OXFORD

INTERNATIONAL
AQA EXAMINATIONS

Please write clearly in block capitals.

Centre number | | | | | | Candidate number | | | | |

Surname _____

Forename(s) _____

Candidate signature _____

I declare this is my own work.

INTERNATIONAL GCSE

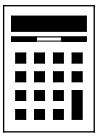
CHEMISTRY

Paper 2

Wednesday 10 November 2021 07:00 GMT Time allowed: 1 hour 30 minutes

Materials

For this paper you must have:
- a pencil and a ruler
- a scientific calculator
- the periodic table (enclosed).



Instructions
- Use black ink or black ball-point pen.
- Pencil should only be used for drawing.
- Fill in the boxes at the top of this page.
- Answer **all** questions.
- You must answer the questions in the spaces provided. Do not write outside the box around each page or on blank pages.
- If you need extra space for your answer(s), use the lined pages at the end of this book. Write the question number against your answer(s).
- Do all rough work in this book. Cross through any work you do not want to be marked.
- Show all your working.

For Examiner's Use	
Question	Mark
1	
2	
3	
4	
5	
6	
7	
8	
9	
TOTAL	

Information
- The marks for questions are shown in brackets.
- The maximum mark for this paper is 90.
- You are expected to use a scientific calculator where appropriate.
- A periodic table is provided as a loose insert.

Do not write outside the box

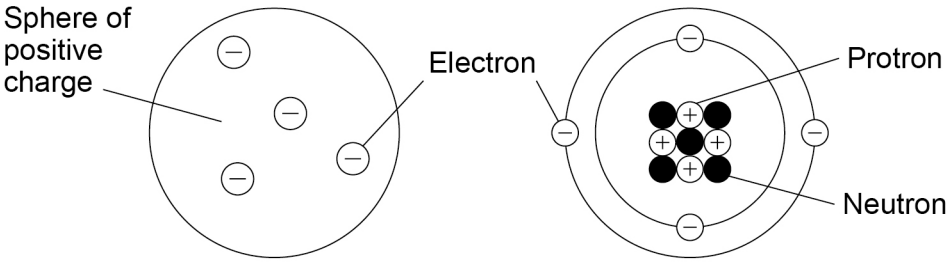
Answer **all** questions in the spaces provided.

0 1 This question is about atoms.

0 1 . 1 The atomic model has developed over time.

Figure 1 shows two different models of an atom of the same element.

Figure 1



Model A **Model B**

Give **four** differences between **Model A** and **Model B**.

[4 marks]

1 _____

_____

2 _____

_____

3 _____

_____

4 _____

_____

0 1 . 2 What is the total number of atoms in a molecule of NH_3?

[1 mark]

Tick (✓) **one** box.

2 ☐ 3 ☐ 4 ☐ 5 ☐

Do not write outside the box

An atom of chlorine is represented as $^{35}_{17}Cl$

0 1 . 3 Give the number of protons, the number of electrons and the number of neutrons in one atom of $^{35}_{17}Cl$

[3 marks]

Number of protons _____

Number of electrons _____

Number of neutrons _____

0 1 . 4 Chlorine has two isotopes.

Complete the sentence.

Choose the answer from the box.

[1 mark]

electrons	**neutrons**	**protons**

Isotopes are atoms of the same element with a different number

of _____ .

9

Turn over for the next question

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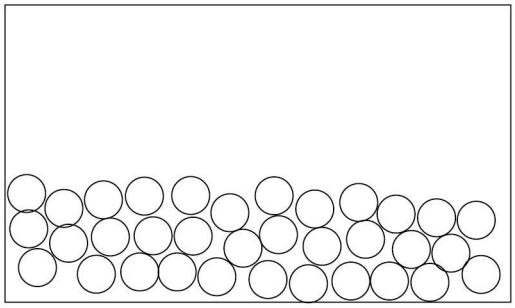
0 2 This question is about states of matter.

0 2 . 1 **Figure 2** represents particles of argon in the liquid state.

Figure 2



Complete the box below to represent particles of argon in the gaseous state.

[1 mark]

0 2 . 2 The melting point of argon is −189 °C.

The boiling point of argon is −186 °C.

Complete the sentence.

[1 mark]

The change of state when argon is warmed from −190 °C to −187 °C is

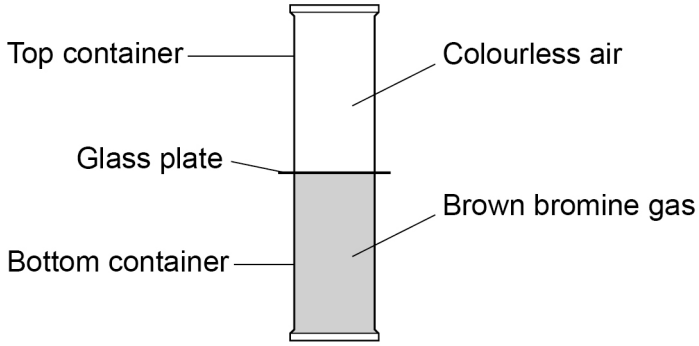
from _____ to _____ .

Do not write outside the box

A teacher demonstrated an experiment using bromine gas and air.

Figure 3 shows the apparatus.

Figure 3



When the glass plate was removed the brown bromine gas moved up into the top container.

0 2 . 3 Name the process that occurred when the glass plate was removed.

[1 mark]

0 2 . 4 The teacher repeats the experiment at a higher temperature.

Explain what will happen to the speed of movement of the brown bromine gas.

[2 marks]

Question 2 continues on the next page

Do not write outside the box

0 2 . 5 A sample of bromine gas has a volume of 0.600 dm^3.

24.0 dm^3 of bromine gas contains 6.02×10^{23} bromine molecules.

Calculate the number of bromine molecules in the sample.

[2 marks]

Number of bromine molecules = _____

7

Do not write outside the box

0 3 This question is about reactions of the halogens.

0 3 . 1 A teacher demonstrated the reaction of chlorine with sodium.

A student made the following observations:

- a **silver solid** reacted vigorously producing a yellow flame
- the colour of a **green gas** disappeared
- a **white solid** was produced.

Name the substances described by the observations.

[3 marks]

Silver solid _____

Green gas _____

White solid _____

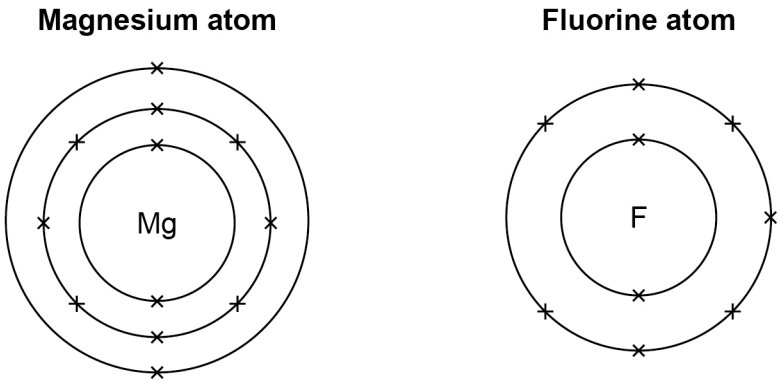
Question 3 continues on the next page

Do not write outside the box

0 3 . 2 Magnesium reacts with fluorine to produce magnesium fluoride (MgF_2).

Figure 4 represents the electronic structure of a magnesium atom and of a fluorine atom.

Figure 4



Describe what happens when magnesium atoms react with fluorine atoms to produce magnesium fluoride.

Answer in terms of electrons.

[4 marks]

Do not write outside the box

Chlorine reacts with potassium bromide in a displacement reaction.

The equation for the reaction is:

$$Cl_2 + 2\,KBr \rightarrow Br_2 + 2\,KCl$$

0 3 . 3 Explain why chlorine is more reactive than bromine.

[3 marks]

0 3 . 4 Bromide ions (Br^-) are oxidised when bromine is displaced by chlorine.

Why is this described as oxidation?

[1 mark]

11

Turn over for the next question

Do not write outside the box

0 4 A student reacted copper carbonate with sulfuric acid.

0 4 . 1 Carbon dioxide was produced.

Name the other **two** products of the reaction between copper carbonate and sulfuric acid.

[2 marks]

1 _____

2 _____

The student measured the volume of carbon dioxide produced.

The volume was recorded every 20 seconds for 180 seconds.

Table 1 shows **some** of the results.

Table 1

Time in seconds	Volume of carbon dioxide in cm^3
0	0
20	16
40	30
60	42
80	53
100	62
120	68

0 4 . 2 The student observed that the reaction had finished after 160 seconds.

Suggest what the student observed to show that the reaction had finished.

[1 mark]

_____

_____

Do not write outside the box

0 4 . 3 Complete **Figure 5**.

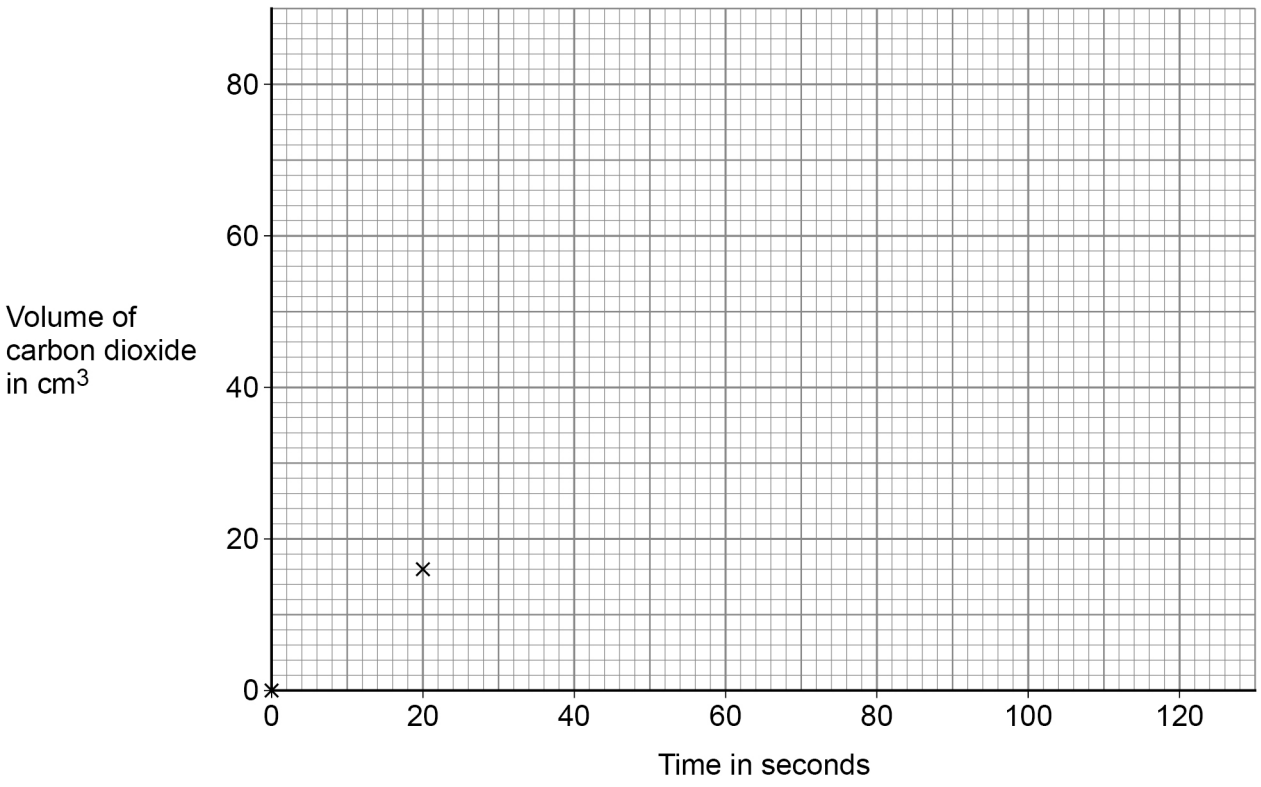
You should:

- plot the data from **Table 1** on **Figure 5**
- draw a line of best fit.

The first 2 points from **Table 1** have been plotted for you.

[3 marks]

Figure 5



0 4 . 4 The concentration of sulfuric acid decreases during the reaction.

Explain how the decreasing concentration of sulfuric acid affects the rate of the reaction.

[2 marks]

8

Turn over ►

Do not write outside the box

0 5 This question is about metals.

0 5 . 1 **Table 2** shows information about some transition metals.

Table 2

Transition metal		
Name	**Atomic number**	**Melting point in °C**
Titanium	22	1660
Vanadium	23	1890
Chromium	24	1857
Iron	26	1535
Cobalt	27	1495
Nickel	28	1455

Describe the trend in melting points with increasing atomic number for the transition metals shown in **Table 2**.

[2 marks]

0 5 . 2 Describe how the melting points of transition metals compare with the melting points of Group 1 metals.

[1 mark]

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0 5 . 3 **Table 3** gives information about the metals iron, sodium, and zinc.

Table 3

	Iron	**Sodium**	**Zinc**
Density in g/cm^3	7.86	0.97	7.14
Hardness in arbitrary units	4.0	0.5	2.5
Formulae of chlorides	$FeCl_2$ $FeCl_3$	NaCl	$ZnCl_2$
Colour of chlorides	green yellow	white	white

A student concludes that zinc is **not** a transition metal.

Evaluate the student's conclusion.

[4 marks]

Question 5 continues on the next page

Turn over ►

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Vanadium(V) oxide is a catalyst.

0 5 . 4 Describe the effect a catalyst has on the rate of a reaction.

[1 mark]

0 5 . 5 Vanadium(V) oxide (V_2O_5) can be produced by reacting vanadium with oxygen.

Balance the equation for the reaction.

[1 mark]

$$\_\_\_\_\ V + \_\_\_\_\ O_2 \rightarrow \_\_\_\_\ V_2O_5$$

9

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0 6 This question is about analysis.

Mixture **A** is a solution containing different transition metal ions.

0 6 . 1 Sodium hydroxide solution can be used to identify transition metal ions.

A student added sodium hydroxide solution to mixture **A**.

The student was **not** able to identify the transition metal ions in the mixture.

Suggest **one** reason why.

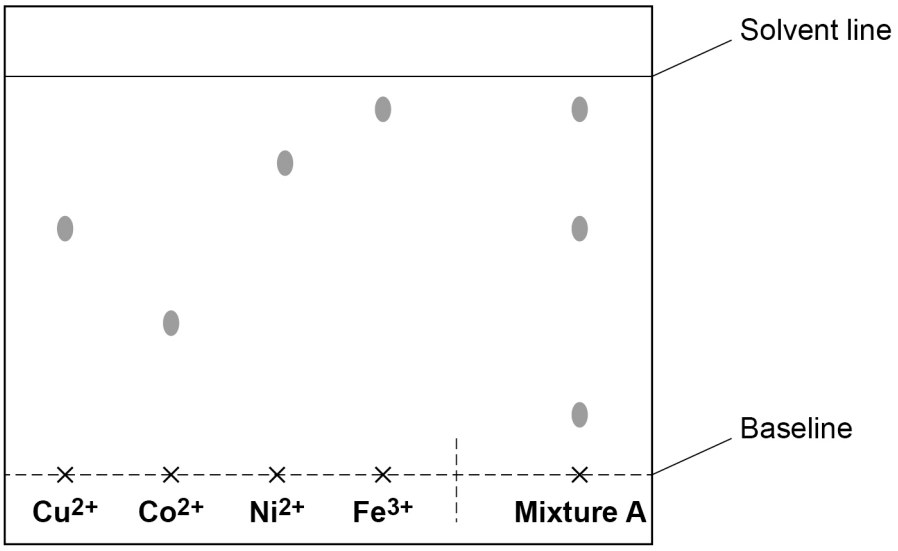
[1 mark]

The student used paper chromatography to investigate the composition of mixture **A**.

The student compared mixture **A** with solutions containing Cu^{2+} ions, Co^{2+} ions, Ni^{2+} ions and Fe^{3+} ions.

Figure 6 shows the results.

Figure 6



0 6 . 2 Give **one** reason why the baseline was drawn in pencil.

[1 mark]

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0 6 . 3 Describe the composition of mixture **A**.

Use **Figure 6**.

[2 marks]

0 6 . 4 Determine the R_f value of the Co^{2+} ions in **Figure 6**.

Use the equation:

$$R_f = \frac{\text{distance moved by } Co^{2+} \text{ ions}}{\text{distance moved by solvent}}$$

[3 marks]

Distance moved by Co^{2+} ions = _____ cm

Distance moved by solvent = _____ cm

R_f value = _____

0 6 . 5 Explain why Cu^{2+} ions and Ni^{2+} ions have moved different distances in **Figure 6**.

[2 marks]

Question 6 continues on the next page

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0 6 . 6 The student did three different tests on a solution of a compound.

Table 4 shows the results.

Table 4

Test	Observation
Flame test	Red colour
Add sodium hydroxide solution	White precipitate forms
Add dilute nitric acid followed by silver nitrate solution	Cream precipitate forms

Name the compound.

[2 marks]

11

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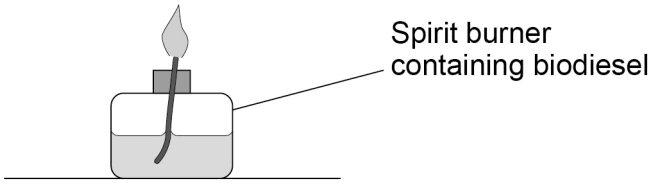
0 7 This question is about biodiesel.

0 7 . 1 A student did an experiment to determine the amount of energy released by burning biodiesel.

The student used a spirit burner to burn the biodiesel.

Figure 7 shows a spirit burner.

Figure 7



Describe a method to determine the amount of energy released by burning 1 g of biodiesel.

[6 marks]

Question 7 continues on the next page

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Fuels can be made by mixing biodiesel with hydrocarbons from crude oil.

Scientists investigated fuel mixtures containing biodiesel and hydrocarbon fuels.

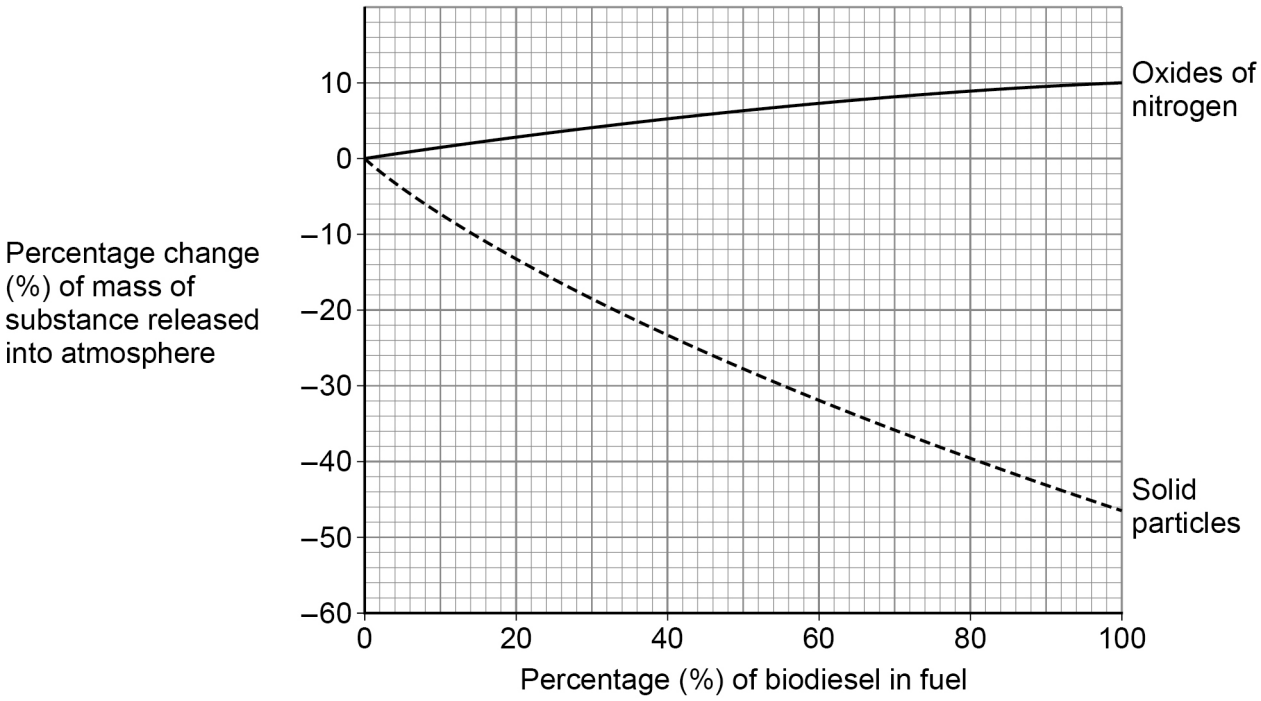
The scientists measured the masses of substances released into the atmosphere when a fuel mixture burned.

The substances released into the atmosphere include:

- oxides of nitrogen
- solid particles.

Figure 8 shows the results.

Figure 8



0 7 . 2 Explain how changing the percentage of biodiesel in a fuel will affect environmental problems caused by oxides of nitrogen.

Use **Figure 8**.

[2 marks]

Do not write outside the box

0 7 . 3 Explain how changing the percentage of biodiesel in a fuel will affect environmental problems caused by solid particles.

Use **Figure 8**.

[2 marks]

0 7 . 4 **Table 5** shows some information about two biodiesel fuels.

Table 5

	Biodiesel A	**Biodiesel B**
Raw material	Used cooking oil	Soya bean oil
Source of raw material	Sunflowers grown on existing farm land	Soya bean plants grown in cleared forest
Carbon footprint in grams of carbon dioxide per kJ of energy	0.013	0.103

Evaluate the use of biodiesel **A** and of biodiesel **B**.

[4 marks]

14

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0 8 This question is about hydrogen halides.

0 8 . 1 The equations for the decomposition of hydrogen chloride and of hydrogen iodide are:

$$2\,HCl \rightarrow H_2 + Cl_2$$

$$2\,HI \rightarrow H_2 + I_2$$

The decomposition of hydrogen chloride has a much larger activation energy than the decomposition of hydrogen iodide.

Explain what effect the larger activation energy has on the rate of reaction.

[2 marks]

0 8 . 2 The reactions in Question **08.1** are endothermic.

Explain endothermic reactions in terms of bond making and bond breaking.

[3 marks]

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0 8 . 3 Hydrogen chloride reacts with ethene.

Figure 9 shows the displayed structures of the reactants and the product.

Figure 9

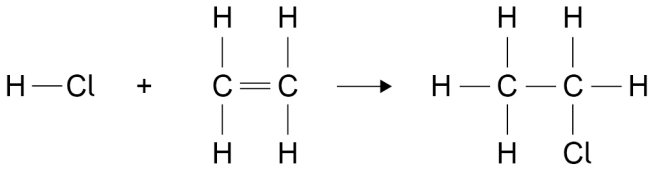

Table 6 shows the bond energies.

Table 6

Bond	Bond energy in kJ/mol
H−Cl	432
C=C	612
C−H	413
C−C	347
C−Cl	346

Calculate the overall energy change for the reaction.

[3 marks]

Overall energy change = _____ kJ/mol

8

Turn over ►

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0 9 A student did a titration.

The student used:

- potassium hydroxide solution of concentration 0.150 mol/dm^3
- sulfuric acid of unknown concentration.

0 9 . 1 Calculate the mass of potassium hydroxide (KOH) needed to make 250 cm^3 of 0.150 mol/dm^3 solution.

Relative atomic masses (A_r): H = 1 O = 16 K = 39

[4 marks]

Mass of potassium hydroxide = _____ g

Do not write outside the box

0 9 . 2 This is the method used.

1 Measure 25 cm^3 of the potassium hydroxide solution using a measuring cylinder.

2 Add the potassium hydroxide solution to a beaker on a white tile.

3 Add 5 cm^3 of an indicator to the potassium hydroxide solution.

4 Add sulfuric acid from a burette until the indicator changes colour.

5 Repeat steps **1** to **4** until two readings are within 1 cm^3 of each other.

This method did **not** give accurate results.

Give **three** improvements to the method to make the results more accurate.

[3 marks]

1 _____

_____

2 _____

_____

3 _____

_____

Question 9 continues on the next page

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0 9 . 3 The student repeated the titration using a more accurate method.

The student found that 15.0 cm^3 of sulfuric acid completely reacted with 25.0 cm^3 of potassium hydroxide solution of concentration 0.150 mol/dm^3.

The equation for the reaction is:

$$2\,KOH + H_2SO_4 \rightarrow K_2SO_4 + 2\,H_2O$$

Calculate the concentration of the sulfuric acid in mol/dm^3.

[4 marks]

Concentration of the sulfuric acid = _____ mol/dm^3

0 9 . 4 A different student did two titrations using a pH meter.

The student added 30 cm^3 of 0.1 mol/dm^3 potassium hydroxide solution to:

- 20 cm^3 of 0.05 mol/dm^3 hydrochloric acid
- 20 cm^3 of **acid X**.

The student added the potassium hydroxide solution 1 cm^3 at a time and measured the pH of the mixture.

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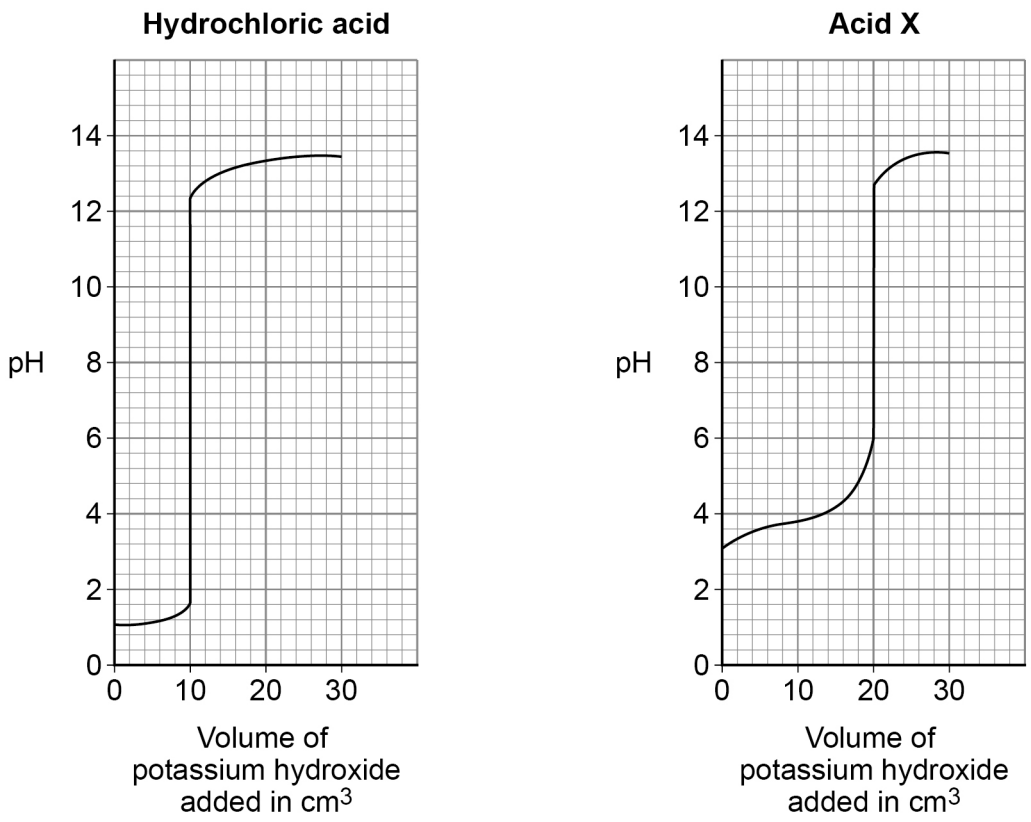
Figure 10 shows the results.

Figure 10



There is a large change in pH when the acid is neutralised by the alkali.

Explain why the results in **Figure 10** show that **acid X** could be ethanoic acid with a concentration of 0.1 mol/dm^3.

[2 marks]

13

END OF QUESTIONS

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