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# Biology

**Unit: KBI0/4BI0**

**Paper: 2B**

Thursday 9 January 2014 – Afternoon

**Time: 1 hour**

Paper Reference

**KBI0/2B**  
**4BI0/2B**

**You must have:**

Calculator

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- **Fill in the boxes** at the top of this page with your name, centre number and candidate number.
- Answer **all** questions.
- Answer the questions in the spaces provided  
– *there may be more space than you need.*
- Show all the steps in any calculations and state the units.

## Information

- The total mark for this paper is 60.
- The marks for **each** question are shown in brackets  
– *use this as a guide as to how much time to spend on each question.*

## Advice

- Read each question carefully before you start to answer it.
- Keep an eye on the time.
- Write your answers neatly and in good English.
- Try to answer every question.
- Check your answers if you have time at the end.

Turn over ►

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**PEARSON**

**Answer ALL questions.**

- 1 Read the passage below. Use the information in the passage and your own knowledge to answer the questions that follow.

**Maggots and Wound Healing**

The photograph shows maggots eating dead tissue at a human wound.



At the beginning of the 20<sup>th</sup> century maggots were widely used to treat wounds. When penicillin started to be used in the 1940s, the use of maggots to treat infections by killing bacteria declined. However, the recent increase in infections caused by antibiotic resistant bacteria such as MRSA (methicillin resistant *Staphylococcus aureus*) is creating renewed interest in maggots.

5

The maggots used in hospitals to treat wounds are bred in a sterile environment. Green blowfly maggots are used as this species only digests dead tissue and does not burrow down into live flesh.

10

It is not fully understood how the maggots work but there are several theories. The first theory is that they produce an antibiotic in their gut called mirabilicide, which kills the bacteria they eat. A second theory is that the maggots secrete enzymes to break down dead tissue, and digest bacteria in the process. A third theory is that the maggots secrete ammonia as a waste product which changes the pH of the wound, making it unfavourable for bacteria to reproduce.

15

Using maggots to treat a wound also helps to speed up the production of new tissue. One hypothesis is that the wriggling movement of maggots acts as the stimulus, but there is little evidence to support this view. A more likely explanation is that the maggots, or their products, stimulate the body's immune system to kill bacteria in the wound and allow the healing process to occur.

20

Doctors have developed a 'maggot bag' for applying the maggots to wounds. The bags take longer to work than if the maggots are free to move in the wound, so are less useful if the wound needs to be treated quickly. It is expensive to use maggot bags because they cost much more than a typical wound dressing.



(a) (i) State what is meant by the term **antibiotic** (line 5).

(1)

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.....

(ii) Name two of the antibiotics mentioned in the passage.

(1)

1 .....

2 .....

(b) (i) Suggest why maggots are bred in a sterile environment (line 7).

(1)

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(ii) Why are green blowfly maggots chosen to treat wounds (line 8)?

(1)

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(c) Suggest the name of an enzyme used by maggots to digest bacteria (line 13).

(1)

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(d) Describe how the body's immune system kills bacteria (lines 19 and 20).

(4)

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(e) Give a disadvantage of using maggot bags to treat wounds (lines 22 to 24).

(1)

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(f) Use your knowledge of natural selection to explain why there has been an increase in the number of MRSA bacteria (line 5).

(4)

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**(Total for Question 1 = 14 marks)**



2 (a) What is meant by the term **gene**?

(2)

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(b) A gene is made from 1000 base pairs. The table shows the percentage of each base found in the gene.

(i) Complete the table by giving the name of the missing base.

(1)

| Percentage of base | Name of base |
|--------------------|--------------|
| 29                 | adenine      |
| 21                 |              |
| 29                 | thymine      |
| 21                 | cytosine     |

(ii) Calculate how many cytosine bases you would expect to find in this gene.

(1)

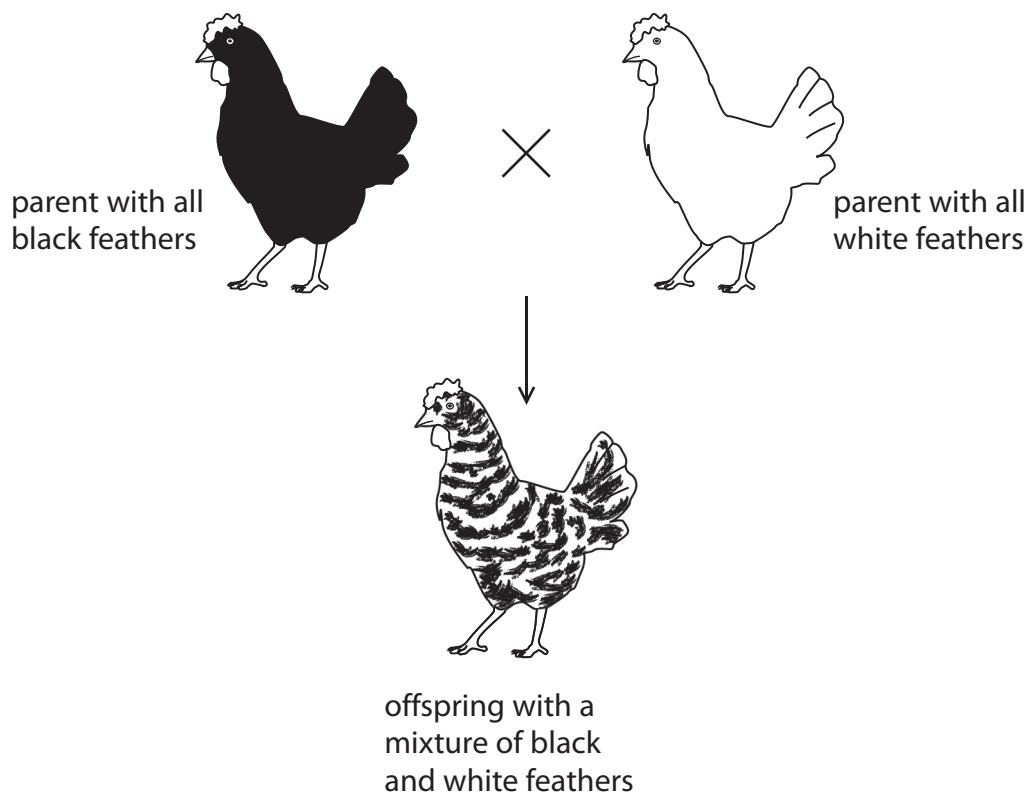
Answer .....



(c) The photograph shows a chicken with a mixture of black feathers and white feathers.



In chickens the inheritance of feather colour is controlled by codominant alleles. The allele for black feathers is  $C^B$ , and the allele for white feathers is  $C^W$ . The diagram shows a parent with all black feathers and a parent with all white feathers. It also shows one of their offspring with a mixture of black and white feathers.



(i) Complete the table by writing the genotype of the chickens shown in the diagram.

(1)

| Chicken  | Genotype |
|--|----------|
| parent with all black feathers                       |          |
| parent with all white feathers                       |          |
| offspring with a mixture of black and white feathers |          |

(ii) Two of the offspring with a mixture of black and white feathers mated. What is the probability that their offspring would also have a mixture of black and white feathers?

(1)

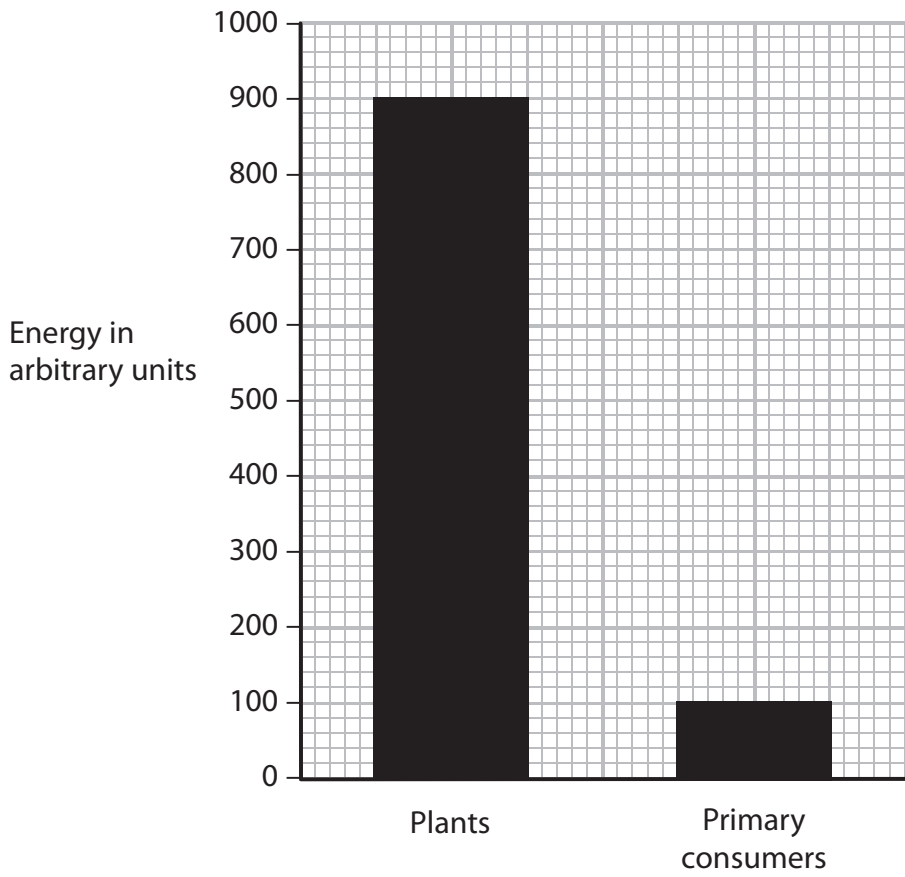
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**(Total for Question 2 = 6 marks)**

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3 The graph shows the units of energy in the plants and primary consumers in a food chain.



- (a) Not all the energy in the plants is transferred to the primary consumers.
  - (i) Calculate the percentage of energy in plants that is transferred to the primary consumers.

Show your working.

(2)

Answer ..... %

- (ii) One reason why energy is not transferred is because certain molecules in plants cannot be digested.

Give two other reasons why energy is not transferred.

(2)

1 .....

2 .....





(b) Primary consumers can digest the starch from plants.

Describe how starch is digested in humans.

(3)

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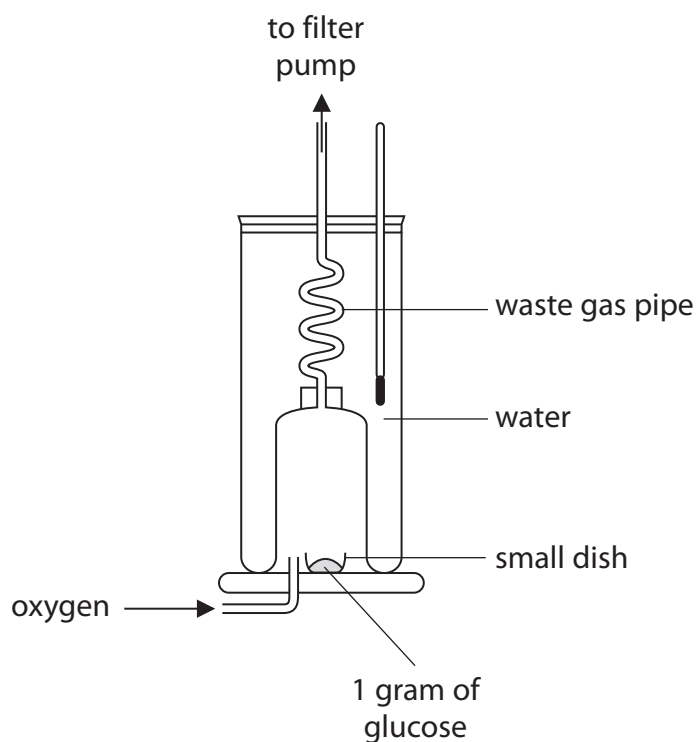
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**(Total for Question 3 = 7 marks)**



4 (a) The diagram shows a piece of apparatus called a calorimeter.



The calorimeter is used to investigate the energy content of one gram of glucose. The glucose burns in the calorimeter and the energy released heats the water.

(i) Suggest why oxygen gas is passed into the calorimeter.

(1)

(ii) Suggest why the waste gas pipe is coiled.

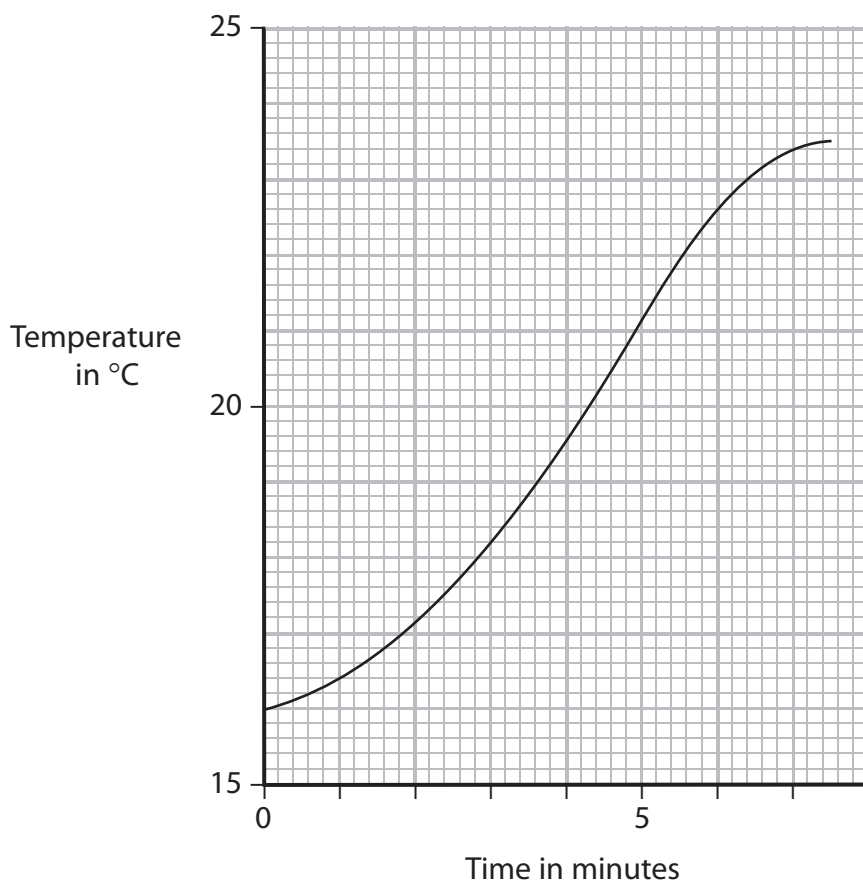
(2)

(iii) Suggest why stirring the water will improve the data collected.

(1)



(b) The calorimeter contains 200 g of water. The graph shows the rise in temperature of the water in the calorimeter during the investigation.



(i) Use the graph to find out the **increase** in the temperature of the water during the investigation.

(1)

..... °C

(ii) Use the formula to calculate the energy content of the 1 g of glucose.

$$\text{energy content in J per g} = \frac{\text{mass of water in g} \times \text{temperature increase in } ^\circ\text{C} \times 4.2}{\text{mass of food in g}}$$

(1)

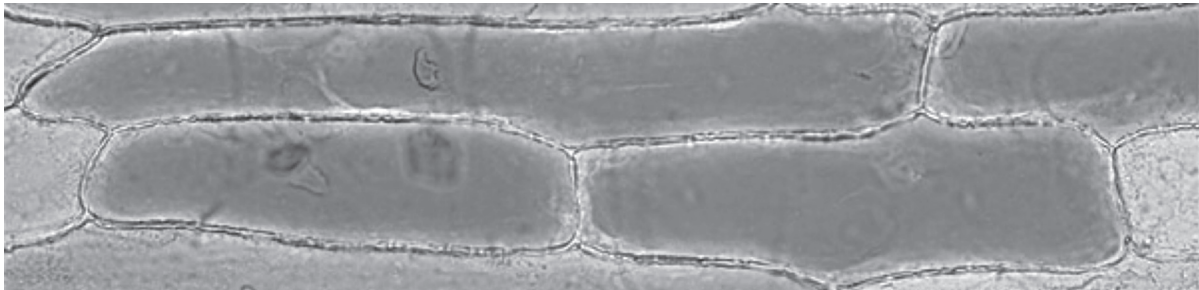
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**(Total for Question 4 = 6 marks)**

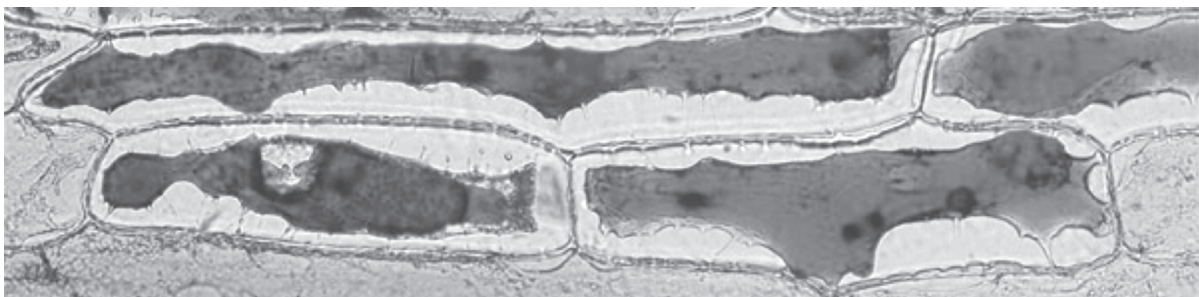


- 5 A student prepared some plant cells taken from an onion. She placed the cells in a few drops of distilled water. She then used a camera attached to a microscope to photograph the cells.

She then added a few drops of concentrated salt solution to the cells and waited a few minutes. She then took another photograph of the same cells.



**photograph of cells in distilled water**



**photograph of cells in concentrated salt solution**

- (a) Describe the differences in the appearance of the cells in concentrated salt solution compared with the cells in distilled water.

(2)

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- (b) The student thought that the differences in the cells were caused by osmosis.

What is meant by the term **osmosis**?

(2)

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(c) Explain what happens to the cells in concentrated salt solution to change their appearance.

(3)

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(d) Another student investigated the appearance of red blood cells in distilled water and in concentrated salt solution.

Use your knowledge of osmosis and the structure of red blood cells to describe and explain what the red blood cells would look like

(i) in distilled water

(2)

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(ii) in concentrated salt solution.

(2)

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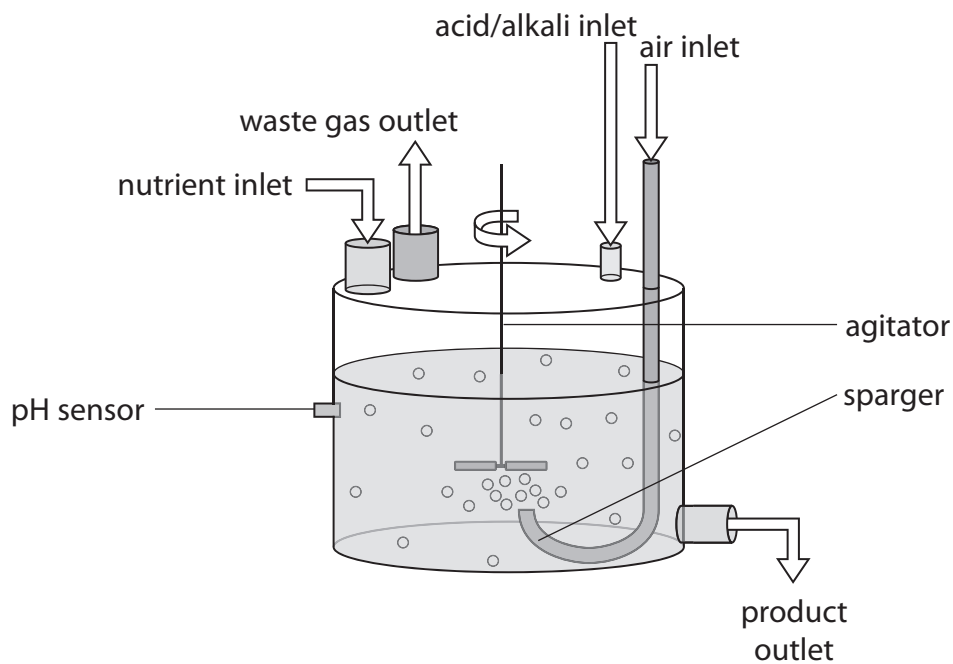
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**(Total for Question 5 = 11 marks)**



- 6 The diagram shows a model of an industrial fermenter used to study how changes in conditions can affect the yield of products.



- (a) An acid or alkali can flow through the acid/alkali inlet to maintain a constant pH within the fermenter.

Explain why the pH needs to be kept within a narrow range.

(3)

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(b) Parts of the fermenter responsible for regulating the temperature are not shown in the diagram.

Name two of these parts.

(2)

1 .....

2 .....

(c) This fermenter uses a sparger to introduce air into the fermenter.

Suggest why it is important to introduce air into the fermenter.

(2)

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(d) Before being used the empty fermenter is cleaned using steam.

Suggest why.

(2)

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**(Total for Question 6 = 9 marks)**

**QUESTION 7 STARTS ON THE NEXT PAGE**



7 The passage describes water pollution caused by untreated human sewage and by fertiliser. Complete the passage by writing a suitable word or words in each of the spaces.

(7)

If sewage gets into fresh water it will increase the number of pathogenic

..... in the water. The sewage contains waste organic material in the

form of ..... from humans. Microorganisms break down this material

using a process called aerobic ..... . This process reduces the level of

..... in the water making it less likely for larger organisms to survive.

Fertilisers can get into water by a process called ..... . The minerals

present in the fertiliser such as ..... cause the rapid growth of

..... in the water.

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**(Total for Question 7 = 7 marks)**

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**TOTAL FOR PAPER = 60 MARKS**

