Cambridge Assessment International Education

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CHEMISTRY **0620/53**

Paper 5 Practical Test **May/June 2024**

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	
Total	

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1 You are going to investigate the rate at which hydrogen gas is made when magnesium ribbon reacts with dilute ethanoic acid at two different temperatures.

Read all of the instructions carefully before starting the experiments.

Instructions
You are going to do two experiments using the apparatus shown in Fig. 1.1.

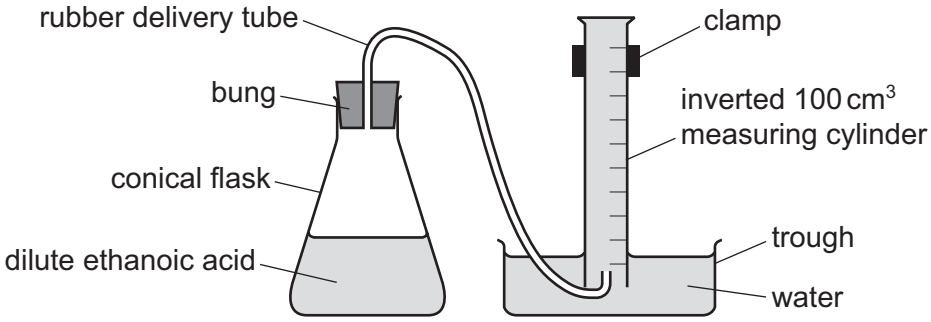


Fig. 1.1

(a) Experiment 1

- Use a 50 cm^3 measuring cylinder to pour 50 cm^3 of dilute ethanoic acid into a conical flask.
- Use a thermometer to measure the initial temperature of the dilute ethanoic acid. Record the initial temperature in Table 1.1.
- Set the apparatus up as shown in Fig. 1.1, ensuring the inverted 100 cm^3 measuring cylinder is full of water.
- Remove the bung from the conical flask, ensuring the delivery tube remains in the measuring cylinder.
- Add a coil of magnesium ribbon to the conical flask, immediately put the bung back into the conical flask and start the timer. If the magnesium sticks to the side of the flask, gently shake the flask so that it is washed off the side.
- Measure the volume of gas collected in the inverted measuring cylinder every 15 seconds for 150 seconds. Record the volume of gas collected in Table 1.2.
- Use the thermometer to measure the final temperature of the mixture in the conical flask. Record the final temperature in Table 1.1.
- Rinse out the conical flask with distilled water.

View solution

Experiment 2

- Repeat Experiment 1 but warm the acid by about 10 °C after it has been poured into the conical flask and before the initial temperature is measured and recorded in Table 1.1.
- Complete Table 1.1.

Table 1.1

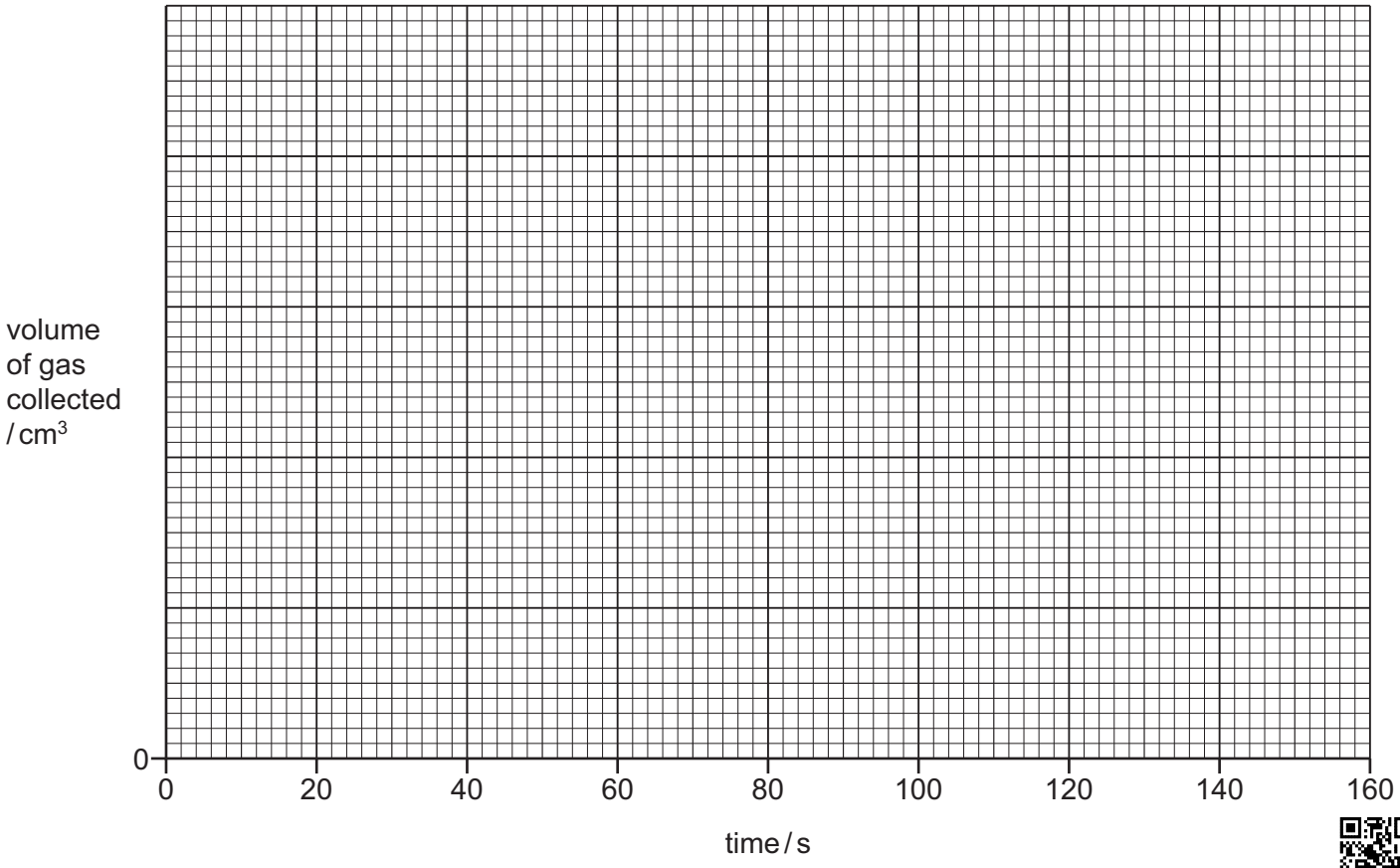
experiment	initial temperature / °C	final temperature / °C	average temperature / °C
1			
2			

Table 1.2

time / s	15	30	45	60	75	90	105	120	135	150
volume of gas collected in Experiment 1 / cm^3										
volume of gas collected in Experiment 2 / cm^3										

[5]

(b) Complete a suitable scale on the *y*-axis and plot your results for Experiments 1 and 2 on Fig. 1.2. Draw two lines of best fit. Both lines **must** start at (0,0). Label your lines.



View solution

Fig. 1.2

[4]

(c) Deduce the volume of gas collected between 50 seconds and 70 seconds in Experiment 1. Show clearly on Fig. 1.2 how you worked out your answer.

View solution

volume of gas collected between 50 seconds and 70 seconds ..... cm^3

[3]

(d) Use Fig. 1.2 to explain which experiment had the faster rate of reaction.

experiment with faster rate .....

explanation .....

.....

View solution [1]

(e) During Experiment 1, the temperature of the mixture in the conical flask changed.

(i) State how this change in temperature alters the rate of the reaction.

View solution

..... [1]

(ii) Describe how the apparatus could be altered to minimise the change in temperature.

View solution

.....

..... [1]

(f) Some gas escapes in the short time between adding the magnesium ribbon to the conical flask and putting the bung back into the conical flask.

Explain how the apparatus could be altered so that no gas escapes and the results of the experiment are more accurate. You may draw a diagram to help explain your answer.

View solution

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..... [2]

(g) Describe one **other** way in which the results of Experiments 1 and 2 could be made more accurate.

.....

..... [1]

(h) Sketch on Fig. 1.2 the graph you would expect when Experiment 2 is repeated using ethanoic acid with a higher concentration.

View solution

Label your line **H**. [1]

[Total: 19]

2 You are provided with one solid: solid **K**.

Do the following tests on solid **K**, recording all of your observations at each stage.

Tests on solid K

(a) Transfer approximately half of solid **K** to a boiling tube. Heat solid **K** gently and then strongly.

Record your observations.

View solution

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..... [2]

(b) Transfer the remaining solid **K** to a boiling tube. Add about 5 cm depth of dilute hydrochloric acid to the sample of solid **K** in the boiling tube. Test any gas produced.

Keep the solution made for use in the rest of this question.

View solution

Record your observations.

.....

..... [3]

The solution made in **(b)** is solution **L**. Decant solution **L** into four approximately equal portions in two boiling tubes and two test-tubes.

(c) To the first portion of solution **L** in a boiling tube, add aqueous ammonia dropwise until it is in excess.

Record your observations.

View solution

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..... [3]

(d) Gently warm the second portion of solution **L** in a boiling tube. Leave the hot solution to cool for a few minutes.

Record your observations.

View solution

..... [1]

(e) (i) To the third portion of solution **L**, add a few drops of aqueous potassium iodide.

View solution

Keep the product for use in (e)(ii).

Record your observations.

..... [1]

(ii) To the product from **(e)(i)**, add a few drops of aqueous starch.

View solution

Keep the product for use in (e)(iii).

Record your observations.

..... [1]

(iii) To the product from **(e)(ii)**, add about 2 cm depth of aqueous sodium thiosulfate.

View solution

Record your observations.

..... [1]

(f) Carry out a flame test on the fourth portion of solution **L**.

View solution

Record your observations.

..... [1]

(g) Identify solid **K**.

View solution

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..... [2]

[Total: 15]

3 Iron rusts slowly when exposed to water and air. There is an increase in mass when iron rusts as the insoluble solid hydrated iron(III) oxide forms.

View solution

Cast iron, mild steel and stainless steel are all alloys that contain iron.

Plan an experiment to find which of these three alloys rusts most quickly when exposed to water and air. Include in your answer how the results of the experiment will show which alloy rusts most quickly.

You are provided with powdered cast iron, powdered mild steel, powdered stainless steel and common laboratory apparatus.

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..... [6]

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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.
sulfite, SO_3^{2-}	add a small volume of acidified aqueous potassium manganate(VII)	the acidified aqueous potassium manganate(VII) changes colour from purple to colourless

Tests for aqueous cations

cation	effect of aqueous sodium hydroxide	effect of aqueous ammonia
aluminium, Al^{3+}	white ppt., soluble in excess, giving a colourless solution	white ppt., insoluble in excess
ammonium, NH_4^+	ammonia produced on warming	–
calcium, Ca^{2+}	white ppt., insoluble in excess	no ppt. or very slight white ppt.
chromium(III), Cr^{3+}	green ppt., soluble in excess	green ppt., insoluble in excess
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

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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
sulfur dioxide, SO_2	turns acidified aqueous potassium manganate(VII) from purple to colourless

Flame tests for metal ions

metal ion	flame colour
lithium, Li^+	red
sodium, Na^+	yellow
potassium, K^+	lilac
calcium, Ca^{2+}	orange-red
barium, Ba^{2+}	light green
copper(II), Cu^{2+}	blue-green

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