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PHYSICAL SCIENCE

0652/52

Paper 5 Practical Test

October/November 2020

1 hour 15 minutes

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 40.
- 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 | |
| Total | |

This document has **16** pages. Blank pages are indicated.

1 You are going to investigate the rate of reaction of magnesium with hydrochloric acid.

You are going to use 2 different solutions of hydrochloric acid, **H** and **J**.

(a) Procedure

- Measure 50 cm^3 hydrochloric acid **H** using a measuring cylinder and pour it into a conical flask.
- Set up the apparatus shown in Fig. 1.1.

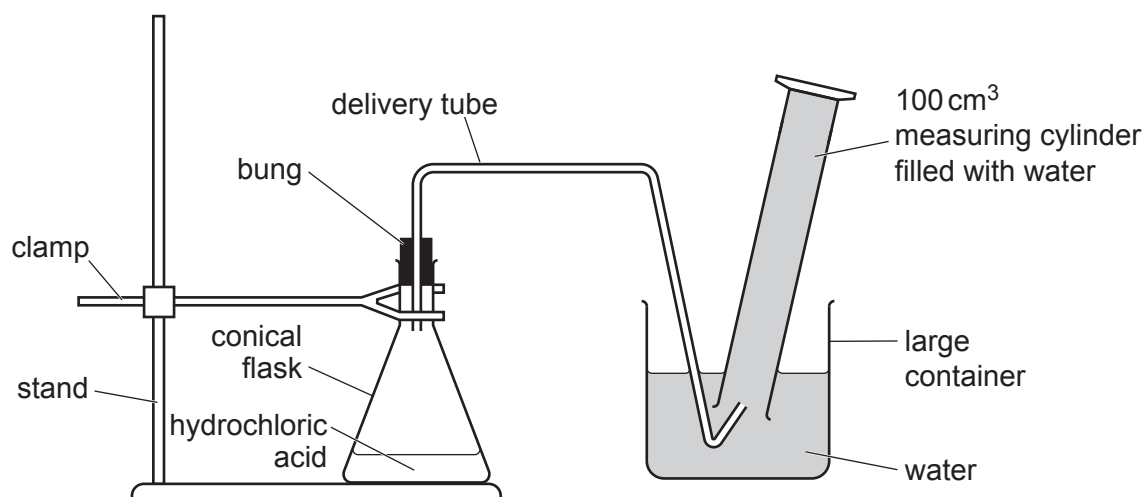


Fig. 1.1

- Remove the bung from the conical flask.
- Add one 6.0 cm length of magnesium ribbon to the conical flask.
- Replace the bung quickly. As soon as the bung is in place, start the stop-clock.
- Measure the volume of gas produced every 30 seconds for 4 minutes or until the measuring cylinder is full.

(i) Record in Table 1.1 on page 4 the volumes to the nearest 1 cm^3 .

[2]

- (ii) • Rinse the conical flask.
 • Repeat the procedure in (a) using 50 cm³ hydrochloric acid J.

Record in Table 1.1 the volumes to the nearest 1 cm³.

[2]

Table 1.1

| time/s | hydrochloric acid H volume of gas/cm ³ | hydrochloric acid J volume of gas/cm ³ |
|--------|--|--|
| 0 | | |
| 30 | | |
| 60 | | |
| 90 | | |
| 120 | | |
| 150 | | |
| 180 | | |
| 210 | | |
| 240 | | |

- (b) You are going to plot a graph of both sets of results on the same grid. Consider both sets of data before you add the scales to the axes.

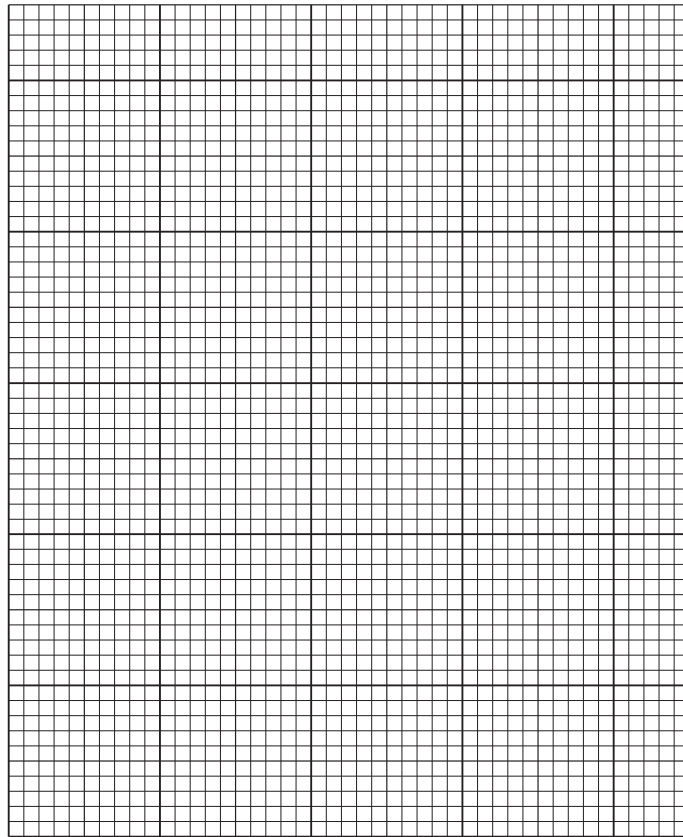
On the grid provided on page 5, plot a graph of volume of gas produced (vertical axis) against time for hydrochloric acid H.

Draw the line of best fit and label it H.

On the same grid, plot a graph of volume of gas produced (vertical axis) against time for hydrochloric acid J.

Draw the line of best fit and label it J.

[5]



(c) State which acid, **H** or **J**, is more concentrated.

Explain your answer by referring to the graph.

acid

explanation

..... [1]

(d) A student repeats the experiment with acid **H** but first heats the acid to 50°C. The same length of magnesium ribbon is used. The reaction happens more quickly.

Draw a line on the grid to show the results expected. Label the line **D**. [2]

(e) Suggest **one** change to the apparatus to improve the accuracy of the investigation.

.....

..... [1]

[Total: 13]

- 2 You are going to measure the spring constant k of a spring by two different methods. The spring constant k of a spring is a measure of the stiffness of the spring.

(a) **Method 1**

Measure the unstretched length l_0 of the spring in centimetres to the nearest millimetre. Do not include the loops at the end of the spring in your measurement.

$$l_0 = \dots\dots\dots \text{ cm [1]}$$

- (b) • Attach the spring to the clamp as shown in Fig. 2.1.

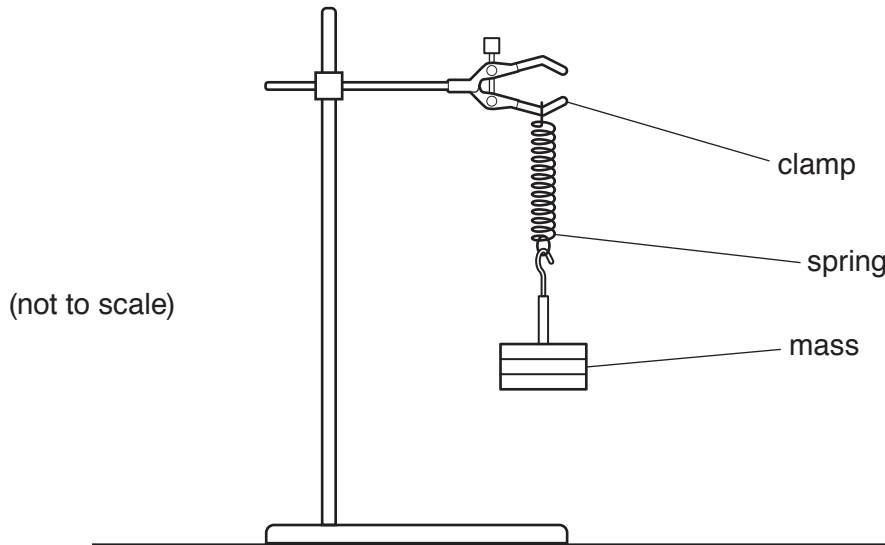


Fig. 2.1

- Hang a 0.3 kg mass (300 g) on the spring.

Measure the new length l_1 of the spring.

$$l_1 = \dots\dots\dots \text{ cm}$$

Leave the mass on the spring.

Calculate the extension e of the spring produced by the mass. Use the equation:

$$e = l_1 - l_0$$

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

- (c) Calculate the spring constant k of the spring. Use the equation:

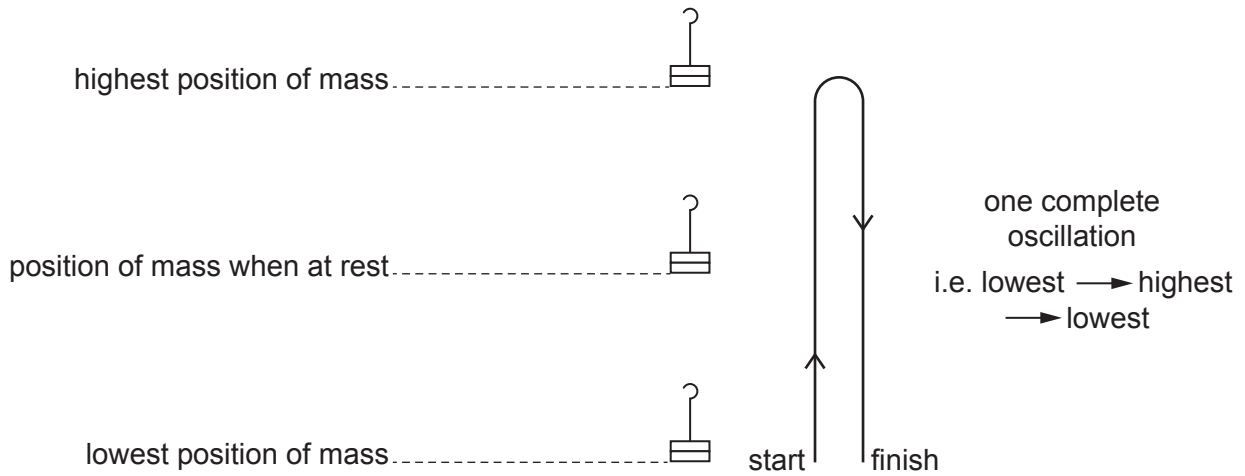
$$k = \frac{W}{e}$$

where the weight W of the mass = 3 N.

$$k = \dots\dots\dots \text{ N/cm [1]}$$

(d) Method 2

Pull the mass down approximately 2 cm and release it. The mass oscillates up and down. The period T of the oscillations is the time taken for **one** oscillation. One complete oscillation of the mass is shown in Fig. 2.2.

**Fig. 2.2**

- (i) • Measure the time t for 20 oscillations.

Record time t in Table 2.1.

[1]

Table 2.1

| mass m /kg | time t for 20 oscillations/s | period T /s | T^2 /s ² |
|--------------|-----------------------------------|---------------|-----------------------|
| 0.30 | | | |

- (ii) Use your answer from (i) to calculate the period T , the time for **one** oscillation of the mass. Record this value in Table 3.1. [1]

- (iii) Calculate the value of T^2 . Record your answer in Table 2.1 to two significant figures. [1]

- (e) Calculate the spring constant k of the spring. Use the equation:

$$k = \frac{0.12}{T^2}$$

$k =$ N/cm [1]

(f) Compare your values of k from (c) and (e).

Explain whether they agree with each other within the limits of experimental error.

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

(g) In both methods, it is important to avoid line-of-sight (parallax) errors when measuring the length of the spring and when timing the oscillations.

Describe how you avoided this error in each method.

length of the spring method
.....
.....

timing the oscillations method
.....
.....

[2]

[Total: 10]

Question 3 begins over the page

3 You are going to investigate the effective resistance of two different combinations of lamps.

The circuit shown in Fig. 3.1 has been set up for you. This is circuit 1.

The voltmeter in the circuit is not shown in the circuit diagram.

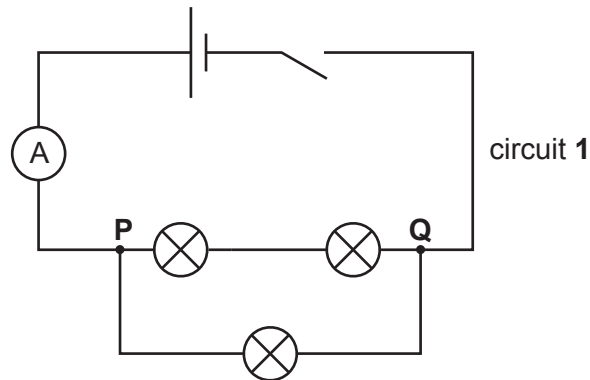


Fig. 3.1

(a) On Fig. 3.1, draw the symbol for the voltmeter connected to measure the potential difference (p.d.) between points **P** and **Q**. [1]

- (b)
- Close the switch.
 - Measure and record in Table 3.1 the potential difference V between **P** and **Q** and the current I .
 - Open the switch. [2]

Table 3.1

| | p.d. V/V | current I/A | resistance $R/.....$ |
|-----------|------------|---------------|----------------------|
| circuit 1 | | | |
| circuit 2 | | | |

(c) Reconnect the lamps between **P** and **Q** as shown in Fig. 3.2. This is circuit 2.

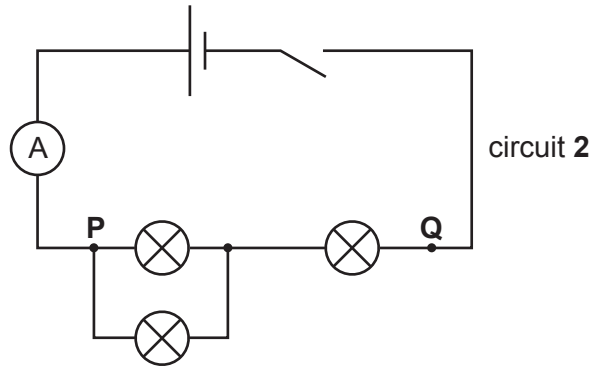


Fig. 3.2

Repeat the steps in (b). [2]

(d) (i) Complete the column headings in Table 3.1 by giving the unit for resistance R . [1]

(ii) Calculate and record in Table 3.1 the resistance R of circuits 1 and 2. Use the equation:

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

[2]

(e) A teacher makes the following statement.

“If each lamp has the same resistance,

$$\frac{\text{resistance of circuit 2}}{\text{resistance of circuit 1}} = 2.25”$$

State whether your results support the teacher’s suggestion. Justify your statement by using the values of R you have calculated in Table 3.1.

.....

 [1]

(f) The resistance of a lamp is altered by a change in the temperature of its filament.

During the experiment, a student observes that the lamps in the circuits have different brightnesses.

Suggest how this might have affected the results of this experiment.

.....
 [1]

[Total: 10]

4 Aqueous sodium hydroxide is an alkali.

When aqueous sodium hydroxide reacts with hydrochloric acid, a neutralisation reaction takes place and aqueous sodium chloride is made.

The word equation for this reaction is shown.



To make **pure** aqueous sodium chloride, the amount of aqueous sodium hydroxide added needs to be the exact amount to just neutralise the hydrochloric acid.

Plan an experiment to make a pure sample of sodium chloride **solid**.

You may use any common laboratory apparatus, aqueous sodium hydroxide, hydrochloric acid and any named indicator.

Your plan should include:

- a brief description of the method including the apparatus you would use
- safety precautions **and** explain why these are needed
- how you make sure the sodium chloride is pure
- the measurements you will make.

A diagram is not required but you may draw one if it helps to explain your plan.

You will **not** be doing this experiment.

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 (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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