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| Candidate surname | Other names |
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Centre Number | Candidate Number

# Pearson Edexcel International GCSE (9–1)

## Tuesday 16 May 2023

Morning (Time: 2 hours)

**Paper reference** **4BI1/1B 4SD0/1B**

# Biology

**UNIT: 4BI1**

**Science (Double Award) 4BI1/4SD0**

**PAPER: 1B**

**You must have:**
Ruler, calculator

Total Marks

## Instructions

- Use **black** ink or ball-point pen.
- If pencil is used for diagrams/sketches/graphs it must be dark (HB or B).
- **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.*

## Information

- The total mark for this paper is 110.
- 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.
- Try to answer every question.
- Check your answers if you have time at the end.

*Turn over* ▶

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**Answer ALL questions.**

**Some questions must be answered with a cross in a box ☒. If you change your mind a an answer, put a line through the box ☒ and then mark your new answer with a cross ☒**

**1** (a) All living organisms share characteristics.

(i) State two characteristics that all living organisms share.

**(2)**

1 .....

.....

2 .....

(ii) Some organisms are pathogens.

Which of these organisms can cause a bacterial disease in humans?

**(1)**

☒ **A** *Chlorella*

☒ **B** *Lactobacillus bulgaricus*

☒ **C** *Mucor*

☒ **D** *Pneumococcus*

(b) Viruses are pathogens but not living organisms.

(i) Describe the effect of a named virus that infects plants.

**(2)**

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(ii) Give three differences between the structure of viruses and bacteria.

1 .....

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3 .....

**(Total for Question 1 = 8 marks)**

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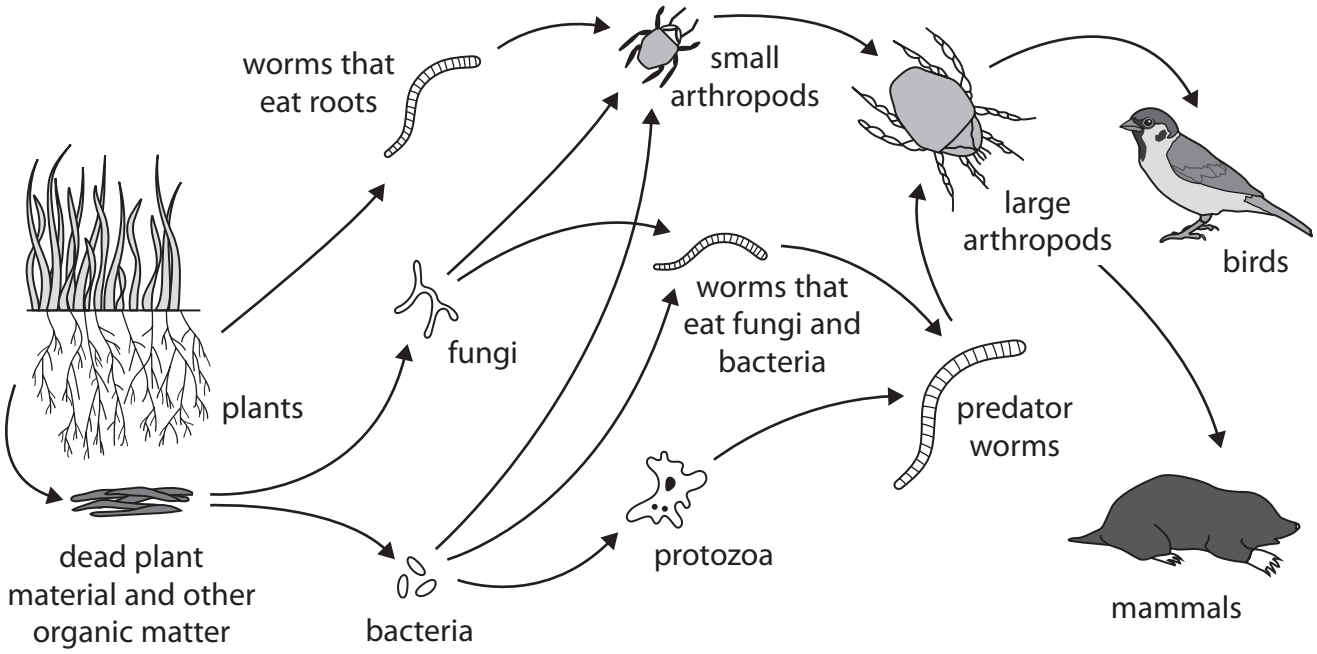
**2** The diagram shows part of a food web from an ecosystem.




(a) (i) Using the information in the food web, draw a food chain that contains five trophic levels and includes the birds.

**(2)**

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(ii) Describe how the bacteria and fungi obtain energy from the organic matte

(b) A pesticide gets into this ecosystem.

The pesticide kills small and large arthropods.

Explain how this affects the population of birds and the population of worms that eat roots.

**(3)**

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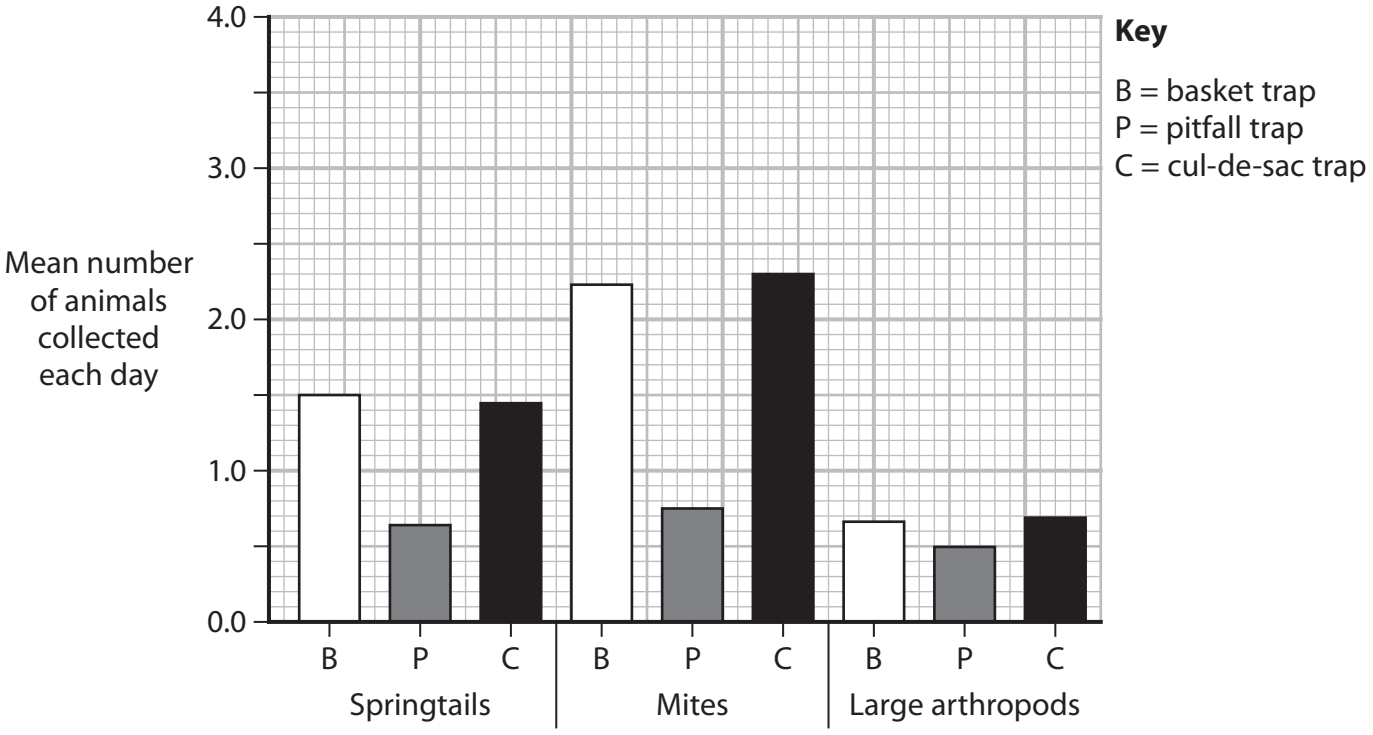
(c) Scientists use three different traps to collect some soil animals.

These traps are a basket trap, a pitfall trap, and a cul-de-sac trap.

The number of animals collected by each trap are counted each day.

The animals collected are classified into three types: springtails, mites and large arthropods.

The graph shows the scientists' results.

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Discuss the number of each animal type collected by the three traps.

Refer to the scientists' results in your answer.

**(5)**

**(Total for Question 2 = 13 marks)**

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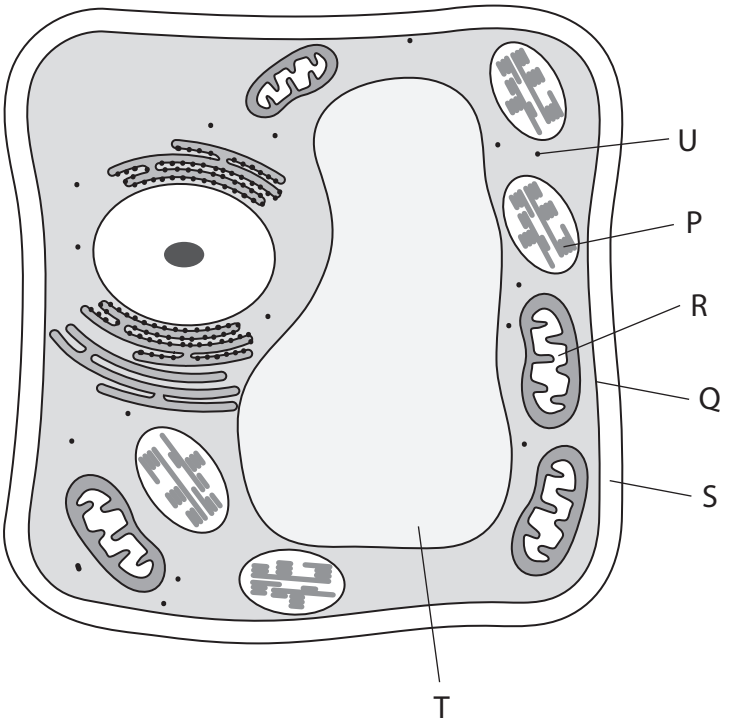
**3** The diagram shows a plant cell with some structures labelled.




(a) (i) Which structure is the cell vacuole?

**(1)**

- ☒ **A** P
- ☒ **B** R
- ☒ **C** S
- ☒ **D** T

(ii) Which structure is the site of photosynthesis?

**(1)**

- ☒ **A** P
- ☒ **B** Q
- ☒ **C** R
- ☒ **D** T

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(iii) Which structure is the cell wall?

- ☒ **A** P
- ☒ **B** Q
- ☒ **C** S
- ☒ **D** T

(iv) Structure U is the site of protein synthesis in the cell.

What is the name of structure U?

**(1)**

- ☒ **A** chloroplast
- ☒ **B** mitochondrion
- ☒ **C** ribosome
- ☒ **D** starch granule

(b) A cell is shaped like a cube.

Each side has a length of 0.053 mm.

Calculate the surface area to volume ratio of this cell.

Give your answer in the form n : 1

**(3)**

surface area to volume ratio = ..... : 1

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(c) Animal cells, unlike plant cells, do not have a cell wall.

(i) Explain how this difference affects red blood cells when placed in distilled water.

**(3)**

(ii) Explain how this difference affects red blood cells when placed in a concentrated salt solution.

**(2)**

**(Total for Question 3 = 12 marks)**

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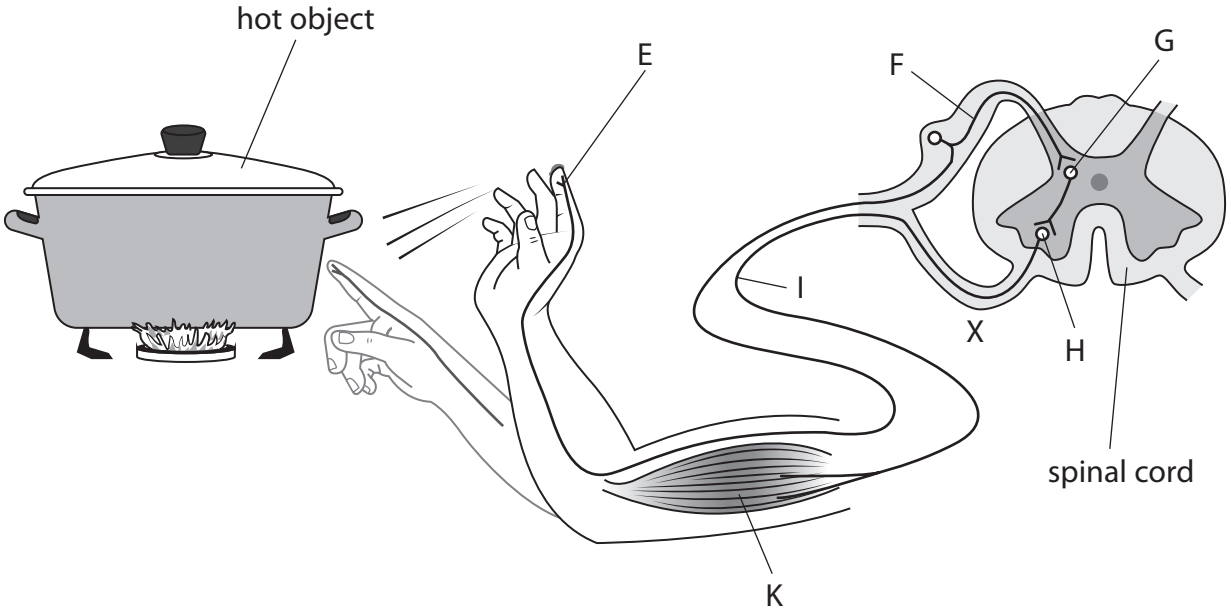
**4** The diagram shows a human reflex response to touching a hot object.

Some of the structures in the reflex arc are labelled.




(a) (i) Give the name of this reflex response.

**(1)**

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(ii) Draw an arrow on the diagram to show the direction of the nerve impulse at point X.

**(1)**

(iii) Which structure detects the stimulus?

**(1)**

- ☒ **A** E
- ☒ **B** F
- ☒ **C** H
- ☒ **D** K

(iv) Which structure is the motor neurone?

**(1)**

- ☒ **A** F
- ☒ **B** G
- ☒ **C** I
- ☒ **D** K

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(b) (i) A neurone is 1.10 m in length.

The speed of the nerve impulse in this neurone is 120 metres per second.

Calculate the time, in seconds, for the impulse to pass along the neurone.

Give your answer in standard form.

**(2)**

time ..... s

(ii) Describe how the impulse passes from neurone to neurone in the reflex arc.

**(2)**

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(c) Pain has a survival function.

If a person damages their ankle, they sense pain.

(i) Explain how sensing pain benefits an organism.

**(2)**

(ii) Some medicines are used to reduce pain.

These medicines work by preventing communication between the injured ankle and the brain.

Explain which components of the nervous system may be affected by these medicines.

**(4)**

**(Total for Question 4 = 14 marks)**

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**5** Red blood cells and white blood cells are two of the components found in human blood.

(a) State two other components of blood.

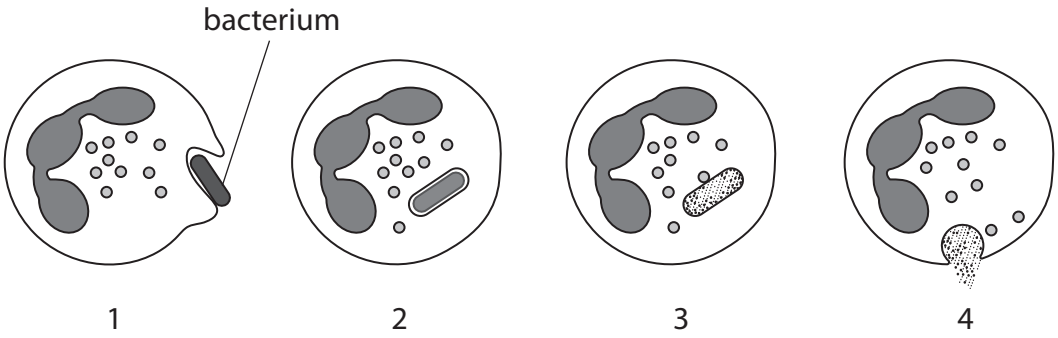
**(2)**

1 .....

2 .....

(b) Some white blood cells destroy pathogens.

The diagram shows four stages in this process.




Describe what is happening in each stage of this process.

**(4)**

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(c) The picture shows a human red blood cell.



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(i) The actual diameter of this human red blood cell is 8.1 μm.

Determine the magnification of the picture.

[1 mm = 1000 μm]

**(3)**

magnification = .....

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(ii) Patients with reduced numbers of red blood cells are described as anaemic

In an investigation, scientists measure the percentage oxygen saturation of the blood and the rate of tissue deoxygenation. The rate of tissue deoxygenation is a measure of how fast oxygen is lost from the tissues.

They use four groups of patients.

- non-anaemic patients with normal blood flow
- anaemic patients with normal blood flow
- non-anaemic patients with slow blood flow
- anaemic patients with slow blood flow

The table shows the scientists' results.

| | **Patient Group** | | | |
|---|---|---|---|---|
| | **normal blood flow** | | **slow blood flow** | |
| | **non-anaemic** | **anaemic** | **non-anaemic** | **anaemic** |
| **Number of patients** | 251 | 30 | 48 | 10 |
| **Mean percentage oxygen saturation of blood (%)** | 81 | 76 | 77 | 68 |
| **Mean rate of tissue deoxygenation in percentage per minute** | 17 | 20 | 15 | 17 |

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Discuss the relationships between anaemia, blood flow, percentage oxyge saturation of blood and rate of tissue deoxygenation.

You should refer to data in the table and use your biological knowledge in your answer.

**(5)**

**(Total for Question 5 = 14 marks)**

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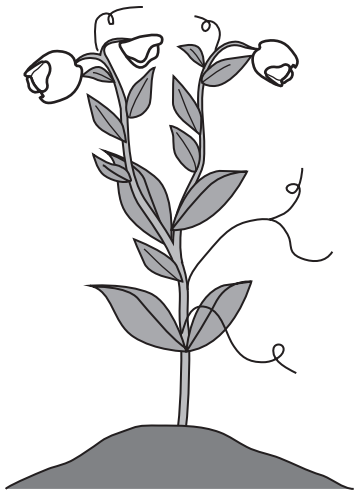
**6** Many characteristics of pea plants are genetically controlled.

One of these characteristics is flower position.

Flower position can either be axial or terminal.



Axial



Terminal

In a first cross, scientists crossed pea plants with axial flowers with pea plants with terminal flowers.

This first cross produced 1120 offspring plants.

All of these offspring plants had axial flowers.

(a) Use a genetic diagram to show the genotypes of the parent plants, the gametes they produce and the genotypes of the offspring plants.

**(3)**

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(b) The scientists allowed the offspring from the first cross to self-fertilise.

This second cross produced 858 second generation plants. 608 of the plants had axial flowers and the other plants had terminal flowers.

(i) Calculate the ratio of plants with axial flowers to plants with terminal flowers.

Give your answer in the form n : 1

**(2)**

ratio = ..... : 1

(ii) Explain why the ratio of plants with axial flowers to plants with terminal flowers is different from the expected ratio.

**(3)**

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(c) Scientists want to discover if plants with axial flowers produce more seeds tha plants with terminal flowers.

Design an investigation to discover whether plants with axial flowers produce more seeds than plants with terminal flowers.

Include experimental details in your answer and write in full sentences.

**(6)**

**(Total for Question 6 = 14 marks)**

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**7** Lipase digests lipid into fatty acids and glycerol. The fatty acids change the pH of the solution.

A student uses this method to investigate the effect of temperature on the activity of lipase.

**Step 1** label a test tube with the temperature (20 °C)

**Step 2** add 5 drops of phenolphthalein indicator to the test tube

**Step 3** add 5 $cm^3$ of milk to the test tube

**Step 4** add 7 $cm^3$ of sodium carbonate solution to the test tube (the contents of the test tube will now be pink)

**Step 5** place a thermometer in the test tube

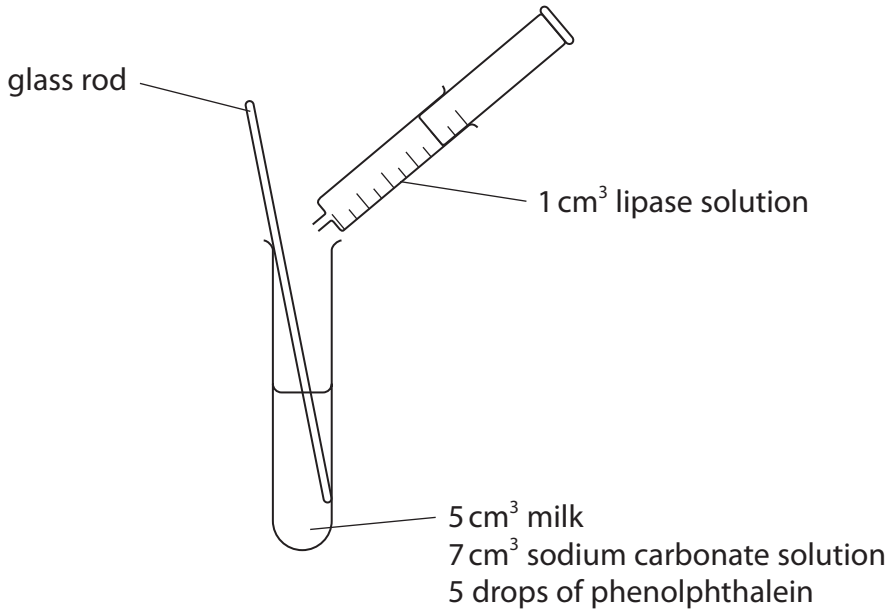
**Step 6** place the test tube in a water bath at 20 °C for 5 minutes

**Step 7** place a beaker containing lipase in the same water bath for 5 minutes

**Step 8** replace the thermometer with a glass rod

**Step 9** measure out 1 $cm^3$ of lipase from the beaker in the water bath

**Step 10** add the lipase to the test tube, stir the contents and record the time until the contents lose their pink colour




The student repeats this method for five more temperatures, 25 °C, 30 °C, 35 °C, 40 °C and 45 °C.

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(a) State why the student leaves the test tube and the beaker in the water bath fo 5 minutes in steps 6 and 7.

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(b) (i) Give the dependent variable in this investigation.

**(1)**

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(ii) State one variable the student controls in their investigation.

**(1)**

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(c) Suggest the purpose of the phenolphthalein indicator in the investigation.

**(1)**

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(d) The table shows the student's results.

| Temperature in °C | Time taken for contents to lose the pink colour in seconds |
|---|---|
| 20 | 385 |
| 25 | 340 |
| 30 | 300 |
| 35 | 250 |
| 40 | 275 |
| 45 | 360 |

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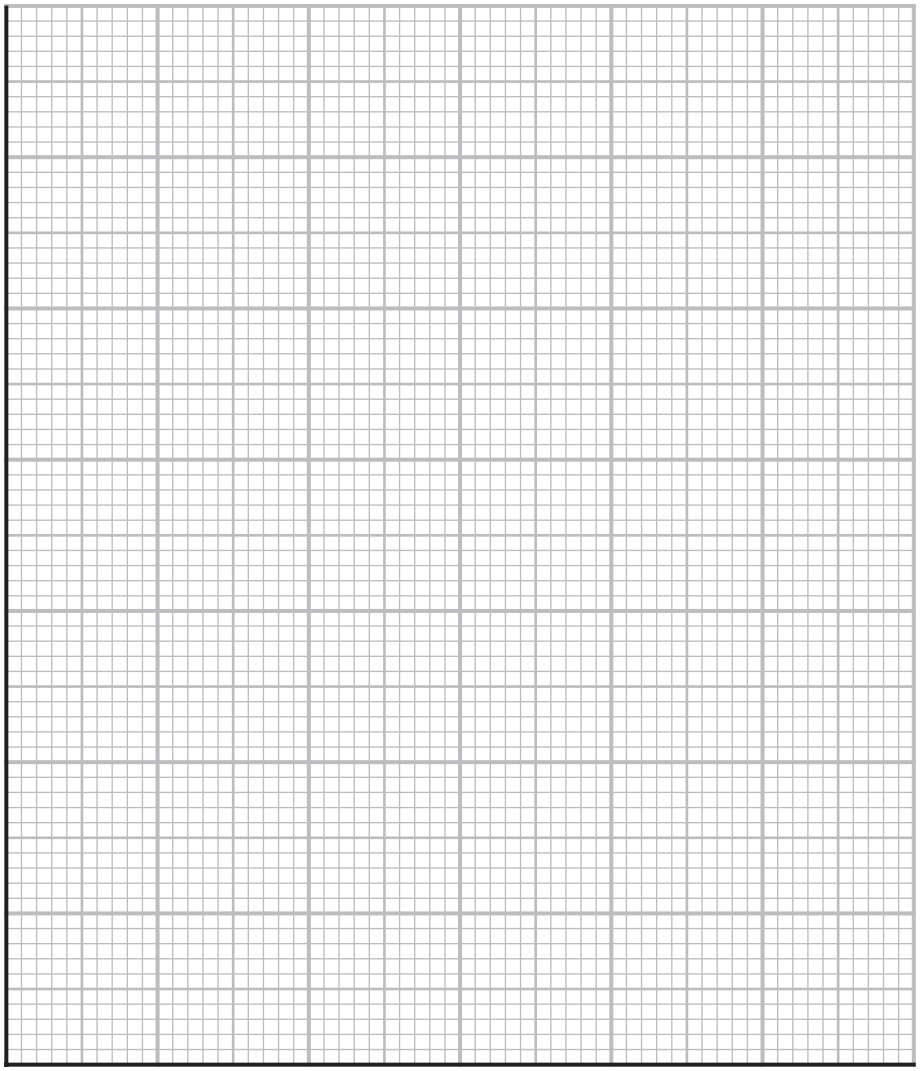
Plot a line graph to show the effect of temperature on the time taken for the contents of the test tube to lose the pink colour.

Use a ruler to join your points with straight lines.

**(5)**



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(e) Explain why increasing temperature affects the time taken for the contents of t test tube to lose the pink colour.

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**(Total for Question 7 = 13 marks)**

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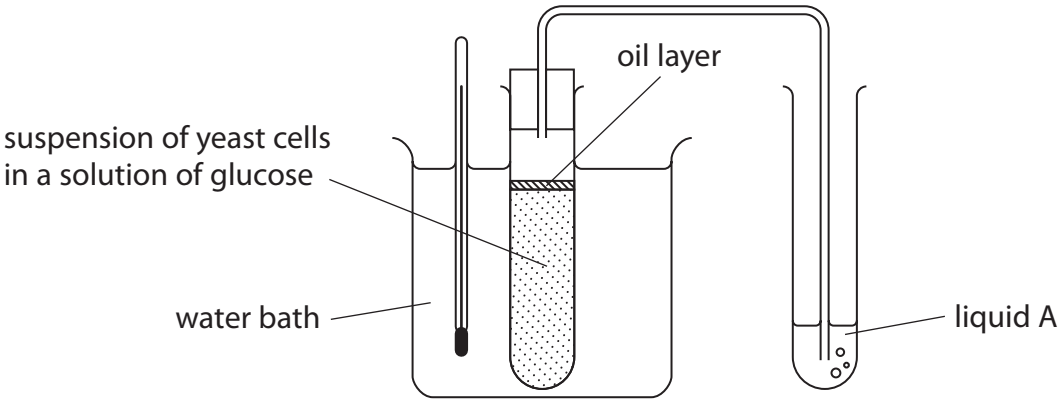
**8** Yeast can be used in experiments to investigate the effect of different concentratio of glucose solution on the rate of anaerobic respiration.

The diagram shows apparatus used to measure the rate of anaerobic respiration in yeast.




(a) Give the function of the water bath.

**(1)**

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(b) Liquid A can be used to identify the gas released during anaerobic respiration by the yeast.

Explain which substance can be used as liquid A.

**(2)**

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(c) A student wants to accurately measure the rate of anaerobic respiration in yeast using this apparatus.

State what additional apparatus they would require.

**(1)**

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(d) The process of anaerobic respiration is sometimes referred to as fermentation.

Industrial fermenters are used to grow microorganisms. These microorganisms produce penicillin, an antibiotic that is used to treat bacterial infections.

(i) Explain how named conditions in an industrial fermenter are controlled.

**(4)**

(ii) Some antibiotics are becoming less effective at controlling bacterial infections.

Explain how bacteria have evolved so that antibiotics are less effective.

**(4)**

**(Total for Question 8 = 12 marks)**

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**9** Genetically modified bacteria are used to produce the hormone insulin.

(a) Explain how these genetically modified bacteria are produced.

**(4)**

(b) Explain the role of insulin in the human body.

**(2)**

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(c) Some people are unable to produce insulin.

This condition is called diabetes mellitus.

People with diabetes mellitus control the condition by using insulin injections, controlling their diet, and monitoring how much they exercise.

(i) Explain why the insulin is injected rather than taken by mouth.

**(2)**

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(ii) State why people with diabetes mellitus need to monitor how much they exercise.

**(1)**

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(iii) State how people with diabetes mellitus may need to modify their diet compared with people who do not have diabetes mellitus.

**(1)**

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**(Total for Question 9 = 10 marks)**

**TOTAL FOR PAPER = 110 MARKS**

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