Cambridge Assessment International Education

Cambridge IGCSE™

CANDIDATE NAME

CENTRE NUMBER

CANDIDATE NUMBER

CO-ORDINATED SCIENCES **0654/63**

Paper 6 Alternative to Practical **May/June 2025**

1 hour 30 minutes

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 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.

This document has **24** pages. Any blank pages are indicated.

DC (CJ/FC) 346285/5

1 Urine tests are commonly used for the diagnosis of diseases.

A student investigates four samples of urine **A**, **B**, **C** and **D** to determine if there is any indication of disease.

The presence of reducing sugars or proteins in the urine samples can indicate disease.

(a) **(i)** Describe how to test for reducing sugars.

Give the colours observed during the test.

method ....

....

initial colour of testing solution ....

colour observed for a positive result ....
[4]

(ii) Describe how to test for proteins.

Give the colours observed during the test.

method ....

....

initial colour of testing solution ....

colour observed for a positive result ....
[3]

(b) Some chemicals are detected using a testing strip as shown in Fig. 1.1.

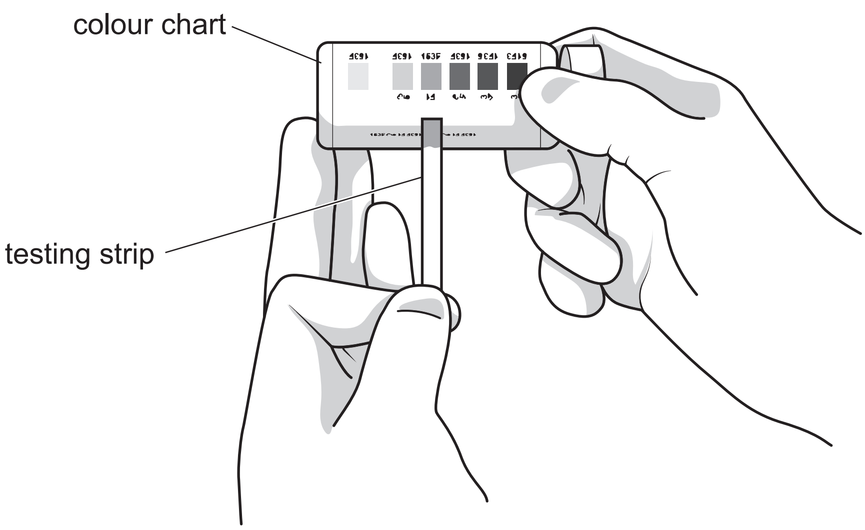

Fig. 1.1

The testing strip is dipped into a sample, removed, and the colour compared to a colour chart.

The student uses testing strips to test the four urine samples for proteins, glucose, ketones and nitrites.

The results are shown in Table 1.1.

Table 1.1

sample	proteins	glucose	ketones	nitrites
A	✗	✓	✓	✗
B	✗	✗	✗	✗
C	✓	✗	✗	✓
D	✓	✗	✗	✗

key
✓ = present
✗ = not present

Proteins, glucose, ketones and nitrites are **not** usually present in the urine of a healthy person.

People with diabetes have glucose and ketones in their urine.
People with nephritis have proteins and nitrites in their urine.
People suffering starvation have proteins and **no** nitrites in their urine.

State if the information in Table 1.1 indicates the presence of diabetes, nephritis, starvation or if the person is healthy.

Explain your answer.

sample **A** ....

....

sample **B** ....

....

sample **C** ....

....

sample **D** ....

....

[4]

(c) The chemical test for the presence of nitrite is:

- heat with aqueous sodium hydroxide and add aluminium foil
- the gas released turns damp red litmus paper blue.

Give **two** reasons why people use testing strips for nitrite instead of doing this chemical test.

Do **not** include cost in your answer.

1 ....

....

2 ....

....
[2]

[Total: 13]

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2 The pH of urine in a healthy person is approximately 6.5.

A student suggests that the pH of urine changes as the amount of water a person drinks during the day changes.

Plan an investigation to determine the relationship between the volume of water a person drinks and the pH of their urine three hours later.

You may use any common laboratory apparatus in your plan.

In your plan, include:

- the apparatus and chemicals you will need
- a brief description of the method
- the measurements you will make and how you make them as valid as possible
- the variables you will control
- how you will process your results to reach a conclusion.

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

DO NOT WRITE IN THIS MARGIN

[7]

3 A student investigates the effect of concentration on the rate of a reaction.

When aqueous sodium thiosulfate reacts with aqueous iron(III) nitrate, the reaction mixture immediately turns a dark brown-purple colour. This colour then starts to fade.

The time taken for the colour of the mixture to fade is called the reaction time, and is used to find the rate of the reaction.

Fig. 3.1 shows the experiment.

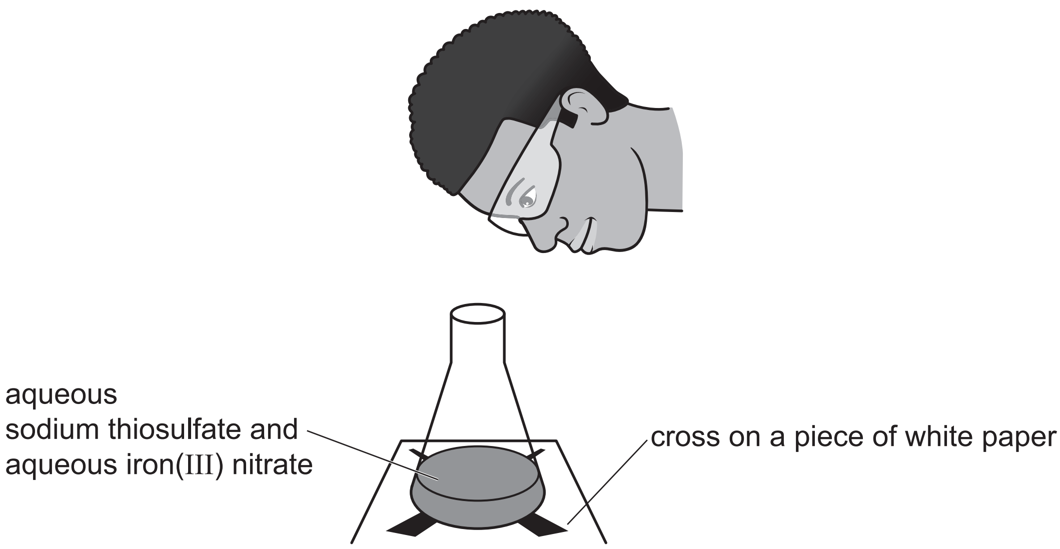

Fig. 3.1

When the colour fades, the cross on the paper becomes visible through the reaction mixture.

Aqueous sodium thiosulfate is made less concentrated by adding water to it.

(a) Procedure

The student:

step **1** puts 30 cm^3 of aqueous sodium thiosulfate into a conical flask

step **2** places the conical flask on a piece of white paper marked with a cross

step **3** adds 25 cm^3 of aqueous iron(III) nitrate to the flask

step **4** swirls the flask and immediately starts a stop-watch

step **5** looks through the mixture and when the cross **just** becomes visible, stops the stop-watch

step **6** records in Table 3.1 this reaction time in seconds to the nearest second.

The student repeats the procedure using the quantities of aqueous sodium thiosulfate, water and aqueous iron(III) nitrate shown in Table 3.1.

Table 3.1

volume of aqueous sodium thiosulfate / cm^3	volume of water / cm^3	volume of aqueous iron(III) nitrate / cm^3	reaction time / s	rate of reaction per 100 s
30	0	25	24	4.2
20	10	25		
15	15	25	51	2.0
10	20	25		

Fig. 3.2 shows the stop-watch readings for 20 cm^3 of aqueous sodium thiosulfate and 10 cm^3 of aqueous sodium thiosulfate.

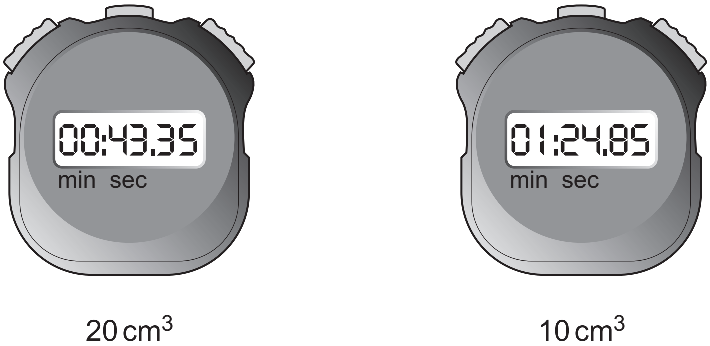

Fig. 3.2

Record these times in Table 3.1. [2]

(b) **(i)** Suggest why it is difficult to determine the reaction time.

....

.... [1]

(ii) Suggest why the student swirls the flask in step **4**.

....

.... [1]

(iii) State what happens to the reaction time when the volume of aqueous sodium thiosulfate is doubled.

Explain your answer using data from Table 3.1.

statement ....

explanation ....

....

[1]

(c) (i) Calculate the rate of reaction for the reactions using 20 cm^3 and 10 cm^3 of aqueous sodium thiosulfate.

Use the equation shown.

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

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

(ii) State the relationship between concentration of aqueous sodium thiosulfate and rate of reaction.

Explain how you arrived at your answer.

....

....

....

.... [2]

(d) (i) State the name of a piece of apparatus suitable for measuring 25 cm^3 more accurately than a measuring cylinder.

.... [1]

(ii) Suggest why the total volume in the conical flask must be the same for each experiment.

Do **not** include fair test in your answer.

....

.... [1]

(iii) Suggest why repeating the experiment several times increases confidence in the results.

....

.... [1]

(iv) Predict the rate of reaction when 0 cm^3 of aqueous sodium thiosulfate, 30 cm^3 of water and 25 cm^3 of aqueous iron(III) nitrate are used.

Explain your answer.

rate of reaction = ...

explanation ....

....

[1]

(e) A reaction happens when reactant particles collide with each other.

When the concentration increases, there are more particles in the solution and they are closer together.

Suggest why the **rate** of reaction changes as the concentration of the aqueous sodium thiosulfate changes.

....

.... [1]

(f) Aqueous iron(III) nitrate is yellow.

Aqueous iron(III) nitrate is weakly acidic.

Explain why universal indicator is **not** used to find the pH of aqueous iron(III) nitrate.

....

.... [1]

[Total: 15]

4 A student identifies the ions present in aqueous **H**.

(a) The student:

- adds a sample of aqueous **H** to 5 test-tubes
- does each of the tests in Table 4.1 on the 5 samples of aqueous **H** and records their observations.

Table 4.1

test number	test	observations
1	add a few drops of aqueous sodium hydroxide add excess aqueous sodium hydroxide	white ppt. dissolves in excess to form a colourless solution
2	add a few drops of aqueous ammonia add excess aqueous ammonia	white ppt. dissolves in excess to form a colourless solution
3	add dilute nitric acid and aqueous barium nitrate	colourless solution
4	add dilute nitric acid and aqueous silver nitrate	white ppt.
5	flame test	lilac

(i) Fig. 4.1 shows the measuring cylinder reading for the volume of aqueous **H** added to each test-tube.

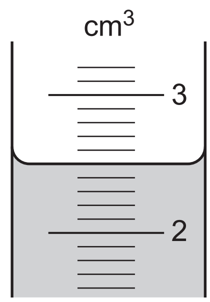

Fig. 4.1

State the volume of aqueous **H**.

volume = ... cm^3 [1]

(ii) State the identity of all of the ions in aqueous **H**.

....

.... [1]

(b) Explain why dilute nitric acid is added in tests **3** and **4**.

....

.... [1]

(c) Describe how to do a flame test.

....

....

....

.... [2]

[Total: 5]

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5 A student investigates how the resistance of a lamp depends on the potential difference across the lamp.

The student uses the circuit shown in Fig. 5.1.

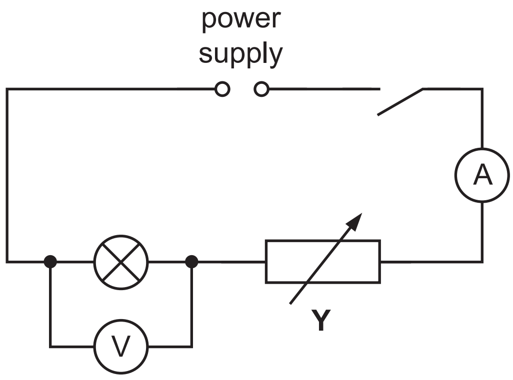

Fig. 5.1

The student measures the current I and the potential difference V.

Component **Y** changes the values of I and V.

Procedure

The student:

- closes the switch
- slowly adjusts component **Y** until V is 0.3 V
- records in Table 5.1 the current I and potential difference V for result **1**
- opens the switch.

(a) **(i)** State the name of component **Y**.

.... [1]

(ii) The student repeats the procedure for different values of *V*.

The readings on the voltmeter and ammeter for result **4** are shown in Fig. 5.2.

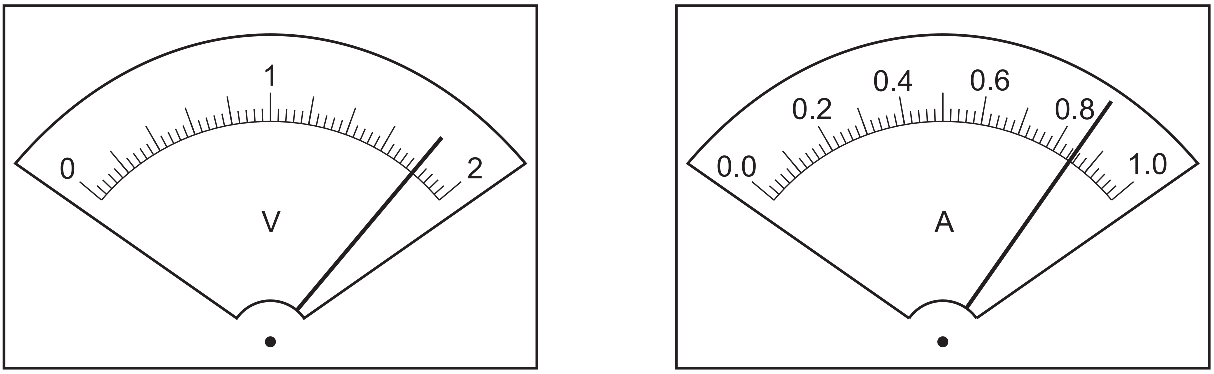

Fig. 5.2

Record in Table 5.1 the readings of the voltmeter and the ammeter.

Table 5.1

result	potential difference *V* / V	current *I* / A	resistance *R* / Ω
1	0.3	0.40	0.8
2	0.8	0.60	1.3
3	1.3	0.75	1.7
4			
5	2.1	0.90	2.3
6	2.5	0.95	2.6

[2]

(iii) Calculate the resistance *R* for result **4**.

Use the equation shown.

$$R = \frac{V}{I}$$

Record in Table 5.1 your value of *R*. [1]

(iv) Suggest why it is good experimental practice to open the switch between readings.

....

.... [1]

(b) **(i)** On the grid, plot resistance *R* (vertical axis) against potential difference *V*.

[3]

(ii) Draw the line of best fit. [1]

(iii) Use your graph to describe the relationship between *R* and *V*.

....

.... [1]

(iv) A student says *R* is directly proportional to *V*.

State if the student is correct.

Explain your answer.

statement ....

explanation ....

....

[1]

[Total: 11]

6 A student does an experiment to calculate the spring constant *k* of a spring.

The spring constant is a measure of the stiffness of a spring.

The student uses the apparatus shown in Fig. 6.1.

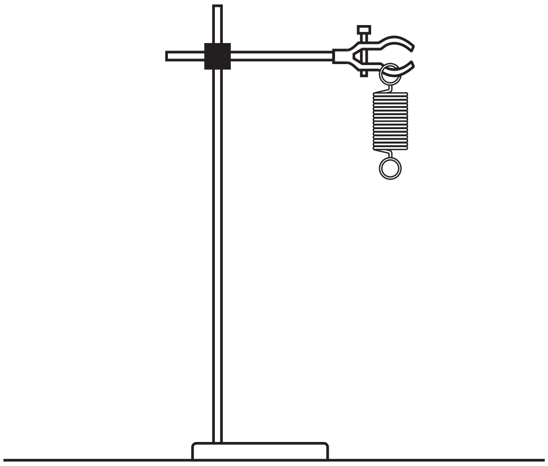

Fig. 6.1

(a) **(i)** Fig. 6.2 shows the unstretched spring drawn to a scale of one-half full size.

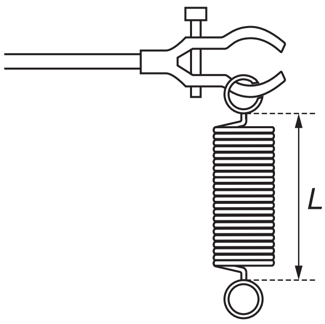

Fig. 6.2

Record the length *L* of the spring in cm to the nearest 0.1 cm.

L = ... cm [1]

(ii) Calculate the actual unstretched length l_0 of the spring.

l_0 = ... cm [1]

(iii) The student suspends a mass of 200 g from the spring and measures the length l_1.

Fig. 6.3 shows the bottom of the stretched spring and a ruler.

The zero end of the ruler is level with the top of the spring, not including the loop.

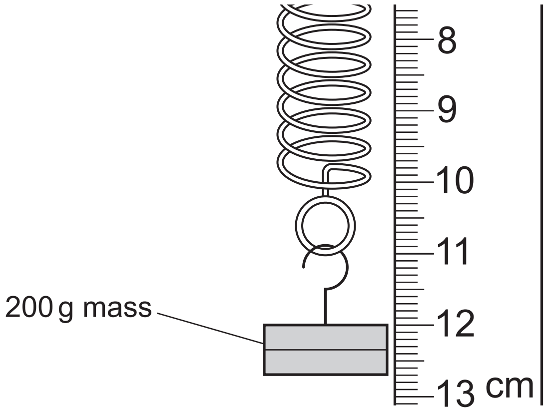

Fig. 6.3

Record the length l_1 of the spring.

Do **not** include the loop at the end of the spring in the measurement.

l_1 = ... cm [1]

(iv) Calculate the extension e of the spring.

Use the equation shown.

$$e = l_1 - l_0$$

e = ... cm [1]

(v) Calculate the spring constant k.

Use the equation shown.

$$k = \frac{2.0}{e}$$

k = ... N/cm [1]

(vi) Describe **one** technique you would use to obtain an accurate value for l_1.

....

.... [1]

(b) **(i)** A teacher does the same experiment and calculates the spring constant *k* as 0.25 N / cm.

Two values are considered to be equal within the limits of experimental error if they are within 10% of each other.

State if your value for *k* in **(a)(v)** and the teacher's value are equal within the limits of experimental error.

Justify your answer with a calculation.

....

.... [2]

(ii) Another student does the same experiment using a mass of 200 g but uses a spring with a larger spring constant.

Suggest a value for the extension *e*.

Explain your answer.

value .... cm

explanation ....

....
[1]

[Total: 9]

NOTES FOR USE IN QUALITATIVE ANALYSIS

Tests for anions

anion	*test*	*test result*
carbonate, CO_3^{2-}	add dilute acid, then test for carbon dioxide gas	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.
iodide, I^- [in solution]	acidify with dilute nitric acid, then add aqueous silver nitrate	yellow ppt.
nitrate, NO_3^- [in solution]	add aqueous sodium hydroxide, then aluminium foil; warm carefully	ammonia produced
sulfate, SO_4^{2-} [in solution]	acidify with dilute nitric acid, then add aqueous barium nitrate	white ppt.

Tests for aqueous cations

cation	*effect of aqueous sodium hydroxide*	*effect of aqueous ammonia*
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, ppt. turns brown near surface on standing	green ppt., insoluble in excess, ppt. turns brown near surface on standing
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

gas	*test and test result*
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

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

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