1   The method used to prepare a salt depends on its solubility in water.
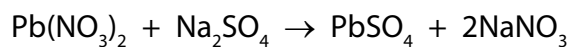
(a) Complete Figure 9 by placing one tick in each row to show whether the salt is soluble or insoluble.

(2)

salt	soluble	insoluble
ammonium chloride		
lithium sulfate		
magnesium carbonate		

Figure 9

(b) Lead nitrate solution mixed with sodium sulfate solution forms lead sulfate as a precipitate.

$$Pb(NO_3)_2 \ + \ Na_2SO_4 \ \rightarrow \ PbSO_4 \ + \ 2NaNO_3$$

The theoretical yield of lead sulfate for this reaction was 2.85 g.
The actual yield of lead sulfate obtained was 2.53 g.

Calculate the percentage yield of lead sulfate in this experiment.

Give your answer to two significant figures.

(3)

percentage yield = ...%

(c) The method used to make the lead sulfate is:

- pour 100 cm³ lead nitrate solution into a beaker
- add drops of sodium sulfate solution until a precipitate is seen
- allow the precipitate to settle to the bottom of the beaker
- pour off the liquid
- use a spatula to transfer the solid lead sulfate onto a filter paper

Explain **two** ways of improving this experimental method to increase the amount and quality of lead sulfate obtained from the same volume of lead nitrate solution.

(4)

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(d) Ammonium nitrate is produced from ammonia and nitric acid on a large scale in industry.

Ammonium nitrate can also be made in the laboratory by titrating ammonia solution with dilute nitric acid.

$$NH_3 + HNO_3 \rightarrow NH_4NO_3$$
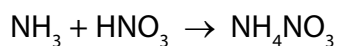
Ammonium nitrate crystals can then be obtained by evaporating off some of the water from the solution.

Give **two** reasons why this laboratory method is not suitable for use on a large scale in industry.

(2)

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(Total for Question 1 = 11 marks)

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

An acid reacts with a metal oxide to form

(1)

⊠ **A** a salt and hydrogen only

⊠ **B** a salt and oxygen only

⊠ **C** a salt only

⊠ **D** a salt and water only

(b) Acids also react with metal carbonates.

The word equation for the reaction of copper carbonate with dilute nitric acid is

copper carbonate (s) + nitric acid (aq) → copper nitrate (aq) + carbon dioxide (g) + water (l)

(i) State **two** things you would **see** when solid copper carbonate reacts with dilute nitric acid.

(2)

....

....

....

(ii) Write the balanced equation for the reaction of copper carbonate with dilute nitric acid.

(3)

....

(c) Two gases can be produced by the electrolysis of water, under suitable conditions.

(i) Explain what is meant by **electrolysis**.

(2)

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(ii) One of the gases is oxygen.

Describe a test to show the gas is oxygen.

(2)

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(Total for Question 2 = 10 marks)

3 (a) Hydrochloric acid can be electrolysed using this apparatus.

chlorine

hydrochloric
acid

6V dc
supply
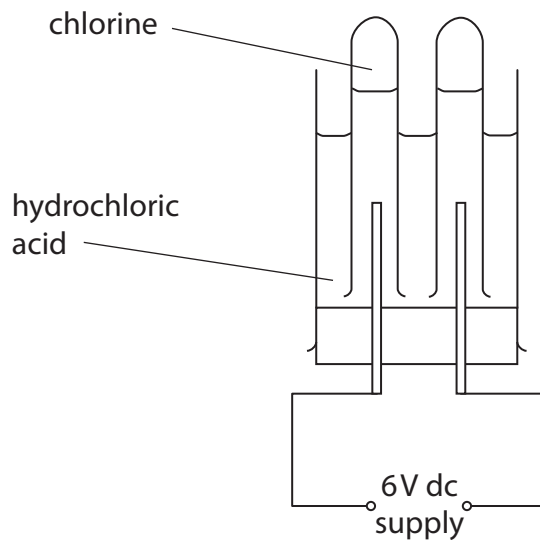
(i) State the form of energy used to carry out the electrolysis.

(1)

....

(ii) Chlorine gas is formed at one electrode.

Name the gas formed at the other electrode.

(1)

....

(iii) Describe the test to show that a gas is chlorine.

(2)

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(b) Which of these can be used to obtain chlorine from sea water?

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

(1)

   ☒ **A** corrosion

   ☒ **B** electrolysis

   ☒ **C** fractional distillation

   ☒ **D** neutralisation

(c) Acids react with metal carbonates.

   Complete the word equation for this type of reaction.

(1)

   acid + metal carbonate → salt + water + ...

(d) Acids also react with metal oxides.

   Complete and balance the equation for the reaction between copper oxide, CuO, and dilute hydrochloric acid, HCl.

(2)

$$CuO + \text{............} HCl \rightarrow CuCl_2 + \text{..........................}$$
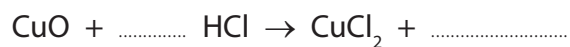
(Total for Question 3 = 8 marks)

4 (a) Substance **X** is an ammonium salt.

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

   A test was carried out to find which anion is present in substance **X**.
   Dilute hydrochloric acid was added to a sample of substance **X**.
   There was effervescence and the gas given off turned limewater milky.

   The anion present in substance **X** is

   (1)

   ☒ **A** carbonate ion, CO_3^{2-}

   ☒ **B** chloride ion, Cl^-

   ☒ **C** nitrate ion, NO_3^-

   ☒ **D** sulfate ion, SO_4^{2-}

   (ii) Describe how sodium hydroxide solution can be used to show that ammonium ions are present in substance **X**.

   (2)

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(b) Aluminium ions, Al^{3+}, react with hydroxide ions in solution to give a white precipitate of aluminium hydroxide.

   Write the ionic equation for this reaction.

   (3)

....

*(c) A technician found some colourless crystals of a substance left, unlabelled, in a beaker in a laboratory.

She knew the substance was one of potassium sulfate, potassium iodide, sodium sulfate or sodium iodide.

Explain how, using chemical tests, the technician could find out if the substance left in the beaker was potassium sulfate, potassium iodide, sodium sulfate or sodium iodide.

You may include equations in your answer.

(6)

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(Total for Question 4 = 12 marks)