

**Questions are for both separate science and combined science students unless indicated in the question**

**Q1.**

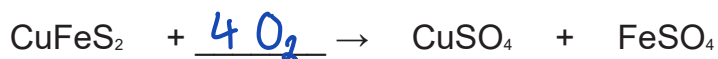
Copper is extracted from metal ores.

Chalcopyrite is a metal ore containing a compound with the formula  $\text{CuFeS}_2$

- (a)  $\text{CuFeS}_2$  reacts with oxygen to produce copper(II) sulfate and iron(II) sulfate.

Complete the equation for this reaction.

You should balance the equation.



(2)

- (b) Calculate the percentage by mass of copper in  $\text{CuFeS}_2$

Relative atomic masses ( $A_r$ ): S = 32 Fe = 56 Cu = 63.5

$$M_r(\text{CuFeS}_2) = 63.5 + 56 + (2 \times 32) = 183.5$$

$$\% \text{ mass Cu} = \frac{63.5}{183.5} \times 100 = 34.6\%$$

Percentage by mass = 34.6 %

(3)

- (c) Describe a test to show the presence of copper(II) ions in a solution of copper(II) sulfate.

Give the result of the test. (chemistry only)

Test Add sodium hydroxide NaOH

Result Blue precipitate

(2)

- (d) Copper can be extracted from low-grade ores by bioleaching.

Describe what is meant by bioleaching. (HT only)

The use of bacteria  
to produce leachate solutions  
that contain metal (copper) compounds.

(2)

(Total 9 marks)

**Q2.**

This question is about water.

- (a) Sewage is waste water.

Sewage contains organic matter.

Describe how sewage is treated to remove organic matter.

Screening / Grit removal  
 Sedimentation - to produce sewage sludge & effluent  
 Anaerobic digestion of solid sewage sludge  
 Aerobic biological treatment of liquid effluent

(4)

Sea water and ground water are treated to make them potable.

The table below shows information about the composition and treatment of sea water and of ground water.

	Sea water	Ground water
Concentration of sodium ions and chloride ions before <b>Process 1</b>	Na <sup>+</sup> : 0.5 mol/dm <sup>3</sup> Cl <sup>-</sup> : 0.5 mol/dm <sup>3</sup>	Na <sup>+</sup> : 0.001 mol/dm <sup>3</sup> Cl <sup>-</sup> : 0.001 mol/dm <sup>3</sup>
<b>Process 1</b>	Reverse osmosis	Filtration
Concentration of sodium ions and chloride ions after <b>Process 1</b>	<b>X</b>	Na <sup>+</sup> : 0.001 mol/dm <sup>3</sup> Cl <sup>-</sup> : 0.001 mol/dm <sup>3</sup>
<b>Process 2</b>	Add ozone	Expose to ultraviolet light

- (b) Sea water is desalinated during **Process 1**.

Which pair of concentrations could represent **X** in the table above? (**chemistry only**) (**HT only**)

Tick (✓) **one** box.

Na<sup>+</sup> : 0.003 mol/dm<sup>3</sup>

Cl<sup>-</sup> : 0.003 mol/dm<sup>3</sup>

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Cl<sup>-</sup> : 0.5 mol/dm<sup>3</sup>

(1)

- (c) Explain why the concentrations of sodium ions and of chloride ions in the ground water in the table above are unchanged by **Process 1**.

The ions pass through the filter,  
because the ions are in solution

(2)

- (d) Explain why the ground water in the table above requires **Process 2** before the water is safe to drink.

The ground water contains microbes which  
are harmful to health.  
So the water is sterilised to destroy the  
microbes.

(2)

- (e) After treatment the ground water in the table above is sold by a company as pure water.

The ground water in above table is not chemically pure because the water contains sodium ions and chloride ions.

Suggest what the company means by 'pure'.

The water is in its natural state,  
i.e. unadulterated

(1)

- (f) Chlorine is also used to treat some ground water.

Describe the test for chlorine gas.

Give the result of the test.

Test Use damp litmus paper

Result The paper is bleached, turns white.

(2)

(Total 12 marks)