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CO-ORDINATED SCIENCES

0654/52

Paper 5 Practical Test

February/March 2024

2 hours

You must answer on the question paper.

You will need: The materials and apparatus listed in the confidential instructions

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 60.
- The number of marks for each question or part question is shown in brackets [].
- Notes for use in qualitative analysis are provided in the question paper.

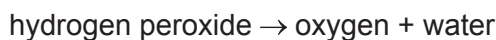
For Examiner's Use	
1	
2	
3	
4	
5	
6	
Total	

This document has **20** pages. Any blank pages are indicated.

1 You are going to investigate the effect of catalase on the breakdown of hydrogen peroxide.

Catalase is an enzyme found in living cells such as potato cells.

Catalase speeds up the breakdown of hydrogen peroxide into oxygen gas and water.



You are provided with some potato puree and some hydrogen peroxide solution.

(a) (i) Fig. 1.1 shows the assembled apparatus.

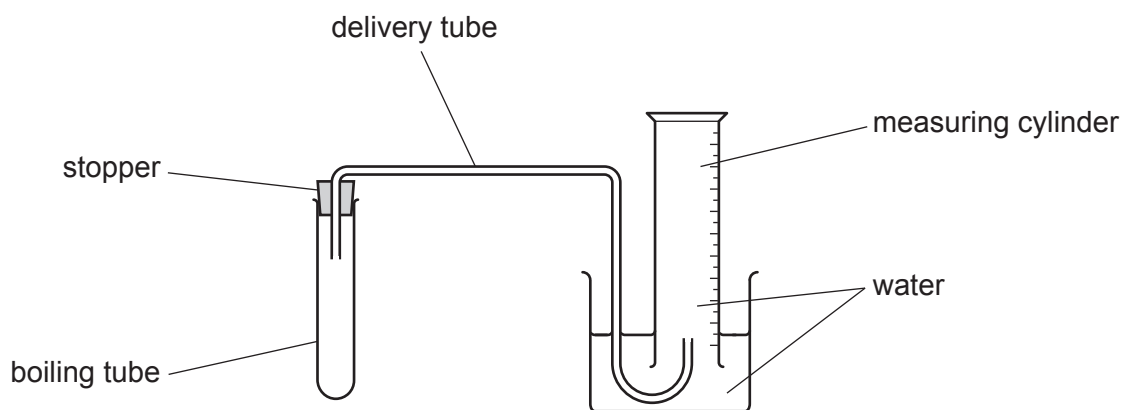


Fig. 1.1

Procedure

- Use the stirring rod to mix the potato puree.
- Remove the stopper from the boiling tube and add about 2 cm depth of potato puree.
- Use the syringe to add 2 cm³ of hydrogen peroxide solution to the boiling tube and quickly replace the stopper.
- Immediately start the stop-watch.
- Record in Table 1.1 the **total** volume of gas collected in the measuring cylinder every minute for 6 minutes. Record your values to the nearest 0.5 cm³.

Table 1.1

time / min	total volume of gas collected / cm ³	volume of gas collected in each interval of 1 minute / cm ³
0	0	0
1		
2		
3		
4		
5		
6		

[4]

(ii) Calculate the volume of gas collected in each interval of 1 minute.

Use the equations shown.

The value for 1 minute = total volume at 1 minute – the total volume at 0 minutes.

The value for 2 minutes = total volume at 2 minutes – the total volume at 1 minute.

The remaining values are calculated similarly.

Record your values in Table 1.1.

[2]

(b) A student suggests that the volume of gas collected in the final interval of 1 minute is less than the volume of gas collected in the first interval of 1 minute.

(i) Explain why the student expects the volume of gas collected in each 1 minute interval to decrease during the experiment.

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

(ii) State if your results support the student's suggestion.

Use values from Table 1.1 to explain your answer.

statement

explanation

..... [1]

(c) Explain why repeating the procedure increases confidence in the results.

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

(d) Suggest **one** source of error in the procedure.

State how to overcome this error.

error

statement

.....

[2]

(e) Put about 1 cm depth of hydrogen peroxide solution into a clean test-tube.

Add a few drops of universal indicator solution to this test-tube.

State the colour observed.

Determine the pH of the hydrogen peroxide solution using the colour chart.

Use the pH to describe the nature of the hydrogen peroxide solution.

colour

pH

description

[2]

[Total: 13]

2 Fertilisers contain nutrients that are added to crops to help them grow.

A farmer has a choice of three fertilisers, **A**, **B** and **C** for use on his rice crop.

Plan an investigation to find out which fertiliser produces the highest rate of growth of the rice plants.

You are provided with:

- rice plant seedlings
- fertilisers **A**, **B** and **C**.

You may also use any common laboratory apparatus.

You are not required to do this investigation.

Include in your plan:

- the apparatus needed
- a brief description of the method
- the measurements you will make
- the variables you will control
- how you will process your results to draw a conclusion.

You may include a results table if you wish, you are not required to enter any readings in the table.

You may include a labelled diagram if you wish.

3 You are going to investigate which metal ions catalyse a reaction.

When aqueous sodium thiosulfate reacts with aqueous iron(III) nitrate the reaction mixture immediately turns a dark brown-purple colour.

The colour of this mixture slowly fades.

A catalyst will make the brown-purple colour fade more quickly.

Fig. 3.1 shows the experiment.

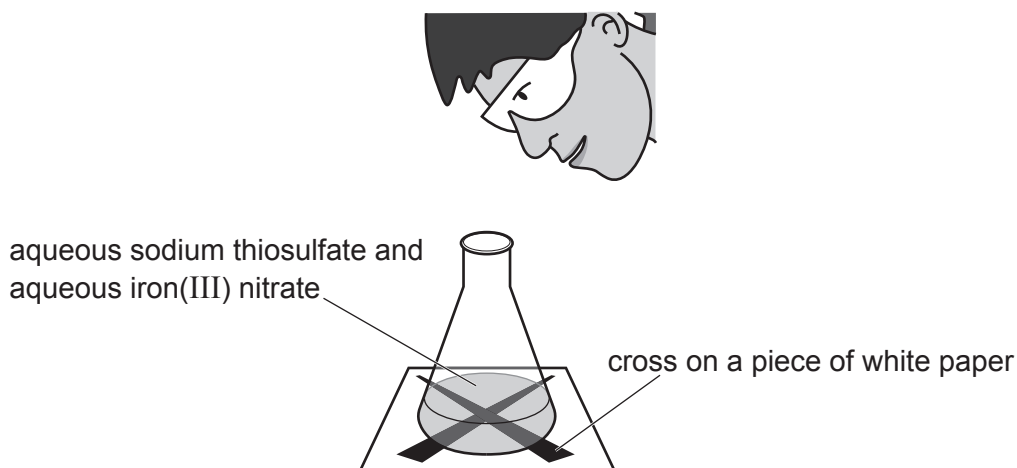


Fig. 3.1

When the brown-purple colour fades it is possible to see the cross through the reaction mixture.

The time for the cross to become visible is measured.

(a) (i) Procedure

- Step 1 Using the measuring cylinder labelled **S**, add 20cm^3 of aqueous sodium thiosulfate into a clean conical flask.
- Step 2 Place the conical flask over the cross on the piece of paper.
- Step 3 Using a clean dropping pipette add only 1 drop of distilled water to the conical flask.
- Step 4 Using the measuring cylinder labelled **I** measure 20cm^3 of aqueous iron(III) nitrate.
- Step 5 Add the aqueous iron(III) nitrate to the conical flask, immediately swirl the flask and start the stop-watch.
- Step 6 Look through the mixture and when the cross becomes visible stop the stop-watch.
- Step 7 Record in Table 3.1 the time taken to the nearest second.

[1]

Table 3.1

aqueous solution added in Step 3	time taken for the cross to become visible /s	rate of reaction per 100 s
distilled water		
copper(II) ions		
iron(II) ions		
sodium ions		
zinc ions		

- (ii) Repeat the procedure in (a)(i) four times. Each repeat has one drop of a different solution added in Step 3 as shown in Table 3.1. [4]

- (b) (i) Calculate the rate of each reaction.

Use the equation shown.

$$\text{rate of reaction} = \frac{100}{\text{time taken}}$$

Record in Table 3.1 your values to **two** significant figures. [2]

- (ii) Distilled water is **not** a catalyst for this reaction.

The experiment with distilled water is a control for the investigation.

Explain why a control is used.

.....
 [1]

- (iii) Use the values in Table 3.1 to place the aqueous copper(II) ions, aqueous iron(II) ions, aqueous sodium ions and aqueous zinc ions in order of the rates of reaction.

highest rate (best catalyst)

↓

.....

.....

lowest rate

[1]

- (c) (i) Repeat the procedure in (a)(i) but in Step 3 add 5 drops of aqueous copper(II) ions instead of one drop of distilled water.

Record the time taken for the cross to become visible.

time = s [1]

(ii) Suggest why 5 drops of each solution are **not** used in the procedure in (a)(i).

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

[Total: 11]

4 You are going to identify two aqueous solutions, **J** and **K**.

(a) **Procedure**

- Add approximately 1 cm depth of aqueous **J** into each of three test-tubes.
- Complete the tests detailed in Table 4.1.
- Record your observations in Table 4.1.
- Repeat the tests using aqueous **K** instead of aqueous **J**.
- Record your observations in Table 4.1.

Table 4.1

test	observations	
	aqueous J	aqueous K
add a few drops of aqueous ammonia		
add excess aqueous ammonia		
add 1 cm depth of dilute nitric acid followed by a few drops of aqueous silver nitrate		
add 1 cm depth of dilute nitric acid followed by 1 cm depth of aqueous barium nitrate		

[7]

(b) State the identity of aqueous **J** and aqueous **K**.

aqueous **J**

aqueous **K**

[2]

[Total: 9]

5 You are going to measure the focal length f of a converging lens.

The equipment is assembled as shown in Fig. 5.1.

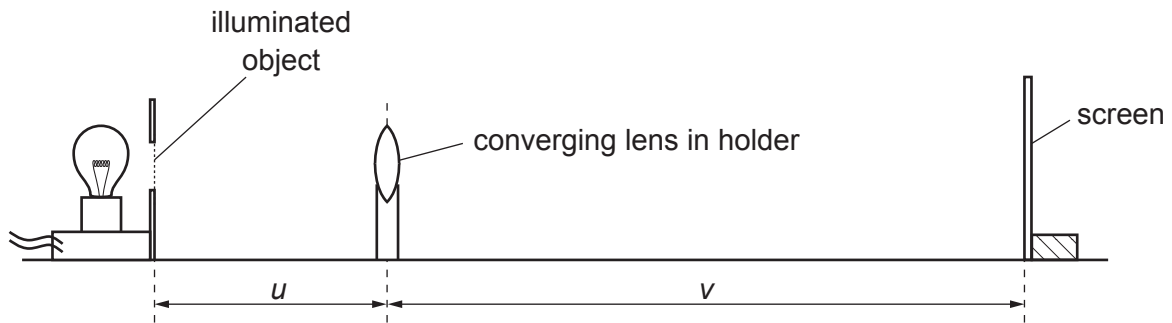


Fig. 5.1

(a) (i) Procedure

- Switch on the lamp.
- Place the lens a distance $u = 20.0$ cm from the illuminated object. The illuminated object is the triangular hole in the card.
- Adjust the position of the screen until a sharp image of the illuminated object is formed on the screen.
- Record in Table 5.1 the image distance v from the screen to the lens to the nearest 0.1 cm.

Table 5.1

object distance u /cm	image distance v /cm	magnification m
20.0		
30.0		
40.0		
50.0		
60.0		

[1]

(ii) Calculate the magnification m of the image.

Use the equation shown.

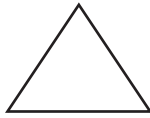
$$m = \frac{\text{image distance}}{\text{object distance}}$$

Record m to **one** decimal place in Table 5.1.

[1]

(b) Fig. 5.2 shows the illuminated object.

In the blank space on the right-hand side of the illuminated object, draw a diagram of the image seen on the screen.



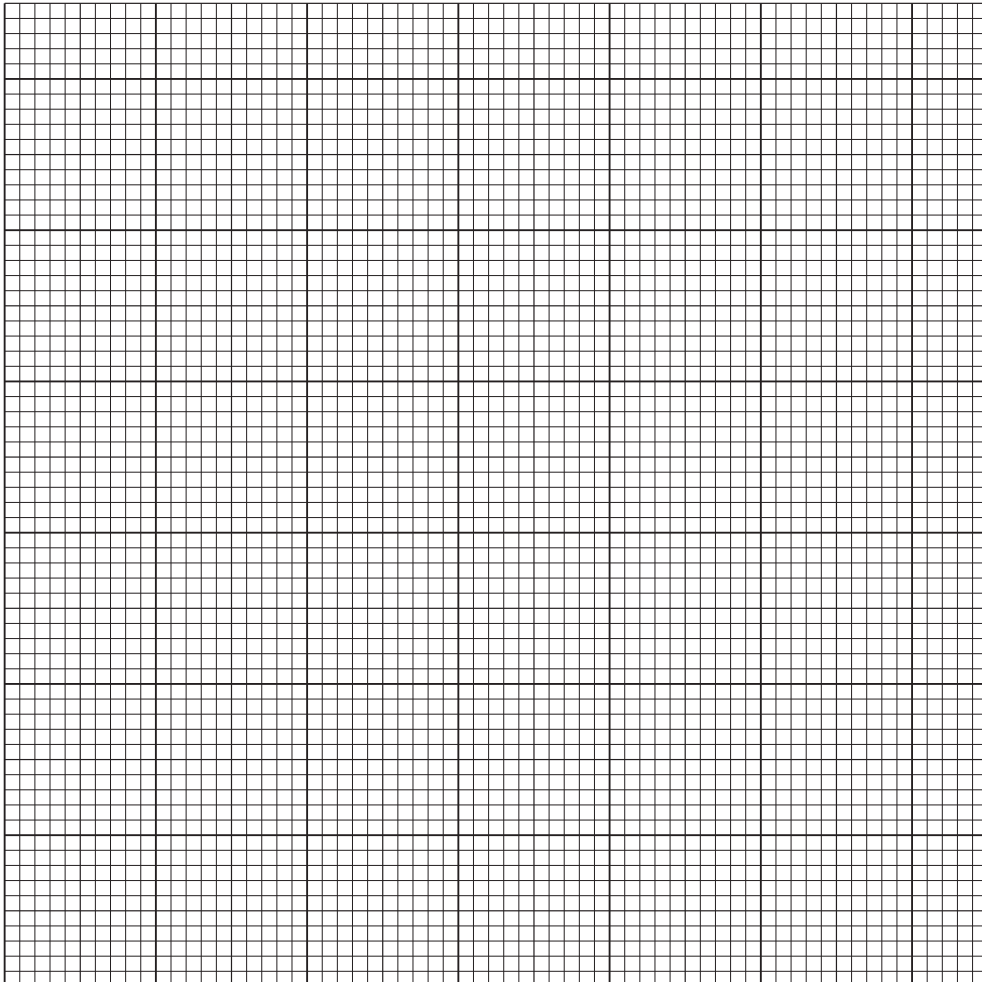
illuminated object

Fig. 5.2

[2]

(c) Repeat the procedure in (a) for values of $u = 30.0$ cm, 40.0 cm, 50.0 cm, and 60.0 cm. [2]

(d) (i) On the grid, plot a graph of v (vertical axis) against m .



[3]

(ii) Draw the best-fit straight line.

[1]

(iii) The gradient of the line is equal to the focal length f of the lens.

Calculate the gradient of your line.

Show on your graph the values you choose to calculate the gradient.

$f = \dots\dots\dots$ [2]

(e) When measuring u and v , it is important to avoid line-of-sight (parallax) errors.

Describe how to avoid such errors.

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

[Total: 13]

6 You are going to investigate the stretching of a spring.

The spring and the metre ruler have been assembled for you as shown in Fig. 6.1.

Do **not** remove the spring from the clamp. Do **not** adjust the height of the clamps.

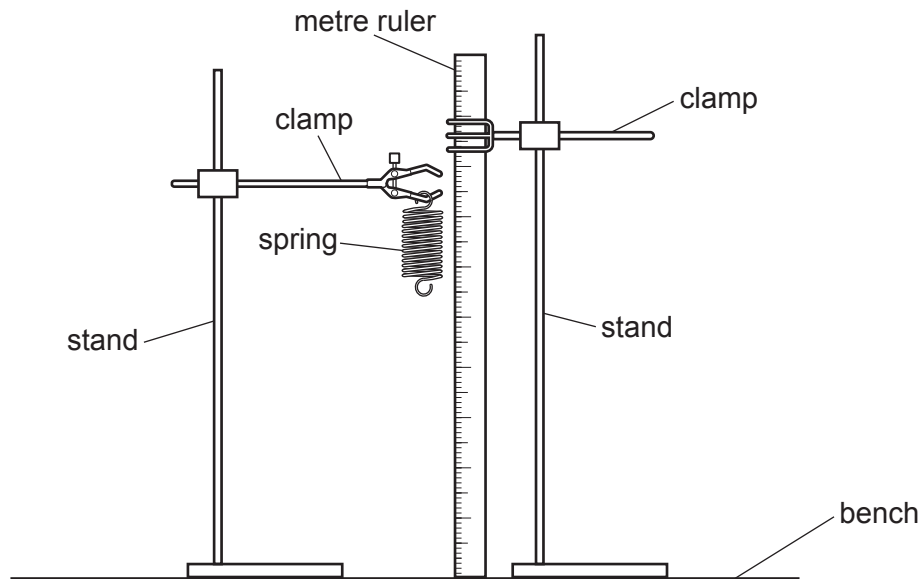


Fig. 6.1

(a) (i) Take the reading r on the metre ruler at the bottom of the spring.

Use the set-square to make this reading accurate.

Record in Table 6.1 the reading r to the nearest 0.1 cm for mass $m = 0\text{g}$.

Table 6.1

mass m /g	0	100	200	400
reading r /cm				

[1]

(ii) Draw a diagram to show how you use the set-square to take an accurate reading.

[1]

(b) Procedure

- Suspend a mass $m = 100\text{g}$ from the spring.
- Record in Table 6.1 the reading r at the bottom of the spring.

Repeat this procedure for masses $m = 200\text{g}$ and 400g . [2]

(c) A student suggests that the reading r on the metre ruler is directly proportional to the mass m .

State if your readings support this suggestion.

Use values from Table 6.1 to justify your answer.

statement

justification

..... [1]

(d) Procedure

- Remove the 400g mass from the spring.
- Suspend the load L from the spring.

(i) Record the reading r at the bottom of the spring to the nearest 0.1 cm .

$r = \dots\dots\dots\text{ cm}$ [1]

(ii) Use your answer to **(d)(i)** and the readings in Table 6.1 to predict the mass M of the load L .

$M = \dots\dots\dots\text{ g}$ [1]

[Total: 7]

NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

<i>anion</i>	<i>test</i>	<i>test result</i>
carbonate (CO_3^{2-})	add dilute acid	effervescence, carbon dioxide produced
chloride (Cl^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	white ppt.
bromide (Br^-) [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	cream ppt.
nitrate (NO_3^-) [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate (SO_4^{2-}) [in solution]	acidify, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

<i>cation</i>	<i>effect of aqueous sodium hydroxide</i>	<i>effect of aqueous ammonia</i>
ammonium (NH_4^+)	ammonia produced on warming	–
calcium (Ca^{2+})	white ppt., insoluble in excess	no ppt., or very slight white ppt.
copper(II) (Cu^{2+})	light blue ppt., insoluble in excess	light blue ppt., soluble in excess, giving a dark blue solution
iron(II) (Fe^{2+})	green ppt., insoluble in excess	green ppt., insoluble in excess
iron(III) (Fe^{3+})	red-brown ppt., insoluble in excess	red-brown ppt., insoluble in excess
zinc (Zn^{2+})	white ppt., soluble in excess, giving a colourless solution	white ppt., soluble in excess, giving a colourless solution

Tests for gases

<i>gas</i>	<i>test and test result</i>
ammonia (NH_3)	turns damp, red litmus paper blue
carbon dioxide (CO_2)	turns limewater milky
chlorine (Cl_2)	bleaches damp litmus paper
hydrogen (H_2)	'pops' with a lighted splint
oxygen (O_2)	relights a glowing splint

Flame tests for metal ions

<i>metal ion</i>	<i>flame colour</i>
lithium (Li^+)	red
sodium (Na^+)	yellow
potassium (K^+)	lilac
copper(II) (Cu^{2+})	blue-green

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