

Revision Booklet - Potable Water

Chemistry Paper 2

AQA Chemistry (8462) from 2016 Topics C4.10 Using resources				
Topic	Student Checklist	R	A	G
4.10.1 Using the Earth's resources and obtaining potable water	State what humans use Earth's resources for, give some examples of natural resources that they use			
	Define the term finite and distinguish between finite and renewable resources			
	Explain what sustainable development is and discuss the role chemistry plays in sustainable development, including improving agricultural and industrial processes			
	State examples of natural products that are supplemented or replaced by agricultural and synthetic products			
	Discuss the importance of water quality for human life, including defining potable water			
	Describe methods to produce potable water, including desalination of salty water or sea water and the potential problems of desalination			
	<i>Required practical 13: analysis and purification of water samples from different sources, including pH, dissolved solids and distillation.</i>			
	Describe waste water as a product of urban lifestyles and industrial processes that includes organic matter, harmful microbes and harmful chemicals			
	Describe the process of sewage treatment and compare the ease of obtaining potable water from waste water as opposed to ground or salt water			
	HT ONLY: Name and describe alternative biological methods for extracting metals, including phytomining and bioleaching			
	HT ONLY: Evaluate alternative methods for extracting metals			

Humans use the Earth's resources to provide **warmth, shelter, food** and **transport**.

These natural resources are supplemented by **agriculture, providing food, timber, clothing** and **fuels**.

Finite resources (**there is only a limited supply of them**) from the Earth, oceans and atmosphere are processed to provide energy and materials



Chemistry plays an important role in improving **agricultural and industrial processes** to provide new products and in **sustainable development**, which is development that meets the needs of current generations without compromising the ability of future generations to meet their own needs.



Farmers spray fertilisers onto crops so they can produce more food from less area of land.

Potable Water

Water of appropriate quality is essential for life. For humans, drinking water should have sufficiently **low levels of dissolved salts and microbes**.



Water that is **safe to drink is called potable water**. Potable water is **not pure water** in the chemical sense because it **contains dissolved substances**.

The methods used to produce potable water depend on available supplies of water and local conditions.

In the United Kingdom (UK), rain provides water with low levels of dissolved substances (fresh water) that collects in the ground and in **lakes and rivers**



Most potable water is produced by

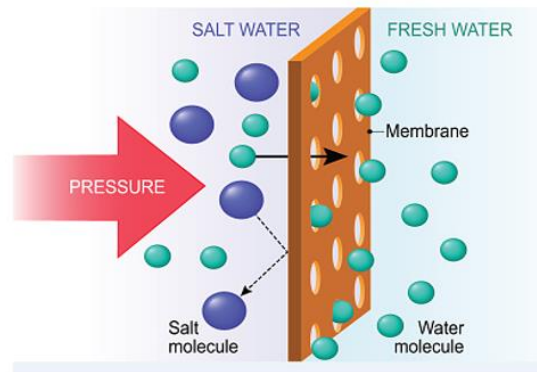
- choosing an appropriate source of fresh water
- passing the water through filter beds
- sterilising

Sterilising agents used for potable water include chlorine, ozone or ultraviolet light.

If supplies of fresh water are limited, **desalination** of salty water or sea water may be required. Desalination can be done by **distillation** or by the processes that use membranes such as **reverse osmosis**.



Desalination by distillation in Hamburg Germany



Desalination by reverse osmosis using a **membrane**

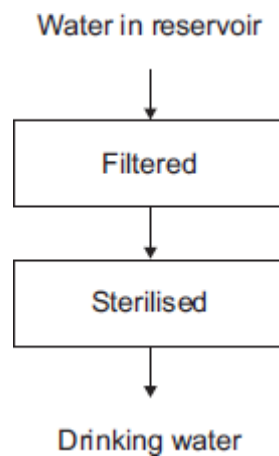
Both types of desalination require **large amounts of energy**

EXAM QUESTIONS

Q1.

This question is about drinking water.

(a) The flow diagram below shows how water is made suitable for drinking.



(i) What is removed when the water is filtered?

Tick (✓) **one** box.

Gases

Liquids

Solids

(1)

(ii) What is used to sterilise the water?

Tick (✓) **one** box.

Carbon

Chlorine

Sodium chloride

(1)

(iii) Why is the water sterilised?

(1)

(b) Water can be purified by distillation.

Drinking water is **not** usually purified by distillation because distillation is expensive.

Complete the sentence.

Distillation is expensive because it requires a lot of

(1)

(c) Why do some water companies add fluoride to drinking water?

(1)

(Total 5 marks)

Q2.

Water in Britain is taken from reservoirs to use as drinking water.



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(a) What are the **two** main steps used to treat water from reservoirs?

Give **one** reason for each step.

(4)

(b) Some people use water filters to treat water before drinking it.

(i) Water filters remove hardness from hard water.

What is in water filters that removes hardness from water?

(1)

(ii) Suggest why water filters used in the home contain particles of silver.

(1)

(c) Pure water can be produced by distillation.

Why is distillation **not** usually an economic method of treating water for drinking?

(1)

(d) Drinking hard water has health benefits.

State **one** health benefit of drinking hard water.

(1)

(Total 8 marks)

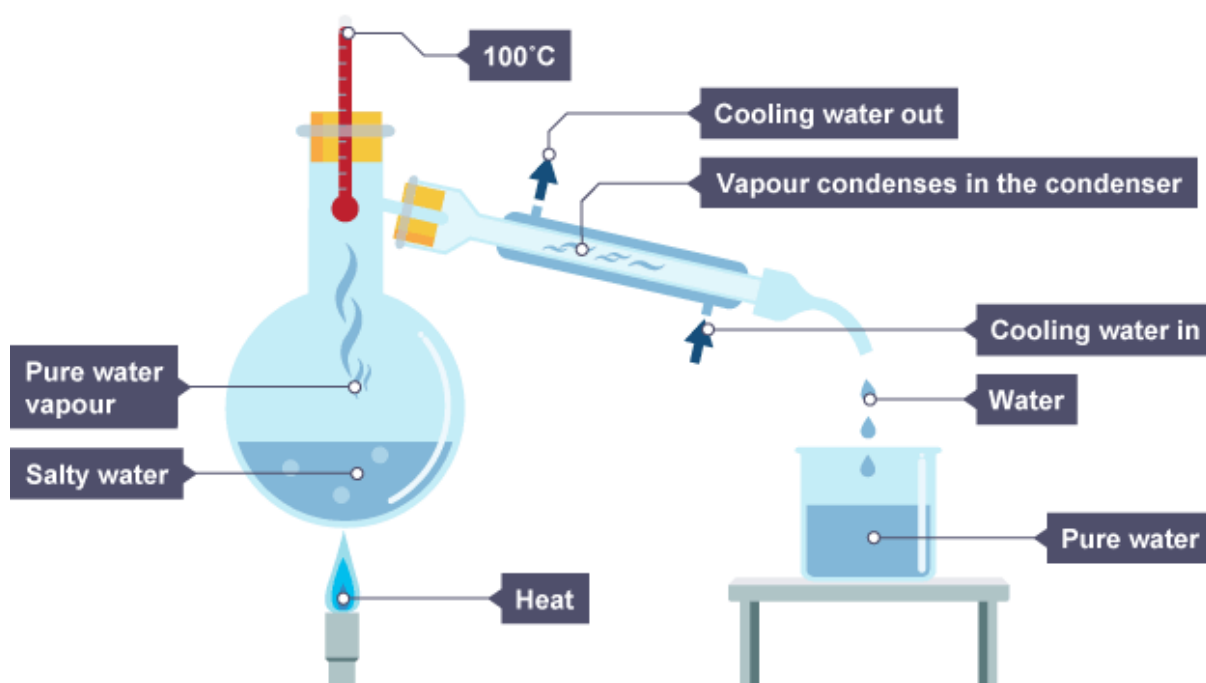
Required Practical – Analysis and purification of water

Method – Part 1 (Analysing water samples)

1. For each sample of water you are given, test the pH using either a pH meter or universal indicator and an appropriate colour chart. Record your observations carefully.
2. For each sample of water, pour 50 cm³ into a clean pre-weighed evaporating basin. Heat gently over a Bunsen burner, tripod and gauze until no liquid remains. Allow to cool, then weigh the evaporating basin again and calculate the mass of solid that remains in the evaporating basin.
- 3.

Method – Part 2 (Distillation of sea water)

Set up distillation apparatus as below:



As the sea water is heated the vapour condenses to produce pure water.

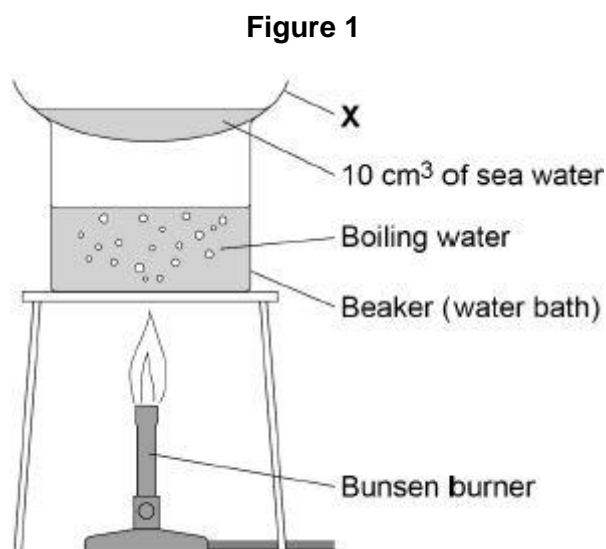
Hazard	Possible harm	Possible precaution
Acidic or alkaline water samples	Irritating to eyes or skin	Rinse off skin if contact occurs and wear eye protection
Hot apparatus	Burns	Allow hot apparatus time to cool before touching

EXAM QUESTIONS

Q1.

A student tested a sea water sample for dissolved solids.

Figure 1 shows the apparatus.



(a) What is apparatus **X** on **Figure 1**?

Tick **one** box.

- Boiling tube
- Condenser
- Funnel
- Watch glass

(1)

(b) The student did the test four times.

The student calculated the mass of solid on apparatus **X** after heating.

The table below shows the student's results.

	Test 1	Test 2	Test 3	Test 4
Mass of solid in grams	0.12	0.29	0.14	0.15

Calculate the mean mass of solid.

Do not include the anomalous result in your calculation.

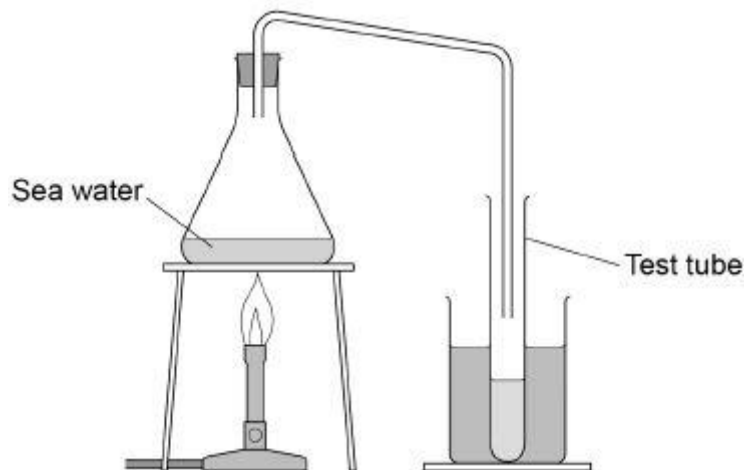
Give your answer to 2 significant figures.

Mean mass = _____ g

(3)

The student distilled a sample of sea water in the apparatus shown in **Figure 2**

Figure 2



(c) What change of state is happening at the surface of the sea water in **Figure 2**?

(1)

(d) Describe how the water in the test tube in **Figure 2** is different from the sea water.

(1)

(e) Why does producing drinking water from sea water using distillation cost a lot of money?

(1)

(f) River water is filtered then sterilised to make drinking water.

Why are these **two** processes done?

Filtering

Sterilising

(2)

(Total 9 marks)

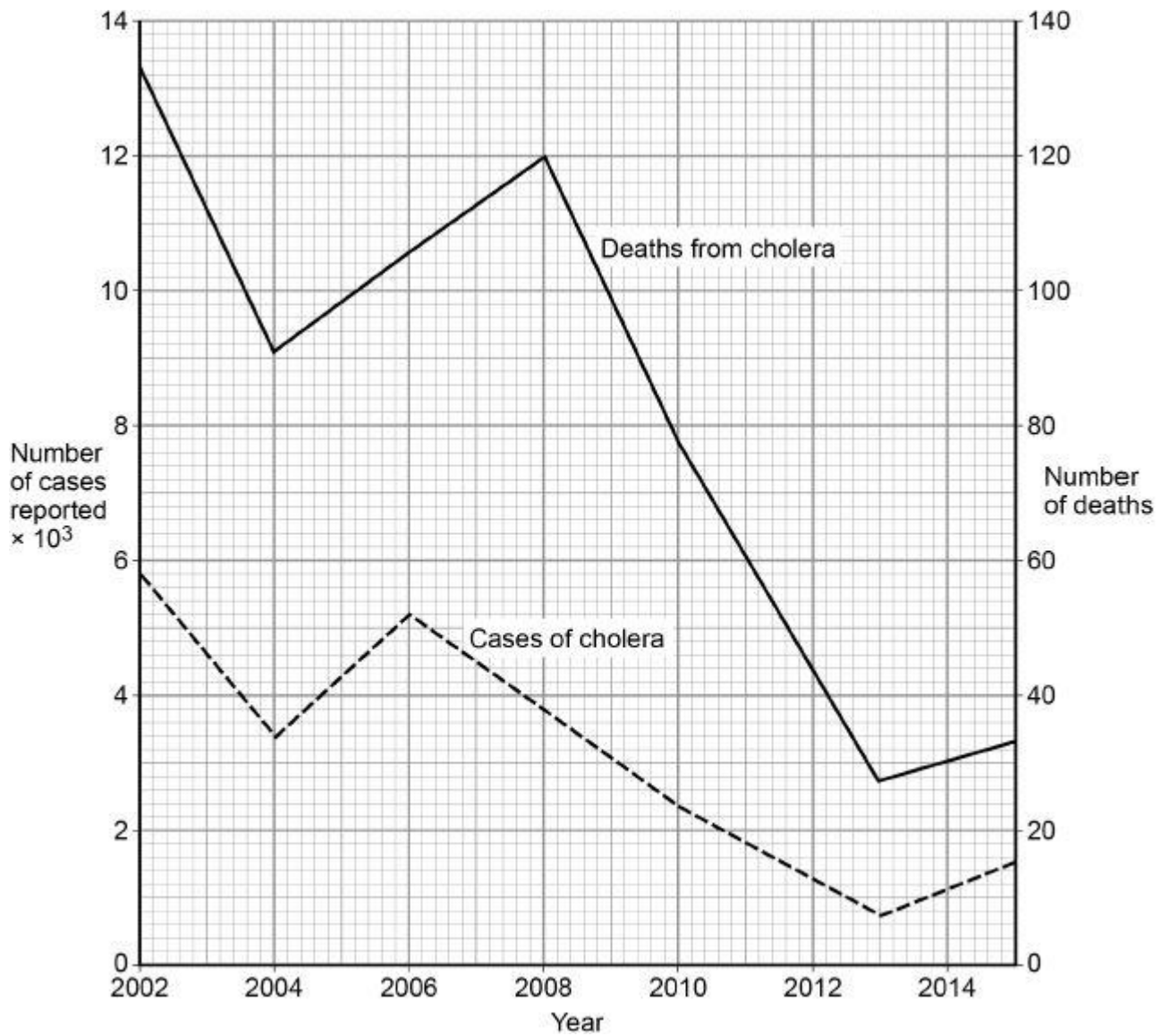
Q2.

Getting safe drinking water is a problem for millions of people.

Cholera is a waterborne disease.

Figure 1 shows data about cholera from one area of Africa.

Figure 1



(a) What percentage of cases of cholera reported in 2004 resulted in deaths in 2004?

Give your answer to 2 significant figures.

Percentage deaths = _____

(4)

(b) A student concluded that a cholera epidemic occurred in 2008.

Give **one** reason for and **one** reason against the student's conclusion.

Use information from **Figure 1**.

(2)

(c) A different student concluded that a cholera epidemic had occurred in 2002.

Why can we **not** be sure of this from the data given in **Figure 1**?

(1)

(d) Suggest **two** possible ways in which cholera might spread in one area of Africa.

1. _____

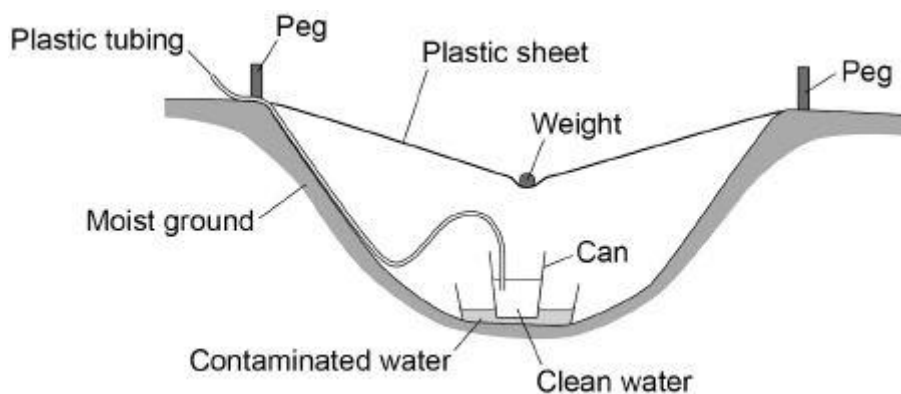
2. _____

(2)

(e) There are a number of ways to provide clean and safe water for people.

Figure 2 shows a simple method for collecting clean water. This method is called solar distillation.

Figure 2



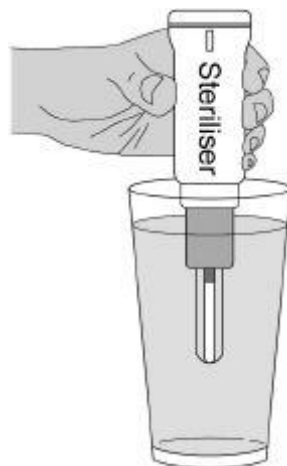
Explain the processes that occur in the method shown in **Figure 2** to provide clean drinking water.

(5)

- (f) Another method of making water safe to drink is to use a portable steriliser.

Figure 3 shows a portable steriliser.

Figure 3



The steriliser emits light.

Explain how the steriliser kills the bacteria in the water.

(3)

(Total 17 marks)

Urban lifestyles and industrial processes produce **large amounts of waste water** that require treatment before being released into the environment.

Sewage and agricultural waste water require **removal** of

- **organic matter**
- **harmful microbes**

Industrial waste water may require **removal** of

- **organic matter**
- **harmful chemicals**

Sewage treatment includes

- **screening** and grit removal
- **sedimentation** to produce sewage sludge and effluent
- **anaerobic digestion** of sewage sludge
- **aerobic biological treatment** of effluent



Alternative methods of extracting metals (HT only)

The Earth's resources of metal ores are limited.

The damage done by mining can be seen in the picture on the right. With a lot of waste produced the copper ore being mined recently contains less and less copper.

Copper ores are becoming **scarce** and new ways of extracting copper from low-grade ores including **phytomining**, and **bioleaching** are being developed. These methods avoid traditional mining methods of digging, moving and disposing of large amounts of rock.



Phytomining uses **plants** to **absorb metal compounds** (often from the waste from previous mining). The plants are harvested and then burned to produce ash that contains metal compounds.

Bioleaching uses **bacteria** to produce **leachate solutions** that contain (dissolved) **metal compounds**. The metal compounds can be processed to obtain the metal. For example, copper can be obtained from solutions of copper compounds by displacement using scrap iron or by electrolysis.

EXAM QUESTIONS:

Q1.

Used disposable nappies are sent to landfill.

- (a) 1 600 000 babies in the UK use disposable nappies.

Each baby uses 5 nappies in 1 day.

Calculate the total number of disposable nappies used in 1 day.

Give your answer in standard form.

Total number of nappies = _____

(2)

Disposable nappies contain a hydrogel.

A hydrogel is a substance that absorbs water.

A nappy manufacturer investigated the mass of water absorbed by different masses of a hydrogel.

Table 1 shows the results.

Table 1

Mass of hydrogel in g	Mass of water absorbed in g			Mean mass of water absorbed in g
	Experiment 1	Experiment 2	Experiment 3	
0.5	148	151	151	X
1.0	292	295	304	297
1.5	452	456	500	454
2.0	599	610	606	605
2.5	742	753	755	750

- (b) One of the results for 1.5 g of hydrogel is anomalous.

Which experiment has an anomalous result?

Tick **one** box.

Experiment 1

Experiment 2

Experiment 3

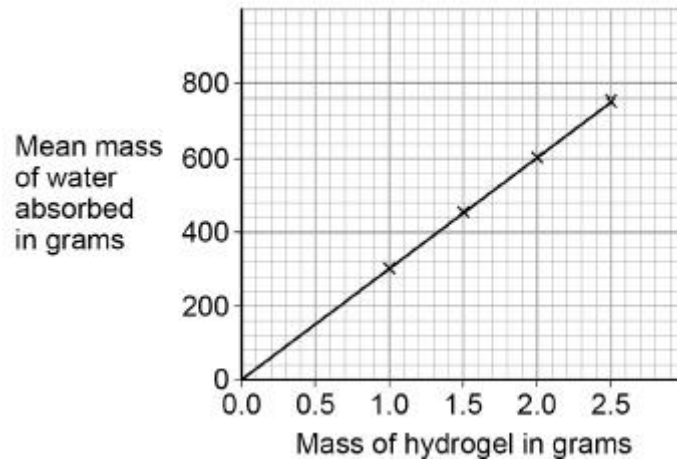
(1)

(c) Calculate value **X** in **Table 1**.

X = _____ g

(2)

Some of the results are shown on the graph.



(d) Determine the mass of water absorbed by 1.8 g of hydrogel.

Use the graph.

Mass of water absorbed = _____ g

(1)

(e) Which of the following is a valid conclusion from the graph.

Tick **one** box.

mean mass of water absorbed in grams \propto mass of hydrogel in grams

mean mass of water absorbed in grams = mass of hydrogel in grams

mean mass of water absorbed in grams « mass of hydrogel in grams

mean mass of water absorbed in grams ~ mass of hydrogel in grams

(1)

(f) Fabric nappies are an alternative to disposable nappies.

Table 2 shows information from a life cycle assessment of fabric nappies and disposable nappies.

Table 2

	Fabric nappy	Disposable nappy
Reusable	Yes - can be reused many times	No
Biodegradable	Yes	No
Carbon dioxide produced per nappy in g	564	519
Water used to make each nappy in m³	1.34	0.15

Compare the advantages and disadvantages of using fabric nappies instead of disposable nappies.

Use data from **Table 2**.

(4)

(Total 11 marks)

Q2.

This question is about copper and its compounds.

(a) The table shows information about bioleaching and phytomining.

Bioleaching and phytomining are used to extract copper from low grade ores.

	Bioleaching	Phytomining
Metal extracted from	Waste from quarrying	Contaminated ground
Speed of process	Very slow	Slow, made more efficient using quick-growing plants
Pollution	Produces a solution of toxic chemicals which may run off into rivers Takes a long time to stop the process if river pollution occurs	Involves combustion of plants but decontaminates polluted ground

Compare phytomining and bioleaching.

Use the information in the table.

(4)

(b) Describe how copper sulfate solution is obtained from the plants used in phytomining.

(2)

(c) Copper is displaced from a solution of copper sulfate using iron.

Write a balanced symbol equation for this reaction.

(2)

(d) How does this displacement reaction take place?

Tick **one** box.

Electron sharing

Electron transfer

Proton transfer

(1)

(e) Describe how copper conducts electricity.

(2)

(f) Suggest how anhydrous copper sulfate is used to test for water.

(2)

(Total 13 marks)

Q3.

Copper is found in the Earth's crust as an ore containing copper sulfide. Large areas of land, where this ore was once quarried, are contaminated with low percentages of copper sulfide. Copper would be too expensive to extract from this contaminated land using the traditional method of quarrying and then heating

in a furnace.

- (a) Extracting copper from this land by the traditional method would have a major environmental impact.

Give **two** reasons why.

(2)

- (b) One way to extract the copper from land that contains low percentages of copper sulfide is by bioleaching. Bioleaching uses bacteria. The bacteria produce a solution of copper sulfate.

It is possible to get copper from a solution of copper sulfate using scrap iron.

- (i) It is economical to use scrap iron to get copper.

Give **one** reason why.

(1)

- (ii) Iron can be used to get copper from copper sulfate solution.

Explain why.

(2)

(Total 5 marks)