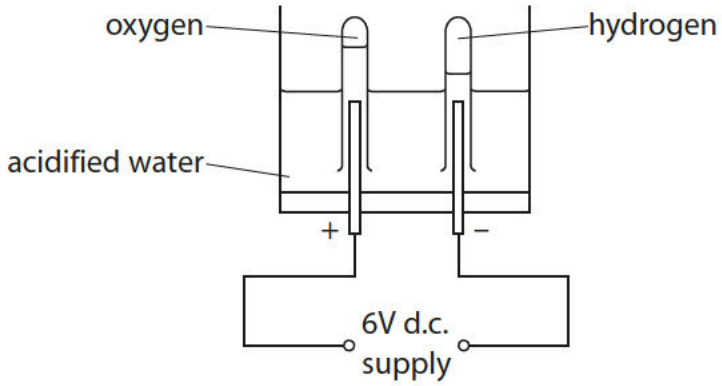
1 (a) Water, acidified with a small amount of dilute sulfuric acid, can be decomposed by electrolysis using the apparatus shown.



(i) State the form of energy used to carry out the electrolysis.

(1)

.....

(ii) During the electrolysis, hydrogen is formed at one of the electrodes.

Describe a test to show that this gas is hydrogen.

(2)

.....

.....

.....

.....

(b) Electrolysis is also used to produce chlorine on a large scale.

Name a raw material that can be electrolysed to produce chlorine.

(1)

.....

(c) (i) Complete the sentence by putting a cross (☒) in the box next to your answer.

Acids are neutralised by metal hydroxides to form

(1)

☐ **A** salt only

☐ **B** salt and hydrogen only

☐ **C** salt and oxygen only

☐ **D** salt and water only

(ii) Acids can also be neutralised by metal carbonates.

Dilute sulfuric acid is neutralised by copper carbonate as shown in the word equation.

copper carbonate + sulfuric acid → copper sulfate + carbon dioxide + water

Copper carbonate is a green powder.

Describe what you would **see** when copper carbonate powder is added to dilute sulfuric acid.

(2)

.....

.....

.....

.....

(d) Two experiments were carried out to test the effectiveness of tablets of three different indigestion remedies, A, B and C.

For each remedy, the experiments were carried out on both a whole and a crushed tablet.

In experiment 1, each tablet was added to excess hydrochloric acid and the time taken for the tablet to react completely was recorded.

In experiment 2, the volume of acid neutralised by each tablet was determined.

The table shows the results obtained for the investigation.

tablet of	state of tablet	experiment 1 : time taken for the tablet to react completely / s	experiment 2 : volume of acid neutralised / cm^3
A	whole	75	25.0
	crushed	30	25.0
B	whole	59	25.0
	crushed	19	25.0
C	whole	120	50.0
	crushed	44	50.0

(i) Explain, using information from the table, which of the tablets contains the most of the active ingredient to overcome indigestion.

(2)

.....

.....

.....

.....

(ii) Explain, using information from the table, whether faster relief of indigestion is achieved by using a given tablet whole or crushed.

(1)

.....

.....

.....

(Total for Question 1 = 10 marks)

2 (a) Magnesium carbonate reacts with dilute nitric acid.

Give the names of the products formed in this reaction.

(2)

.....

(b) Zinc oxide, ZnO, reacts with dilute hydrochloric acid to form zinc chloride, $ZnCl_2$, and water.

(i) Complete the sentence by putting a cross (☒) in the box next to your answer.

This reaction is an example of

(1)

☐ **A** combustion

☐ **B** thermal decomposition

☐ **C** neutralisation

☐ **D** oxidation

(ii) Write the balanced equation for the reaction between zinc oxide and dilute hydrochloric acid.

(3)

.....

*(c) Electrolysis of hydrochloric acid can produce hydrogen and chlorine.

The apparatus for the electrolysis is

hydrochloric acid

two carbon rods

a suitable container for the electrolysis reaction

a suitable source of electricity

test tubes

Describe how the apparatus can be used to electrolyse hydrochloric acid and how the gases produced can be tested to show that they are hydrogen and chlorine.

You may use a diagram to help your answer.

(6)

(Total for Question 2 = 12 marks)

3 (a) Which of the following pairs of substances contains one substance that is soluble in water and one that is insoluble in water?

Put a cross (☒) in the box next to your answer.

(1)

☐ **A** aluminium nitrate and lead sulfate

☐ **B** ammonium chloride and copper sulfate

☐ **C** copper hydroxide and lead sulfate

☐ **D** sodium hydroxide and potassium nitrate

(b) Barium chloride is an ionic compound and has a high melting point.

Explain why barium chloride has a high melting point.

(2)

.....

.....

.....

.....

(c) Barium chloride solution is used to test for the presence of sulfate ions in a solution.

When sulfate ions are present, insoluble barium sulfate is formed.

(i) Describe the appearance of barium sulfate.

(1)

.....

(ii) Complete the balanced equation for the reaction between barium chloride and potassium sulfate.

(2)

$BaCl_2 + K_2SO_4 \rightarrow$ .....

(d) Compound **X** is a metal carbonate.

(i) A flame test was carried out on compound **X**.
A lilac flame was seen.

Complete the sentence by putting a cross (☒) in the box next to your answer.

(1)

The formula of the metal ion in compound **X** is

☐ **A** Ca^{2+}

☐ **B** Cu^{2+}

☐ **C** K^{+}

☐ **D** Na^{+}

(ii) Lead carbonate is an insoluble salt.

Describe how a pure, dry sample of solid lead carbonate can be obtained from sodium carbonate solution and lead nitrate solution.

(3)

.....

.....

.....

.....

.....

.....

(Total for Question 3 = 10 marks)

4 To make pure sodium chloride from sodium hydroxide solution and dilute hydrochloric acid, a titration has to be used.

The equation for the reaction is

$$HCl(aq) + NaOH(aq) \rightarrow NaCl(\quad) + H_2O(\quad)$$

(a) Which state symbols follow NaCl and H_2O to complete the equation?

Put a cross (☒) in the box next to your answer.

(1)

		NaCl	$_2$O
☐	**A**	s	
☐	**B**	aq	
☐	**C**	s	a
☐	**D**	aq	

(b) The reaction above is a neutralisation reaction.

Write the ionic equation for the reaction.

(2)

.....

(c) When sodium hydroxide solution is titrated with dilute hydrochloric acid, an acid-base indicator is used.
The hydrochloric acid is added from a burette to the sodium hydroxide solution in a conical flask.
At the end point the indicator changes colour.

(i) Give the name of a suitable indicator to use in this titration.

(1)

.....

(ii) State the colour change for this indicator at the end point.

(1)

from ..... to .....

(d) A sodium hydroxide solution was made up by dissolving 20.0 g of sodium hydroxide in water and making the volume of the solution up to 1.00 dm^3. Calculate the concentration of sodium hydroxide, NaOH, in this solution in mol dm^{-3}.

(relative atomic masses: H = 1.00, O = 16.0, Na = 23.0)

(2)

concentration = ... mol dm^{-3}

(e) In another experiment, a titration was carried out.
25.0 cm^3 of 1.50 mol dm^{-3} sodium hydroxide solution, NaOH, was titrated with hydrochloric acid.
The volume of the hydrochloric acid required to neutralise the sodium hydroxide solution was 30.0 cm^3.

Calculate the concentration of the hydrochloric acid, HCl, in mol dm^{-3}.

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

(3)

concentration = ... mol dm^{-3}

(Total for Question 4 = 10 marks)