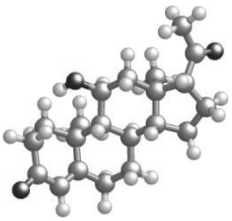

Chem!stry

Name: …… **( )**

Class: ……

Date: …… **/** …… **/** ……

Theory Questions for Practical Exam – Part One

1. Two metal salts, solution **E** and **F**, were analysed.

E was a mixture of iron(II) sulfate and ammonium sulfate.

The tests on the solutions and some of the observations are in the following table.

Complete the observations in the table.

tests	observations
Tests on Solution **E** **(a)** Appearance of solution **E**.	……
The solution was divided into three equal portions in separate test tubes. **(b)** Dilute nitric acid and aqueous barium nitrate were added to the first portion of the solution.	……
(c) **(i)** Sodium hydroxide was added dropwise, and then in excess, to the second portion of the solution. **(ii)** The mixture was filtered and the filtrate heated. The gas given off was tested with damp litmus paper.	…… …… …… ……
(d) Dilute sulfuric acid and aqueous potassium manganate(VII) were added to the third portion of the solution. Aqueous sodium hydroxide was then added dropwise to the mixture until it was in excess.	…… …… …… ……
Tests on Solution **F** **(e)** Appearance of solution **F**.	Yellow solution.
(f) Zinc powder was added to solution **F**. The solution was observed for five minutes. The gas given off was tested with a burning splint.	Rapid effervescence. Turned blue, green and finally light purple. Burning splint popped.

(g) Write an ionic equation for the reaction that takes place in **(b)**.

……...

(h) Write an ionic equation for the reaction that takes place in **(c) (i)**.

……...

(i) State the type of reaction that takes place between iron(II) sulfate and acidified potassium manganate(VII) in **(d)**.

……...

(j) What conclusions can you draw about the nature of solution **F**?

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2. Ethanedioic acid dihydrate, $H_2C_2O_4 \cdot 2H_2O$, is a white crystalline solid. The acid is soluble in water and can be found in the leaves of rhubarb, which is a type of vegetable.

Leaves of the rhubarb plant contain ethanedioic acid dihydrate.

Plan an experiment to obtain crystals of ethanedioic acid dihydrate from some rhubarb leaves. You are provided with common laboratory apparatus, water and sand.

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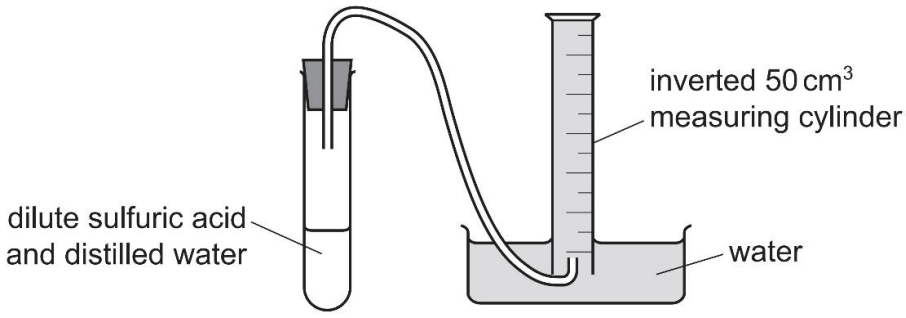
3. A student investigated the time take to collect 40 cm^3 of hydrogen gas when magnesium reacts with dilute sulfuric acid.

Five experiments were conducted using the apparatus shown below.



Experiment 1

- Using a measuring cylinder, 8 cm^3 of sulfuric acid was poured into the boiling tube.
- Using a second measuring cylinder, 12 cm^3 of distilled water was added to the acid in the boiling tube.
- The acid was set up as shown in the diagram, ensuring the inverted measuring cylinder was full of water.
- The bung was removed from the boiling tube.
- A coiled length of magnesium ribbon was added to the boiling tube. The bung was immediately replaced, and the timer started.
- The time taken for 40 cm^3 of gas to be collected was measured.
- The student felt the outside of the boiling tube.

(a) Write a balanced chemical equation for the reaction between dilute sulfuric acid and magnesium.

……...

(b) The student noticed that the boiling tube felt warm. What does this tell you about the type of rection that is taking place?

……...

(c) Describe one change that could be made to the apparatus to keep the temperature of the contents of the boiling tube constant during the reaction.

……...

Experiment 2

- The boiling tube was rinsed out with distilled water.
- Experiment 1 was repeated using 10 cm^3 of sulfuric acid and 10 cm^3 of distilled water.

Experiment 3

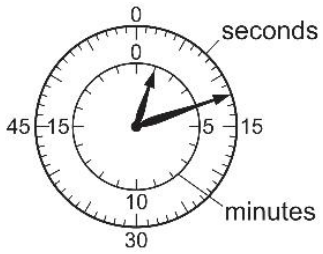
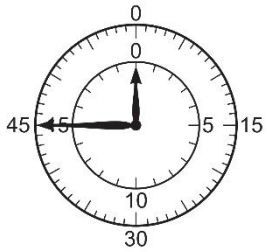
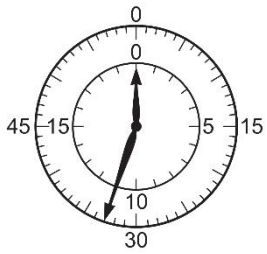
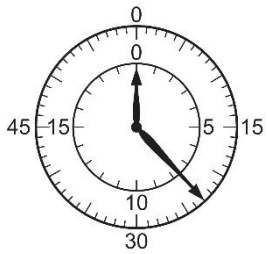
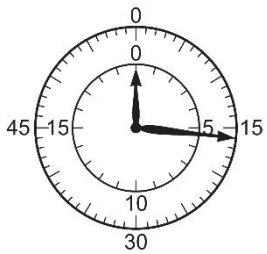
- Experiment 2 was repeated using 12 cm^3 of sulfuric acid and 8 cm^3 of distilled water.

Experiment 4

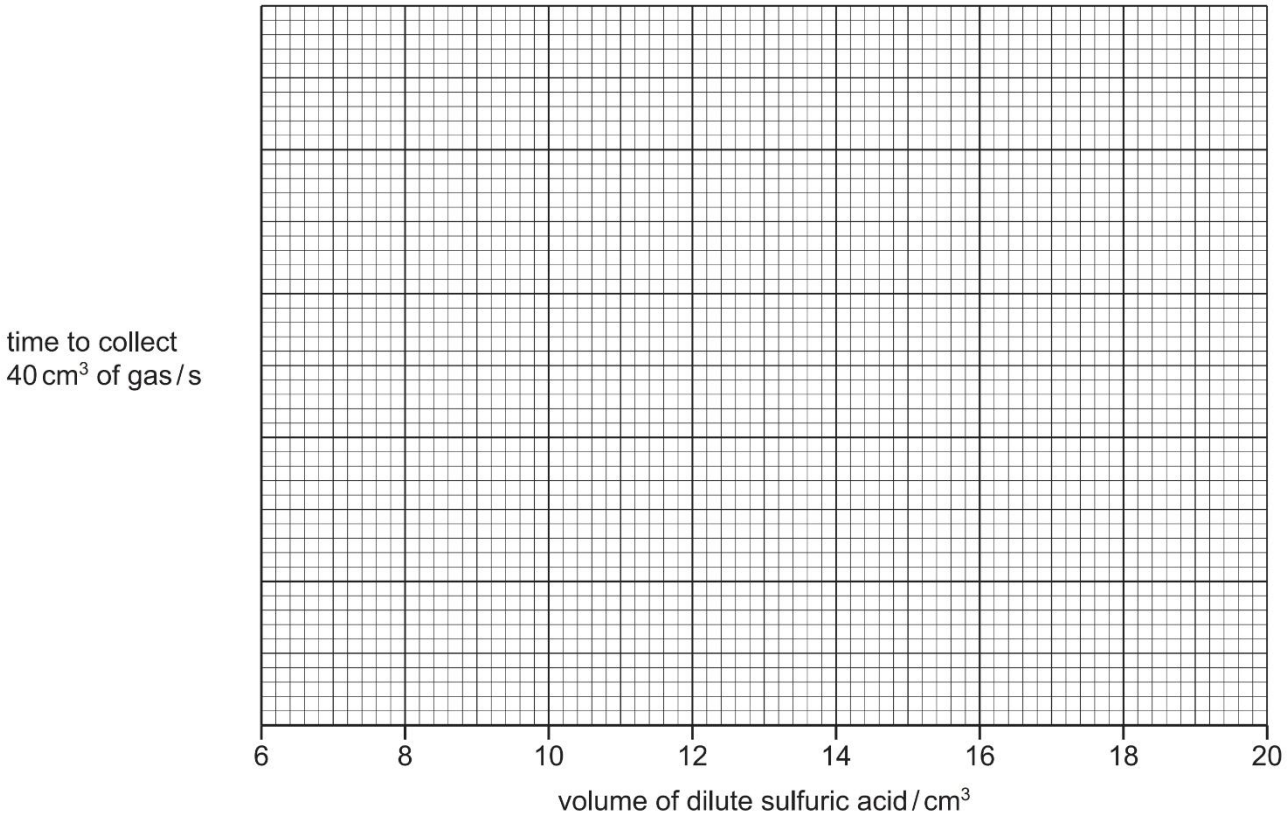
- Experiment 2 was repeated using 16 cm^3 of sulfuric acid and 4 cm^3 of distilled water.

Experiment 5

- Experiment 2 was repeated using 20 cm^3 of sulfuric acid and no distilled water.

experiment	volume of dilute sulfuric acid / cm^3	volume of distilled water / cm^3	timer diagram	time to collect 40 cm^3 of gas / s
1	8			
2	10			
3	12			
4	16			
5	20			

(d) Add a suitable scale to the *y*-axis and plot the results from Experiments 1 to 5 on the grid. Draw a smooth line graph through the points.



(e) **(i)** From your graph, deduce the time taken to collect 40 cm^3 of gas if the experiment was repeated using 9 cm^3 of dilute sulfuric acid.
Show clearly on the grid how you worked out your answer.

…… s

(ii) What volume of distilled water would be needed if the experiment was repeated using 9 cm^3 of dilute sulfuric acid?

…… cm^3

(f) The rate of reaction can be calculated using the equation shown:

$$\text{rate of reaction} = \frac{\text{volume of gas collected}}{\text{time taken to collect the gas}}$$

(i) Use this equation to calculate the rate of reaction in Experiment 1. Give the units for the rate of reaction you have calculated

rate of reaction = …… units = ……

(ii) In which Experiment, 1, 2, 3, 4 or 5, was the rate of reaction greatest?

.....

(g) Why would measuring the volume of dilute sulfuric acid with a burette rather than a measuring cylinder be an improvement?

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(h) The magnesium starts to react with the dilute sulfuric acid as soon as it is added.

(i) Why does this decrease the accuracy of the investigation?

.....

(ii) Describe **one** improvement that you could make to overcome this problem.

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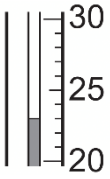
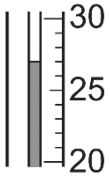
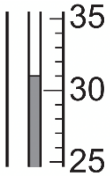
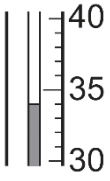
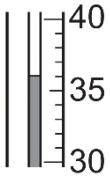
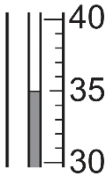
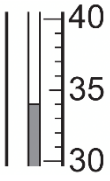
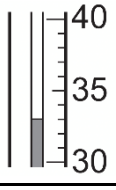
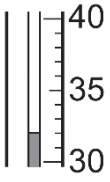
4. A student investigated the reaction of aqueous sodium hydroxide with two different acids, **G** and **H**.

Two experiments were carried out.

Experiment 1

- Using a measuring cylinder, 20 cm^3 of the solution of acid **G** was poured into a polystyrene cup. The initial temperature of the solution was measured.
- A burette was filled with aqueous sodium hydroxide to the 0.00 cm^3 mark. 5.00 cm^3 of aqueous sodium hydroxide was added to the solution of **G** in the cup and the mixture stirred. The maximum temperature of the solution was measured.
- A further 5.00 cm^3 of aqueous sodium hydroxide was added to the cup and the mixture stirred. The maximum temperature of the mixture was measured.
- Further 5.00 cm^3 portions of aqueous sodium hydroxide were added to the cup, until a total volume of 40.00 cm^3 of sodium hydroxide had been added. After each addition, the mixture was stirred and the maximum temperatures measured.

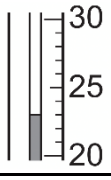
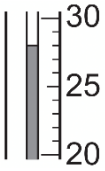
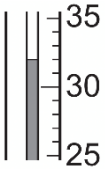
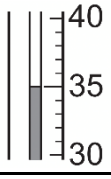
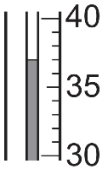
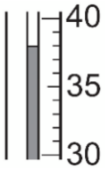
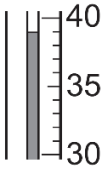
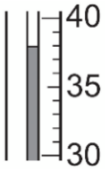
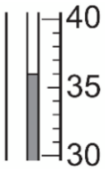
(a) Use the thermometer diagrams in the table to record the temperatures.

volume of aqueous sodium hydroxide added / cm^3	thermometer diagram	maximum temperature of solution in polystyrene cup / °C
0.00		
5.00		
10.00		
15.00		
20.00		
25.00		
30.00		
35.00		
40.00		

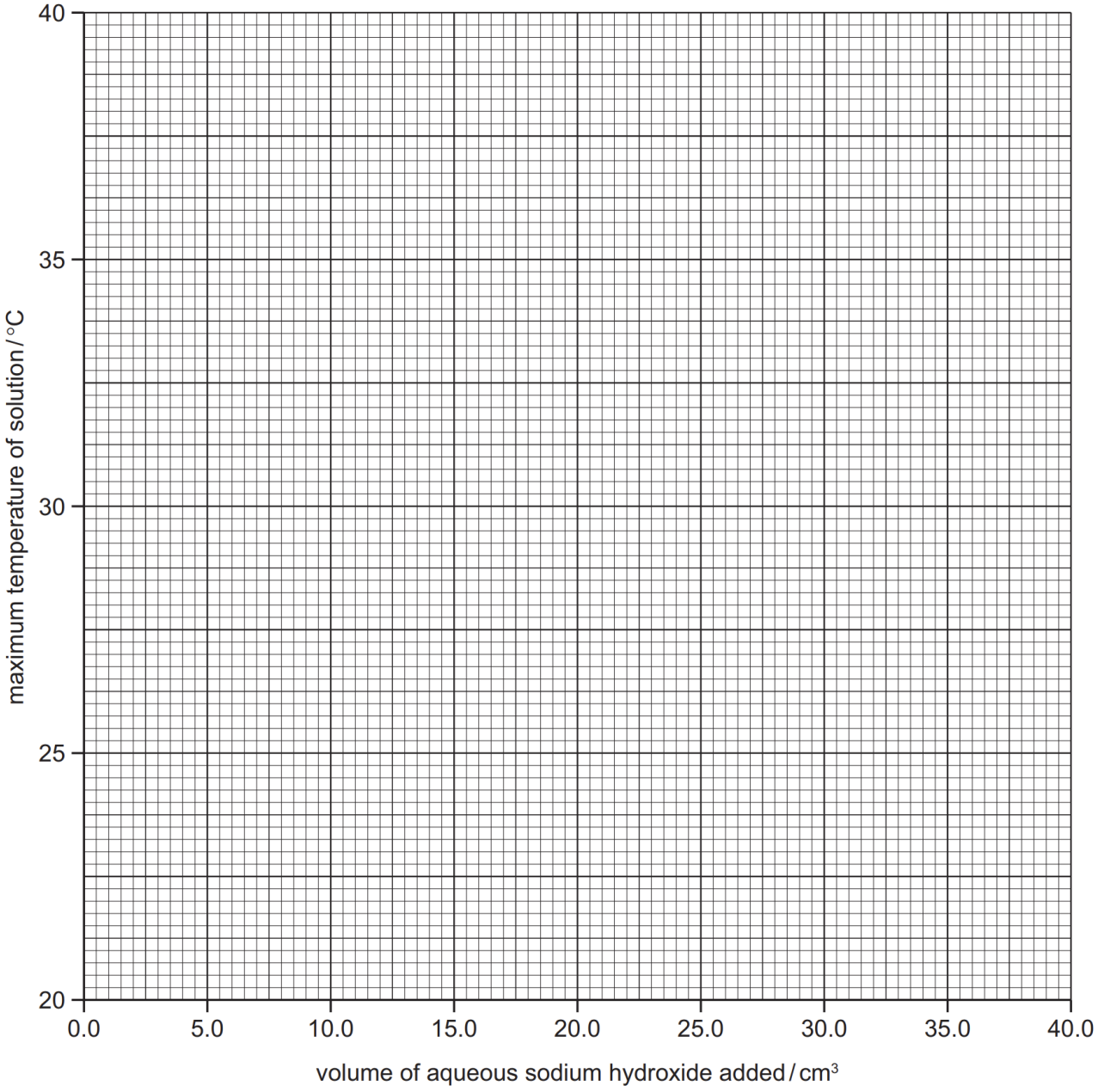
Experiment 2

- Experiment 1 was repeated using 20 cm^3 of the solution of acid **H** instead of the solution of acid **G**.

(b) Use the thermometer diagrams in the table to record the temperatures.

volume of aqueous sodium hydroxide added / cm^3	thermometer diagram	maximum temperature of solution in polystyrene cup / °C
0.00		
5.00		
10.00		
15.00		
20.00		
25.00		
30.00		
35.00		
40.00		

(c) Plot the results for Experiments 1 and 2 on the grid and draw two smooth line graphs. Clearly label your graphs.



(d) Use your graph to estimate the maximum temperature of the reaction mixture when 8.00 cm^3 of aqueous sodium hydroxide was added to 20 cm^3 of the solution of acid **G**. Show clearly on the graph how you worked out your answer.

.....

(e) What type of chemical reaction, other than neutralisation, occurs when acid **H** reacts with aqueous sodium hydroxide?

.....

(f) **(i)** In which experiment was the temperature change greater?

.....

(ii) Suggest why the temperature change was greater in this experiment.

……

……

(g) The thermal energy released during a neutralisation reaction can be calculated using the equation:

energy released (J) = mass of solution (g) x maximum temperature rise (^{o}C) $\times$ 4.2

Use your graph to determine the maximum change in temperature for Experiment 2, and hence calculate the thermal energy released during this reaction.
Assume that 1.0 cm^3 of solution has a mass of 1.0 g.

maximum change in temperature = …… ^{o}C

thermal energy released …… J

5. A mixture of two solids, **C** and **D**, was analysed. Solid **C** was lead(II) nitrate, which is water-soluble. Solid **D** was insoluble.

The tests on **C** and **D**, and some of the observations, are in the following table.

Complete the observations in the table.

tests	observations
Water was added to the mixture in a boiling tube and shaken. The contents of the tube were filtered. <u>Tests on Filtrate</u> **(a)** To about 1cm^3 of the solution, a few drops of dilute nitric acid and about 1 cm^3 of aqueous potassium iodide was added. **(b)** To about 1 cm^3 of the solution, sodium hydroxide solution and aluminium powder were added. The mixture was heated. Any gases given off were tested with damp pH indicator paper.	…… …… …… …… …… …… …… ……
<u>Tests on Residue</u> **(c)** Dilute hydrochloric acid was added to the residue. The gas given off was tested with limewater. The solution was divided into two equal portions. **(i)** To the first portion, aqueous sodium hydroxide was added a little at a time until in excess. **(ii)** To the second portion, aqueous ammonia solution was added a little at a time until in excess.	Rapid effervescence. Gas gives a white precipitate with limewater. White precipitate, dissolves in excess aqueous sodium hydroxide to give a colourless solution. White precipitate, dissolves in excess aqueous sodium hydroxide to give a colourless solution.

(d) Write the ionic equation for the reaction that takes place in **(a)**.

……...

(e) Identify the gas given off in **(c)**.

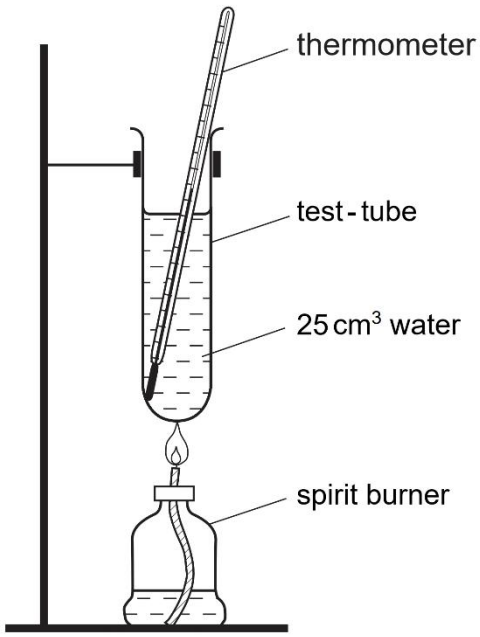
……...

(f) Identify solid **D**.

……...

6. Diesel is a liquid fuel obtained from crude oil. Biodiesel is a fuel made from oil obtained from the seeds of plants such as sunflowers.

Using the apparatus below plan an experiment to investigate which of these two fuels produces more energy.



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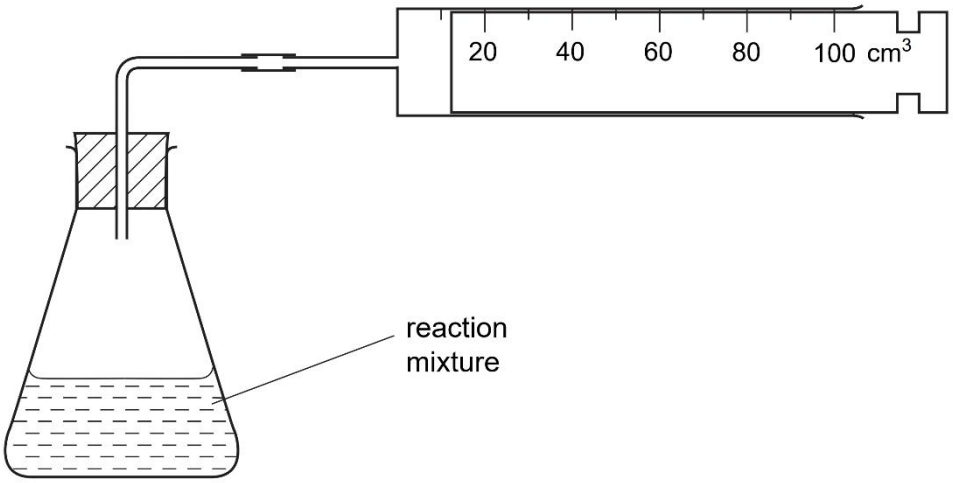
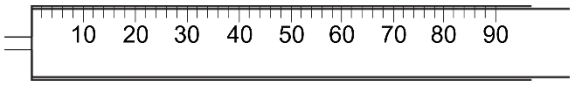
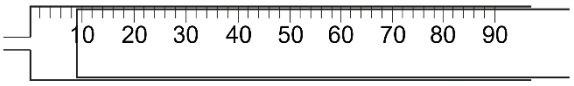
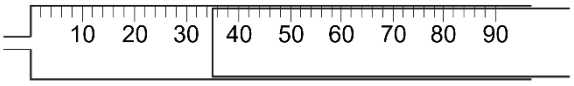
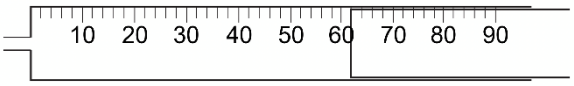
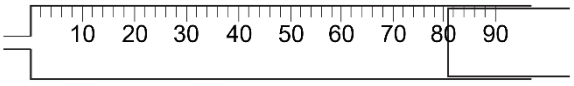
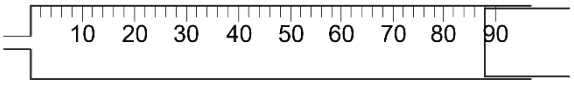
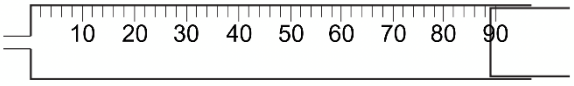
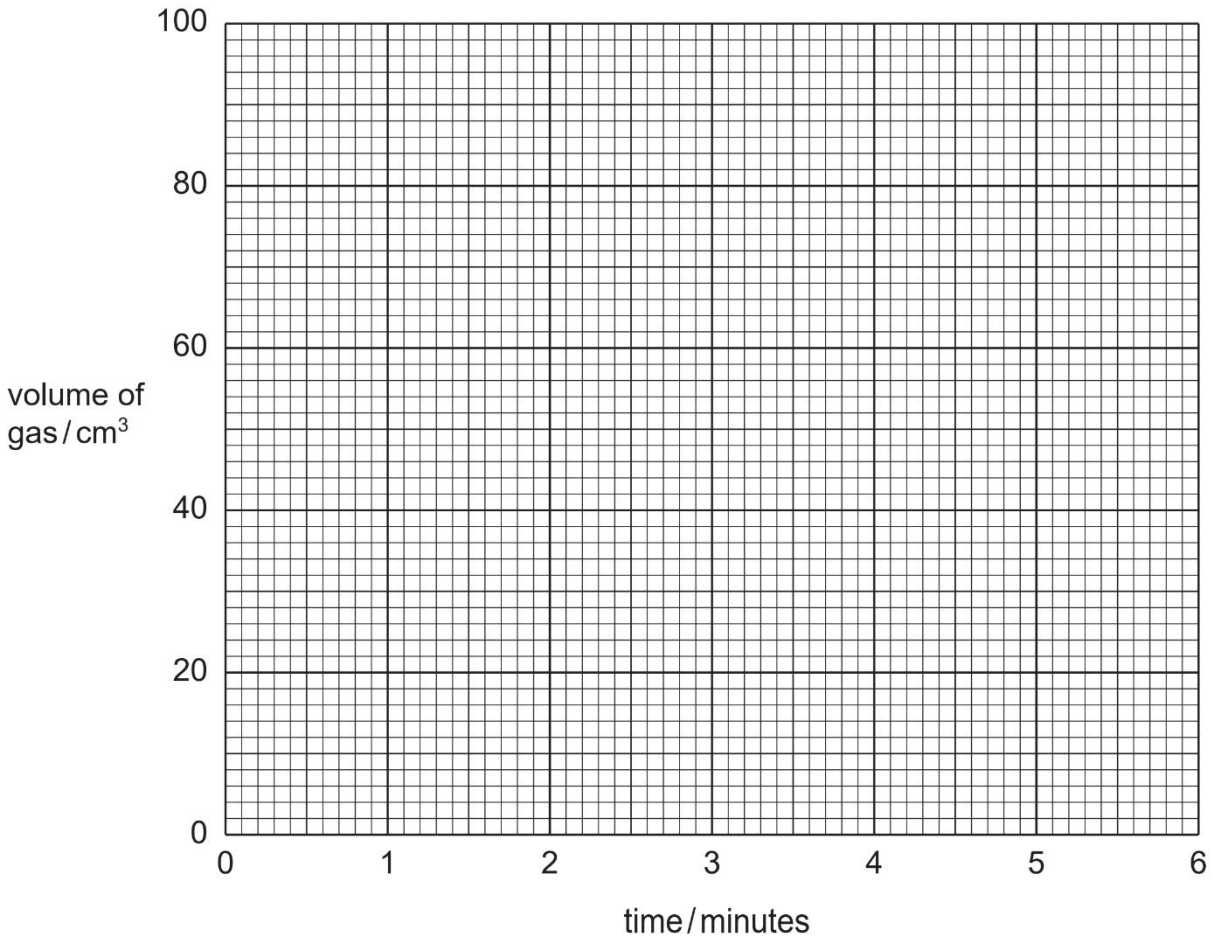
7. An investigation into the reaction of calcium with water was carried out using the apparatus below. The temperature of the water increased during the experiment.



The volume of hydrogen collected at one minute intervals was measured. Use the diagrams to record the volumes in the table.

time / minutes	syringe diagram	volume of gas / cm^3
0		
1		
2		
3		
4		
5		
6		

(a) Plot the results on the grid. Join all of the results with a smooth curve.



(b) Write a balanced chemical equation, including state symbols, for the reaction between calcium and water.

……...

(c) What type of chemical reaction occurs when calcium reacts with water?

……...

(d) **(i)** Use the graph to describe how the speed of this reaction changes during the six minutes.

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(ii) Explain possible reasons for the changes in **(d)(i)**.

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8. The manufacture of a health supplement claims that each tablet of its supplement contains 50% of vitamin C by mass. The health supplement was analysed to determine its vitamin C content.

For the analysis, one tablet of the supplement was dissolved completely in 250.0 cm^3 of distilled water. 20.0 cm^3 of the solution was pipetted out and titrated with sodium hydroxide. The data from the analysis is shown below.

Titration Data

Trial	1	2	3
Final burette reading / cm^3	27.95	27.50	27.40
Initial burette reading / cm^3	0.00	0.00	0.00
Volume of NaOH used / cm^3	27.95	27.50	27.40
Tick best results			

Mass of one tablet = 4.00 g

Concentration of aqueous sodium hydroxide = 0.0500 mol dm^{-3}

(a) Calculate the average volume of sodium hydroxide needed to completely react with 20.0 cm^3 of the vitamin C solution.

(b) Calculate the amount (in mol) of sodium hydroxide that reacted with 20.0 cm^3 of the vitamin C solution.

(c) Using H_2A to represent vitamin C, the chemical equation of vitamin C reacting with sodium hydroxide is as follows:

$$H_2A(aq) + 2NaOH(aq) \rightarrow Na_2A(aq) + 2H_2O(l)$$

Calculate the amount (in mol) of vitamin C in 20.0 cm^3 of the solution.

(d) Calculate the amount (in mol) of vitamin C in one tablet of the health supplement.

(e) Calculate the mass in grams of vitamin C in one tablet of the health supplement.

The relative molecular mass of vitamin C is 176.2.

(f) Comment on whether or not the manufacturer's claim is valid.

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9. **W** is a mixture of two compounds which together contain four ions.

The following table shows the tests a student did on **W**.

Any gas produced was tested.

Complete the table by describing the conclusion in test **(a)**, the observations in test **(b)** and the tests and observations in both **(c)** and **(d)**.

test	observation	conclusion
(a) **W** was dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.	A coloured solution was produced.	
(b) **(i)** To the first part, aqueous sodium hydroxide was added until a change was seen. **(ii)** An excess of aqueous sodium hydroxide was added was added to the mixture from **(i)**. **(iii)** The mixture from **(ii)** was heated.		**W** may contain Fe^{2+} ions. The presence of Fe^{2+} ions in **W** is confirmed. **W** contains NH_4^+ ions.
(c)		**W** contains SO_4^{2-} ions.
(d)		**W** contains Cl^- ions.

(e) Suggest the formula for each of the two compounds which could have been used to make up solution **W**.

…… and ……

10. The following table shows the tests a student performs on compound **Q**, and the conclusions that are drawn from the observations that are made.

test	observation	conclusion
(a) **Q** was dissolved in water and the solution divided into three parts for tests **(b)**, **(c)** and **(d)**.	A colourless solution is obtained.	
(b) **(i)**		**Q** may contain Al^{3+} ions, Ca^{2+} ions, Pb^{2+} ions or Zn^{2+} ions.
(ii)		**Q** may contain Ca^{2+} ions.
(c) To the second part, aqueous ammonia was added until a change was seen.		The presence of Ca^{2+} ions in **Q** is confirmed.
(d)		**Q** contains NO_3^- ions.

(e) Give the name and formula of compound **Q**.

……...

(f) Write the balanced chemical equation for the reaction that takes place in test **(b) (i)**.

……...

(g) Write the ionic equation for the reaction that takes place in test **(b) (i)**.

……...

11. Calcium ammonium nitrate, $CaNH_4(NO_3)_3$, is a water soluble compound.

Describe a series of tests, and the observations, to identify the calcium, ammonium and nitrate ions in a sample of $CaNH_4(NO_3)_3$.

Your description will need to explain how to prevent ammonium ions from interfering with the test for nitrate ions.

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12. **(a)** The reaction between aqueous barium chloride and dilute sulfuric acid produces a precipitate of barium sulfate. State the colour of this precipitate.

……...

A series of experiments are done to find the mass of precipitate formed when different volumes of dilute sulfuric acid are added to a fixed volume of aqueous barium chloride.

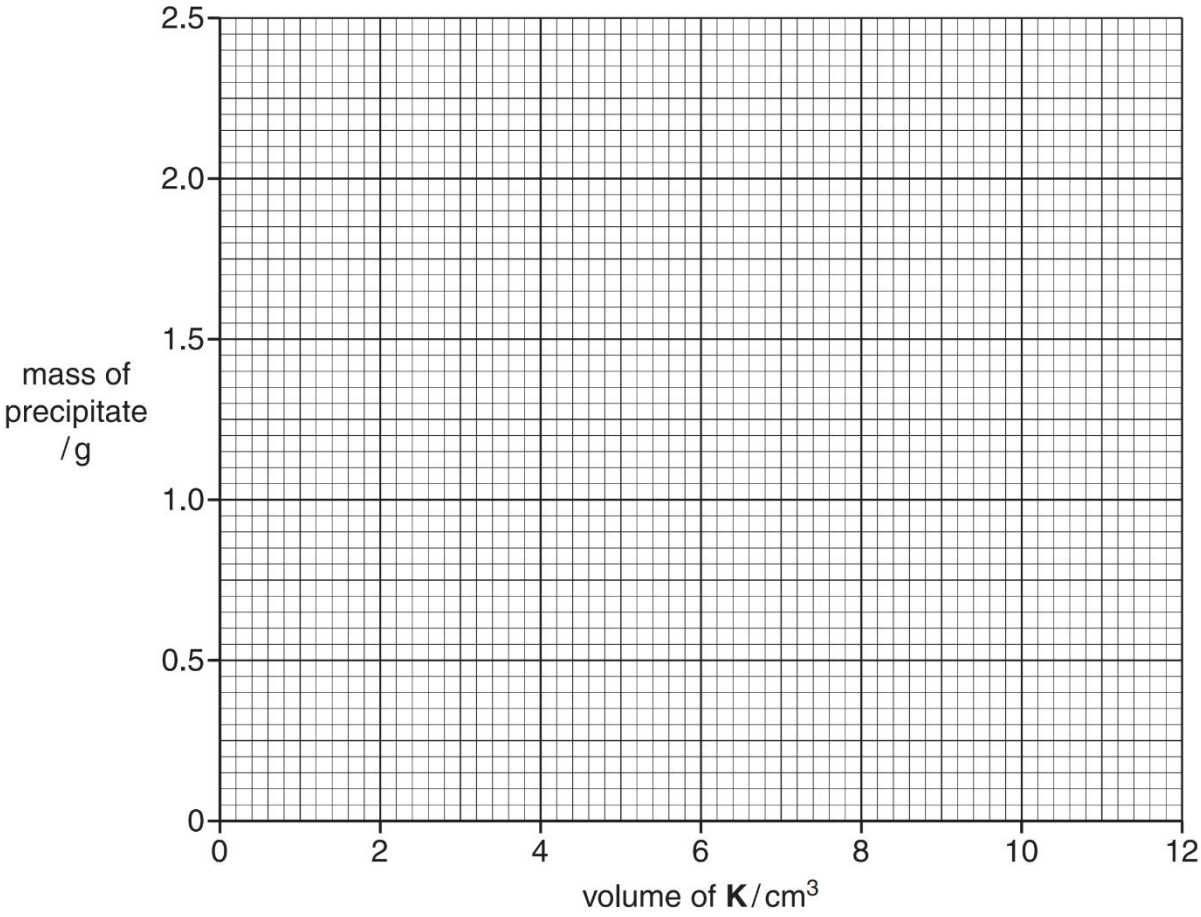
Solution **J** is 1.00 mol dm^{-3} barium chloride.
Solution **K** is sulfuric acid of unknown concentration.

10.0 cm^3 of solution **J** are poured into each of six test tubes. Increasing volumes of **K** are added to each test tube. The mixtures are filtered and the precipitates washed with water, dried and placed in a previously weighed container which is then reweighed.

(b) The table below shows the results of these experiments. Complete the final column.

volume of **J** / cm^3	volume of **K** / cm^3	mass of empty container / g	mass of container + precipitate / g	mass of precipitate / g
10.0	2.0	3.50	4.08	
10.0	4.0	3.50	4.55	
10.0	6.0	3.50	5.25	
10.0	8.0	3.50	5.83	
10.0	10.0	3.50	5.83	
10.0	12.0	3.50	5.83	

(c) Plot the mass of precipitate against the volume of **K** on the grid provide below. Join the points with **two** straight lines of best fit.



(d) One of the results is incorrect. Circle this result on your graph and suggest what the correct result should be.

…… g

(e) Use the data on your graph to deduce:

(i) The volume of **K** that would produce 1.50 g of precipitate.

…… cm^3

(ii) The maximum mass of precipitate that is produced.

…… g

(iii) The minimum volume of **K** that reacts completely with the maximum mass in **(ii)**.

…… g

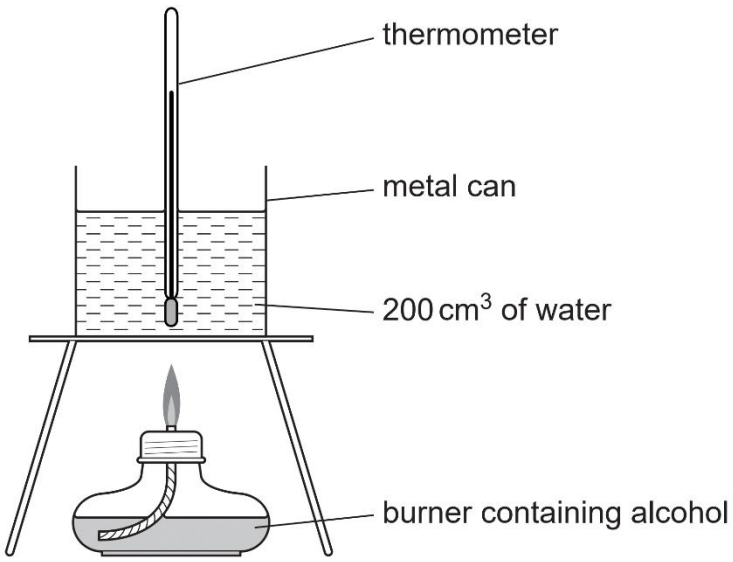
(f) Write the balanced chemical equation for the reaction between aqueous barium chloride and dilute sulfuric acid.

……...

(g) Using your answers to **(e) (iii)** and **(f)**, calculate the concentration of the sulfuric acid, **K**, used in the experiment.

…… mol dm^{-3}

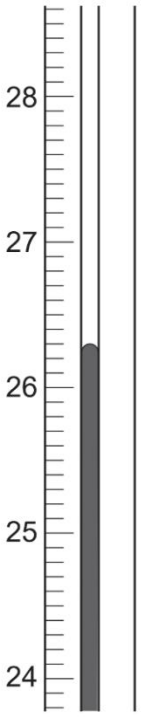
13. When alcohols burn, they give out heat. A student used the apparatus below to investigate the amount of heat produced when propan-1-ol was burnt.



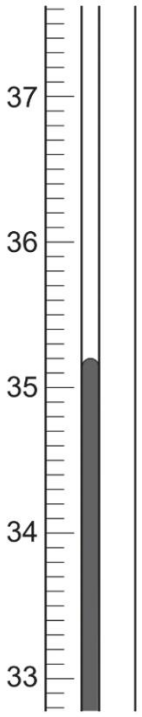
- Some propan-1-ol was put into the burner, which was then weighed.
- The initial temperature of the water was noted.
- The burner was lit and the flame was allowed to burn for several minutes.
- The flame was extinguished and the final temperature of the water was noted.
- The burner was reweighed.

The diagrams below show parts of the thermometer stem for each of the temperature readings.

initial temperature



final temperature



(a) Use the weighings and the thermometer readings to complete the following tables.

(i) Initial mass of burner + propan-1-ol = 70.12 g

Final mass of burner + propan-1-ol = 69.87 g

Mass of propan-1-ol burnt = …… g

(ii) Final temperature of water = …… °C

Initial temperature of water = …… °C

Rise in temperature = …… °C

(b) **(i)** Calculate the relative molecular mass of propan-1-ol, C_3H_7OH.

[A_r: H = 1.0, C = 12.0, O = 16.0]

……

(ii) Using your answers to **(a) (i)** and **(b) (i)**, calculate the moles of propan-1-ol burnt.

…… moles

(iii) Using your answers **(a) (ii)** and **(b) (ii)**, calculate ΔH, the heat produced when one mole of propan-1-ol was burnt by using this formula:

$$\Delta H = \frac{-0.84 \times \text{rise in temperature}}{\text{number of moles of propanol burnt}} \text{ kJ/mol.}$$

…… kJ mol^{-1}

(c) What general name is given to a reaction having a negative value of ΔH?

……...

(d) A reference book gives the value of ΔH as –2010 kJ mol^{-1}.

Suggest **two** reasons why the value obtained in the experiment was **less** than this.

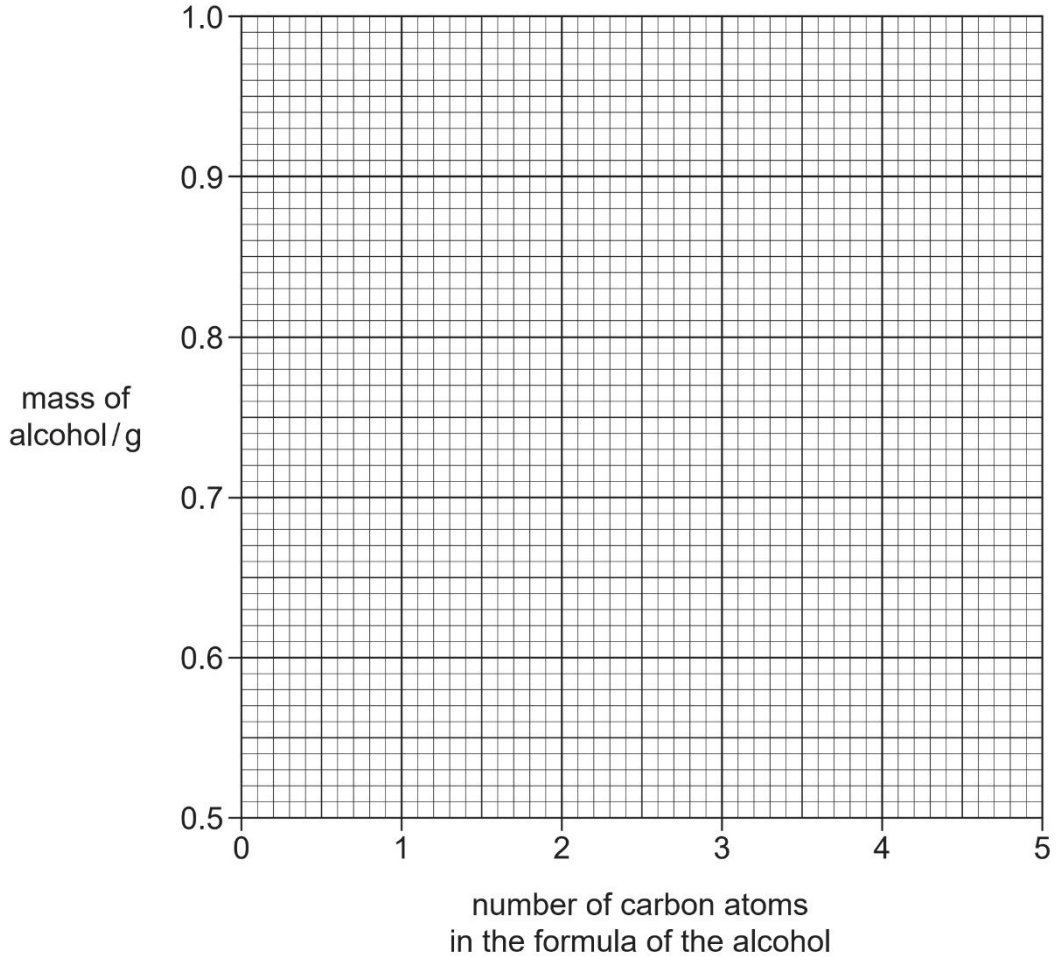
1. ……
2. ……

The experiment was repeated using four different alcohols. Each burner in turn was weighed and then the alcohol was allowed to burn until the temperature of the water had risen by 15 °C. The flame was then extinguished and the burner reweighed.

The following results were obtained.

alcohol	formula	mass of alcohol burned / g
methanol	CH_3OH	0.90
ethanol	C_2H_5OH	0.70
propan-1-ol	C_3H_7OH	0.62
pentan-1-ol	$C_5H_{11}OH$	0.57

(e) Plot the points on the grid below and draw a smooth curve through the points.



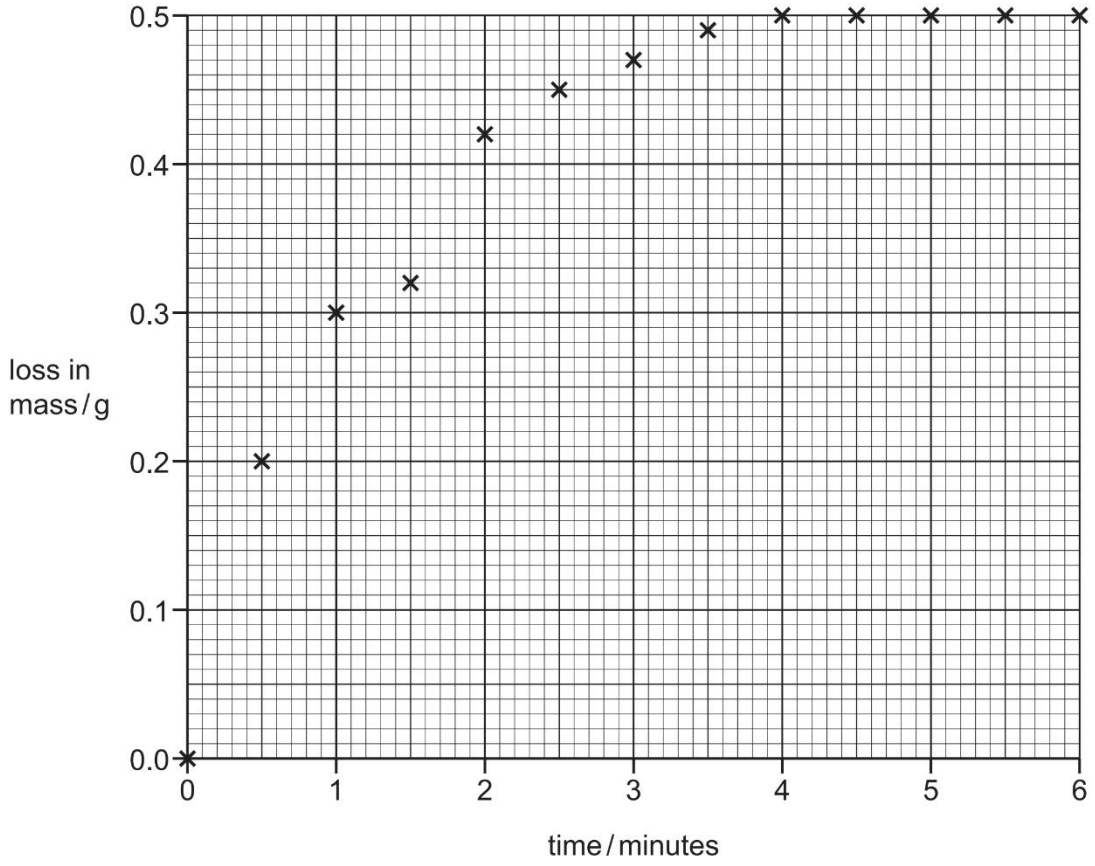
(f) Predict the mass of butan-1-ol, C_4H_9OH, which, on combustion, would raise the temperature of the water by 15 °C.

…… g

14. An experiment was carried out to measure the speed (rate) of reaction between magnesium carbonate and excess dilute nitric acid.

50 cm^3 of dilute nitric acid was poured into a conical flask and placed on a balance. 1.0 g of powdered magnesium carbonate was added to the flask. The mass of the flask and its contents decreased as carbon dioxide gas was given off. The loss in mass was recorded every 30 seconds for six minutes.

The results of the experiment are shown, plotted on the axes below.



(a) Suggest a hazard symbol that should be used to label the bottle of dilute nitric acid.

……

(b) Draw a smooth line graph through the points plotted on the axes above.

(c) Explain why the graph for this experiment should pass through the origin (0, 0).

……

……

(d) How long does the reaction take to finish?

……

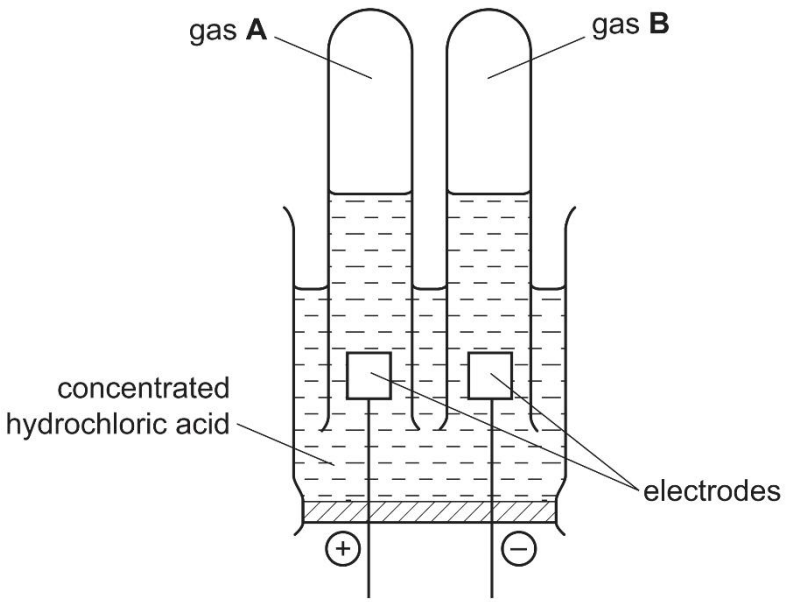
(e) Explain why the curve levels out to a constant mass.

……

……

(f) The experiment was repeated using 0.5 g of granular (lumps) magnesium carbonate. On the axes above, sketch the graph that you would expect to obtain for this reaction.

15. Electricity was passed through a solution of concentrated hydrochloric acid for 5 minutes. The results are shown below.



(a) Name gas **A** and state the qualitative test for this gas.

……...

……...

(b) Name gas **B** and state the qualitative test for this gas.

……...

……...

(c) Suggest a suitable material that the electrodes could be made from.

……...

(d) With reference to a suitable balanced chemical equation, explain why the volume of gas **A** and the volume of gas **B** are the same.

……...

……...

……...

(e) State one variable that could be increased in order to produce larger volumes of gas **A** and gas **B** in within the same duration of 5 minutes.

……...

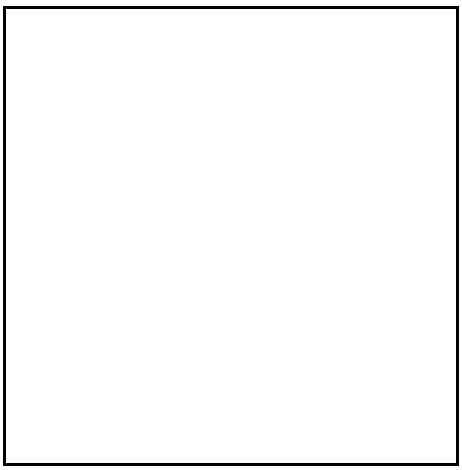
(f) How would the results of this experiment be different if **dilute** hydrochloric acid were used in place of the original **concentrated** hydrochloric acid?

……...

……...

……...

- Scan the QR code below to view the answers to this assignment.



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