



CANDIDATE
NAME

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CENTRE
NUMBER

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CANDIDATE
NUMBER

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0653/62

February/March 2021

1 hour

No additional materials are needed.

- Answer **all** questions.
- Use a black or dark blue pen. You may use an HB pencil for any diagrams or graphs.
- Write your name, centre number and candidate number in the boxes at the top of the page.
- Write your answer to each question in the space provided.
- Do **not** use an erasable pen or correction fluid.
- Do **not** write on any bar codes.
- You may use a calculator.
- You should show all your working and use appropriate units.

- The total mark for this paper is 40.
- The number of marks for each question or part question is shown in brackets [].

This document has **16** pages. Any blank pages are indicated.

- 1 A student investigates the rate of respiration in yeast cells. Yeast is a single-celled organism similar to plant and animal cells.

The student is provided with a yeast suspension and some yeast suspension that has been boiled.

As yeast cells respire they produce carbon dioxide gas.

- (a) Describe the observation that shows that a gas is made in a liquid.

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

- (b) The student does the following procedure:

Step 1 puts 1 cm³ **distilled water** into a test-tube labelled **A**

Step 2 fills test-tube **A** to the top with yeast suspension

Step 3 puts 1 cm³ **5% glucose** solution into a test-tube labelled **B**

Step 4 fills test-tube **B** to the top with yeast suspension

Step 5 puts 1 cm³ **5% glucose** solution into a test-tube labelled **C**

Step 6 fills test-tube **C** to the top with **boiled** yeast suspension

Fig. 1.1 shows the filled test-tubes.

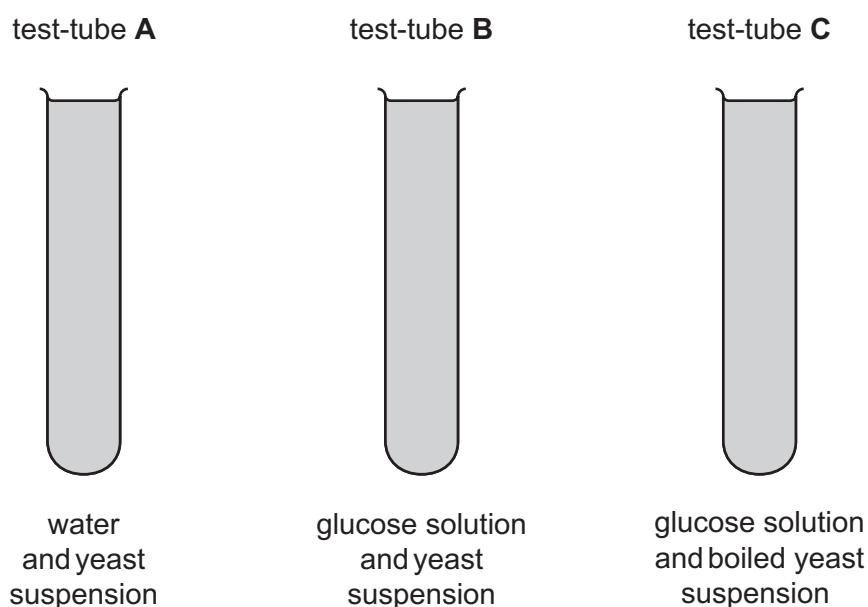


Fig. 1.1

Step 7 places a large test-tube (boiling tube) over the top of each of the test-tubes **A**, **B** and **C**

Step 8 turns the test-tubes upside down as shown in Fig. 1.2

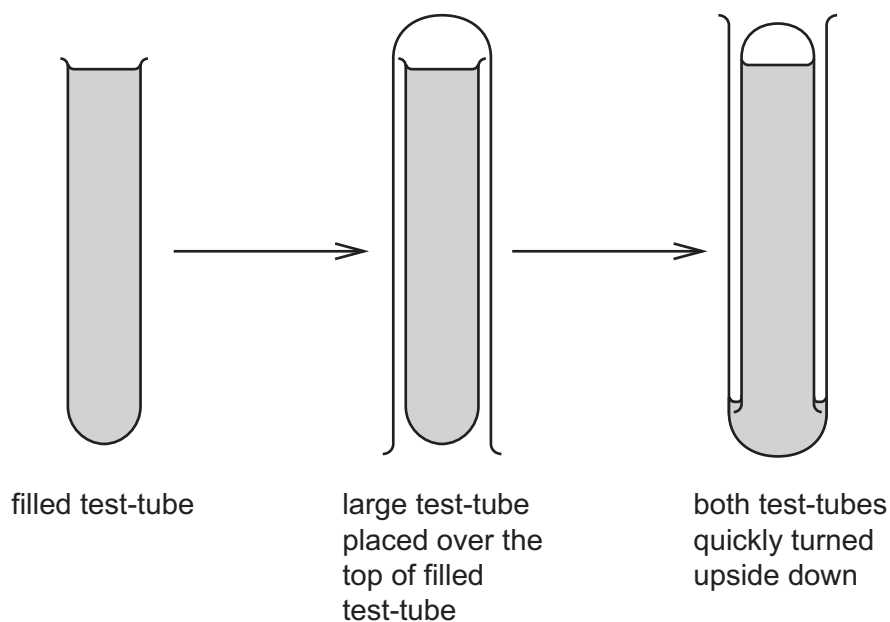


Fig. 1.2

Step 9 places all of the test-tubes into a water-bath at 40 °C

Step 10 leaves the test-tubes in the water-bath for 5 minutes.

If gas is made in the small test-tube, the liquid is pushed out into the large test-tube.

After 5 minutes the student measures the height of the liquid in each large test-tube (boiling tube), as shown in Fig. 1.3.

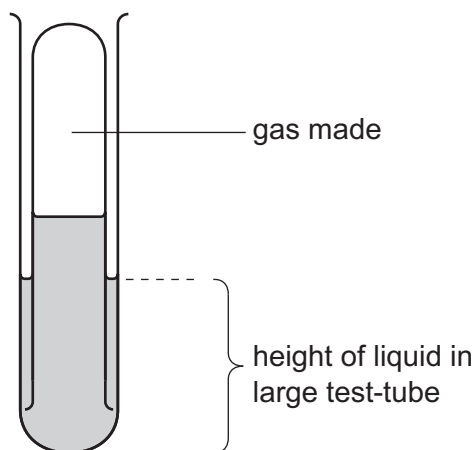


Fig. 1.3

The results are recorded in Table 1.1.

Table 1.1

test-tube	height of liquid /mm
A	18
B	
C	5

- (i) Fig. 1.4 shows the height of liquid in the large test-tube around test-tube **B**.

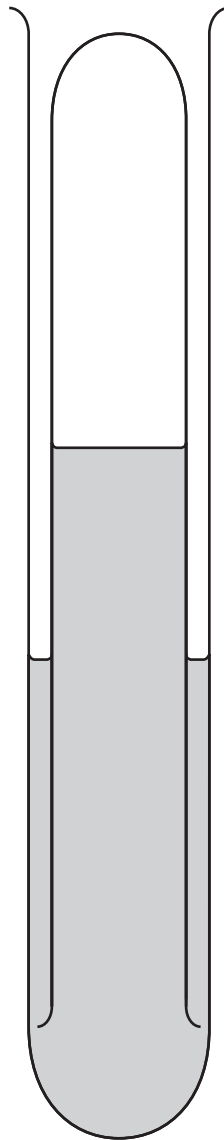


Fig. 1.4

Measure this height to the nearest mm and record it in Table 1.1.

[1]

- (ii) Test-tube **B** contains glucose.

Test-tube **A** contains no glucose.

Use this information to explain the difference in the results for test-tube **B** and test-tube **A**.

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

- (iii) Test-tube **C** is used as a type of control.

Explain the purpose of this control.

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

- (iv) Explain why it is difficult to get an accurate value for the height of a liquid in a test-tube.

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

- (v) Describe a test to find out if the gas made is carbon dioxide. Include the observation for a positive result.

test
.....
observation [1]

- (vi) State **one** variable that is kept constant in this investigation.

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

- (c) The teacher does a similar experiment at 40°C to investigate the effect of different concentrations of glucose on the yeast suspension. The teacher measures the volume of gas collected after 5 minutes.

The results are shown in Table 1.2.

Table 1.2

percentage concentration of glucose solution	volume of gas collected after 5 minutes /cm ³
6	3
7	8
8	7
9	18
10	23
11	23

- (i) The result for 8% glucose solution is anomalous.

Suggest what might have caused this anomalous result.

.....
 [1]

- (ii) Predict the expected volume of gas for the 8% glucose solution.

.....cm³ [1]

- (iii) Describe the relationship between the percentage concentration of glucose solution and the volume of gas made.

.....

 [2]

- (iv) Suggest a piece of apparatus suitable for collecting the gas and measuring its volume.

..... [1]

- (v) The teacher repeats their investigation at 20 °C instead of 40 °C. Suggest what effect, if any, a lower temperature has on the results.

.....

..... [1]

[Total: 13]

- 2 A student prepares a sample of the insoluble salt barium sulfate by reacting aqueous copper(II) sulfate with aqueous barium nitrate.

(a) Procedure

The student:

- measures 15 cm^3 of aqueous copper(II) sulfate and pours it into a beaker
- measures 7.5 cm^3 of aqueous barium nitrate and pours it into the beaker
- stirs the reaction mixture
- filters the reaction mixture and collects the blue filtrate in a conical flask.

- (i) Explain why a 10 cm^3 measuring cylinder is used to measure the aqueous barium nitrate rather than a 25 cm^3 measuring cylinder.

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

- (ii) State one observation of the **filtrate** in the conical flask that shows it contains copper(II) ions.

..... [1]

- (b)** The residue of barium sulfate on the filter paper is impure.

- (i) The impure residue contains some soluble copper(II) compounds.

Describe how the student purifies the barium sulfate by removing the soluble copper(II) compounds from the residue.

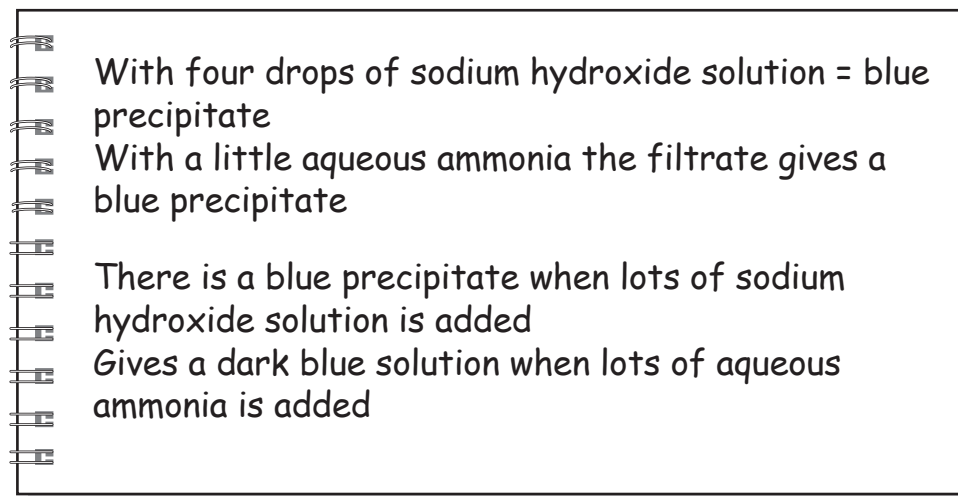
.....
..... [1]

- (ii) State the colour of the purified barium sulfate precipitate.

..... [1]

(c) The student tests two samples of the filtrate.

Here is a page from the student's notebook.



Present these results in a results table.

Include the headings for the table, the tests used and the observations.

[3]

[Total: 7]

- 3 Calcium hydroxide is a white solid that is added to acidic soils to increase their pH.

Calcium hydroxide neutralises acids such as dilute nitric acid to make a salt and water.

Plan an investigation to find out how the pH of dilute nitric acid changes as calcium hydroxide is added to the acid.

You are provided with:

- calcium hydroxide powder
- dilute nitric acid
- Universal Indicator solution.

You may use any common laboratory apparatus in your plan.

In your plan, include:

- the apparatus needed
- a brief description of the method and explain any safety precautions you should take
- what you would measure
- which variables you would keep constant
- how you would process your results to draw a conclusion.

You may include a labelled diagram if you wish.

You may include a table that can be used to record the results if you wish.

4 A student investigates the rate at which hot water cools.

(a) Procedure

The student:

- $\frac{3}{4}$ fills a beaker with water at room temperature
- records in Table 4.1 the initial temperature of the water in the beaker
- half-fills a test-tube with hot water
- records in Table 4.1 the initial temperature of the hot water in the test-tube
- secures the test-tube in the beaker so that the hot water level is below the level of the water in the beaker
- records in Table 4.1 the temperature of the water in the beaker and the temperature of the water in the test-tube every 30 s for 180 s.

(i) Fig. 4.1 shows an incomplete diagram of the student's experiment.

Complete Fig. 4.1 by:

- marking the hot water level in the test-tube
- adding a thermometer to measure the temperature of the hot water.

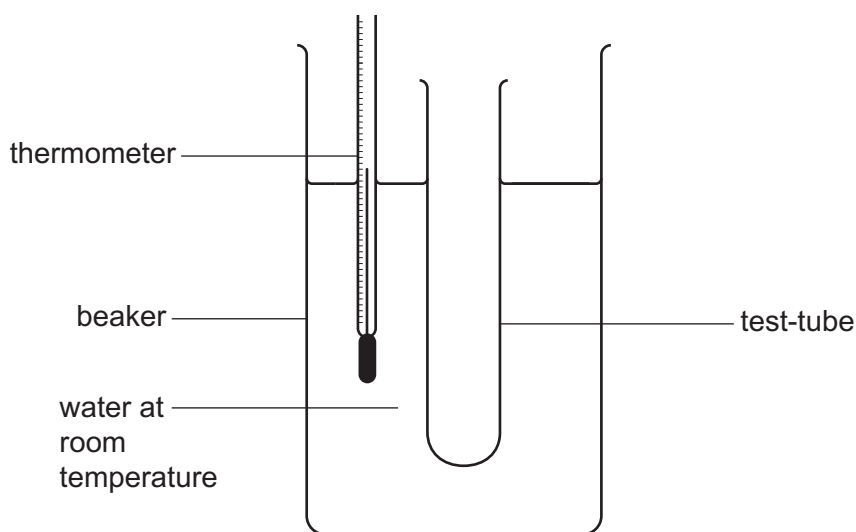


Fig. 4.1

[2]

- (ii) Fig. 4.2 shows the thermometer readings at 180 s. Record these temperatures in Table 4.1.

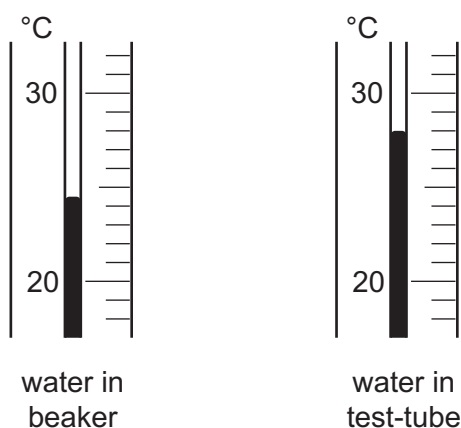


Fig. 4.2

Table 4.1

time /s	temperature of water in	
	beaker /°C	test-tube /°C
0	23.5	76.0
30	23.5	57.0
60	23.5	45.0
90	23.5	38.0
120	24.0	33.5
150	24.0	30.0
180		

[3]

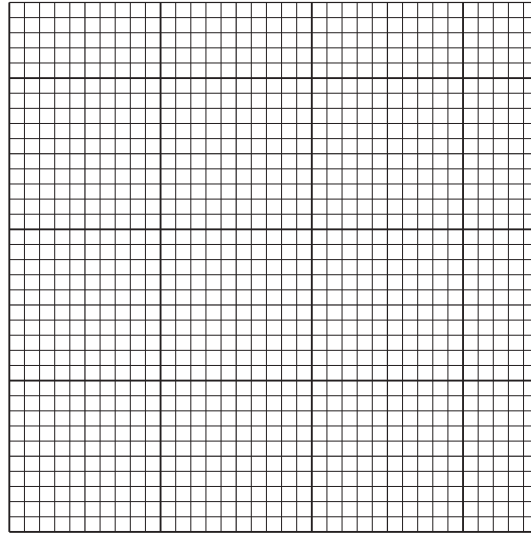
- (iii) Describe one practical technique the student uses to ensure that the temperature of the water in the beaker is measured accurately.

.....
 [1]

- (iv) Suggest why the temperature of the water in the beaker changes during the experiment.

.....
 [1]

- (b) (i) Plot a graph of the temperature of the hot water in the **test-tube** (vertical axis) against time using the results in Table 4.1. Do **not** start the temperature scale at 0 °C.



[3]

- (ii) Draw the best-fit curve.

[1]

- (c) (i) Calculate the rate of cooling of the hot water in the **test-tube** during the first 30 s. Use the equation shown.

$$\text{rate of cooling during first 30 s} = \frac{\text{temperature at 0 s} - \text{temperature at 30 s}}{30}$$

Give your answer to **two** significant figures.

rate of cooling = °C/s [1]

- (ii) Describe how the rate of cooling of the hot water in the test-tube changes during the 180 s.

.....

..... [1]

[Total: 13]

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