**1(a).** In a neutralisation reaction dilute sulfuric acid, H2SO4, reacts with potassium hydroxide solution, KOH.

$H_2SO_4$ + 2KOH ✓ $K_2SO_4$ + $2H_2O$

Calculate the mass of potassium sulfate, $K_2SO_4$, that could be made from 6.54 g of dilute sulfuric acid, $H_2SO_4$.

Give your answer to **3** significant figures.

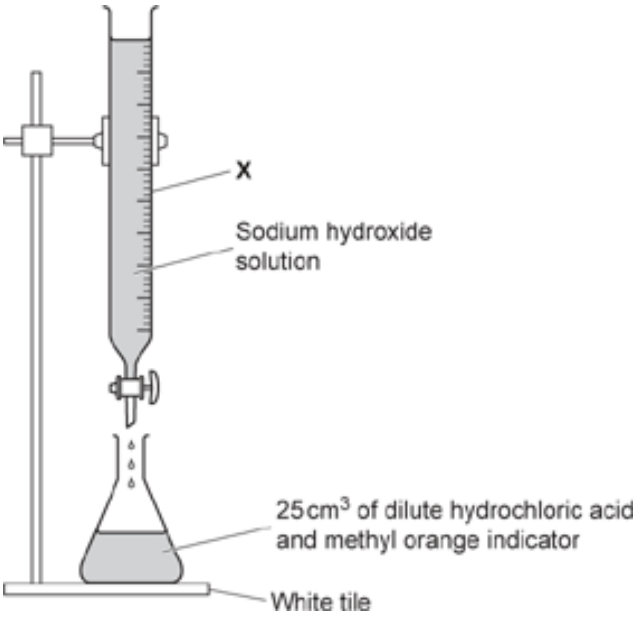
Relative atomic mass ($A_r$): H = 1.0 K = 39.1 O = 16.0 S = 32.1

Mass of potassium sulfate = ..... g **[4]**

**(b).** A student investigates the neutralisation reaction between sodium hydroxide solution and dilute hydrochloric acid.

They do a titration experiment.

The diagram shows the apparatus they use.




What is the name of the piece of equipment labelled **X**?

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**[1]**

**(c).** The student places the conical flask on a white tile.

Explain why.

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**[1]**

**(d).** The student adds the alkali to the acid drop by drop near the endpoint of the titration.

Explain why.

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**[1]**

**(e).** The neutralisation reaction between sodium hydroxide solution, NaOH, and dilute hydrochloric acid, HCl, makes a salt and water.

Write the **balanced symbol** equation for the reaction.

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**[2]**

**2.** Magnesium carbonate, $MgCO_3$, decomposes to make magnesium oxide, MgO.

Carbon dioxide is a waste product.

$MgCO_3 \rightarrow MgO + CO_2$

Relative formula mass ($M_r$): MgO = 40.3 $CO_2$ = 44.0

What is the atom economy of the reaction?

Use the equation:

$$\text{atom economy} = \frac{M_r \text{ of desired product}}{\text{total } M_r \text{ mass of all products}} \times 100$$

**A** 47.8%
**B** 52.2%
**C** 91.6%
**D** 109.0%

Your answer ☐ **[1]**

**3.** This is the equation for a reaction.

$NaOH + HCl \rightarrow NaCl + H_2O$

i. What type of reaction is this?

Tick (✓) **one** box.

Polymerisation ☐
Neutralisation ☐
Reversible ☐
Thermal decomposition ☐

**[1]**

ii. Water is a waste product in this reaction.

Calculate the **atom economy** for the reaction.

Relative atomic mass ($A_r$): H = 1.0 O = 16.0 Na = 23.0 C*l* = 35.5

Atom economy = ..... % **[3]**

**4.** Iron reacts with dilute sulfuric acid, $H_2SO_4$.

Iron sulfate, $FeSO_4$, and hydrogen gas, $H_2$, are made.

i. Write the **balanced symbol** equation for this reaction.

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

ii. A student reacts 2.8 g of iron with dilute sulfuric acid.

The student makes 5.4 g of iron sulfate.

They predicted that they should have made 7.6 g of iron sulfate.

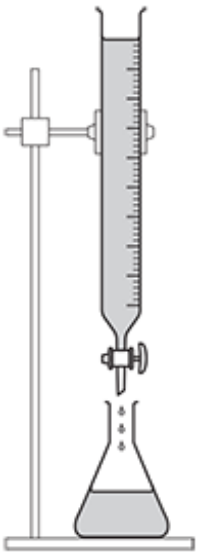
Calculate their **percentage yield**.

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

Percentage yield of iron sulfate = ..... % **[3]**

**5.** A student plans a titration experiment.

The diagram shows some of the apparatus they use.



The student writes their method.

**A** Add a few drops of methyl orange indicator.
**B** Fill the burette with dilute hydrochloric acid. Record the initial reading on the burette.
**C** Empty the sodium hydroxide solution from the pipette into a conical flask.
**D** Stop adding the dilute hydrochloric acid when the indicator just changes colour.
**E** Repeat these steps until you have two concordant results.
**F** Use a pipette filler to fill a glass pipette with 25.0 $cm^3$ of sodium hydroxide solution.
**G** Add the dilute hydrochloric acid to the sodium hydroxide solution while swirling the conical flask.

The steps in the method are **not** in the correct order.

Write the letters in the boxes to show the correct order of the steps. The first and last steps have been filled in for you.

| B | | | | | | E |
|---|---|---|---|---|---|---|

**[4]**

**6.** In an experiment, a teacher reacts 0.1 g of zinc with excess hydrochloric acid.

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

Calculate the **mass** of hydrogen gas made.

Relative atomic mass ($A_r$): H = 1.0 Zn = 65.4

Mass of hydrogen gas = ..... g **[3]**

**7.** Calcium carbonate, $CaCO_3$, thermally decomposes to make calcium oxide, CaO, and carbon dioxide.

$CaCO_3 \rightarrow CaO + CO_2$

5.0 g of calcium carbonate makes 2.8 g of calcium oxide.

How much carbon dioxide is made?

**A** 2.2 g
**B** 2.8 g
**C** 4.4 g
**D** 7.8 g

Your answer ☐ **[1]**

**END OF QUESTION PAPER**