



# HUA YI SECONDARY SCHOOL

## PRELIMINARY EXAM 2024

# 4-G3

NAME

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CLASS

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INDEX  
NUMBER

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### BIOLOGY

### PAPER 3

6093/03

27 August 2024

1 hour 50 mins

Additional Materials: Nil

### READ THESE INSTRUCTIONS FIRST

Write your Name, Class, and Index Number on all the work you hand in.  
Write in dark blue or black pen.  
You may use an HB pencil for any diagrams, graphs or rough working.  
The use of an approved scientific calculator is expected, where appropriate.  
Do not use staples, paper clips, highlighters, glue, or correction fluid.

Answer **all** questions.

The number of marks is given in brackets [ ] at the end of each question or part question.

The use of an approved scientific calculator is expected, where appropriate.

You may lose marks if you do not show your working or if you do not use appropriate units.

|            |
|------------|
| Shift      |
|            |
| Laboratory |
|            |

Total

40

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Setter: Mr Edwin Khoo

[Turn Over

**You are advised to read the whole question before you start.**

- 1 Fig. 1.1 shows an African elephant. African elephants do not sweat and do not pant. Under the savanna sun, one main cooling mechanism for African elephants occurs through their large ear.



**Fig. 1.1**

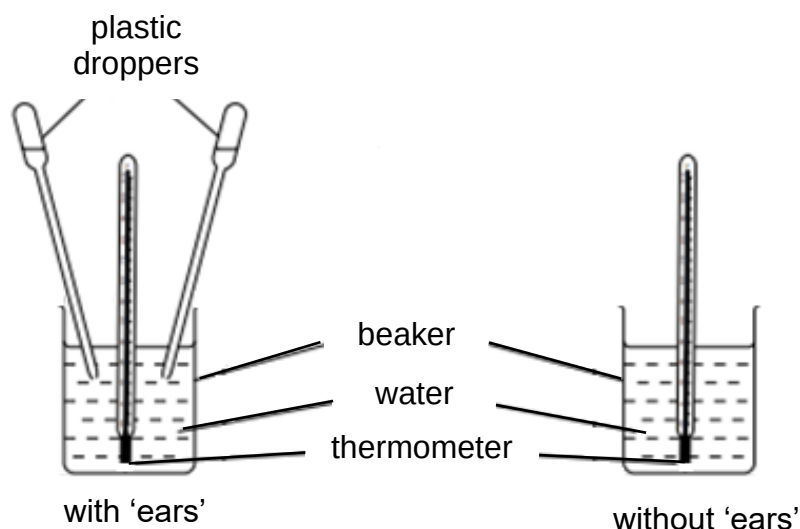
Blood flow to the elephant's ears is changed in response to its body temperature, similar to the way that blood flow towards the skin of a human is changed during thermoregulation.

You will investigate how this cooling mechanism affects the rate of heat loss. The ears of the elephant are represented by two plastic droppers.

Step 1 Set up the apparatus as shown in Fig. 1.2 using the glass beaker provided.

Step 2 Collect 200 cm<sup>3</sup> of hot water in the glass beaker.

Step 3 Measure and record the initial temperature of the water in the beaker.



**Fig. 1.2**

**Fig. 1.3**

Step 4 Start the stopwatch.

Step 5 Begin to squeeze and release the droppers so that they are emptied and filled with hot water. Continue to do this throughout the experiment.

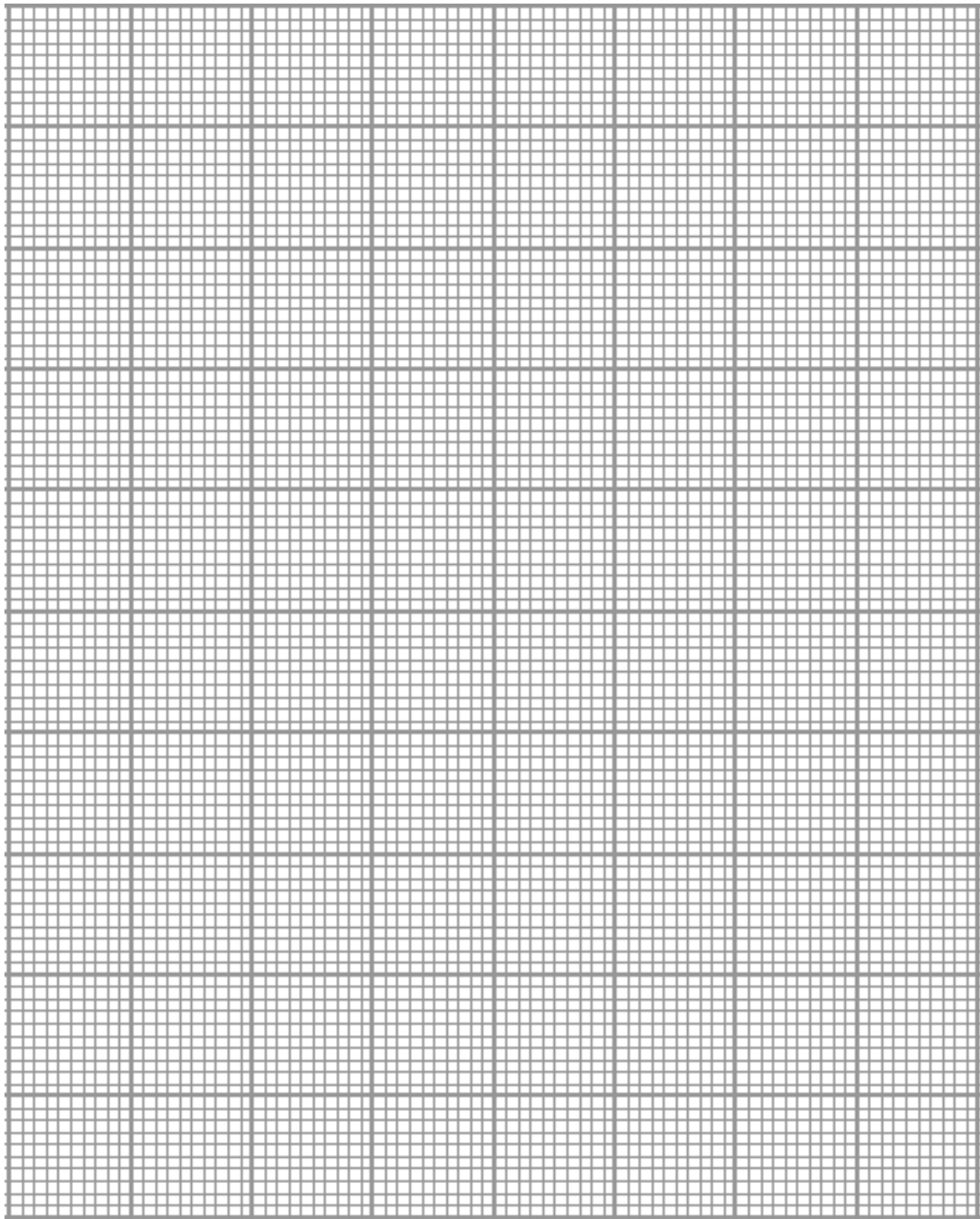
Step 6 Measure and record in **(a)** the temperature of the water in the beaker every minute for a total of eight minutes.

Step 7 Repeat Steps 1 to 6 for the beaker without ears by setting up the apparatus as shown in Fig. 1.3.

**(a)** Record your results in a table.

[3]

- (b)** Plot a graph to show how the temperature of each set up changed over time. Draw lines of best fit for your graph.



[4]

- (c) (i)** Suggest what the gradient of the graph represents.

..... [1]

- (ii)** Using the graph in **(b)**, comment on the effectiveness of the droppers as a cooling mechanism.

.....

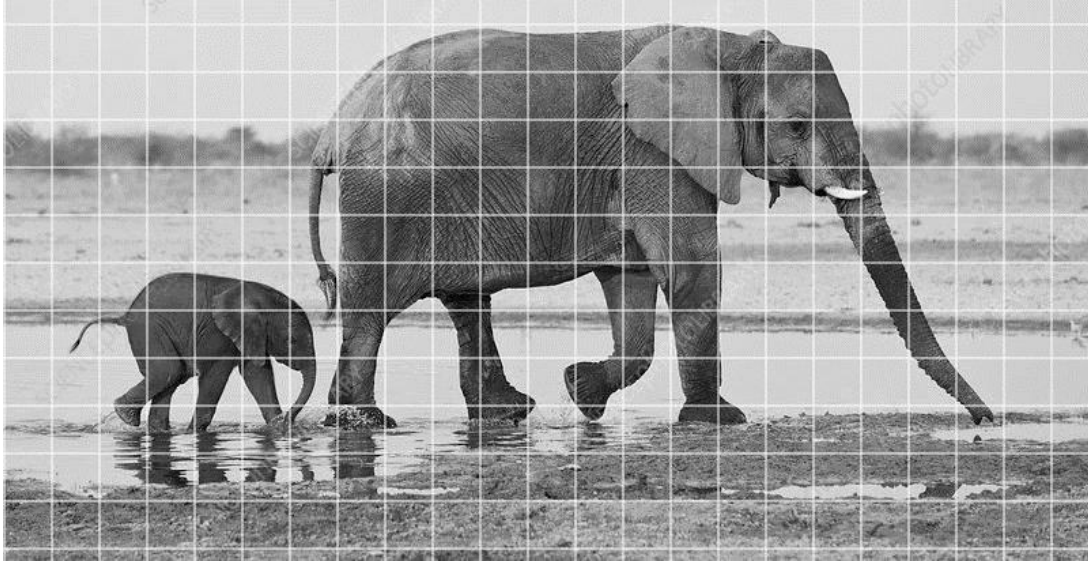
.....

..... [2]

- (d) Suggest how this experiment may **not** accurately reflect how elephants lose heat through their ears.

.....  
 ..... [1]

- (e) Fig.1.4 is a picture of an adult elephant with a juvenile elephant.



**Fig. 1.4**

- (i) Using the grid provided, estimate the area of the ear of the juvenile and the adult.

*Assume the area of one square to be 1 unit<sup>2</sup>.*

ear area (juvenile): ..... unit<sup>2</sup>

ear area (adult): ..... unit<sup>2</sup> [1]

- (ii) Using the grid provided, estimate the area of the entire juvenile and adult elephant.

*Assume the area of one square to be 1 unit<sup>2</sup>.*

ear area (juvenile): ..... unit<sup>2</sup>

ear area (adult): ..... unit<sup>2</sup> [1]

- (iii) Express the proportion of ear area to body area as a percentage for the juvenile and adult elephant.

percentage of ear to body area (juvenile): ..... %

percentage of ear to body area (adult): ..... % [1]

- (iv)** Using the information in **(iii)**, predict the ability of the juvenile elephant to cool down its body as compared to the adult elephant.

..... [1]

- (v)** Make modifications to the experiment shown in Fig. 1.1 and 1.2 so that it can test the prediction that you made in **(f)(iv)**.

Clearly show how it can test your prediction.

.....

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[Total: 25]

- 2 Aquatic plants live in water and exchange gases with the water around them.

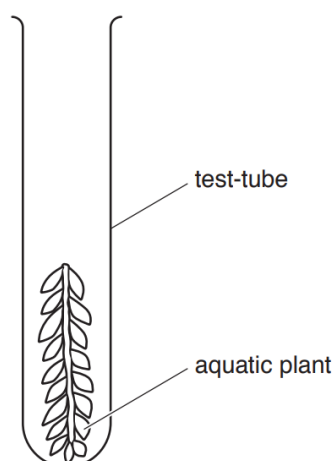
When carbon dioxide dissolves in water, the solution becomes more acidic.

Hydrogencarbonate indicator (bicarbonate indicator) can be used to detect changes in the pH of a solution. It changes colour as follows:

**most acidic** ←————→ **most alkaline**  
 yellow                      red                      purple

You will be investigating the gas exchange of two pieces of an aquatic plant using hydrogencarbonate indicator.

- Step 1 Add 5 cm<sup>3</sup> of hydrogencarbonate indicator into a measuring cylinder.
- Step 2 Add 30 cm<sup>3</sup> of distilled water into the measuring cylinder. Stir the solution with the glass rod. The resulting solution is the dilute hydrogencarbonate indicator that will be used for the experiment.



**Fig. 2.1**

- Step 3 Place one piece of the plant in a test tube and carefully push it down so that one end touches the bottom of the test tube as shown in the Fig. 2.1. Label this test tube **A**.
- Step 4 Pour the dilute hydrogencarbonate indicator prepared in Step 2 into test tube **A**. Ensure that the plant is completely submerged in the indicator. Record the volume of indicator added into test tube **A**.
- volume of indicator added = ..... cm<sup>3</sup>
- Step 5 Place the second piece of plant in another test tube and carefully push it down so that one end touches the bottom of the test tube. Label this test tube **B**.
- Step 6 Add the same volume of indicator that you added to test tube **A**, ensuring the plant is completely submerged.
- Step 7 Wrap aluminium foil around test tube **B** completely to prevent any light from entering.

- Step 8 Place both test tubes together on a test tube rack, approximately 10 cm away from a lamp. Turn on the lamp and start the stopwatch.
- Step 9 Leave test tubes **A** and **B** for 30 minutes.
- Step 10 Set up a control by adding the same volume of hydrogencarbonate indicator into test tube **C**. Place test tube **C** on the test tube rack.
- Step 11 At the end of 30 minutes, decant the indicator solutions in **A** and **B** into clean test tubes. Record observations of the colour of the indicator in these two test tubes in Table 2.1.
- (a) Record your results for test tube **A** and **B** in Table 2.1.

Table 2.1

| test tube | initial colour of hydrogen carbonate indicator | final colour of hydrogen carbonate indicator |
|-----------|------------------------------------------------|----------------------------------------------|
| <b>A</b>  |                                                |                                              |
| <b>B</b>  |                                                |                                              |

[1]

- (b) Explain the difference in results for test tubes **A** and **B**.

.....

.....

..... [2]

- (c) State **one** source of error and suggest a possible improvement to the method used in the investigation.

source of error .....

.....

improvement .....

..... [2]

[Total: 5]

- 3** Antibiotics are medicines used to prevent and treat bacterial infections. Antibiotic resistance occurs when populations of bacteria change in response to the use of these medicines. Bacteria, not humans or animals, become antibiotic-resistant, and the infections they cause are harder to treat than those caused by non-resistant bacteria.

When a patient misses a dose of antibiotics, it can lead to higher chances of antibiotic-resistant bacteria being present.

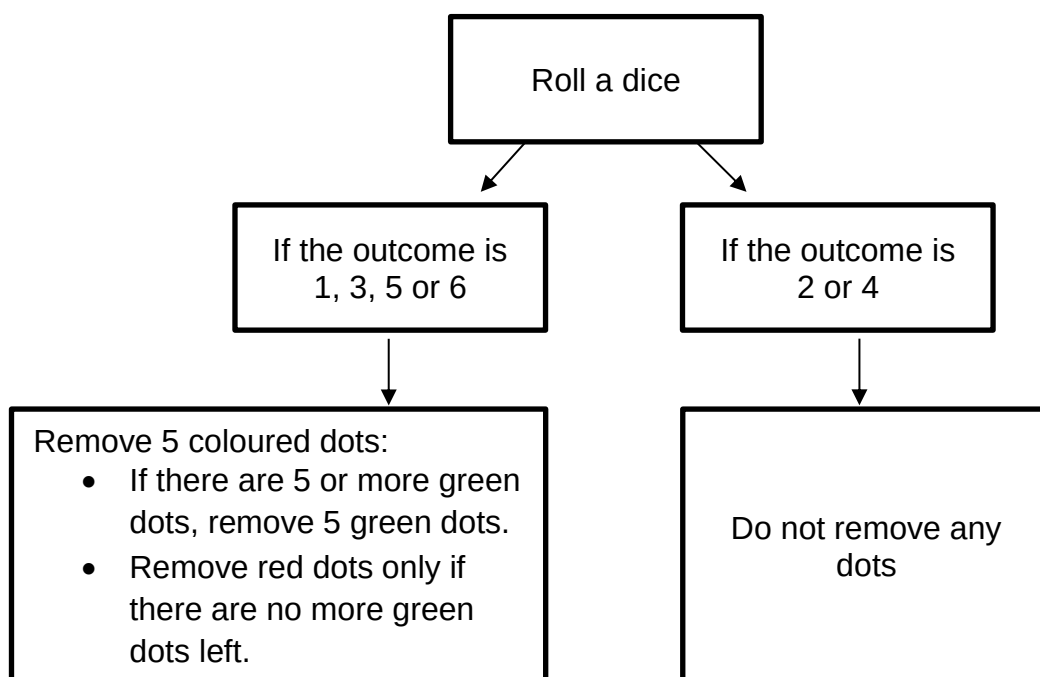
A person is having a bacterial infection. The doctor prescribed antibiotics for him. In this experiment, you will simulate the two days after the doctor gave him antibiotics. You will observe how consuming, or not consuming antibiotics, can lead to the survival of bacteria, and how antibiotic resistance could develop.

You are given the following:

- 1 dice
- 30 dots of coloured paper (20 green and 10 red)
- Petri dish labelled 'P'

Refer to the following procedure to begin your stimulation.

- Step 1** Place 8 green dots and 2 red dots into the petri dish labelled 'P'. The dots represent bacteria numbers.
- Step 2** For the first round, roll the dice and record the result in Table 3.1.
- Step 3** Removal: With the result from Step 2, remove the coloured dots according to the instructions given in Fig. 3.1.



**Fig. 3.1**

- Step 4** Record the number of coloured dots for each colour in Table 3.1 after the removal.

Step 5 Addition: Double the number of red and green dots in the petri dish. Record the number of coloured dots for each colour in Table 3.1 after the addition. This is the end of the first round.

Step 6 Repeat steps 2-5 for the second round.

(a) (i) Complete the remaining columns in Table 3.1.

**Table 3.1**

| round | outcome of dice | bacteria count after removal |     | total number of bacteria | bacterial count after addition |     | new total number of bacteria |
|-------|-----------------|------------------------------|-----|--------------------------|--------------------------------|-----|------------------------------|
|       |                 | green                        | red |                          | green                          | red |                              |
| 1     |                 |                              |     |                          |                                |     |                              |
| 2     |                 |                              |     |                          |                                |     |                              |

[2]

(ii) Using Table 3.1, calculate the percentage change in the total number of bacteria at the end of the experiment.

[2]

(b) Suggest what the dice outcomes '2' and '4' represent.

..... [1]

(c) The red and green dots represent the same species of bacteria.

Suggest the difference between the red and green type of bacteria. Explain your answer.

.....  
 ..... [2]

(d) (i) Predict the results of the simulation if seven rounds of dice roll are carried out instead of two.

..... [1]

(ii) Hence, explain why patients should complete the course of antibiotics even when they are feeling better.

..... [1]

- (e) Fig. 3.2 shows a micrograph of blood smear from an individual infected with *Bacillus anthracis*, a disease-causing bacteria. One of the bacterial cells is labelled X.

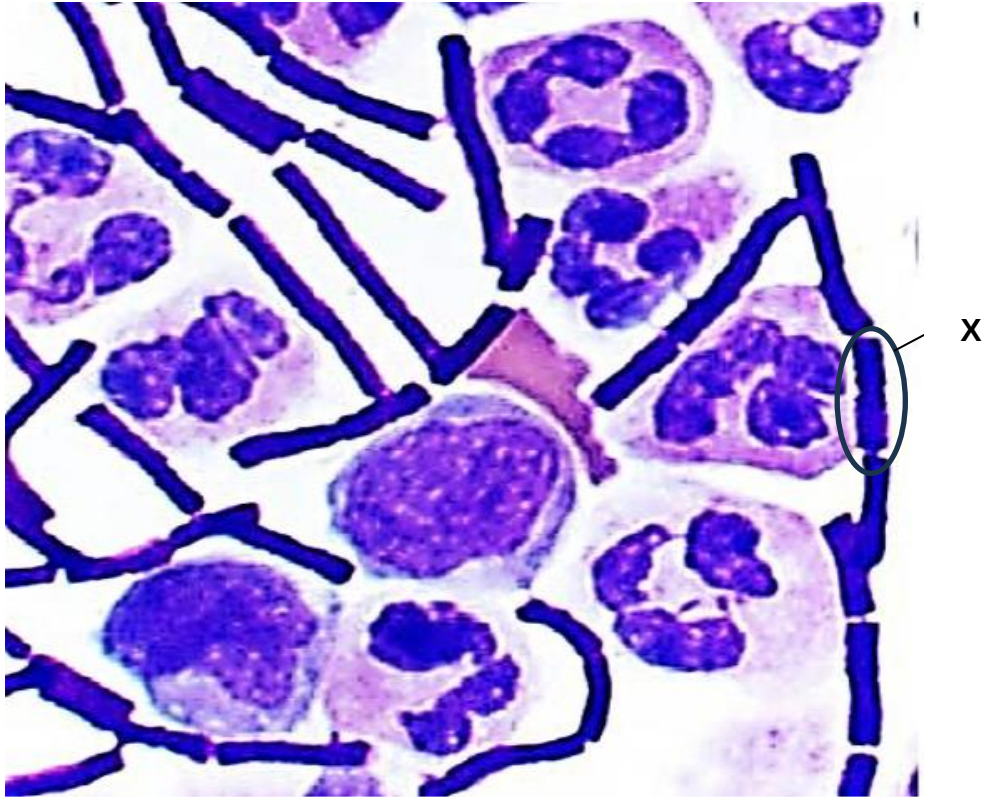


Fig. 3.2

- (i) Make a drawing of this bacterial cell (X) and the other cells in contact with it. Show the shape, as well as details of the cells (if any).

[3]

- (ii) Measure the length of the *Bacillus anthracis* labelled X in Fig. 3.2.

length = ..... mm [1]

- (iii) The actual length of **X** is 0.0005 cm.

Calculate the magnification of the length of **X** in Fig. 3.2. Give your answer as a whole number.

magnification = ..... [2]

[Total: 15]

**END OF PAPER**