GCSE Chemistry Trilogy



Required Practical Question Book

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| **Name:** | **Class:** | **Teacher:** |

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| **Practical 1**  **Making Salts** | **/ 29** | **Practical 4**  **Chromatography** | **/ 16** |
| **Practical 2**  **Temperature Changes** | **/ 16** | **Practical 5**  **Water Purification** | **/ 18** |
| **Practical 3**  **Rates of Reaction** | **/ 25** | **Practical 6**  **Electrolysis** | **/ 27** |

**Required Practical 1: Making Salts**

**Preparation of a pure, dry sample of a soluble salt from an insoluble oxide or carbonate, using a Bunsen**

**burner to heat dilute acid and a water bath or electric heater to evaporate the solution.**

1. Calcium chloride (CaCl2) is a soluble salt.

Calcium chloride can be made by reacting dilute hydrochloric acid with either solid calcium oxide or solid calcium carbonate.

(a)     Name the type of reaction that takes place when dilute hydrochloric acid reacts with calcium oxide.

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**(1)**

(b)     Write a balanced symbol equation for the reaction of dilute hydrochloric acid with calcium oxide.

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**(2)**

(c)     A student added solid calcium oxide to dilute hydrochloric acid in a beaker.

The student added solid calcium carbonate to dilute hydrochloric acid in another beaker.

Describe **one** difference between the two reactions that the student would **see**.

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**(1)**

(d)     Describe how crystals of calcium chloride can be made from calcium carbonate and dilute hydrochloric acid.

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**(4)**

(e)     A student dissolved some crystals of a salt in water.

The student added sodium hydroxide solution to the salt solution.

The student added sodium hydroxide solution until it was in excess.

(i)      Describe what the student would **see** if the salt contained calcium ions.

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**(2)**

(ii)     Why does the result you have described in part (e)(i) **not** prove that the salt contains calcium ions?

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**(1)**

(iii)    Describe an additional test the student could do that would prove the salt contains calcium ions.

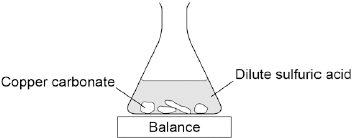
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**(2)**

1. Describe a safe method for making pure crystals of copper sulfate from copper carbonate and dilute sulfuric acid. Use the information in the figure below to help you.



In your method you should name all of the apparatus you will use.

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**(6)**

1. A student investigated the reactions of copper carbonate and copper oxide with dilute hydrochloric acid.

In both reactions one of the products is copper chloride.

(a)     Describe how a sample of copper chloride crystals could be made from copper carbonate and dilute hydrochloric acid.

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**(4)**

(b)     A student wanted to make 11.0 g of copper chloride.

The equation for the reaction is:

                             CuCO3 + 2HCl  →  CuCl2 + H2O + CO2

Relative atomic masses, *A*r: H = 1; C = 12; O = 16; Cl = 35.5; Cu = 63.5

Calculate the mass of copper carbonate the student should react with dilute hydrochloric acid to make 11.0 g of copper chloride.

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Mass of copper carbonate = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ g

**(4)**

(c)     The percentage yield of copper chloride was 79.1 %.

Calculate the mass of copper chloride the student actually produced.

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Actual mass of copper chloride produced = \_\_\_\_\_\_\_\_\_\_\_\_ g

**(2)**

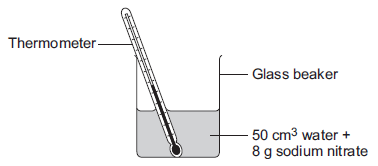
**Required Practical 2: Temperature Changes**

**Investigate the variables that affect temperature changes in reacting solutions such as, e.g. acid plus metals, acid plus carbonates, neutralisations, displacement of metals.**

1. This question is about temperature changes.

(a)     A student investigated the temperature change when 8 g of sodium nitrate dissolves in 50 cm3 of water.

The diagram below shows the apparatus the student used.



The student did the experiment five times.

**Table 1** shows the results.

|  |  |
| --- | --- |
| **Table 1** | |
| **Experiment** | **Decrease in temperature of water in °C** |
| 1 | 5.9 |
| 2 | 5.7 |
| 3 | 7.2 |
| 4 | 5.6 |
| 5 | 5.8 |

(i)      Calculate the mean decrease in temperature.

Do not use the anomalous result in your calculation.

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Mean decrease in temperature = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ °C

**(2)**

(ii)     Suggest **one** change in the apparatus in the diagram above which would improve the accuracy of the results.

Give a reason for your answer.

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**(2)**

(b)     The student investigated the temperature change when different masses of sodium carbonate were added to 50 cm3 of water at 20 °C.

**Table 2** below shows the results.

|  |  |
| --- | --- |
| **Table 2** | |
| **Mass of sodium carbonate in g** | **Final temperature of solution in °C** |
| 2.0 | 21.5 |
| 4.0 | 23.0 |
| 6.0 | 24.5 |
| 8.0 | 26.0 |
| 10.0 | 26.6 |
| 12.0 | 26.6 |
| 14.0 | 26.6 |

Describe the relationship between the mass of sodium carbonate added and the final temperature of the solution.

Use values from **Table 2** in your answer.

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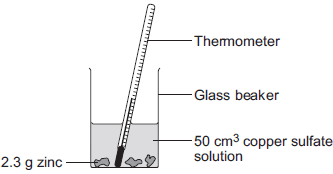
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**(3)**

1. A student investigated the temperature change when zinc reacts with copper sulfate solution.

The student used a different concentration of copper sulfate solution for each experiment.

The student used the apparatus shown below.



The student:

•        measured 50 cm3 copper sulfate solution into a glass beaker

•        measured the temperature of the copper sulfate solution

•        added 2.3 g zinc

•        measured the highest temperature

•        repeated the experiment using copper sulfate solution with different concentrations.

The equation for the reaction is:

Zn(s)     +                 CuSO4(aq)               https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q15S2F06_files/img02.png     Cu(s)       +              ZnSO4(aq)

zinc       +      copper sulfate solution    https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q15S2F06_files/img02.png    copper      +    zinc sulfate solution

(a)     The thermometer reading changes during the reaction.

Give **one** other change the student could **see** during the reaction.

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**(1)**

(b)     Suggest **one** improvement the student could make to the apparatus.

Give a reason why this improves the investigation.

Improvement \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Reason \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(c)     **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

The student’s results are shown in the table.

**Table**

|  |  |  |
| --- | --- | --- |
| **Experiment number** | **Concentration of copper sulfate in moles per dm3** | **Increase in temperature in °C** |
| 1 | 0.1 | 5 |
| 2 | 0.2 | 10 |
| 3 | 0.3 | 12 |
| 4 | 0.4 | 20 |
| 5 | 0.5 | 25 |
| 6 | 0.6 | 30 |
| 7 | 0.7 | 35 |
| 8 | 0.8 | 35 |
| 9 | 0.9 | 35 |
| 10 | 1.0 | 35 |

Describe **and** explain the trends shown in the student’s results.

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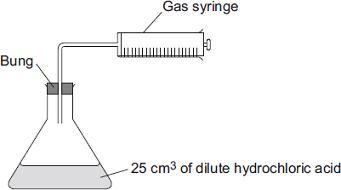
**(6)**

**Required Practical 3: Rates of Reaction**

**Investigate how changes in concentration affect the rates of reactions by both measuring the volume of a gas produced and monitoring a change in colour or turbidity.**

1. A student investigated the reaction between magnesium metal and dilute hydrochloric acid.

The student placed 25 cm3 of dilute hydrochloric acid in a conical flask and set up the apparatus as shown in the diagram.



The student:

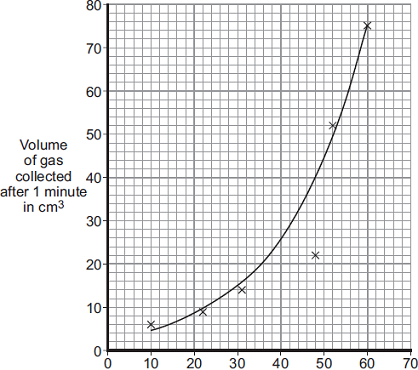
•        took the bung out of the flask and added a single piece of magnesium ribbon 8 cm long

•        put the bung back in the flask and started a stopwatch

•        recorded the volume of gas collected after 1 minute

•        repeated the experiment using different temperatures of acid.

The student plotted his results on a graph.

  
      Temperature of acid in °C

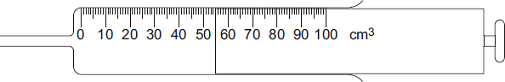
(a)     Write the correct state symbols in the equation.

Choose from (s) for solid, (l) for liquid, (g) for gas and (aq) for aqueous.

Mg (….)    +    2 HCl (….)     https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q13SIP204_files/img03.png    MgCl2 (….)    +    H2 (….)

**(2)**

(b)     The diagram shows a gas syringe after 1 minute.



(i)      What volume of gas has been collected in the gas syringe after 1 minute?

Volume = \_\_\_\_\_\_\_\_\_\_\_\_ cm3

**(1)**

(ii)     Use the graph to determine the temperature of the acid used in this experiment.

Temperature = \_\_\_\_\_\_\_\_\_\_\_\_ °C

**(1)**

(iii)     Calculate the average rate of reaction, in cm3 of hydrogen made per second (cm3/s), for this experiment.

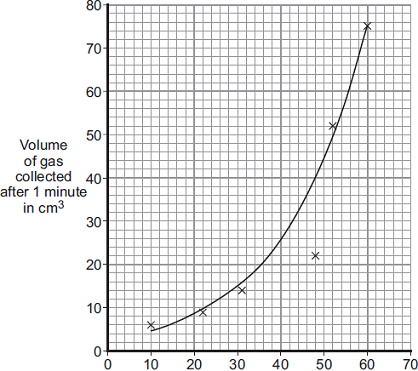
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Rate of reaction = \_\_\_\_\_\_\_\_\_\_\_\_ cm3/s

**(2)**

(c)     The student’s graph has been reprinted to help you answer this question.

  
       Temperature of acid in °C

One of the results on the graph is anomalous.

(i)      Draw a circle on the graph around the anomalous point.

**(1)**

(ii)     Suggest what may have happened to cause this anomalous result.

Explain your answer.

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**(2)**

(d)     Explain how the student could improve the accuracy of the volume of gas recorded at each temperature.

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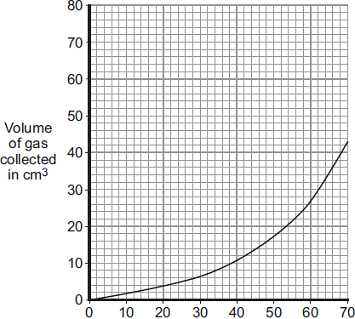
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**(3)**

(e)     The student then used the same apparatus to measure the volume of gas produced every 10 seconds at 40 °C.

The student’s results are shown on the graph.

  
      Time in seconds

The rate at which the gas was produced got faster over the first 60 seconds.

The student’s teacher gave two possible explanations of why the reaction got faster.

**Explanation 1**  
There was a layer of magnesium oxide on the surface of the magnesium.  
The layer of magnesium oxide prevented the magnesium reacting with the acid.  
As the magnesium oxide reacted slowly with the acid, the magnesium was exposed to the acid and hydrogen gas was produced.

**Explanation 2**  
The reaction is exothermic, and so the temperature of the acid increased during the reaction.

(i)      Describe further experimental work the student could do to see if **Explanation 1** is correct.

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(ii)     Describe further experimental work the student could do to see if **Explanation 2** is correct.

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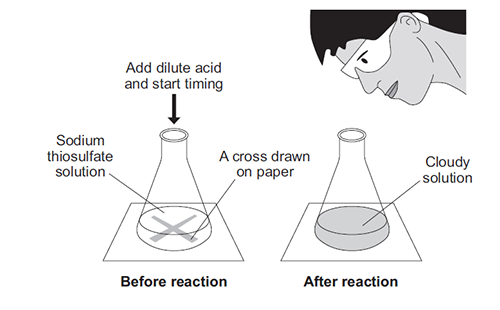
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**(2)**

1. A student investigated the effect of temperature on the rate of a reaction.

The picture below shows an experiment.



The student:

•        put sodium thiosulfate solution into a conical flask

•        heated the sodium thiosulfate solution to the required temperature

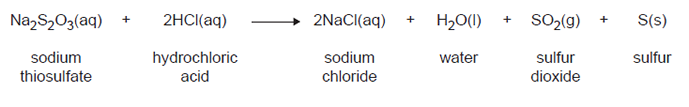
•        put the flask on a cross drawn on a piece of paper

•        added dilute hydrochloric acid and started a stopclock

•        stopped the stopclock when the cross could no longer be seen

•        repeated the experiment at different temperatures.

The equation for the reaction is:



(a)     Explain why the solution goes cloudy.

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**(2)**

(b)     Give **two** variables the student must control to make the investigation a fair test.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(c)     State the effect that increasing the temperature of the sodium thiosulfate solution has on the rate of the reaction.

Explain this effect in terms of particles and collisions.

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**(4)**

(d)     Suggest how the student should change the method to investigate the rate of reaction at 5°C.

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**Required Practical 4: Chromatography**

**Investigate how paper chromatography can be used to separate and tell the difference between coloured substances.**

1. A student investigated a food colouring using paper chromatography.

This is the method used.

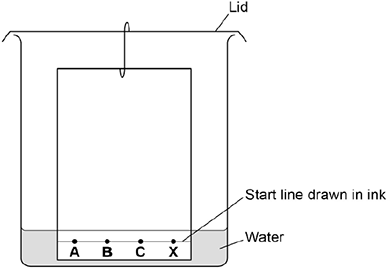
1.       Put a spot of food colouring **X** on the start line.

2.       Put spots of three separate dyes, **A**, **B** and **C**, on the start line.

3.       Place the bottom of the paper in water and leave it for several minutes.

(a)     **Figure 1** shows the apparatus the student used.

**Figure 1**



Give **two** mistakes the student made in setting up the experiment.

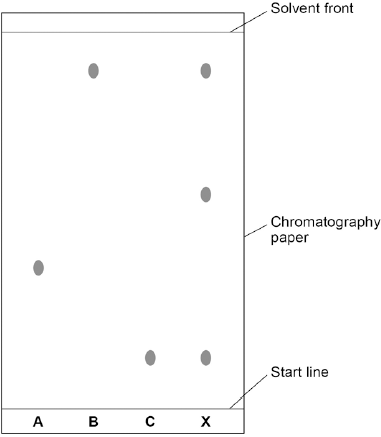
|  |  |
| --- | --- |
| Tick **two** boxes. |  |
| The lid was on the beaker. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F04_files/img02.png |
| The paper did not touch the bottom of the beaker. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F04_files/img02.png |
| The spots were too small. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F04_files/img02.png |
| The start line was drawn in ink. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F04_files/img02.png |
| The water level was above the spots. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F04_files/img02.png |

**(2)**

(b)     Another student set the experiment up correctly.

**Figure 2** shows the student’s results.

**Figure 2**



How many dyes were in **X**?

Tick **one** box.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **1** |  |  | **3** |  |  | **4** |  |  | **6** |  |

**(1)**

(c)     Which dye, **A**, **B** or **C**, is **not** in **X**?

|  |  |
| --- | --- |
| Write your answer in the box. | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F04_files/img02.png |

**(1)**

(d)     Use **Figure 2** to complete the table below.

Calculate the value for Rf for dye **A**.

|  |  |
| --- | --- |
|  | **Distance in mm** |
| Distance moved by dye **A** | \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |
| Distance from start line to solvent front | \_\_\_\_\_\_\_\_\_\_\_\_\_\_ |

Use the equation:

https://app.doublestruck.eu/content/AG_CHM/HTML/Q/QSP182F04_files/img04.png

Give your answer to two significant figures.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

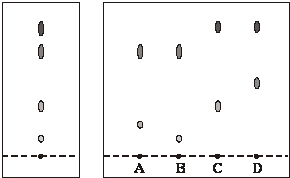
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Rf value = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(5)**

1. Chromatography was carried out on a sample of soft drinks to check that they contained only colours that were safe. This is the result.



            Safe colours        Colours from the soft drinks

What conclusions about the safety of the colours in the soft drinks **A, B, C** and **D** can be made from the results shown by chromatography?

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**(2)**

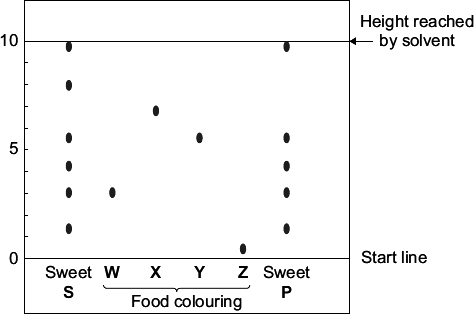
1. Read the article.

|  |
| --- |
| **Problem food colourings** |
| Scientists say they have evidence that some food colourings cause hyperactive behaviour in young children. These food colourings are added to some sweets. |

**W**, **X**, **Y** and **Z** are food colourings that may cause hyperactive behaviour in young children.

A scientist used chromatography to see if these food colourings were used in two sweets, **S** and **P**.

The results are shown on the chromatogram.



(a)     Food colourings, such as **W**, **X**, **Y** and **Z**, are added to some sweets.

Suggest **one** reason why.

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**(1)**

(b)     In chromatography, the Rf value = https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q12SY1F06_files/15_img01.png

Use the scale on the chromatogram to help you to answer this question.

|  |  |
| --- | --- |
| Which food colouring, **W**, **X**, **Y** or **Z**, has an Rf value of 0.7? | https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q12SY1F06_files/box.png |

**(1)**

(c)     From the chromatogram, what conclusions can the scientist make about the colourings in sweets **S** and **P**?

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**Required Practical 5: Water Purification**

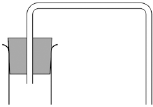
**Analysis and purification of water samples from different sources. To include pH measurement, removal of dissolved solids and distillation.**

1. Some countries make drinking water from sea water.
2. Complete the figure below to show how you can distil salt solution to produce and collect pure water.

Label the following:

•        pure water

•        salt solution



**(3)**

(b)     How could the water be tested to show it is pure?

Give the expected result of the test for pure water.

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**(2)**

(c)     Why is producing drinking water from sea water expensive?

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**(1)**

1. Good quality water is needed for a healthy life.

In the United Kingdom, obtaining safe water for drinking is as simple as turning on a tap.  
The water is made safe to drink by water companies.

          However, in many parts of Africa and Asia, water used for drinking is contaminated and untreated. It is estimated that 2.2 million people die each year as a result of drinking contaminated water.

          Efforts are being made to solve this problem and more water is being treated.

          Describe how water in the United Kingdom is treated.

          Explain how this makes it safe to drink.

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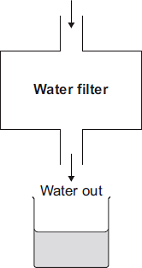
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**(3)**

1. The diagram shows a water filter used in the home.

Water in  


1. A student collected a sample of water from the filter.

The student could show that the filtered water contains dissolved salts without using a chemical test.

Describe how.

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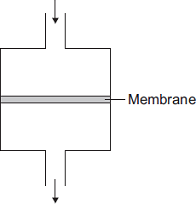
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**(2)**

(b)     Seawater is forced through a membrane to make drinking water.

Seawater  
               
Drinking water

Suggest why water molecules can pass through the membrane, but sodium ions and chloride ions cannot.

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**(1)**

1. Rock salt is a mixture of sand and salt.

Salt dissolves in water. Sand does **not** dissolve in water.

Some students separated rock salt. This is the method used.

1.      Place the rock salt in a beaker.

2.      Add 100 cm3 of cold water.

3.      Allow the sand to settle to the bottom of the beaker.

4.      Carefully pour the salty water into an evaporating dish.

5.      Heat the contents of the evaporating dish with a Bunsen burner until salt crystals start to form.

(a)     Suggest **one** improvement to step 2 to make sure all the salt is dissolved in the water.

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**(1)**

(b)     The salty water in step 4 still contained very small grains of sand.

Suggest **one** improvement to step 4 to remove all the sand.

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**(1)**

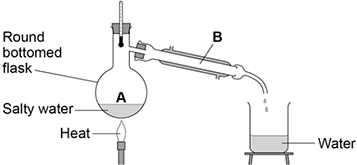
(c)     Suggest **one** safety precaution the students should take in step 5.

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**(1)**

(d)     Another student removed water from salty water using the apparatus in the figure below.



Describe how this technique works by referring to the processes at **A** and **B**.

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**(2)**

(e)     What is the reading on the thermometer during this process?

        \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ °C

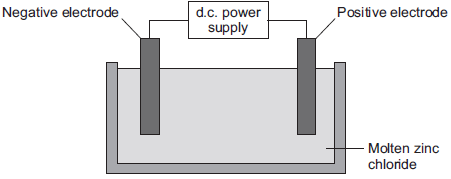
**(1)**

**Required Practical 6: Electrolysis**

**Investigate what happens when aqueous solutions are electrolysed using inert electrodes.**

1. This question is about zinc and magnesium.

Zinc is produced by electrolysis of molten zinc chloride, as shown in the figure below.



(a)    (i)      Why must the zinc chloride be molten for electrolysis?

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**(1)**

(ii)     Describe what happens at the negative electrode.

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**(3)**

(iii)    Complete the half equation for the reaction at the positive electrode.

\_\_\_\_\_\_\_\_    https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q14S2H04_files/img02.png    Cl2    +    \_\_\_\_\_\_\_\_    e–

**(1)**

(b)     Magnesium can be produced from magnesium oxide.

The equation for the reaction is:

Si(s)    +    2 MgO(s)    https://app.doublestruck.eu/content/AG_CHM/HTML/Q/Q14S2H04_files/img02.png    SiO2(s)    +    2 Mg(g)

(i)      How can you tell from the equation that the reaction is done at a high temperature?

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**(1)**

(ii)     This reaction to produce magnesium from magnesium oxide is **endothermic**.

What is meant by an **endothermic** reaction?

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**(1)**

(iii)    A company made magnesium using this reaction.

Calculate the mass of magnesium oxide needed to produce 1.2 tonnes of magnesium.

Relative atomic masses (Ar): O = 16; Mg = 24

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Mass of magnesium oxide needed = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ tonnes

**(3)**

(iv)    The company calculated that they would produce 1.2 tonnes of magnesium, but only 0.9 tonnes was produced.

Calculate the percentage yield.

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Percentage yield = \_\_\_\_\_\_\_\_\_\_ %

**(1)**

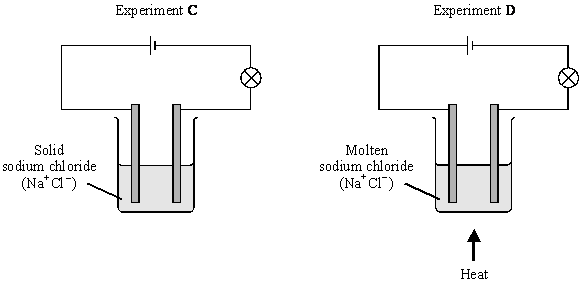
(v)     Give **one** reason why the calculated yield of magnesium might not be obtained.

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**(1)**

1. Two experiments were set up as shown.



(i)      Give **two**observations which would be seen only in Experiment **D**.

1. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

2. \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(ii)     Explain why in Experiment **C** no changes would be seen.

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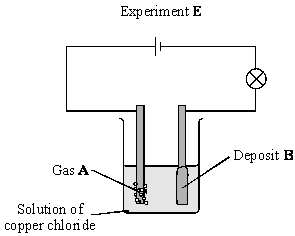
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**(2)**

(b)     Another *electrolysis*experiment used an aqueous solution of copper chloride.



(i)      What does *electrolysis*mean?

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**(2)**

(ii)     Name the gas **A** and the deposit **B**.

Gas **A** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

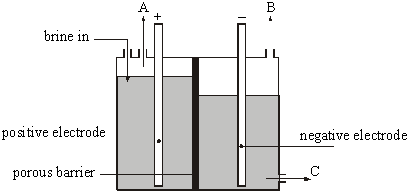
**(2)**

(c)     Give **one**industrial use of electrolysis.

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**(1)**

1. Sodium hydroxide, hydrogen and chlorine can all be made in one industrial process. Electricity is passed through aqueous sodium chloride solution (brine). The diagram below shows a cell that can be used for this process.



(a)     Name A, B and C.

Gas A \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Gas B \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Solution C \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(b)     Balance the equations for the reactions at the electrodes.

(i)      \_\_\_\_\_ Cl–   –   \_\_\_\_\_\_ e–   →   Cl2

(ii)     \_\_\_\_\_ H+   +   \_\_\_\_\_\_ e–   →   H2

**(2)**

(c)     Name the compound in this cell which produces the hydrogen ions.

\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(1)**

(d)     Which type of particles must be able to pass through the barrier to allow the electrolysis to take place?

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**(1)**