





1. The first four elements in group 1 of the periodic table are lithium, sodium, potassium and rubidium.

alkali metals

(a) The group 1 elements are called transition metals

halogens

(1)

(b) A small piece of potassium was dropped on to water.

The potassium reacted violently with the water.

Potassium hydroxide solution and a gas were formed.

(i) Complete the word equation for the reaction by filling in the name of the gas formed.

potassium + water → potassium hydroxide + ..... (1)

(ii) Give the name of a metal in group 1 that is less reactive than potassium with water.

..... (1)

(c) A flame test was carried out on a sample of potassium chloride.

(i) Describe how a flame test is carried out.

.....  
 .....  
 .....  
 ..... (2)

(ii) Which of the following colours in the flame would show the presence of potassium ions in the potassium chloride?

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

green	<input type="checkbox"/>
lilac	<input type="checkbox"/>
red	<input type="checkbox"/>
yellow	<input type="checkbox"/>

(1)

(Total 6 marks)

Q1



2. Copper and iron are two transition metals.  
The metals and their compounds have many uses in industry.

(a) Which **two** of the following properties are typical of transition metals?

Put a cross in two boxes (☒) to show your answers.

- low boiling point
- high melting point
- poor conductors of electricity
- form coloured compounds
- low density

(2)

(b) Ammonia is made by reacting hydrogen with nitrogen.  
This reaction is very slow but it is faster if iron is added.  
The iron is not used up in the reaction.

What name is given to a substance that increases the rate of a reaction in this way?

.....  
(1)

(c) Some metal ions in solution react with sodium hydroxide solution to form precipitates.

(i) What is a **precipitate**?

.....  
.....  
(1)



(ii) Metal ions can be identified by the colour of the precipitates they form with sodium hydroxide solution.

Draw a straight line from each metal ion to the colour of the precipitate it forms. The line for iron(II) ion,  $\text{Fe}^{2+}$ , has been done for you.

metal ion	colour of precipitate
copper ion, $\text{Cu}^{2+}$	● blue
iron(II) ion, $\text{Fe}^{2+}$	● pale green
iron(III) ion, $\text{Fe}^{3+}$	● pale yellow
	● red-brown

(2)

(iii) This test to identify metal ions is a qualitative test.

What is meant by a **qualitative** test?

.....

.....

(1)

(Total 7 marks)

Q2



3. Ethyl butanoate is an ester.  
It has a pleasant smell.

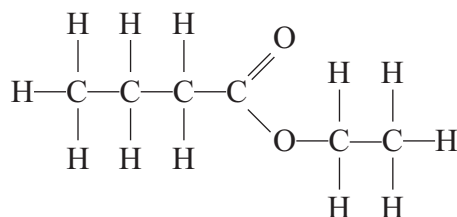
(a) Suggest **two** uses of ethyl butanoate.

1 .....

2 .....

(2)

(b) The structure of a molecule of ethyl butanoate is



Ethyl butanoate is made by reacting an alcohol with butanoic acid.

(i) Give the name of this alcohol.

.....

(1)

(ii) A solution of butanoic acid behaves as a typical acid.  
What colour would you see when a few drops of universal indicator are added to butanoic acid solution?

.....

(1)

(iii) Magnesium metal reacts with butanoic acid solution to produce a gas.  
When the gas is mixed with air and ignited, it burns with a squeaky pop.  
Give the name of the gas.

.....

(1)

(Total 5 marks)

Q3



4. Water is purified to make it suitable for drinking.

(a) Why is it important not to waste purified water?

.....  
.....

(1)

(b) Some countries are short of water suitable for drinking.

Drinking water can be made from seawater.  
Seawater contains dissolved sodium chloride.

(i) Describe a test to show the presence of chloride ions in a solution.

.....  
.....  
.....  
.....

(3)

(ii) Describe an experiment to find the mass of dissolved solid in 2000 cm<sup>3</sup> of seawater.

You are provided with a 2000 cm<sup>3</sup> sample of seawater.

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(3)

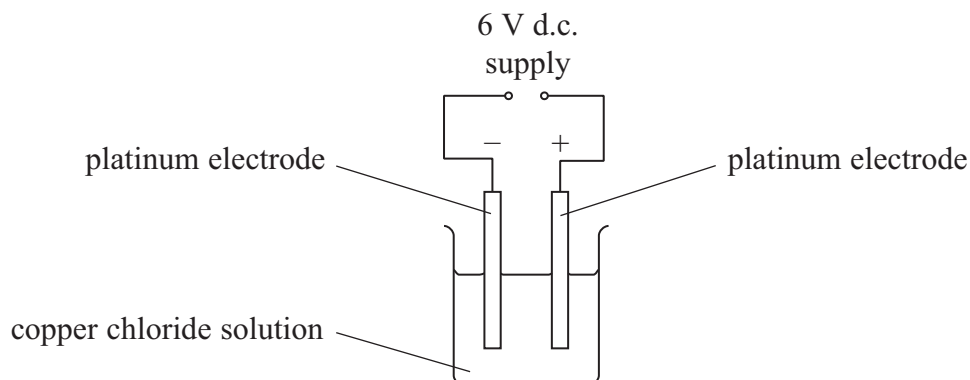
(Total 7 marks)

Q4



5. (a) Copper chloride solution can be electrolysed using the apparatus shown in the diagram.

Both electrodes are made of platinum, which is an unreactive metal.



During the electrolysis copper is formed at the negative electrode.

(i) Describe what you would **see** at the negative electrode.

.....  
 .....

(2)

(ii) Explain how a copper ion,  $\text{Cu}^{2+}$ , becomes a copper atom, Cu.

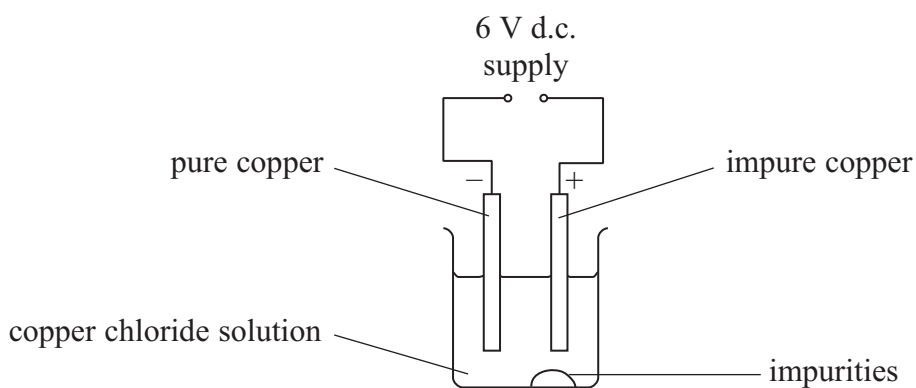
.....  
 .....

(2)





(b) Copper is purified by electrolysis.



(i) During electrolysis, the size of the impure copper electrode decreases. Explain why.

.....

.....

.....

.....

(2)

(ii) During electrolysis, impurities fall off the impure copper electrode and drop to the floor of the cell.

Give the name of a metal that could be found in these impurities.

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(1)

(Total 7 marks)

Q5



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6. Soaps and detergents are used to remove grease marks from clothes.

(a) Soaps are salts of carboxylic acids.

Soaps are made by boiling esters with a concentrated solution of Z.

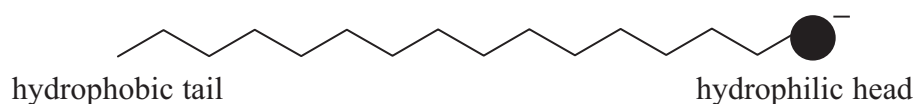
What is Z?

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

ethanol	<input type="checkbox"/>
ethyl ethanoate	<input type="checkbox"/>
hydrochloric acid	<input type="checkbox"/>
sodium hydroxide	<input type="checkbox"/>

(1)

(b) The negative ion in a detergent can be represented as



Describe how these detergent ions remove grease marks from clothes.

.....

.....

.....

.....

.....

(2)

(c) What advantage is there in using soapless detergents rather than soaps in hard-water areas?

.....

.....

(1)

(Total 4 marks)

Q6



7. In the UK over 1 million tonnes of sulphuric acid are manufactured each year.

(a) Give a use of sulphuric acid in industry.

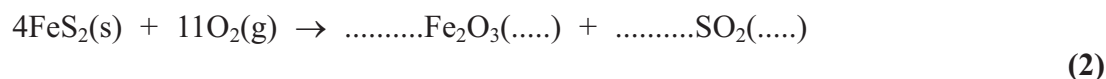
.....  
(1)

(b) The first stage in the manufacture of sulphuric acid is to make sulphur dioxide.

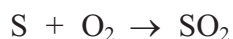
One way of making sulphur dioxide is by heating iron sulphide, FeS<sub>2</sub>, in air to make solid iron(III) oxide, Fe<sub>2</sub>O<sub>3</sub>, and sulphur dioxide, SO<sub>2</sub>.

Add numbers before the formulae on the right hand side to balance the equation for this reaction.

Fill in the missing state symbols.



(c) Another way of making sulphur dioxide is by burning sulphur in air.



Calculate the maximum mass of sulphur dioxide that could be made by burning one tonne of sulphur.

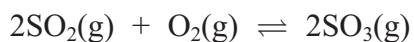
(Relative atomic masses: O = 16; S = 32)

.....  
 .....  
 .....  
 .....  
 .....

answer = ..... tonnes  
(2)



(d) Sulphur dioxide can be reacted with oxygen to form sulphur trioxide.



(i) Calculate the maximum volume of sulphur trioxide that is made if 1000 dm<sup>3</sup> oxygen completely reacted.

.....  
 .....

answer = ..... dm<sup>3</sup>  
**(1)**

(ii) In industry, in the contact process, this reaction is carried out using a metal oxide.  
 Give the name of this oxide.

.....  
**(1)**

(e) Powdered sodium carbonate was added to dilute sulphuric acid.  
 Carbon dioxide was formed.

(i) What would you see when this reaction was carried out?

.....  
 .....  
**(1)**

(ii) In one experiment 120 cm<sup>3</sup> of carbon dioxide was produced.

Calculate the number of moles of carbon dioxide, CO<sub>2</sub>, in 120 cm<sup>3</sup>.

(1 mol of any gas occupies 24 000 cm<sup>3</sup> at room temperature and atmospheric pressure)

.....  
 .....  
 .....

answer = ..... mol  
**(1)**

**(Total 9 marks)**

Q7



8. Some drain cleaners are concentrated solutions of sodium hydroxide.

(a) How would you show that these drain cleaners are alkaline?

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.....

**(2)**

(b) The concentration of sodium hydroxide in a drain cleaner was found by titration. The original drain cleaner was diluted by a known amount. These steps were used in the titration of the diluted solution.

- 1 A 25.00 cm<sup>3</sup> sample of diluted drain cleaner was measured out.
- 2 This sample was transferred to a conical flask.
- 3 A few drops of suitable indicator were added to the solution.
- 4 The sample was titrated with dilute hydrochloric acid.
- 5 The titration was repeated until concordant results were obtained.

(i) What apparatus should be used to measure the 25.00 cm<sup>3</sup> of diluted drain cleaner as accurately as possible (step 1)?

.....

**(1)**

(ii) Name a suitable indicator (step 3).

.....

**(1)**

(iii) Describe how you would carry out an accurate titration (step 4).

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.....  
.....  
.....  
.....  
.....  
.....

**(3)**



(iv) What is the meaning of **concordant** (step 5)?

.....  
 .....  
 .....

(1)

(c) The titration results are shown.

	volume (cm <sup>3</sup> )		
	experiment 1	experiment 2	experiment 3
<b>final reading</b>	25.50	24.90	25.00
<b>initial reading</b>	0.15	0.00	0.20
<b>volume of hydrochloric acid added</b>	25.35		

(i) Complete the table to show the volumes of hydrochloric acid added in experiments 2 and 3.

(1)

(ii) The titration results are used to calculate the concentration of sodium hydroxide in the diluted drain cleaner.  
 Calculate the volume of hydrochloric acid that should be used in the calculation.

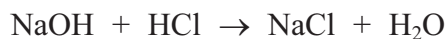
.....  
 .....

answer = ..... cm<sup>3</sup>

(1)



- (iii) The concentration of the hydrochloric acid, HCl, was  $0.100 \text{ mol dm}^{-3}$ .  
 Calculate the concentration of sodium hydroxide, NaOH, in the diluted drain cleaner in  $\text{mol dm}^{-3}$ .



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.....

answer = .....  $\text{mol dm}^{-3}$   
**(3)**

- (d) Sodium hydroxide solution is used in the test for dissolved iron(III) ions,  $\text{Fe}^{3+}$ .  
 A precipitate of iron(III) hydroxide,  $\text{Fe}(\text{OH})_3$ , is formed.

Write the ionic equation for this reaction.

.....  
**(2)**

**Q8**

**(Total 15 marks)**

**TOTAL FOR PAPER: 60 MARKS**

**END**

