Cambridge Assessment International Education

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9235306731

COMBINED SCIENCE **0653/63**

Paper 6 Alternative to Practical **May/June 2021**

1 hour

You must answer on the question paper.

No additional materials are needed.

INSTRUCTIONS

- 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.

INFORMATION

- 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 effect of temperature on the activity of the enzyme pepsin.

Pepsin is an enzyme that breaks down proteins into amino acids as shown in Fig. 1.1.

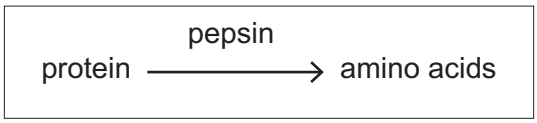


Fig. 1.1

Amino acids are acidic. They have a low pH.

Procedure

The student:

- sets up a water-bath at 10 °C
- puts 5 cm^3 of protein solution into a test-tube and adds 1 cm^3 of 1% pepsin solution
- puts 1 cm^3 of Universal Indicator solution into the test-tube
- stirs the contents of the test-tube with a glass rod
- puts the test-tube into the water-bath
- starts the stop-clock
- records in Table 1.1 the time taken in seconds for the mixture in the test-tube to change from green to red.

The student repeats the procedure using water-baths at 20 °C, 30 °C, 40 °C, and 50 °C.

(a) The student's results are shown in Table 1.1.

(i) Add the units to the headings of Table 1.1.

Table 1.1

temperature /	time taken to change to red / .....
10	135
20	
30	32
40	32
50	

[1]

(ii) The times taken for the colour to change from green to red at 20 °C and 50 °C are shown in Fig. 1.2.

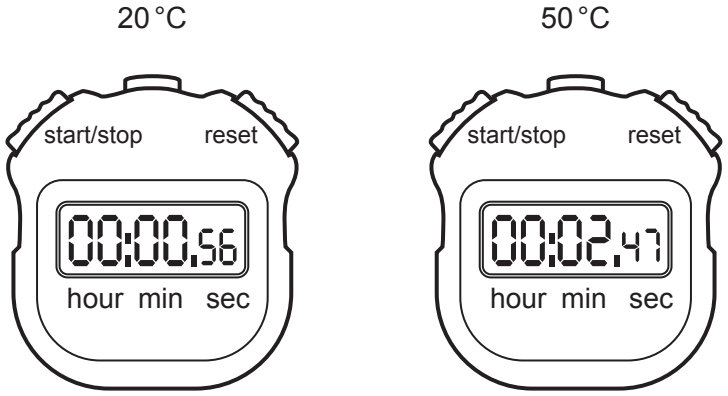


Fig. 1.2

Record these times in Table 1.1. [2]

(b) (i) Describe how the time taken for the Universal Indicator solution to turn red changes as the temperature increases.

.....

.....

.....

..... [2]

(ii) The student repeats the procedure at 35 °C. Predict the time taken for the Universal Indicator solution to change to red.

Explain your answer.

prediction .....

explanation .....

.....

[2]

(c) Fig. 1.3 shows the colour chart for the Universal Indicator solution used by the student.

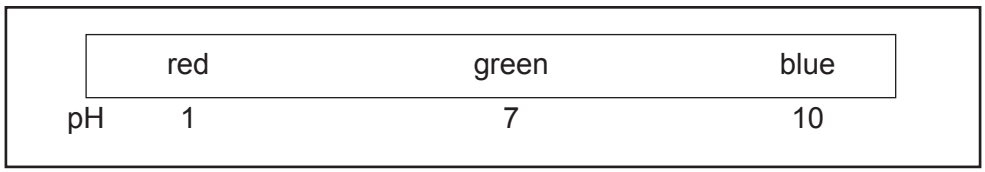


Fig. 1.3

State and explain why the colour of the Universal Indicator solution changes to red.

Use Fig. 1.1 and Fig. 1.3 to support your answer.

.....

.....

.....

..... [2]

(d) The student stirs the contents of the test-tubes before putting them in the water-bath.

State why this is good experimental practice.

.....

..... [1]

(e) State **one** variable that is kept constant during this investigation.

.....

..... [1]

(f) Describe a test that confirms the presence of protein.

Include the colour for a positive result.

test .....

colour .....

[2]

[Total: 13]

2 Antacid tablets are used to reduce the symptoms of indigestion in the stomach caused by excess acid.

A student investigates the reaction of antacid tablets with dilute hydrochloric acid.

During the reaction carbon dioxide gas is made.

The student wants to find out if an increase in temperature increases the total volume of carbon dioxide made.

(a) The student:

- pours 25.0 cm^3 of dilute hydrochloric acid into a conical flask
- sets up the apparatus shown in Fig. 2.1
- removes the bung, quickly adds one antacid tablet, and replaces the bung
- collects the carbon dioxide in apparatus **X**.

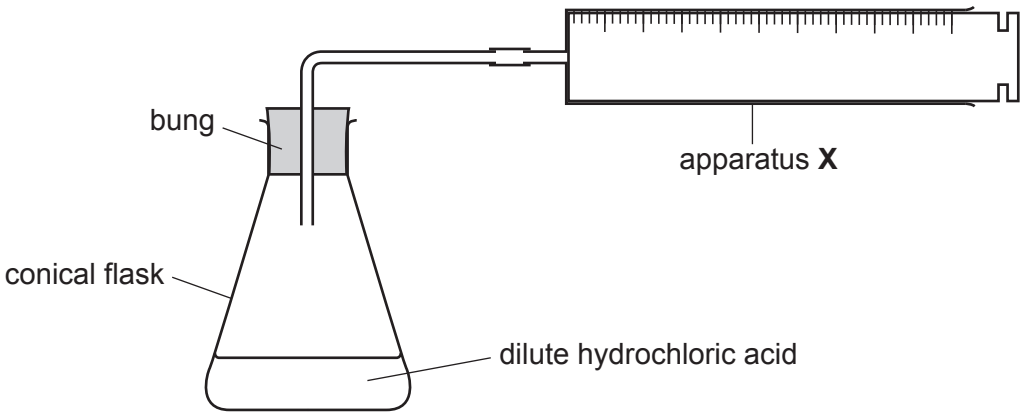


Fig. 2.1

(i) Name apparatus **X**.

..... [1]

(ii) The student does the experiment with the dilute hydrochloric acid at 25 °C.

The student repeats the experiment with the dilute hydrochloric acid at 35 °C.

Fig. 2.2 shows the total volume of carbon dioxide collected in apparatus **X** at each temperature.

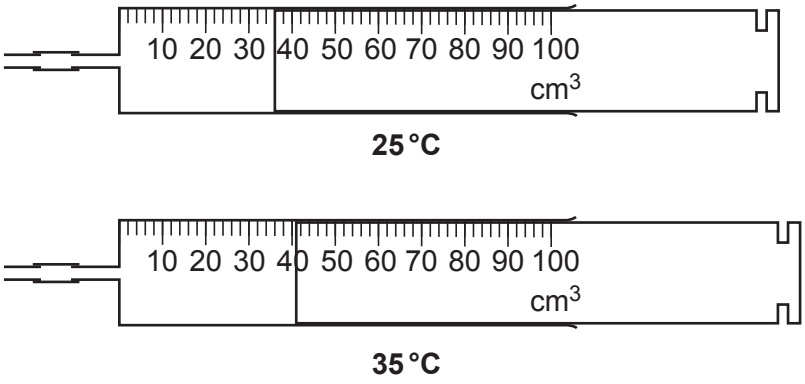


Fig. 2.2

Record these two volumes in Table 2.1.

Table 2.1

temperature / °C	total volume of carbon dioxide / cm^3
25	
35	

[2]

(iii) Some of the gas made is **not** collected in apparatus **X**.

Use the information in the method to suggest why some of the gas is **not** collected.

.....

..... [1]

(iv) Describe a chemical test to confirm that the gas made is carbon dioxide.

Include an observation for a positive result.

test .....

observation .....

[1]

(b) Next, the student:

- dissolves an antacid tablet in water to make a solution
- adds three drops of Universal Indicator to this solution
- observes that the Universal Indicator turns green-blue.

Fig. 2.3 shows a pH colour chart.

	red	orange	yellow	green	dark green	blue	purple
pH	1	4	6	7	8	10	14

Fig. 2.3

(i) Use the pH colour chart in Fig. 2.3 to estimate the pH of the solution of the antacid.

..... [1]

(ii) Explain why using a pH colour chart does **not** give the student an accurate value for the pH of the solution of antacid.

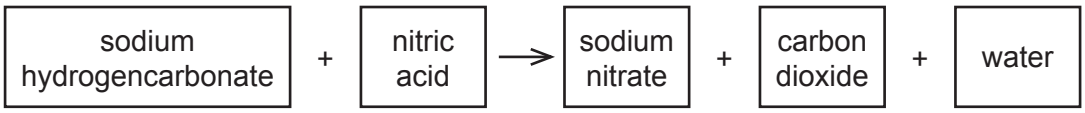
.....

..... [1]

[Total: 7]

[Turn over

3 Sodium hydrogencarbonate is a white solid that reacts with dilute nitric acid as shown in the word equation.



The reaction is endothermic. This means that the temperature of the reaction mixture will decrease during the reaction.

Plan an investigation to find out how the temperature decrease of the reaction mixture depends on the mass of sodium hydrogencarbonate added to the dilute nitric acid.

You are provided with:
- sodium hydrogencarbonate powder
- dilute nitric acid

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 would 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.

.....

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..... [7]

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4 A student measures the efficiency of an electric heating element in a circuit.

The student:

- sets up the apparatus shown in Fig. 4.1
- adds 100 cm^3 of water at room temperature to the beaker
- records in Table 4.1 the initial temperature of the water

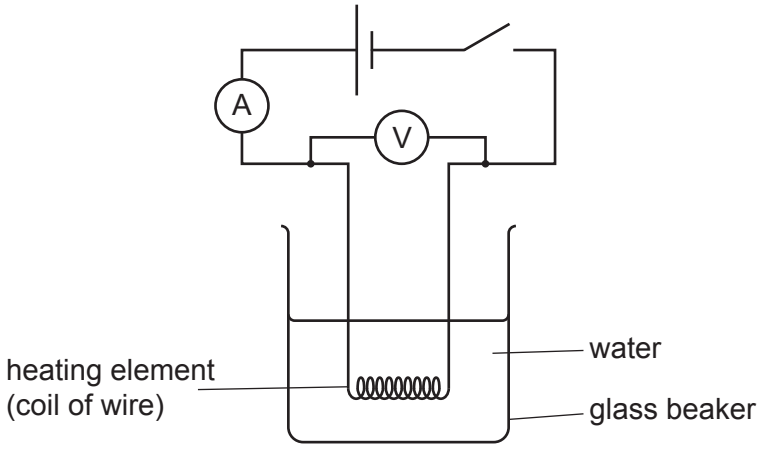


Fig. 4.1

- closes the switch and starts a stop-clock
- records in Table 4.1 the temperature of the water every 5 minutes for 30 minutes.

(a) Fig. 4.2 shows the thermometer reading at 5 minutes.

Record this temperature in Table 4.1.

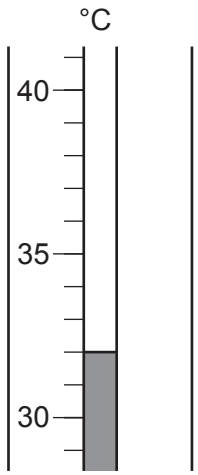


Fig. 4.2

Table 4.1

time / min	temperature / °C
0	25.0
5	
10	38.0
15	42.0
20	
25	46.5
30	49.5

[1]

(b) (i) Plot a graph of temperature against time. Do **not** start the temperature scale at 0.

temperature / °C

time / min

[2]

(ii) Draw the best-fit curve. [1]

(iii) The student did **not** record the temperature at 20 minutes. Use your graph to estimate this temperature reading.

estimate of temperature at 20 min = ... °C [1]

(c) (i) Calculate the increase in temperature of the water after 30 minutes of heating.

temperature increase = ... °C [1]

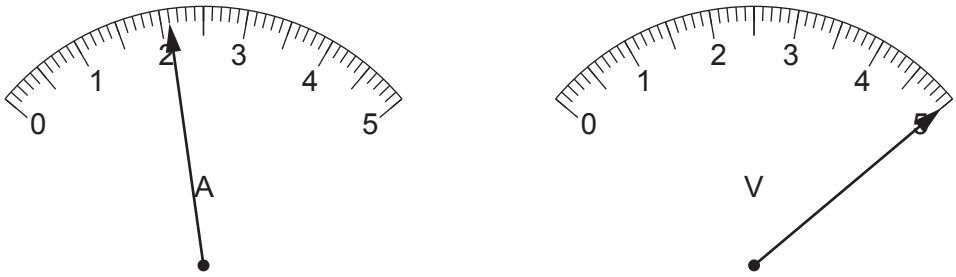
(ii) Calculate the thermal energy gained by the water in 30 minutes. Use your answer in **(c)(i)** and the equation shown.

$$\text{thermal energy} = 100 \times 4.2 \times \text{temperature increase}$$

Give your answer to an appropriate number of significant figures.

thermal energy = ... J [2]

(d) (i) Fig. 4.3 shows the ammeter and voltmeter readings when the circuit is switched on.



ammeter voltmeter

Fig. 4.3

Record the current I in the circuit and also the potential difference V across the coil of wire (heating element).

I = ... A

V = ... V

[2]

(ii) Calculate the electrical energy supplied by the heating element in 30 minutes. Use your values in **(d)(i)** and the equation shown.

$$\text{electrical energy} = V \times I \times 1800$$

electrical energy = ... J [1]

(e) Calculate the efficiency of the heating element. Use your answers in **(c)(ii)** and **(d)(ii)** and the equation shown.

$$\text{efficiency} = \frac{\text{thermal energy}}{\text{electrical energy}} \times 100$$

efficiency = ...% [1]

(f) Suggest how the student can change the apparatus to improve the efficiency calculated in **(e)**.

.....

..... [1]

[Total: 13]

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