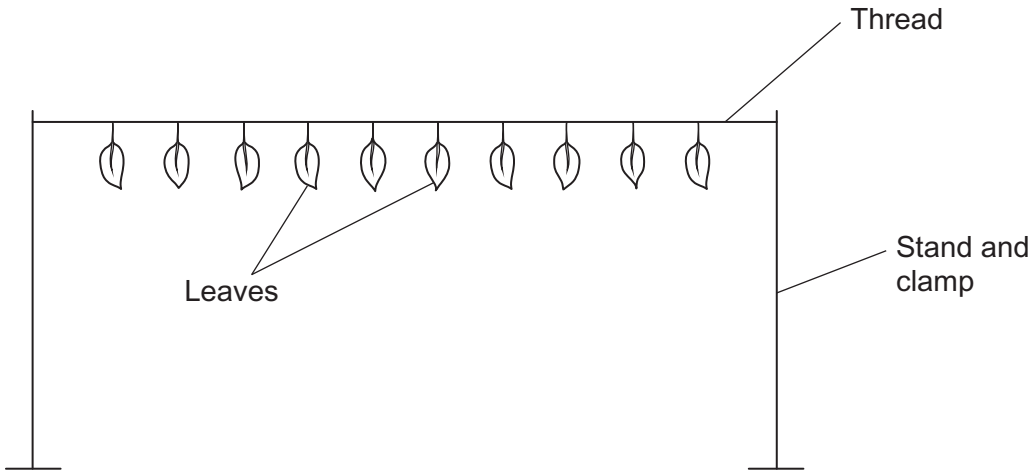
7

Turn over for the next question

7 A student investigated the rate of transpiration from privet leaves.

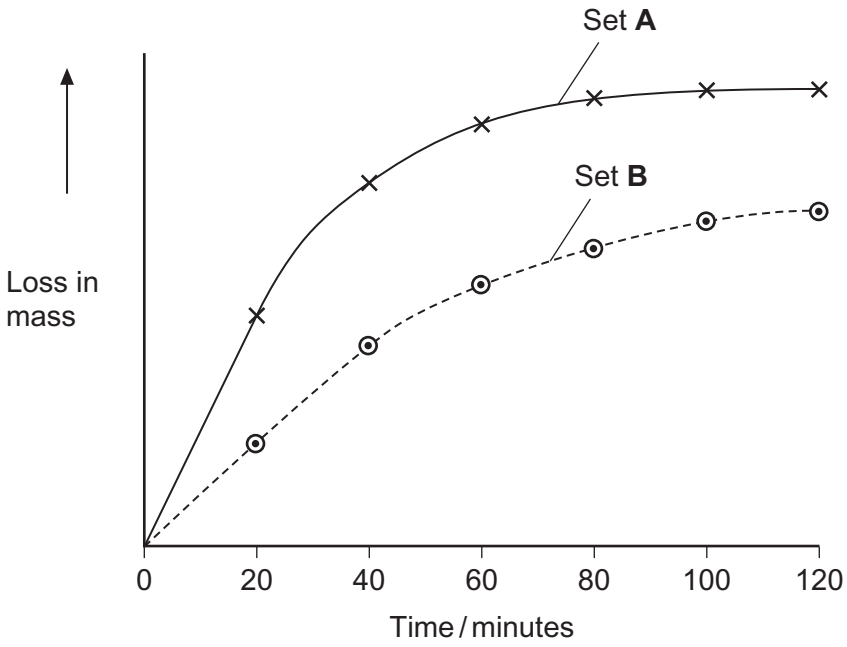
- She obtained two sets of ten privet leaves.
- She left the ten leaves in set **A** untreated. She covered the upper surfaces of the ten leaves in set **B** with grease.
- She weighed each set of leaves and then tied all the leaves in each set to a separate length of thread. This is shown in **Figure 3**.

Figure 3



- She then weighed each set of leaves every 20 minutes over a period of 2 hours and plotted a graph of her results, as shown in **Figure 4**.

Figure 4



7 (a) Give **two** environmental conditions that the student should have kept constant during this investigation.

[2 marks]

1 _____

2 _____

7 (b) The student measured the water loss in milligrams.
Explain the advantage of weighing ten leaves at the same time when taking measurements in milligrams.

[1 mark]

_____

_____

7 (c) Explain the change in mass of untreated leaves in set **A** shown in **Figure 4**.

[3 marks]

_____

_____

_____

_____

_____

_____

_____

7 (d) The results that the student obtained for the leaves in set **B** were different from those for set **A**. Suggest an explanation for this difference.

[2 marks]

_____

_____

_____

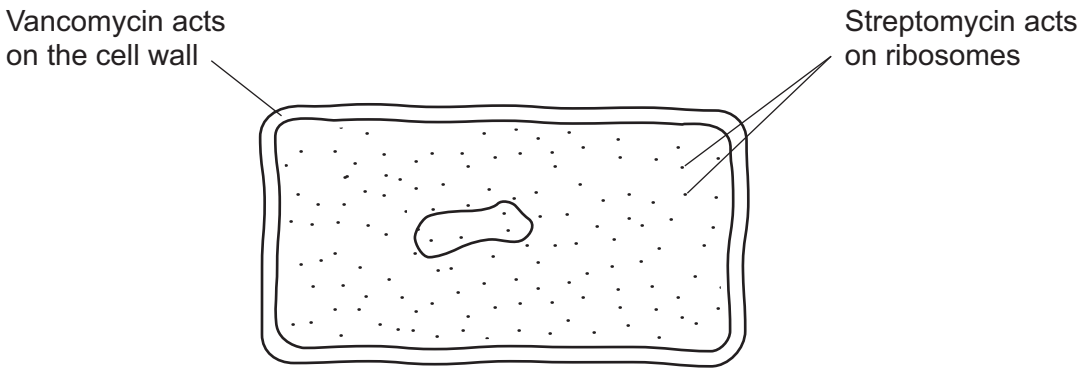
_____

_____

8

8 **Figure 5** shows the structure of a bacterium and the sites of action of two antibiotics.

Figure 5



8 (a) (i) Explain why vancomycin does **not** affect human cells, using information in **Figure 5**.
[1 mark]

8 (a) (ii) Explain how streptomycin prevents bacterial growth, using information in **Figure 5**.
[1 mark]

8 (b) Frequent treatment with vancomycin can result in resistant strains of bacteria.

Explain how.

[3 marks]

[Extra space]

8 (c) The gene for resistance to vancomycin is very common in the bacterium *Enterococcus faecalis*. The same gene has now been found in the bacterium *Staphylococcus aureus*.

Explain how the gene was passed from one species of bacterium to another, using your knowledge of gene transmission.

[3 marks]

[Extra space]

8

9 (a) Describe how DNA is replicated.

[6 marks]

[Extra space]

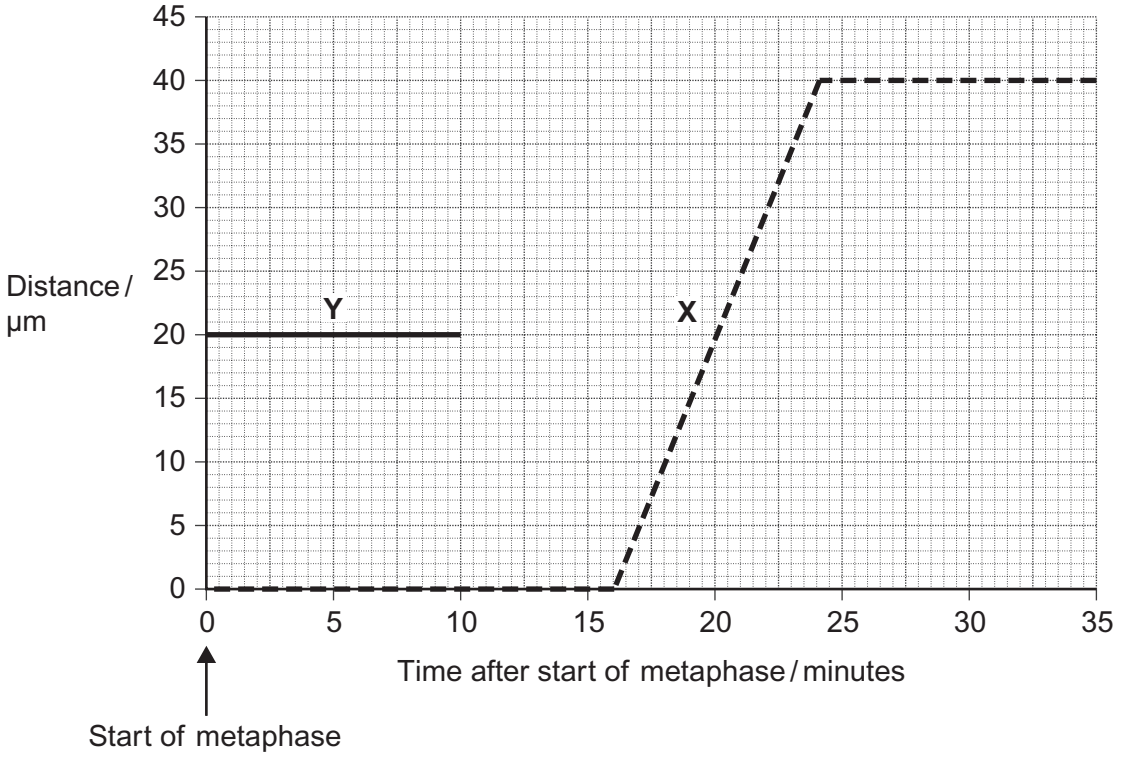
9 (b) **Figure 6** shows information about the movement of chromatids in a cell that has just started metaphase of mitosis.

Key

- - - - = distance between chromatids

——— = distance between each chromatid and the pole to which it is moving

Figure 6



9 (b) (i) What was the duration of metaphase in this cell?

[1 mark]

minutes

9 (b) (ii) Use line **X** to calculate the duration of anaphase in this cell.

[1 mark]

minutes

9 (b) (iii) Complete line **Y** on **Figure 6**.

[2 marks]

Question 9 continues on the next page

9 (c) A doctor investigated the percentage of cells in different stages of the cell cycle in two tissue samples, **C** and **D**. One tissue sample was taken from a cancerous tumour. The other was taken from non-cancerous tissue. **Table 4** shows his results.

Table 4

	Percentage of cells in each stage of the cell cycle	
Stage of the cell cycle	Tissue sample **C**	Tissue sample **D**
Interphase	82	45
Prophase	4	16
Metaphase	5	18
Anaphase	5	12
Telophase	4	9

9 (c) (i) In tissue sample **C**, one cell cycle took 30 hours. Use the data in **Table 4** to calculate the time in which these cells were in interphase during one cell cycle. Show your working.

[2 marks]

Time cells were in interphase _____hours

9 (c) (ii) Explain how the doctor could have recognised which cells were in interphase when looking at the tissue samples.

[1 mark]

_____

_____

_____

9 (c) (iii) Which tissue sample, **C** or **D**, was taken from a cancerous tumour?
Use information in **Table 4** to explain your answer.

[2 marks]

_____

_____

_____

_____

15

Turn over for the next question

10 Erythropoietin (EPO) is a substance produced in the body. It increases the production of red blood cells. Synthetic EPO is made artificially. It is used to treat patients who have a form of anaemia in which there is a reduced number of red blood cells.

Scientists investigated the effect of synthetic EPO on volunteers with this form of anaemia.

- The scientists injected synthetic EPO in a salt solution into patients in the experimental groups. They also set up control groups.
- They gave the different experimental groups different doses of synthetic EPO and different lengths of treatment.
- At the beginning and end of the treatment, the scientists measured each patient's haemoglobin concentration. From these measurements, they calculated the mean increase in haemoglobin concentration.

Some of the results are shown in **Table 5**.

Table 5

Number of volunteers	Length of treatment / weeks	Dose of synthetic EPO / units per kilogram per week	Mean increase in haemoglobin concentration / arbitrary units
58	8	85	19.0
18	8	170	26.0
40	12	150	12.5
82	12	450	34.2
46	24	120	23.0
53	24	240	31.0

10 (a) Explain why treatment with synthetic EPO affects the haemoglobin concentration in these volunteers.

[2 marks]

10 (b) Suggest how the control groups should have been treated in this investigation.

[2 marks]

10 (c) The scientists showed the dose of synthetic EPO in units per kilogram per week.

What information did the scientists need in order to calculate the dose for each volunteer?

[1 mark]

10 (d) Give **three** ways the information that the scientists collected might be useful in treating patients with anaemia.

[3 marks]

1

2

3

Question 10 continues on the next page

10 (e) Some athletes have used synthetic EPO as a performance enhancer.

Explain how synthetic EPO may improve performance in long-distance events.

[4 marks]

[Extra space]

10 (f) Athletes may be tested to see if the concentration of EPO in their blood is above normal.

Suggest how scientists determine the normal concentration of EPO in blood.

[2 marks]

10 (g) Synthetic EPO can increase blood pressure.

Suggest why.

[1 mark]

_____

_____

_____

15

END OF QUESTIONS

There are no questions printed on this page

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