OCR GCSE GATEWAY CHEMISTRY A · J248

CHEMISTRY



EXAM QUESTION PACK

C3.3 TYPES OF CHEMICAL REACTIONS

SCORE	PERCENTAGE
/224	%

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Gateway Chemistry A (9-1)

Types of chemical reactions

Please note that you may see slight differences between this paper and the original.

Candidates answer on the Question paper.

OCR supplied materials:
Additional resources may be supplied with this paper.

Other materials required:
- Pencil
- Ruler (cm/mm)

Duration: Not set

Candidate forename		Candidate surname	

Centre number						Candidate number				

INSTRUCTIONS TO CANDIDATES

- Write your name, centre number and candidate number in the boxes above. Please write clearly and in capital letters.
- Use black ink. HB pencil may be used for graphs and diagrams only.
- Answer **all** the questions, unless your teacher tells you otherwise.
- Read each question carefully. Make sure you know what you have to do before starting your answer.
- Where space is provided below the question, please write your answer there.
- You may use additional paper, or a specific Answer sheet if one is provided, but you must clearly show your candidate number, centre number and question number(s).

INFORMATION FOR CANDIDATES

- The quality of written communication is assessed in questions marked with either a pencil or an asterisk. In History and Geography a *Quality of extended response* question is marked with an asterisk, while a pencil is used for questions in which *Spelling, punctuation and grammar and the use of specialist terminology* is assessed.
- The number of marks is given in brackets **[ ]** at the end of each question or part question.
- The total number of marks for this paper is **224**.
- The total number of marks may take into account some 'either/or' question choices.

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1 Fahmida does three chemical tests on an unknown solution.

Look at her results.

Chemical test	Result
pH probe	pH value is 3
dilute hydrochloric acid followed by barium chloride solution	white precipitate
dilute nitric acid followed by silver nitrate solution	white precipitate

Which ions are present in the solution?

Choose from:

calcium **hydrogen** **iron(II)** **chloride** **sulfate**

Explain your answer.

---

[4]

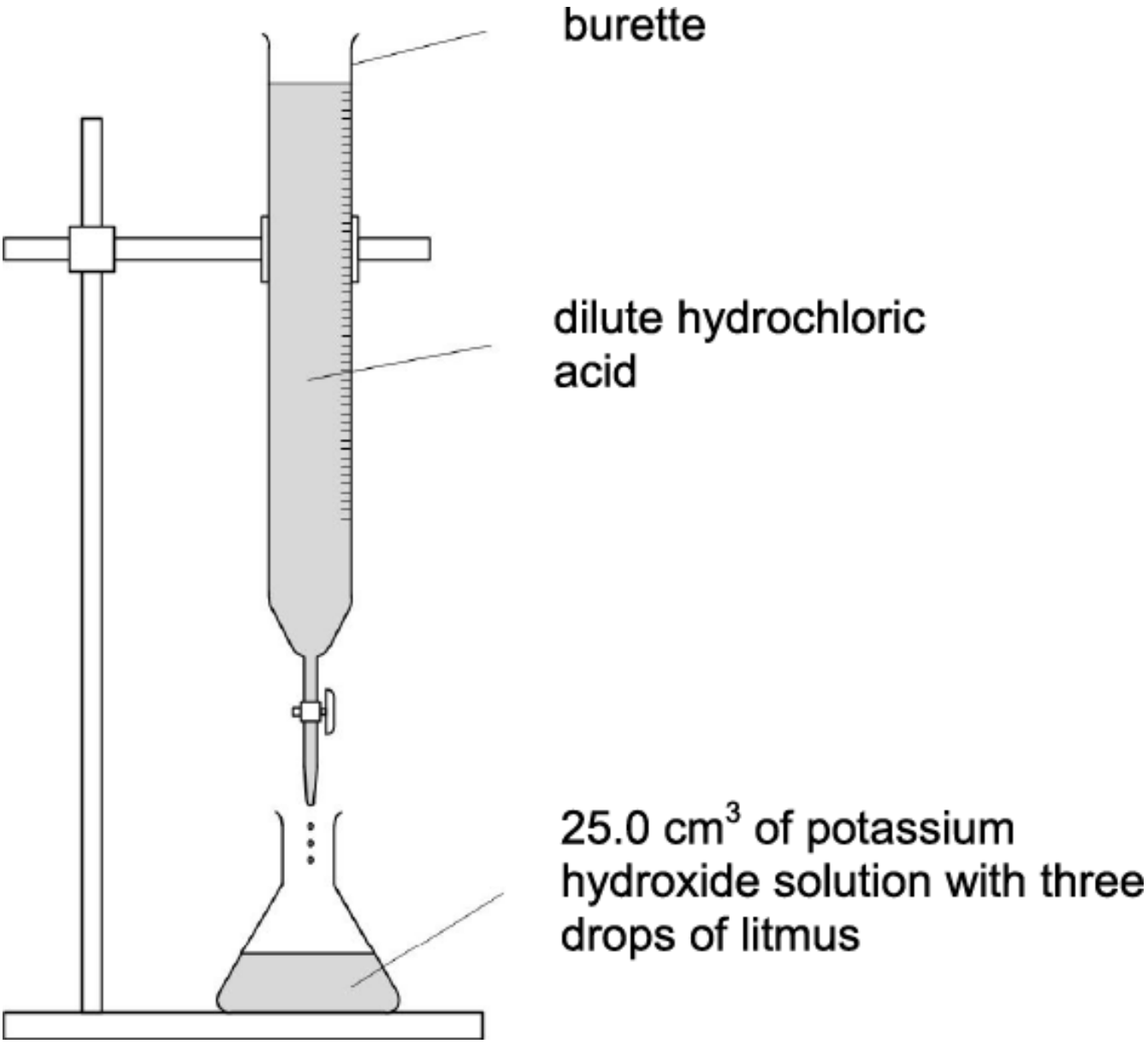
2(a) Sarah does three titrations with dilute hydrochloric acid and potassium hydroxide solution.

Look at the apparatus she uses.

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In her first titration Sarah measures the initial volume of hydrochloric acid in the burette.

She slowly adds the acid until the potassium hydroxide is just neutralised.

She then measures the volume of the hydrochloric acid again.

Describe how Sarah can tell when the potassium hydroxide solution is just neutralised.

---

[2]

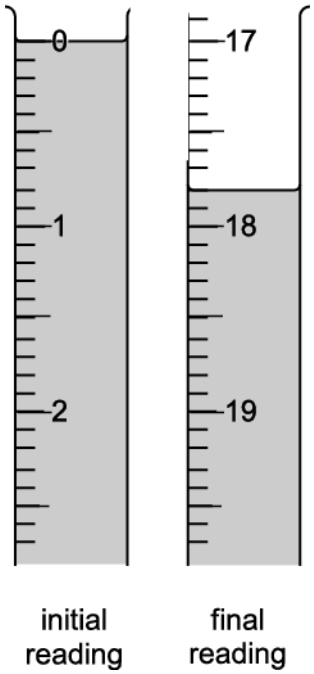
(b) Look at the diagrams. They show parts of the burette during the first titration.

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first titration



Here is Sarah's results table.

Titration number	1	2	3
final reading in cm^3		37.5	32.1
initial reading in cm^3		20.4	15.0
titre (volume of acid added) in cm^3		17.1	17.1

(i) **Complete** the table by reading the burette readings from the diagrams.

[2]

(ii) Sarah thinks the mean titre is 17.1 cm^3.

Is she correct?

Explain your answer.

---

[1]

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3 Ammonium sulfate is a salt.

It is manufactured using the reaction between the alkali ammonia and sulfuric acid.

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$

What type of reaction is this?

[1]

4 Hardeep does some experiments with acids and alkalis.

He measures the pH of a sample of acid and a sample of alkali.

He adds magnesium metal to a sample of the acid and to a sample of the alkali.

What results should Hardeep expect?

	Results for acid experiments	Results for alkali experiments
A	pH below 7 no reaction with magnesium	pH above 7 magnesium fizzes
B	pH below 7 magnesium fizzes	pH above 7 no reaction with magnesium
C	pH above 7 magnesium fizzes	pH above 7 no reaction with magnesium
D	pH above 7 no reaction with magnesium	pH below 7 magnesium fizzes

Your answer ☐

[1]

5 Ann neutralises nitric acid with potassium hydroxide solution.

Which of these shows the **ionic** equation for neutralisation?

A $HNO_3 + KOH \longrightarrow KNO_3 + H_2O$

B $H^+ + OH^- \longrightarrow H_2O$

C $NO_3^- + K^+ \longrightarrow KNO_3$

D $H^+ + NO_3^- \longrightarrow HNO_3$

Your answer ☐

[1]

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6 A student investigates some acids.

She has a solution of hydrochloric acid of concentration 0.01 mol/dm^3.

This solution has a pH of 2.

She increases the concentration of hydrochloric acid from 0.01 mol/dm^3 to 0.1 mol/dm^3.

What is the pH of this new solution?

A 0
B 1
C 3
D 12

Your answer ☐

[1]

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7(a) Zinc nitrate can be made by reacting zinc oxide with nitric acid, HNO_3.

Paul suggests this method for preparing zinc nitrate.

1. Measure $50cm^3$ of dilute nitric acid into a beaker. 2. Add one spatulaful of zinc oxide. 3. Heat the mixture until crystals of zinc nitrate are made.

Paul's method will not make a pure dry sample of zinc nitrate.

What improvements should Paul make to the method to make sure that:

- the reaction is complete
- the zinc nitrate can be separated from the nitric acid and the zinc oxide?

Explain your answer.

---

[4]

(b) Describe why this reaction is a neutralisation reaction.

---

[2]

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8 Magnesium burns in oxygen to make magnesium oxide.

The reaction involves both oxidation and reduction.

$$2Mg(s) + O_2(g) \longrightarrow 2MgO(s)$$

magnesium + oxygen ⟶ magnesium oxide

Complete the sentence.

During this reaction, the oxidising agent is _____ and the

reducing agent is _____.

[1]

9 A student adds calcium to dilute hydrochloric acid. The mixture begins to fizz.

Write a balanced symbol equation for this reaction.

[2]

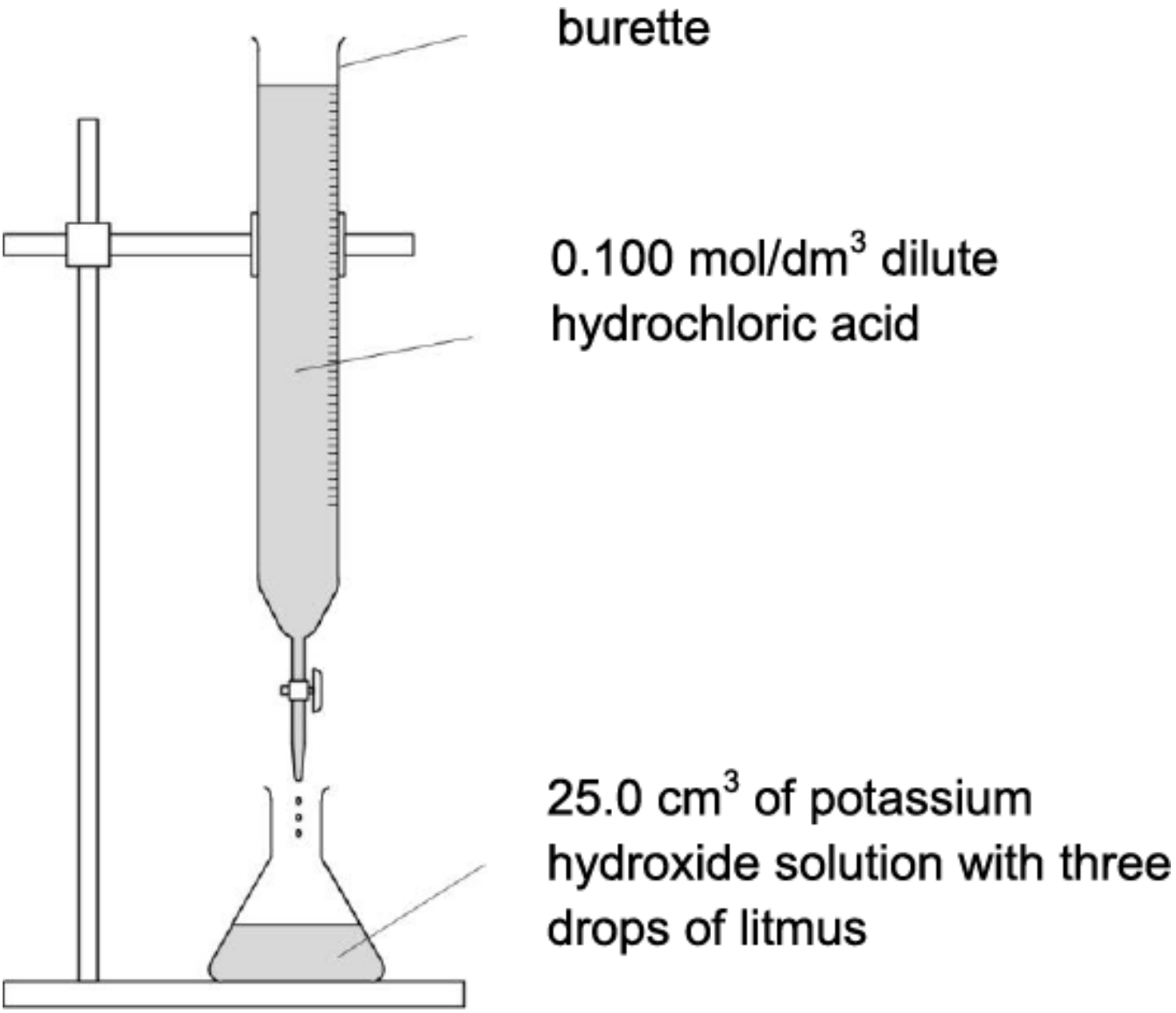
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10(a) Sarah does three titrations with dilute hydrochloric acid and potassium hydroxide solution.

Hydrochloric acid neutralises the alkali potassium hydroxide.

$$HCl(aq) + KOH(aq) \rightarrow KCl(aq) + H_2O(l)$$

Look at the apparatus she uses.



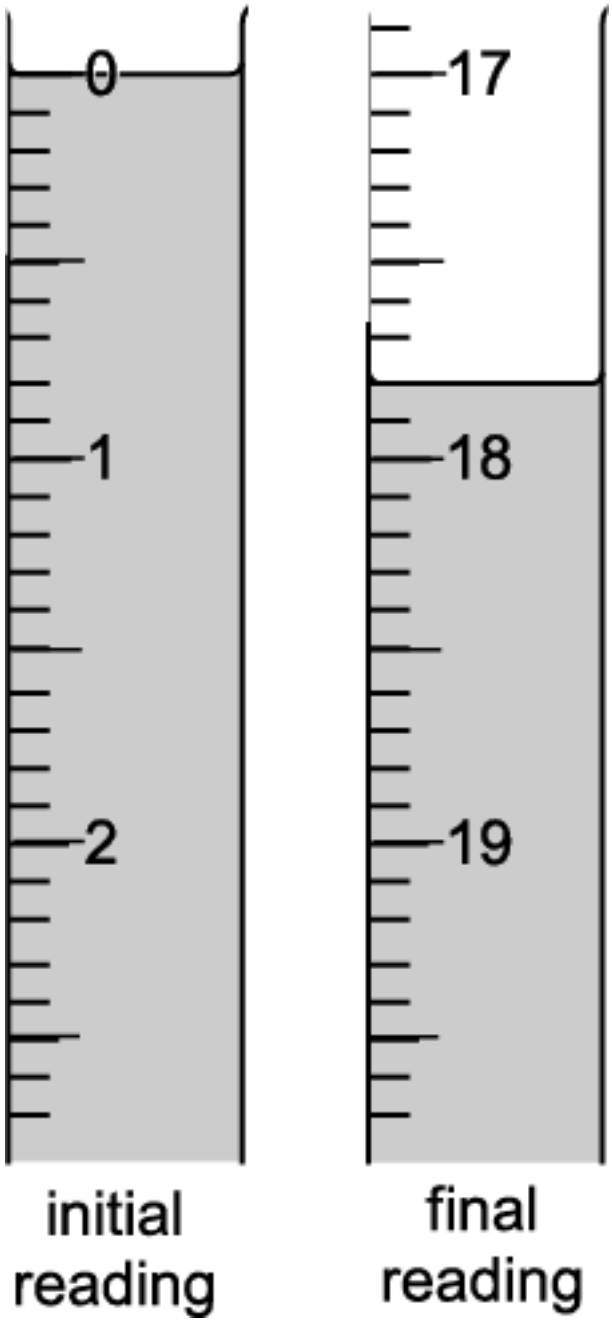
Look at the diagrams. They show parts of the burette during the first titration.

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First titration



Here is Sarah's results table:

Titration number	1	2	3
final reading (cm^3)		37.5	32.1

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initial reading (cm^3)		20.4	15.0
titre (volume of acid added) (cm_3)		17.1	17.1

Use the diagrams and table to help you calculate the mean titre.

Explain your answer.

Mean titre = _____ cm^3 **[2]**

(b) Sarah uses 25.0 cm^3 of potassium hydroxide solution, KOH.

She also uses hydrochloric acid with a concentration of 0.100 mol/dm^3.

Calculate the concentration, in mol/dm^3, of the KOH(aq).

Concentration of KOH(aq) = _____ mol/dm^3 **[2]**

(c) Use your answer to **(b)** to calculate the concentration of the KOH(aq) in g/dm^3.

Concentration of KOH(aq) = _____ g/dm^3 **[2]**

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11 Ammonium sulfate is a salt.

It is made using the reaction between the alkali ammonia and sulfuric acid.

$$2NH_3 + H_2SO_4 \rightarrow (NH_4)_2SO_4$$

(i) Describe how a sample of solid ammonium sulfate is prepared in a laboratory.

Explain why this method is not suitable to be used industrially.

---

[4]

(ii) Predict the maximum mass of ammonium sulfate that can be made from 51 tonnes of ammonia.

Maximum mass = _____ tonnes [2]

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12 Phil investigates some exothermic and endothermic reactions.

He measures the temperature changes during some chemical reactions.

Look at the table. It shows his results.

Reaction	Temperature at start (°C)	Temperature at end (°C)	Temperature change (°C)
A	15	25	+10
B	15	15	0
C	18	15	−3
D	15	20	+5

What can you conclude about the **type** of energy change in each reaction?

Explain your answer.

[4]

13 Magnesium oxide reacts with water to make an alkaline solution.

Describe how you would measure the pH of the magnesium hydroxide solution.

A pH meter is **not** available.

[3]

(i) Zinc nitrate, $Zn(NO_3)_2$, can be made by reacting zinc oxide, ZnO, with nitric acid, HNO_3.

Water, H_2O, is also made.

Write a **balanced symbol** equation for this reaction.

[2]

(ii) Paul suggests this method for preparing zinc nitrate.

1 Measure 50 cm^3 of dilute nitric acid into a beaker.
2 Add 1 spatulaful of zinc oxide.
3 Heat the mixture until crystals of zinc nitrate are made.

Paul's method will not make a pure dry sample of zinc nitrate.

What improvements should Paul make to the method to make sure that:

- the reaction is complete
- the zinc nitrate can be separated from the nitric acid and the zinc oxide?

Explain your answer.

[4]

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15(a) Look at the data about some hydrocarbons.

Name	Number of carbon atoms in molecule	Molecular formula	Boiling point (°C)
ethane	2	C_2H_6	–88
propane	3	C_3H_8	–42
pentane	5	C_5H_{12}	36
hexane	6	C_6H_{14}	69

Butane contains 4 carbon atoms.

Use the table to suggest the molecular formula of butane.

---------- [1]

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(b) The data for ethane and propane have been plotted on the grid.

(i) Plot the data for pentane and hexane on the grid.

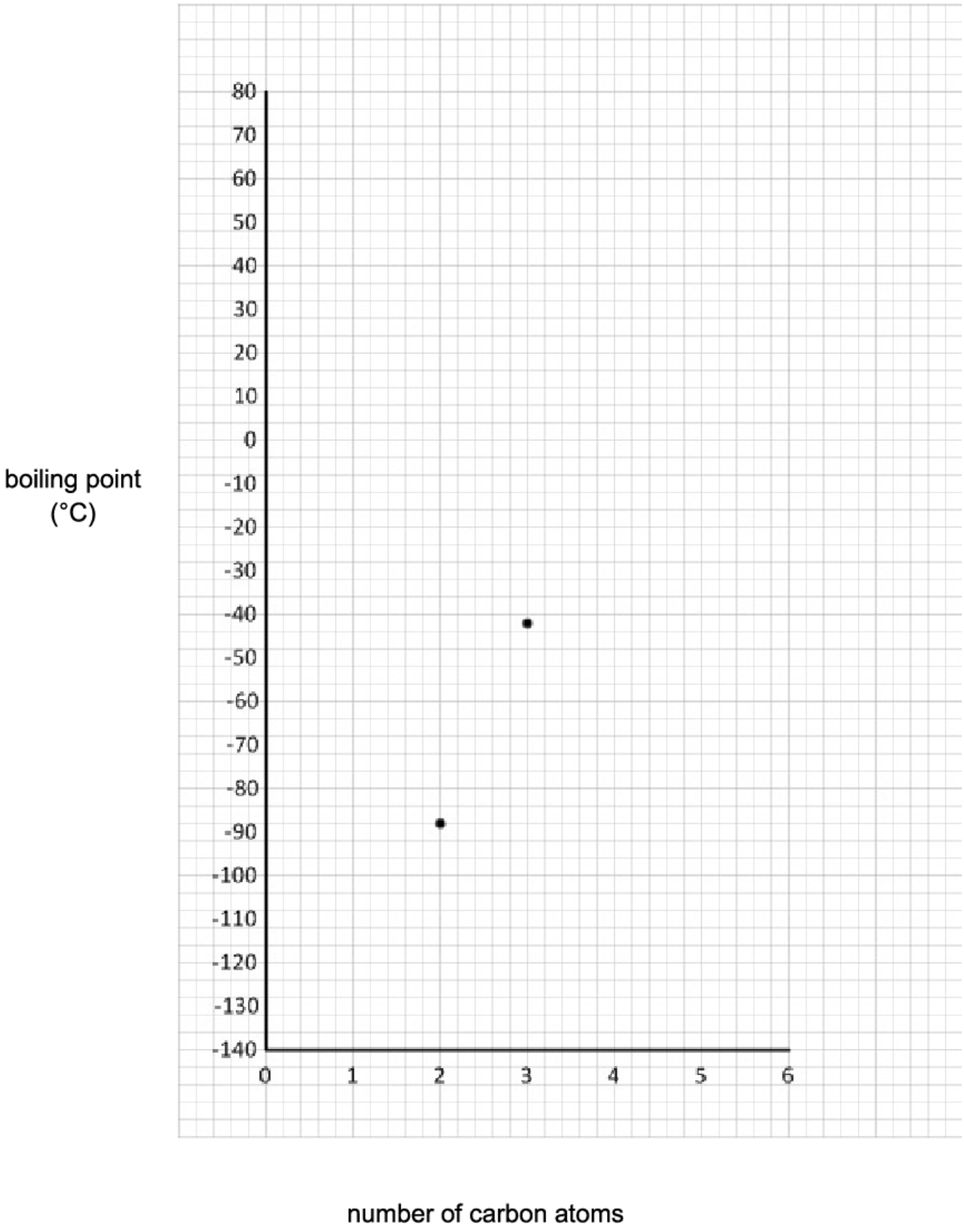
[2]

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Draw the line of best fit.



(ii) Use your graph to estimate the boiling point of butane.

answer:_____ °C [1]

(iii) Describe the relationship between the number of carbon atoms in the molecule and its boiling point.

Use ideas about forces between molecules to explain your answer.

---[2]

16 Colin investigates some displacement reactions.

He puts a small sample of metal powder into a salt solution.

Colin does five different experiments.

Look at his results.

		Colour of solution	
Metal	Salt solution	At start	At end
magnesium	iron(II) sulfate	green	colourless
iron	copper(II) sulfate	blue	green
copper	iron(II) sulfate	green	green
magnesium	copper(II) sulfate	blue	colourless
copper	silver nitrate	colourless	blue

Which mixture of metal and salt solution does not react?

Explain your answer.

---[2]

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17 Orange squash is a concentrated solution.

It has to be diluted with water to make sure that the taste is not too strong.

Some medicines and baby milk both need to be diluted before they are used.

Explain why some medicines and baby milk both need to be diluted.

---

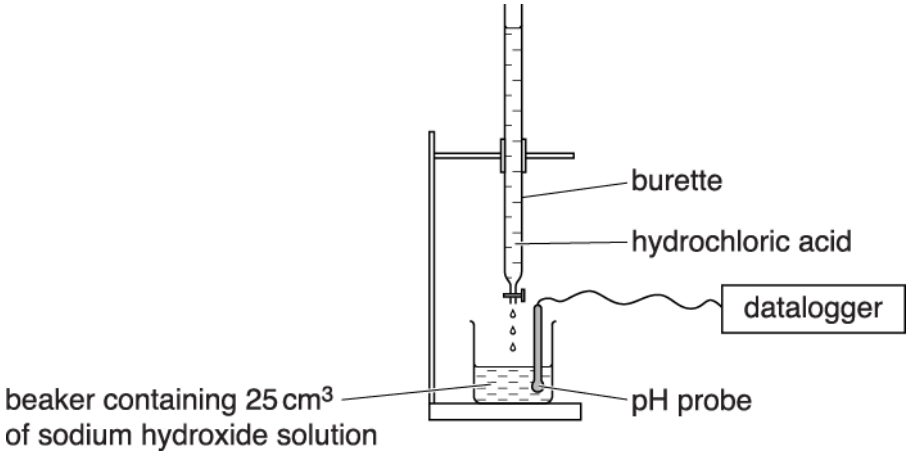
[2]

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18 Stewart and Claire want to do a titration.

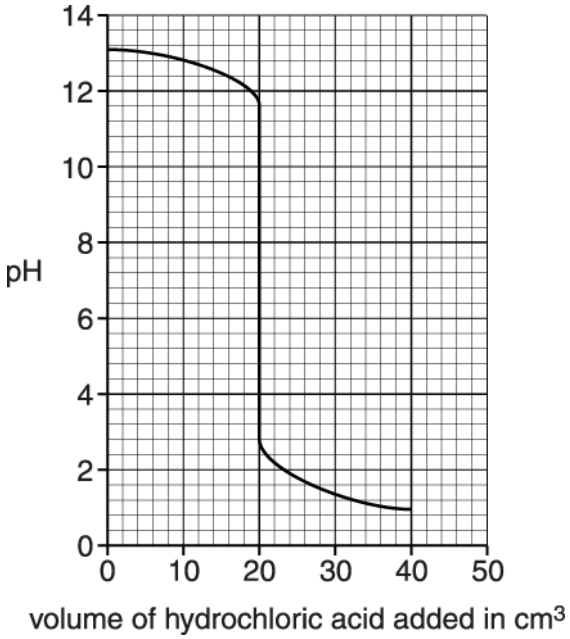
They use a solution of hydrochloric acid with a concentration of 0.10 mol/dm^3.

They titrate 25 cm^3 of a solution of sodium hydroxide with the hydrochloric acid.



They measure the pH of the mixture during the titration.

Look at the graph of their results.



The equation for the reaction is

$$NaOH + HCl \rightarrow NaCl + H_2O$$

What can you deduce from the graph? Include the volume of hydrochloric acid added at the end-point.

Use the graph to calculate the concentration of the sodium hydroxide solution.

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The quality of written communication will be assessed in your answer to this question.

[6]

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19 Nick and Lesley add 25 cm^3 of hydrochloric acid to 1 g of calcium carbonate.

They also add 25 cm^3 of ethanoic acid to 1 g of calcium carbonate.

Both acids have the **same concentration**.

Carbon dioxide is made in both reactions.

(i) The hydrochloric acid reacts faster with calcium carbonate than the ethanoic acid.

Use ideas about particles to explain why.

---

[1]

(ii) Both acids make the same volume of carbon dioxide.

Explain why.

---

[1]

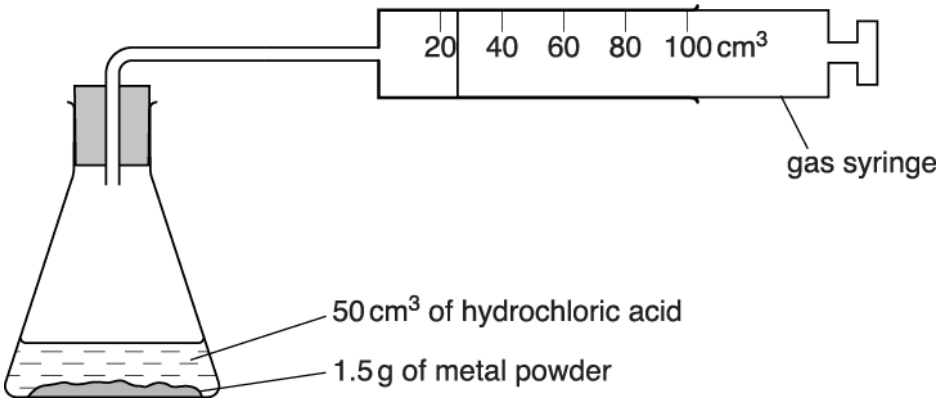
20 Zinc reacts with hydrochloric acid.

Hydrogen gas and zinc chloride are made.

Fatimah and Sam investigate the reaction between acid and metals.

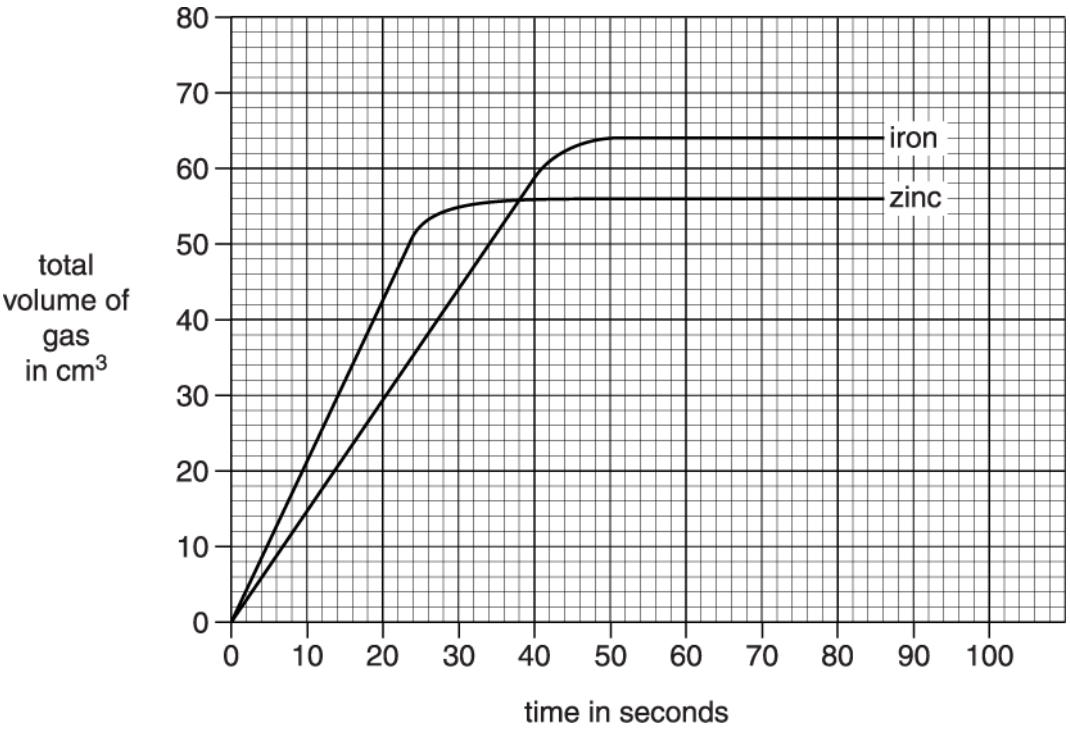
They react dilute hydrochloric acid with zinc powder and then with iron powder.

Look at the apparatus they use.



Every 10 seconds they measure the volume of gas in the gas syringe.

Look at the graph of the results.



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(i) The graph for the reaction of **zinc** is different from the graph for **iron**.

Write about **two** differences in these graphs.

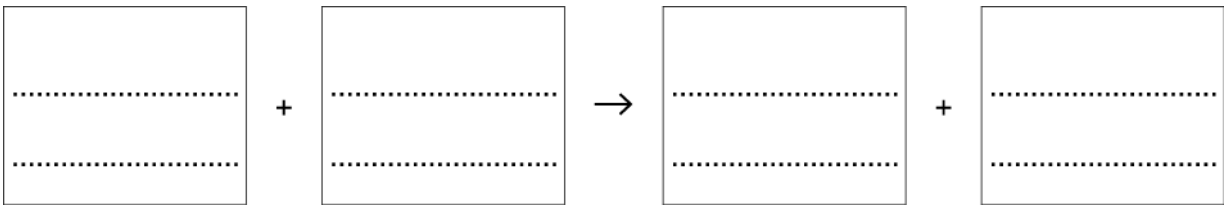
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21 Fertilisers are made by reacting an acid with an alkali.

This is a neutralisation reaction.

(i) Potassium hydroxide reacts with nitric acid.

Write a **word equation** for this reaction.



[2]

(ii) One way to find out the pH of a solution of fertiliser is by using a pH meter.

Write about one **other** way to find the pH.

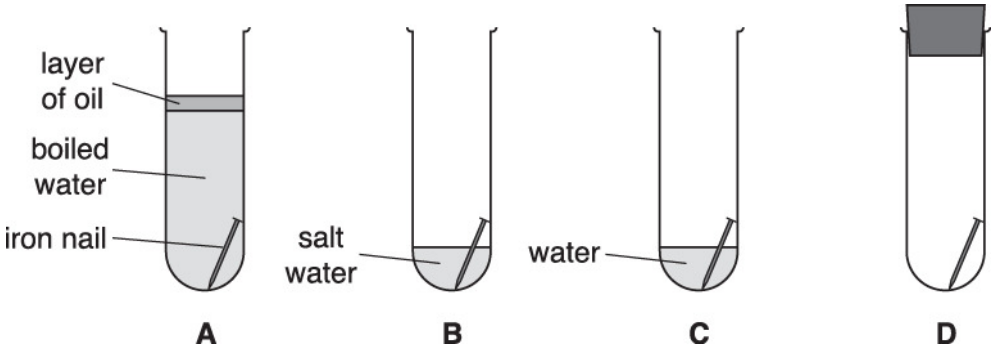
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[2]

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22(a) Robert investigates the rusting of iron.

Look at the diagram. It shows the apparatus he uses.



Substances in contact with iron	boiled water with **no** dissolved air	air and salt water	air and water	air with **no** water
Results	**not** rusty after 10 days	rusty after 24 hours	rusty after 5 days	**not** rusty after 10 days

(i) Robert thinks that **both** air and water are needed for iron to rust.

How do you know that he is right?

Use the diagram to help you.

---

[2]

(ii) Which substance in Robert's investigation **speeds up** rusting?

---

[1]

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(b) Aluminium, A*l*, does not corrode in air.

This is because aluminium reacts with oxygen, O_2.

A protective layer of aluminium oxide, Al_2O_3, is made.

Write a **balanced symbol** equation for this reaction.

---

[2]

23 Copper can be made from copper oxide, CuO, using hydrogen gas.

Look at the equation.

$$CuO + H_2 \rightarrow Cu + H_2O$$

This reaction is an example of **reduction**.

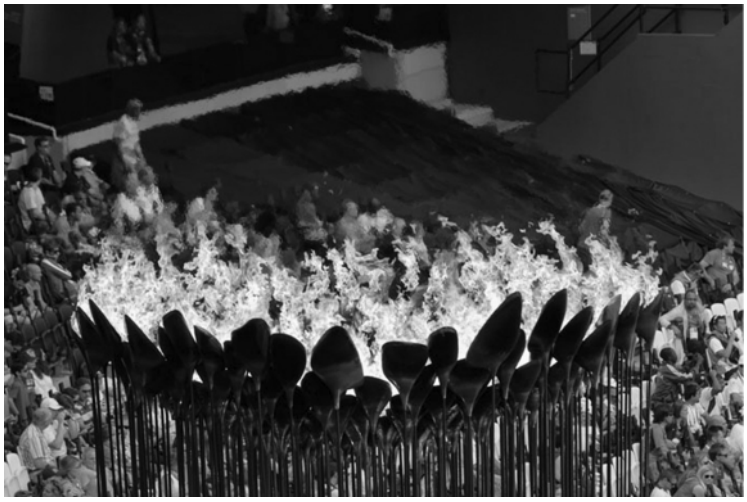
Copper oxide is reduced.

Explain how you can tell from the equation.

---

[1]

24 The Olympic flame for the London Olympics burned a fuel. This fuel was a gas.



The designer decided to use natural gas.

The Olympic flame was yellow in colour and could be seen easily.

Natural gas normally burns with a blue flame.

Suggest **two** reasons why the Olympic flame was yellow and not blue.

--- [2]

25 This question is about the corrosion of metals.

Look at the table. It shows how four metals corrode in different conditions.

Metal	Does the metal corrode in		
	damp air?	damp acidic air?	dry air?
A	no	quickly	no
B	slowly	quickly	no
C	very slowly	very slowly	no
D	very quickly	very quickly	quickly

Metal **A** is aluminium.

Explain how you can tell from the information in the table.

---

[1]

26

(i) Iron rusts in damp air.

Rust is hydrated iron(III) oxide.

Write the **word** equation for the rusting of iron.

---

[1]

(ii) The rusting of iron is an **oxidation** reaction.

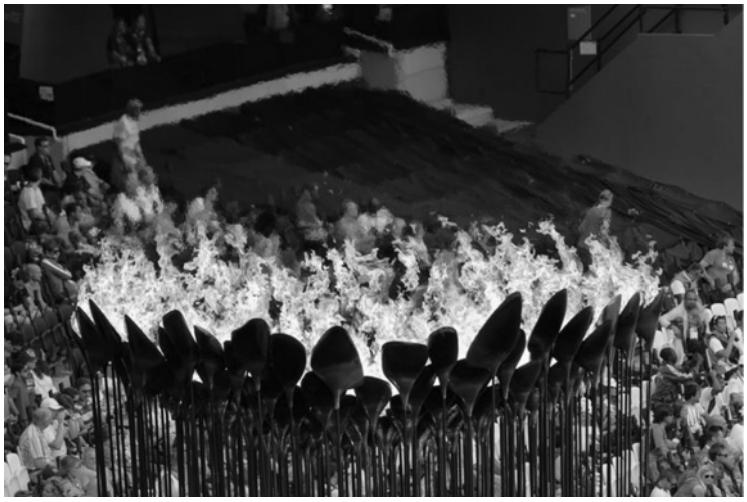
Explain why.

---

[1]

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27 The Olympic flame for the London Olympics burned natural gas.



Natural gas is mostly methane, CH_4.

The Olympic flame was yellow because there was some incomplete combustion.

Construct a **balanced symbol** equation to show the incomplete combustion of methane to make carbon.

[2]

28(a) Hydrochloric acid, HC*l*, reacts with calcium carbonate, $CaCO_3$.

Calcium chloride, $CaCl_2$, carbon dioxide and water are made.

Write a **balanced symbol** equation for this reaction.

[2]

(b) Acids contain hydrogen ions, H^+. Alkalis contain hydroxide ions, OH^-.

Write the **ionic** equation for neutralisation.

[1]

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29 Baking powder is used to make cakes rise.

Baking powder contains sodium hydrogencarbonate.

Sodium hydrogencarbonate decomposes when it is heated.

Write the **balanced symbol** equation for the decomposition of sodium hydrogencarbonate.

[2]

30(a) A bottle contains a solution.



The label has fallen off the bottle.

Sophia wants to find out the pH of the solution in the bottle.

Describe how she can do this.

[2]

(b) An acid reacts with a base to make a salt and water.

$$\text{acid} + \text{base} \rightarrow \text{salt} + \text{water}$$

Look at the table. It shows some acids, bases and the salts made from them.

Acid	Base	Salt
sulfuric acid	copper oxide	copper sulfate
nitric acid	sodium carbonate	_____
_____	zinc oxide	zinc chloride
sulfuric acid	_____	magnesium sulfate

Complete the table.

[3]

(c) Look at the equation for a neutralisation reaction.

$$CuO + 2HCl \rightarrow CuCl_2 + H_2O$$

Write down the **formula** of one **product** of this reaction.

_____

[1]

31 This question is about acids.

Nitric acid is a strong acid and propanoic acid is a weak acid.

David investigates the reaction of both of these acids with calcium carbonate.

Both acids react with calcium carbonate to make a gas.

What is the name of this gas?

Choose from

carbon dioxide

carbon monoxide

hydrogen

nitrogen

propane

answer _____ **[1]**

32 This question is about acids.

Nitric acid, HNO_3, is a strong acid and propanoic acid, C_2H_5COOH, is a weak acid.

David investigates the reaction of both of these acids with calcium carbonate.

David does two experiments

- the first with nitric acid
- the second with propanoic acid.

Each time he puts 50 cm^3 of 2.0 mol/dm^3 acid into a conical flask.

He then adds the same mass of calcium carbonate to each acid.

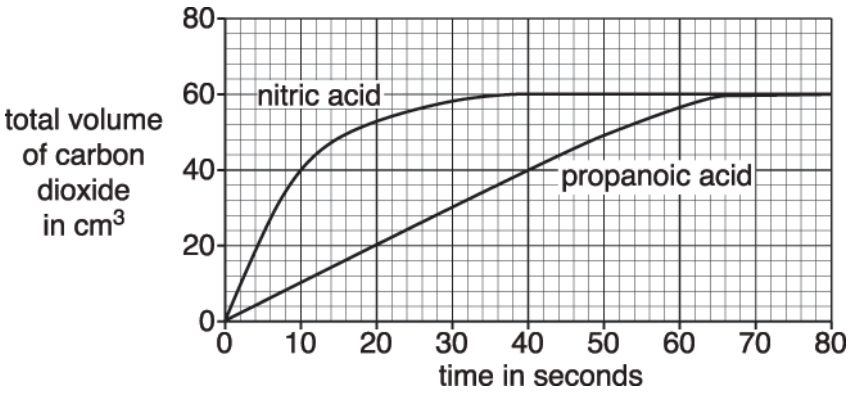
David measures the total volume of carbon dioxide made every 10 seconds.

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Look at the graph of David's results.



The two lines are different shapes because the strength of each acid is different.

Write about the difference between a strong and a weak acid and explain why the two lines are different.

The quality of written communication will be assessed in your answer to this question.

[6]

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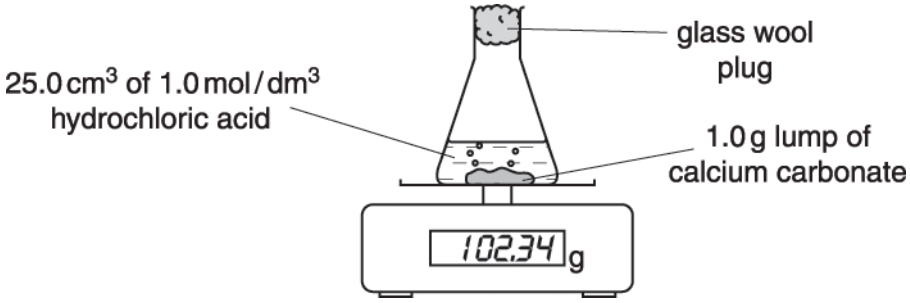
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33 Debbie places a 1.0 g lump of calcium carbonate into a flask.

She adds 25.0 cm^3 of 1.0 mol / dm^3 hydrochloric acid to the flask.

She puts the flask on top of an electronic balance.



This apparatus can be used to find the mass of carbon dioxide made during the reaction.

Debbie repeats the experiment.

This time she uses 25.0 cm^3 of 1.0 mol / dm^3 **ethanoic acid** instead of hydrochloric acid.

The reaction is much slower because ethanoic acid is a weak acid.

Explain why weak acids react **more slowly** than strong acids.

---

[1]

34 Jess investigates the thermal decomposition of copper hydroxide.

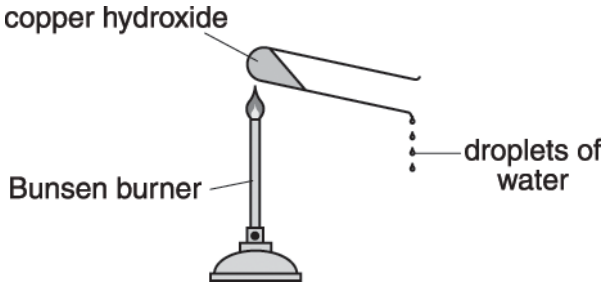
$$\text{copper hydroxide} \rightarrow \text{copper oxide} + \text{water}$$

Look at the apparatus she uses.

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She measures the mass of copper hydroxide at the start.

She then heats the copper hydroxide for 5 minutes.

Jess lets the apparatus cool down.

She then measures the mass of copper oxide made.

Jess does the experiment four more times.

Look at her results.

Experiment number	Mass of copper hydroxide in g	Mass of copper oxide made in g	Mass of water made in g
1	0.50	0.41	
2	1.00	0.82	
3	1.50	1.22	
4	2.00	1.63	
5	2.50	1.90	

Jess predicts that the mass of water made is directly proportional to the mass of copper hydroxide heated.

Is this prediction supported by her results?

Complete the table and use the data to explain your answer.

---

[3]

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35 Hydrochloric acid is a **strong** acid.

Ethanoic acid is a **weak** acid.

Both acids contain hydrogen ions, H^+.

Explain why hydrochloric acid is a strong acid and ethanoic acid is a weak acid.

---

[2]

36 Iron rusts in the presence of oxygen and water.

Look at the equations for two reactions that happen during rusting.

$$Fe - 2e^- \rightarrow Fe^{2+}$$

$$O_2 + 2H_2O + 4e^- \rightarrow 4OH^-$$

Which reaction is oxidation and which is reduction?

Explain your answer.

---

[2]

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37 Hydrochloric acid is a **strong** acid.

Ethanoic acid is a **weak** acid.

Both acids contain hydrogen ions, H^+.

An excess of both acids react with 0.1 g of magnesium to make hydrogen gas.

Both acids have a concentration of 1 mol / dm^3.

(i) Ethanoic acid reacts more slowly with magnesium than hydrochloric acid.

Explain why.

---

[2]

(ii) Both reactions make the same volume of hydrogen.

Explain why.

---

[1]

38(a) Chlorine reacts with sodium bromide solution.

Look at the **ionic** equation for this reaction.

$$Cl_2 + 2Br^- \rightarrow Br_2 + 2Cl^-$$

Explain why chlorine is **reduced** in this reaction.

---

[1]

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(b) Chlorine also reacts with potassium iodide solution, KI.

Iodine and potassium chloride are made.

Construct a **balanced symbol** equation for this reaction.

---

[2]

39(a) Hydrochloric acid is a strong acid.

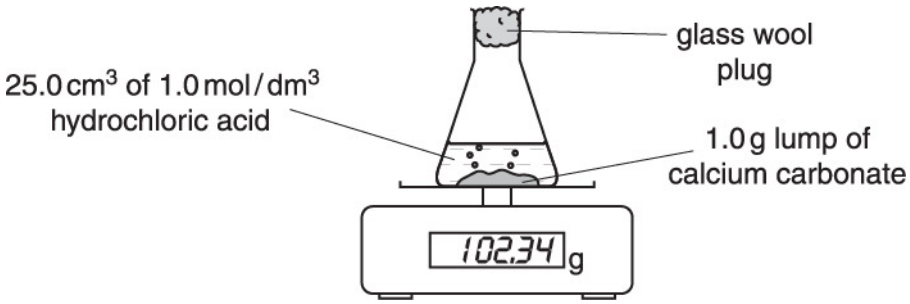
Hydrochloric acid reacts with calcium carbonate.

calcium carbonate + hydrochloric acid → calcium chloride + carbon dioxide + water

Debbie places a 1.0 g lump of calcium carbonate into a flask.

She adds 25.0 cm^3 of 1.0 mol / dm^3 hydrochloric acid to the flask.

Debbie puts the flask on top of an electronic balance.



What happens to the reading on the balance during the reaction?

Explain your answer.

---

[2]

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(b) Debbie repeats the experiment.

This time she uses 25.0 cm^3 of 1.0 mol / dm^3 **ethanoic acid** instead of hydrochloric acid.

Her results are different this time.

How are the results different?

Explain your answer.

---

[2]

40(a) During the electrolysis of sodium bromide solution, bromide ions make bromine molecules.

Complete the equation for this reaction.

..... Br^- – .....e^- → Br_2

[1]

(b) Explain why this reaction is an example of **oxidation**.

---

[1]

41(a)

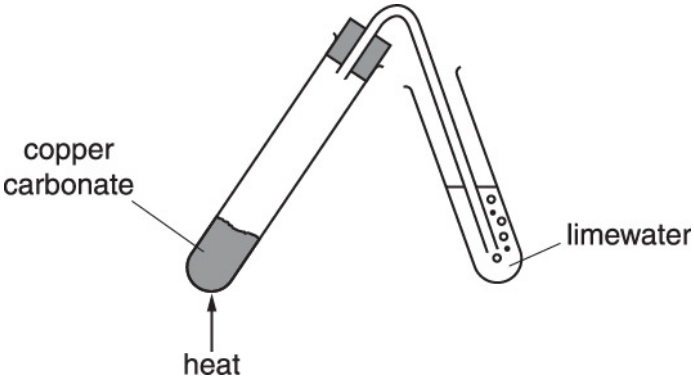
(i) Sam investigates the action of heat on copper carbonate.

Look at the diagram. It shows the apparatus he uses.

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Look at the word equation for the reaction

copper carbonate → copper oxide + carbon dioxide

This is a **thermal decomposition** reaction.

Explain why.

---

[1]

(ii) Sam makes some copper.

Sam heats copper oxide, CuO, with carbon, C.

Copper, Cu, and carbon dioxide, CO_2, are made.

Write a **balanced symbol** equation for this reaction.

---

[2]

(b) Explain one **advantage** and one **problem** of recycling copper.

---

[2]

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42 This question is about fertilisers.

Amy and Chris decide to make **some solid ammonium sulfate** by neutralisation.

They use an acid and an alkali.

Name the acid and alkali they use and describe the experimental method they use.

The quality of written communication will be assessed in your answer to this question.

[6]

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43 Hexane is one of the hydrocarbons found in petrol.

Hexane completely burns in a plentiful supply of air.

Look at the word equation for this reaction.

hexane + oxygen → carbon dioxide + water

(i) Which gas in the air is needed for combustion?

---

[1]

(ii) **Incomplete combustion** happens when there is a limited supply of air.

Write down the **word** equation for the incomplete combustion of hexane.

Use your equation to suggest **one** disadvantage of incomplete combustion.

---

[2]

44 Hilary investigates the reaction between magnesium and hydrochloric acid.

Magnesium chloride and hydrogen are made.

Write down the **word** equation for this reaction.

---

[1]

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45 During the electrolysis of sodium chloride solution, the chloride ions are turned into chlorine molecules.

(i) Complete the equation for this reaction.

$$_____ Cl^- - _____ e^- \rightarrow Cl_2$$

[1]

(ii) Is this reaction **oxidation** or **reduction**?

Explain how you can tell from the equation.

---

[1]

46(a) Martin does another experiment.

He investigates how the pH of an acid affects the rate of corrosion of an one alloy.

The alloy reacts with the acid to produce hydrogen gas.

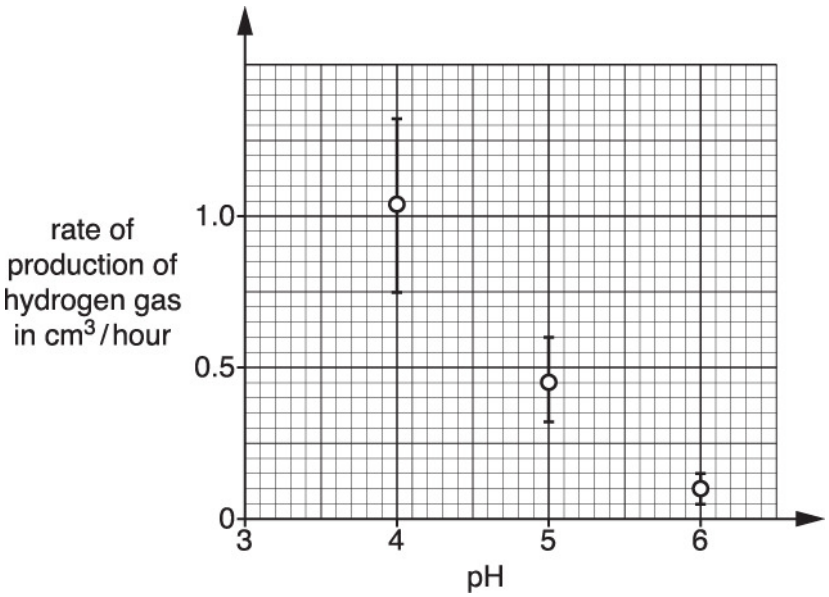
Martin measures the rate at which the hydrogen gas is made.

He does this at three different pH values.

He repeats his experiment five times at each pH and then plots a graph of his results.

Look at his graph.

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(i) What was the **highest** rate of production of hydrogen gas that Martin measured at pH 5?

answer _____ cm^3 / hour

[1]

(ii) At which pH did Martin get the most **repeatable** results?

_____

[1]

(b) Aluminium, A?, reacts with sulfuric acid, H_2SO_4.

Aluminium sulfate, $A?_2(SO_4)_3$, and hydrogen, H_2, are made.

Write a **balanced symbol** equation for this reaction.

_____

[2]

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47 This question is about the extraction of metals.

When iron oxide is heated with carbon, iron is made.

(i) Complete the **word equation** for this reaction.

iron oxide + carbon → ..... + ... [1]

(ii) Iron oxide is **reduced** during this reaction.

Explain how you can tell that iron oxide is reduced.

[1]

48 Magnesium reacts with copper oxide.

Magnesium oxide and copper are made.

magnesium + copper oxide → magnesium oxide + copper

Which substance is the **reducing agent**?

A Copper
B Copper oxide
C Magnesium
D Magnesium oxide

Your answer [1]

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49(a) A teacher investigates neutralisation. She uses hydrochloric acid, HC*l*, and sodium hydroxide, NaOH.

$HCl + NaOH \rightarrow NaCl + H_2O$

She slowly adds 1.0 cm^3 portions of the hydrochloric acid to 20.0 cm^3 of 1.0 mol / dm^3 sodium hydroxide.

She records the pH until she has added an excess of acid.

Look at her results.

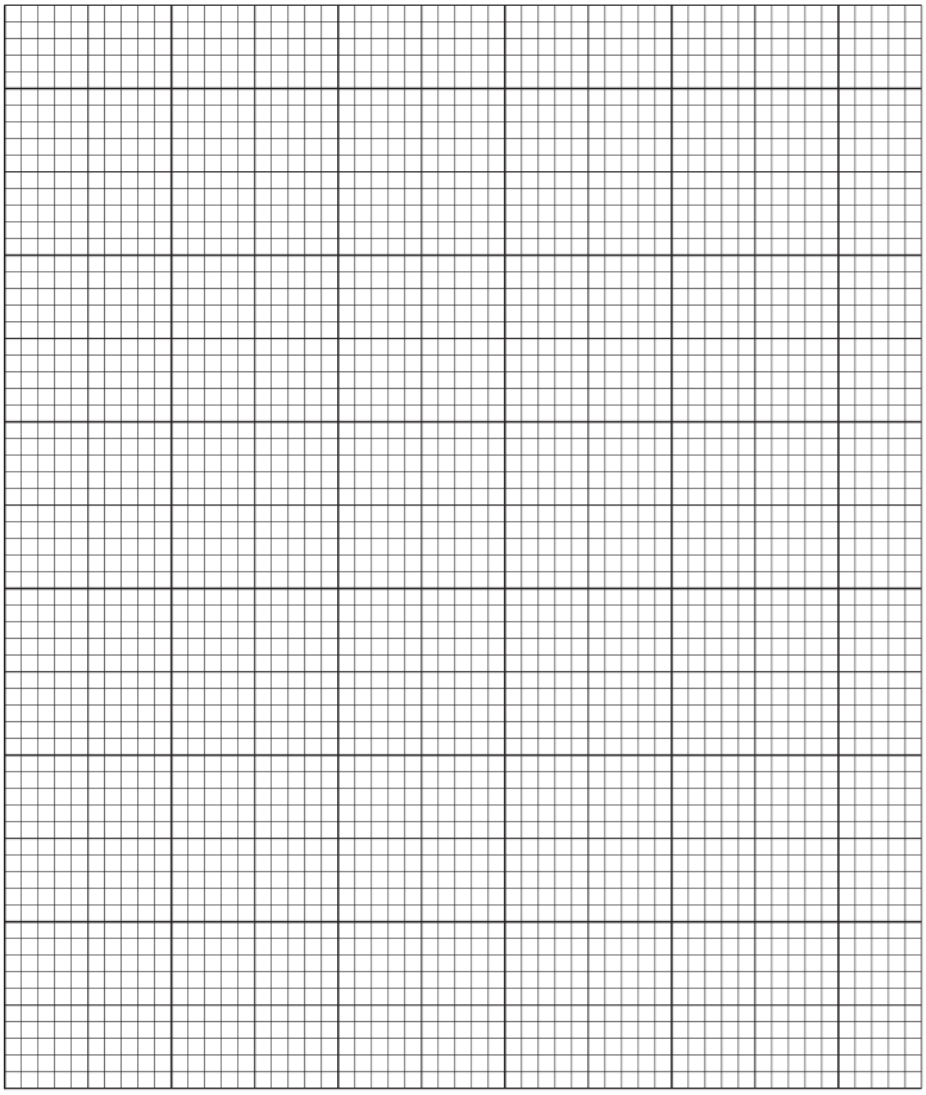
Volume of hydrochloric acid added (cm^3)	pH
0	12.0
1	11.8
2	11.6
3	11.4
4	11.2
5	7.0
6	3.0
7	2.8
8	2.5
9	2.3
10	2.3

(i) Plot a graph of the pH value against the amount of hydrochloric acid added and draw a line of best fit.

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[3]

(ii) Use your graph to estimate the **volume of hydrochloric acid** when the pH is 10.

Volume of hydrochloric acid = ... cm^3 **[1]**

(iii) What happens to the **concentration of hydroxide ions**, OH^-, as the hydrochloric acid is added to the sodium hydroxide?

[1]

(iv) Acidic solutions contain hydrogen ions, H^+. Alkaline solutions contain hydroxide ions, OH^-.

Write the **balanced ionic** equation for neutralisation.

[1]

(b) Hydrochloric acid, HC*l* (aq), is a strong acid. Ethanoic acid, CH_3COOH (aq), is a weak acid.

Explain the difference between a strong and a weak acid.

[2]

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(c)

(i) Nitric acid, HNO_3, is another strong acid.

Nitric acid has a pH of 2.

The teacher adds enough water to reduce the concentration of the nitric acid by a factor of 100.

Calculate the new pH of the nitric acid.

pH = ... **[2]**

(ii) Nitric acid, HNO_3, can also neutralise sodium hydroxide, NaOH.

Sodium nitrate, $NaNO_3$, and water are made.

Write a **balanced symbol** equation for this reaction.

[1]

(iii) Describe how dry sodium nitrate crystals can be made using this reaction.

[2]

50 Lemon juice can be described as a weak acid.

What is the pH value for a weak acid?

A pH 1

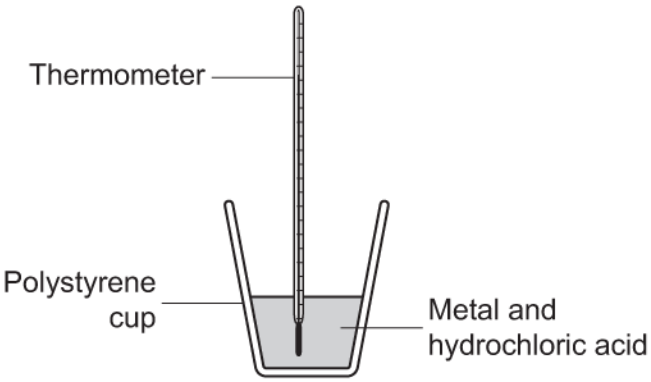
B pH 4

C pH 7

D pH 14

Your answer [ ] **[1]**

51(a) A student investigates the reaction of different metals with hydrochloric acid.



The student repeats the experiment with different metals.

She repeats the experiment three times for each metal.

She measures the temperature change in each experiment.

Look at her results.

Metal	Temperature change (°C)		
	Test 1	Test 2	Test 3
Magnesium	10.3	10.5	10.2
Zinc	8.6	8.7	7.6
Iron	5.2	4.9	5.1

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(i) One of the student's results is anomalous.

Put a (ring) around the anomalous result in the table. [1]

(ii) Suggest a reason why the result could be anomalous.

---

[1]

(iii) Calculate the **mean** temperature change for **magnesium**.

Give your answer to **1** decimal place.

Mean temperature change = ... °C **[2]**

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(b)

(i) The student wants to improve her experiment to get more **accurate** results.

Suggest an improvement to her experiment, which will give more accurate results.

Give a reason for the improvement.

Improvement _____

Reason _____

[2]

(ii) The student concludes that the more reactive the metal is, the higher the temperature rise.

Describe further tests the student can do to confirm her conclusion.

_____

_____

_____ **[2]**

52 Sodium hydroxide reacts with hydrochloric acid. Sodium chloride and water are made.
What is the name of this type of reaction?

A Neutralisation
B Oxidation
C Reduction
D Thermal decomposition

Your answer ☐ **[1]**

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53 A student investigates the reaction of an aqueous solution of sodium hydroxide and sulfuric acid. During the experiment, the student tests the pH of the solution with universal indicator.

(i) Suggest a piece of equipment that the student could use instead of universal indicator paper to test the pH of the solution.

[1]

(ii) Describe how to use the equipment suggested in **(i)**.

[2]

54 Neutralisation occurs when acids react with alkalis.

What is the ionic equation for neutralisation?

A $H^+ + OH^- \rightarrow H_2O$
B $H^- + OH^+ \rightarrow H_2O$
C $H^+ + OH^+ \rightarrow H_2O$
D $H^- + OH^- \rightarrow H_2O$

Your answer ☐ [1]

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55(a) Acids are substances that turn universal indicator paper red.

(i) What makes a substance acidic?

[1]

(ii) Sodium hydroxide, NaOH, is an alkali.

Sodium hydroxide neutralises sulfuric acid, H_2SO_4. The reaction makes a salt called sodium sulfate, Na_2SO_4. Water is also made.

Complete the **balanced symbol equation** for this reaction.

..... $NaOH + H_2SO_4 \rightarrow Na_2SO_4$ + ... H_2O

[2]

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(b) * Potassium chloride is a mineral found in many foods.

A student wants to make a salt called potassium chloride, KC*l*, by neutralisation of an acid by an alkali.

Describe how to make a pure, dry sample of potassium chloride in a laboratory by neutralisation.

[6]

56 Magnesium powder reacts with copper(II) oxide. Magnesium oxide and copper are made.

$Mg + CuO \rightarrow MgO + Cu$

Which substance is the **reducing agent**?

A Magnesium
B Copper oxide
C Magnesium oxide
D Copper

Your answer ☐ **[1]**

57 A farmer wants to test the pH of soil samples. He researches information about different pH test kits.



Look at the information he finds.

pH test kit	Price	pH of soil sample				
		pH 2	pH 4	pH 7	pH 9	pH 14
A	£4.95	Red	Yellow	Green	Blue	Purple
B	£10.99	Yellow	Yellow	Pink	Pink	Pink
C	£11.50	Pink	Orange	Yellow	Blue	Blue
D	£2.99	Colourless	Colourless	Colourless	Pink	Pink
E	£12.75	Red	Orange	Yellow	Yellow	Yellow

* Evaluate the advantages and disadvantages of the pH test kits and suggest which pH test kit the farmer should use.

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[6]

(i) Sodium oxide reacts with water.

An aqueous solution of sodium hydroxide is made.

Write the **balanced symbol equation** for this reaction, including **state symbols**.

[3]

(ii) Sodium hydroxide neutralises acids. It is an alkali.

Which ion do solutions of alkalis contain?

[1]

(iii) A salt is made when sodium hydroxide neutralises sulfuric acid.

Name this salt.

[1]

(iv) A sample of hydrochloric acid has a pH of 1.04.

A student adds water to the hydrochloric acid until the pH is 3.04.

The concentration of hydrogen ions decreases.

Calculate the factor by which the hydrogen ion concentration has decreased.

Decrease in hydrogen ion concentration = ... **[2]**

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59 A student neutralises an alkali with an acid in a titration experiment.

Complete the word equation for the reaction of an acid with an alkali.

acid + alkali → ..... + ... [2]

60 Sulfur dioxide is a pollutant found in many large cities.

Sulfur dioxide is an **acidic** gas.

(i) Suggest a value for the pH of sulfur dioxide.

[1]

(ii) Describe **one** problem caused by sulfur dioxide.

[1]

61 Sodium is in Group 1 of the Periodic Table.

Sodium ions, Na^+, are formed when sodium reacts with water.

Look at the equation. It shows how a sodium ion is formed from a sodium atom.

$Na - e^- \rightarrow Na^+$

The symbol e^- means an electron.

The formation of a sodium ion from a sodium atom is an example of **oxidation**.

Explain why.

[1]

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62 * A student has unlabelled samples of three liquids.

The student knows that the three liquids are:

- pentane, C_5H_{12}
- pentene, C_5H_{10}
- ethanoic acid, CH_3COOH.

Describe tests that the student should do to identify each of the three liquids.

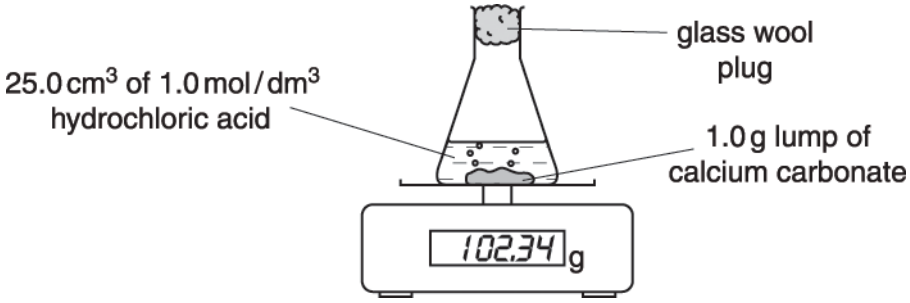
Include **balanced symbol** equations for the reactions described.

[6]

63 Debbie places a 1.0 g lump of calcium carbonate into a flask.

She adds 25.0 cm^3 of 1.0 mol / dm^3 hydrochloric acid to the flask.

She puts the flask on top of an electronic balance.



This apparatus can be used to find the mass of carbon dioxide made during the reaction.

Debbie wants to measure the **volume** of carbon dioxide made during the reaction.

Draw a labelled diagram of the apparatus she should use.

[2]

64 An acid reacts with a base to make a salt and water.

acid + base → salt + water

Look at the table. It shows some acids, bases and the salts made from them.

Acid	Base	Salt
sulfuric acid	copper oxide	copper sulfate
nitric acid	sodium carbonate	_____
_____	zinc oxide	zinc chloride
sulfuric acid	_____	magnesium sulfate

Complete the table.

[3]

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65 Colin investigates displacement reactions.

He adds some iron powder to copper(II) sulfate solution, $CuSO_4$.

A displacement reaction happens.

Look at the ionic equation for this reaction.

$$Fe + Cu^{2+} \longrightarrow Fe^{2+} + Cu$$

This displacement reaction is a **redox** reaction.

Write the **word** equation and the **balanced symbol** equation for the reaction between iron andcopper(II) sulfate.

Explain why this displacement reaction involves both oxidation and reduction.

The quality of written communication will be assessed in your answer to this question.

[6]

66 Which of these is the **best** explanation of what is meant by a strong acid?

A There is a large amount of acid and a small amount of water.
B There is a small amount of acid and a large amount of water.
C The acid is completely ionised in solution in water.
D The acid is partially ionised in solution in water.

Your answer ☐

[1]

END OF QUESTION PAPER

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