

**OCR**

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**GCSE (9–1) Combined Science  
(Chemistry) A (Gateway Science)  
J250/09 Paper 9 (Higher Tier)  
Sample Question Paper**

**H****Date – Morning/Afternoon**

Time allowed: 1 hour 10 minutes

**You must have:**

- the Data Sheet

**You may use:**

- a scientific or graphical calculator
- a ruler



First name

Last name

Centre  
numberCandidate  
number**INSTRUCTIONS**

- Use black ink. You may use an HB pencil for graphs and diagrams.
- Complete the boxes above with your name, centre number and candidate number.
- Answer **all** the questions.
- Write your answer to each question in the space provided.
- Additional paper may be used if required but you must clearly show your candidate number, centre number and question number(s).
- Do **not** write in the bar codes.

**INFORMATION**

- The total mark for this paper is **60**.
- The marks for each question are shown in brackets [ ].
- Quality of extended responses will be assessed in questions marked with an asterisk (\*).
- This document consists of **20** pages. Any blank pages are indicated.

**SECTION A**

Answer **all** the questions.

You should spend a maximum of 20 minutes on this section.

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

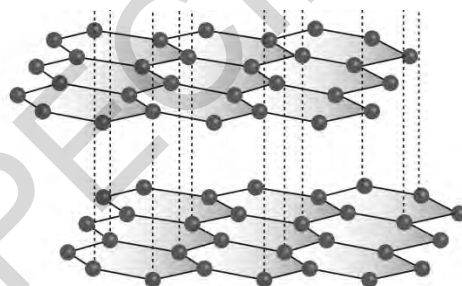
- A** There is a large amount of acid and a small amount of water.
- B** There is a small amount of acid and a large amount of water.
- C** The acid is completely ionised in solution in water.
- D** The acid is partially ionised in solution in water.

Your answer

**[1]**

**2** Look at the diagram.

It shows a structure of carbon.



Which structure of carbon is shown in the diagram?

- A** diamond
- B** fullerene
- C** graphene
- D** graphite

Your answer

**[1]**

3

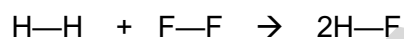
3 What is the approximate radius of an atom in metres?

- A  $300 \times 10^{-1}$
- B  $30 \times 10^{-5}$
- C  $3000 \times 10^{-7}$
- D  $3 \times 10^{-13}$

Your answer

[1]

4 Hydrogen reacts with fluorine to make hydrogen fluoride.



Look at these bond energies.

Bond	Bond energy in kJ/mol
H—H	436
F—F	142
H—F	568

What is the energy change for the reaction between hydrogen and fluorine?

- A -558 kJ/mol
- B -10 kJ/mol
- C +10 kJ/mol
- D +558 kJ/mol

Your answer

[1]

- 5 100 cm<sup>3</sup> of a solution of 1 mol/dm<sup>3</sup> sodium hydroxide is added to 100 cm<sup>3</sup> of a solution of 1 mol/dm<sup>3</sup> hydrochloric acid.

The maximum rise in temperature recorded was T<sub>1</sub>.

The experiment is repeated with 50 cm<sup>3</sup> of each solution.

The maximum rise in temperature recorded was T<sub>2</sub>.

Which of these statements about temperatures T<sub>1</sub> and T<sub>2</sub> is true?

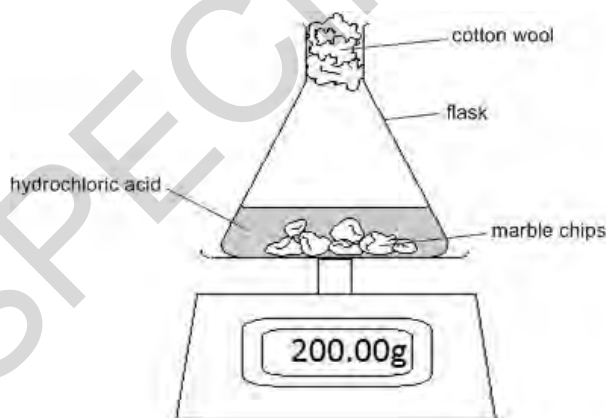
- A T<sub>1</sub> is equal to T<sub>2</sub>
- B T<sub>1</sub> is half the value of T<sub>2</sub>
- C T<sub>2</sub> is half the value of T<sub>1</sub>
- D T<sub>2</sub> is a quarter the value of T<sub>1</sub>

Your answer

[1]

- 6 Look at the diagram.

It shows how the reaction between hydrochloric acid and marble chips (calcium carbonate) can be monitored.



The reading on the balance **decreases** during the reaction.

Which of these statements is the **best** explanation?

- A Acid escapes from the flask.
- B A gas called hydrogen is made which leaves the flask.
- C A gas called carbon dioxide is made which leaves the flask.
- D The temperature in the laboratory changes.

Your answer

[1]

7 A solution of lead nitrate,  $\text{Pb}(\text{NO}_3)_2(\text{aq})$  has a concentration of  $66.2 \text{ g/dm}^3$ .

The relative formula mass,  $M_r$ , of lead(II) nitrate is 331.

What is the concentration, in  $\text{mol/dm}^3$ , of this solution?

A  $2.0 \times 10^{-4} \text{ mol/dm}^3$

B  $2.0 \times 10^{-2} \text{ mol/dm}^3$

C  $2.0 \times 10^{-1} \text{ mol/dm}^3$

D  $5.0 \times 10^{-1} \text{ mol/dm}^3$

Your answer

[1]

8 Which row in the table shows the correct results for an ionic compound?

	Solid compound	Compound dissolved in water	Molten compound
A	conducts	does not conduct	conducts
B	conducts	conducts	conducts
C	conducts	conducts	does not conduct
D	does not conduct	conducts	conducts

Your answer

[1]

6

9 The empirical formula of a compound **Y** is  $\text{CH}_2\text{O}$ .

Compound **Y** has a relative formula mass of 90.

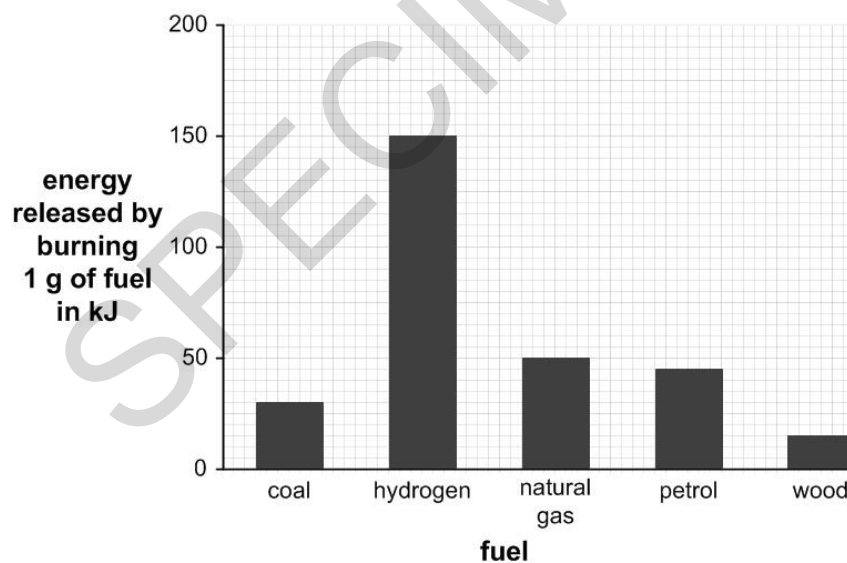
What is the molecular formula of compound **Y**?

- A  $\text{C}_2\text{H}_2\text{O}_4$
- B  $\text{C}_3\text{H}_6\text{O}_3$
- C  $\text{C}_4\text{H}_{10}\text{O}_2$
- D  $\text{C}_6\text{H}_{12}\text{O}_6$

Your answer

[1]

10 The bar chart shows the amount of energy released when 1.0 g of each fuel is completely combusted.



What mass of natural gas is needed to release the same amount of energy as 1.0 g of hydrogen?

- A 3.0 g
- B 3.3 g
- C 6.0 g
- D 10.0 g

Your answer

[1]

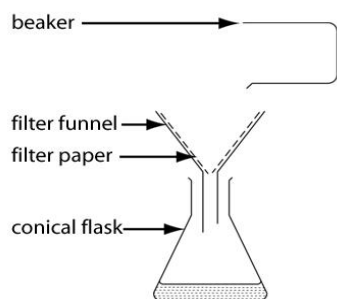




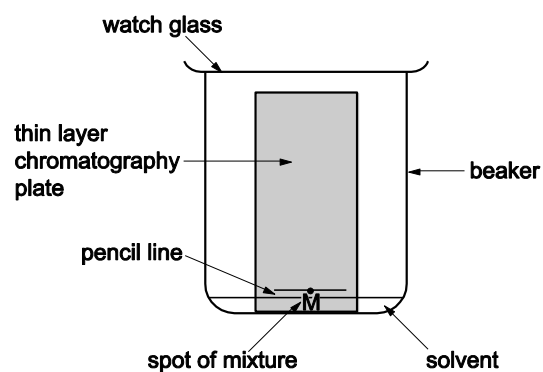


12 Look at the diagrams.

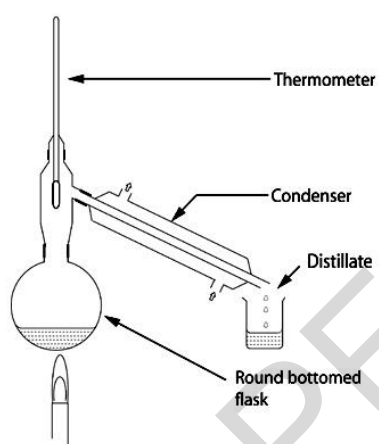
They are not to the same scale.



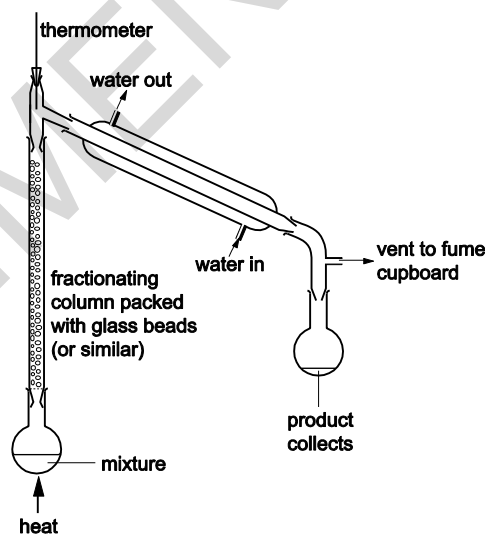
A



B



C



D

(a) Write down the name of the separating technique used in diagram D?

.....

[1]

(b) Lead nitrate solution is added to sodium sulfate solution.

A white precipitate is formed.

Explain how a pure sample of the precipitate can be separated from the mixture.

Refer to one of the diagrams in your answer.

.....

.....

..... [3]

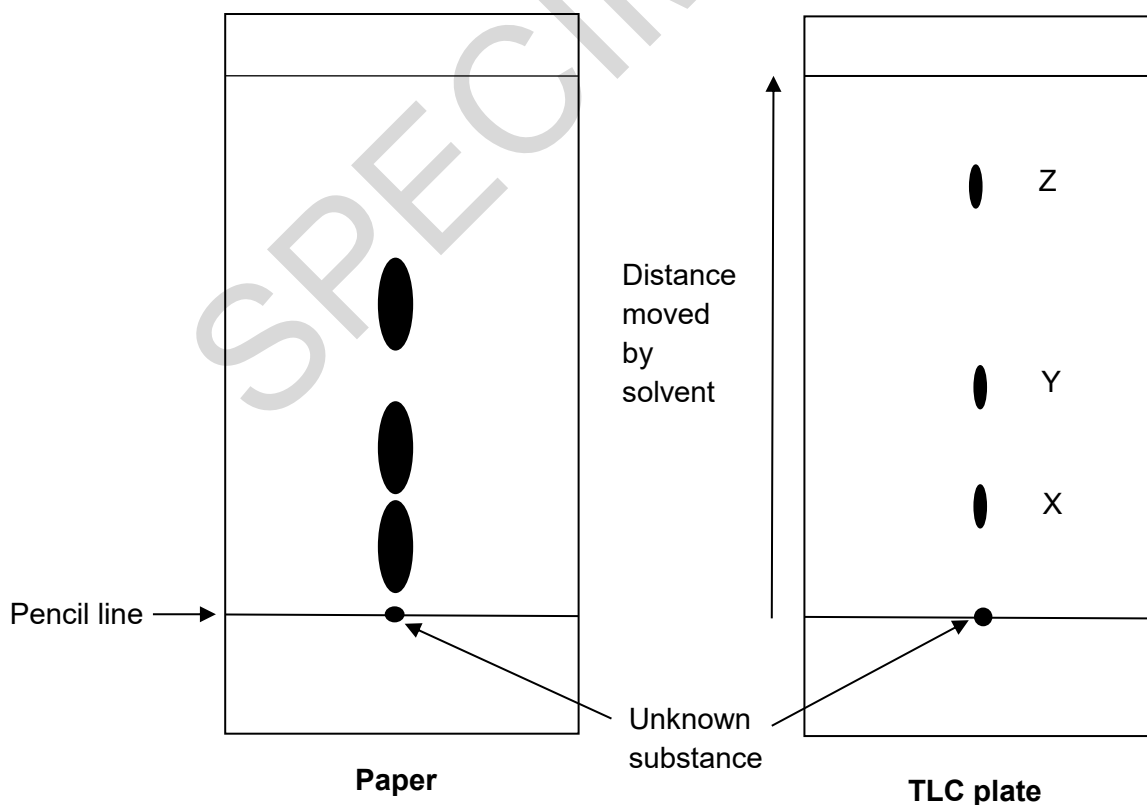
(c) Two scientists investigate an unknown substance.

One scientist uses apparatus **B**.

Another scientist uses the same apparatus but uses a thin layer chromatography (TLC) plate instead of paper.

They put an unknown substance on the centre of the pencil line.

Look at the results.



- (i) Use the thin layer chromatogram to work out the  $R_f$  value for substance Y.

.....  
.....

$R_f$  value = ..... [2]

- (ii) Suggest **two** reasons why TLC might be better than paper.

.....  
.....  
.....  
.....  
..... [2]

SPECIMEN

13 This question is about making copper.

(a) Copper is made using a displacement reaction.

Magnesium is added to copper sulfate solution,  $\text{CuSO}_4$ .

Copper and magnesium sulfate solution,  $\text{MgSO}_4$ , are made.

Write a balanced symbol equation for this reaction.

..... [1]

(b) (i) In the reaction, magnesium atoms become magnesium ions,  $\text{Mg}^{2+}$ , and copper ions,  $\text{Cu}^{2+}$ , become copper atoms.

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

..... [2]

(ii) Write a **balanced half equation** to show what happens to magnesium in this reaction.

Use  $e^-$  to represent an electron.

..... [2]

(c) Explain why this displacement reaction is also a reduction/oxidation reaction.

Use ideas about electrons in your answer.

.....  
.....  
.....  
..... [3]

14 (a) The mass number of an element is 23.

The atomic number of the same element is 11.

(i) How many protons and how many neutrons are there in an atom of this element?

Number of protons:.....

Number of neutrons:.....

[2]

(ii) This element forms an **ion** with a charge of +1.

Work out the number of electrons in an **ion** of this element.

Number of electrons:.....

[1]

(b) Another element has an atomic number of 17.

Calculate the mean mass of an atom of this element. Quote your answer to **three** significant figures.

(The Avogadro constant is  $6.022 \times 10^{23}$  atoms / mol.)

mean mass.....g

[2]

(c) Element **Z** has the electronic structure 2.8.8.1.

Explain how you can tell that the element is potassium.

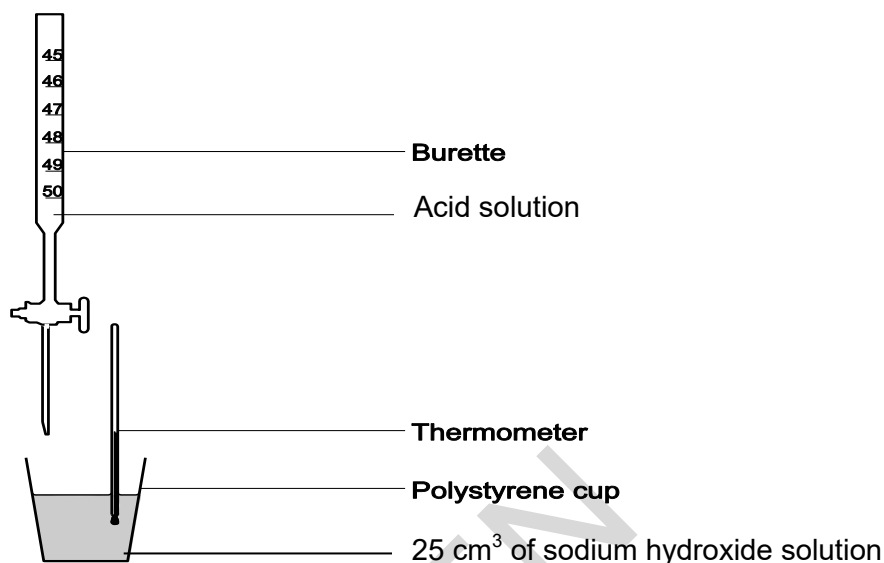
.....

.....

[1]

15 A scientist investigates an acid solution.

Look at the diagram of the apparatus the scientist uses.



(a) (i) The scientist adds universal indicator to the sodium hydroxide solution.

What colour is the universal indicator in the sodium hydroxide solution?

..... [1]

(ii) Universal indicator is a mixed indicator.

Name a single indicator.

..... [1]

(b) The scientist adds acid in 5 cm<sup>3</sup> portions to the sodium hydroxide solution.

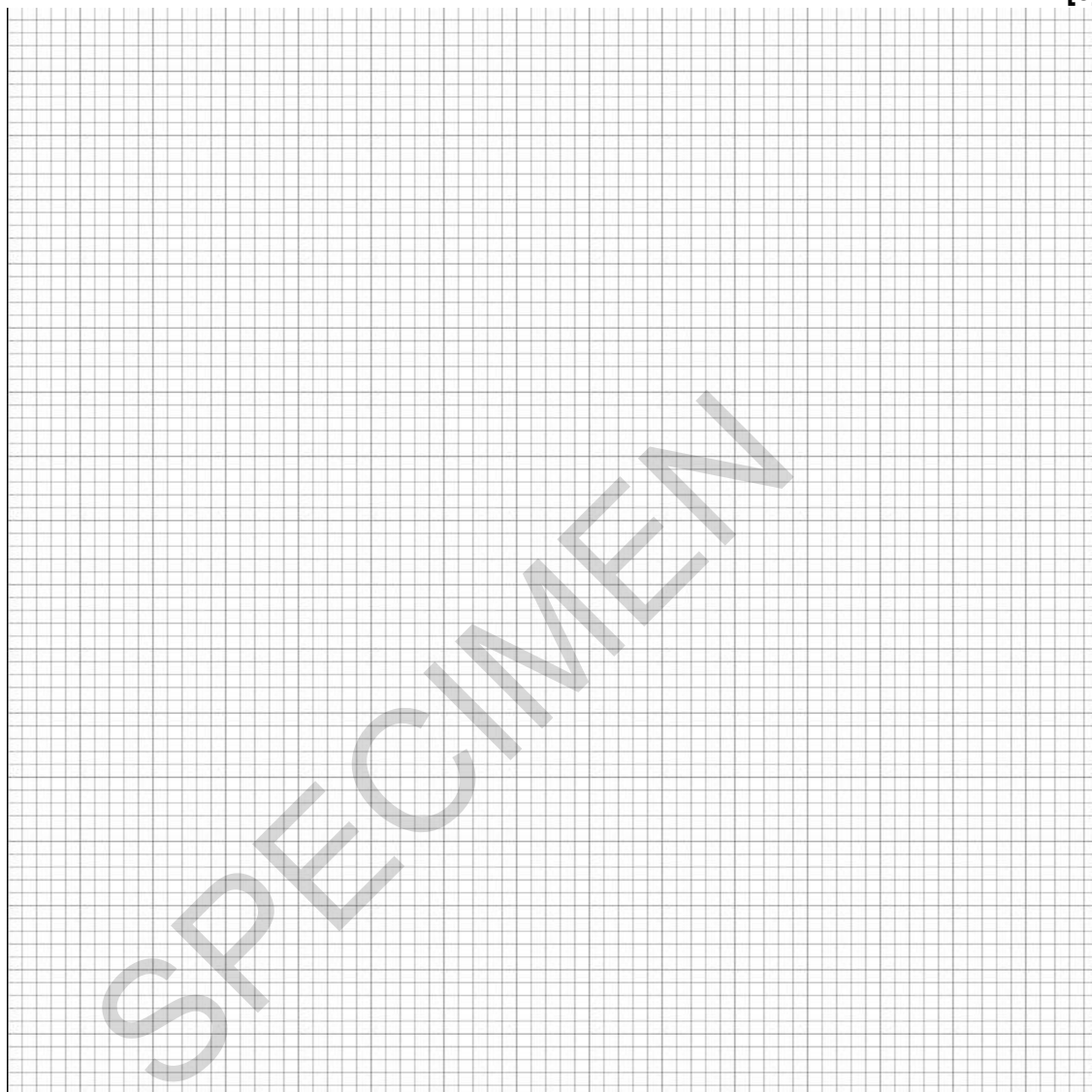
After each addition, the scientist measures the temperature of the reaction mixture.

Look at the table of results. One of the results is anomalous.

Volume of acid added in cm <sup>3</sup>	Temperature in °C
0	23
5	27
10	35
15	41
20	44
25	43
30	42
35	37
40	33
45	36
50	28

- (i) Plot these results on the grid provided. Draw two intersecting lines of best fit:
- One line shows the temperature increasing
  - One line shows the temperature decreasing

[3]



- (ii) What volume of acid is needed to just neutralise  $25\text{cm}^3$  of sodium hydroxide solution in this investigation.

volume of acid..... $\text{cm}^3$

[1]

- (iii) Write the ionic equation of the neutralisation of an acid with an alkali.

.....

[1]

- (iv) How could you improve the results from this investigation?

.....

.....

..... [2]

- 16** Magnesium sulfate crystals can be used as bath salts. They are made in a laboratory by reacting magnesium carbonate with sulfuric acid.

This can be shown in the equation below.



- (a) (i)** What is represented in the equation above as **A**?

**A** ..... [1]

- (ii)** Give the test for this substance.

.....

..... [1]

- (b)** What is the maximum mass of magnesium sulfate which could be formed when 6.72 g of magnesium carbonate is reacted with sulfuric acid?

mass of magnesium sulfate ..... [5]

**END OF QUESTION PAPER**