Materials
For this paper you must have:
- Ruler
- Pencil, Rubber, Protractor and Compass
- Scientific calculator, which you are expected to use when appropriate

Instructions
- Answer all questions
- Answer questions in the space provided
- All working must be shown
- Do all rough work in this book. Cross out any rough work you don’t want to be marked

Information
- The marks for the questions are shown in brackets
Water is important to all living organisms.

In some parts of Africa getting potable water may be difficult.

(a) What is potable water?


Another method of purifying water is Solar Disinfection (SODIS).

The table below gives some information about both methods.

<table>
<thead>
<tr>
<th>Method</th>
<th>Description</th>
<th>Percentage reduction in pathogens that cause diarrhoea</th>
</tr>
</thead>
<tbody>
<tr>
<td>Biosand unit</td>
<td>Before use, it needs to be left for 2 weeks for the bacteria in the unit to grow. Can treat 40 litres of water per hour. Made of concrete. Needs replacing every 10 years.</td>
<td>47</td>
</tr>
<tr>
<td>SODIS</td>
<td>Plastic bottles are filled with water and left in sunlight. Ultraviolet (UV) kills bacteria. Bottles need to be left in sunlight for at least 8 hours. Bottles have to be replaced every 6 months.</td>
<td>31</td>
</tr>
</tbody>
</table>

(c) A 1 litre bottle for SODIS costs 29p. Each litre bottle needs replacing after 6 months.

A family uses 6 litres of potable water per day.

Calculate the cost per year of using SODIS for the family.

___________________________________________________________________
___________________________________________________________________
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Cost per year = £__________________

(2)

(d) Other than cost, give two disadvantages of using the Biosand unit instead of SODIS.

1. _________________________________________________________________

___________________________________________________________________

2. _________________________________________________________________

___________________________________________________________________

(2)
(e) Give **two** advantages of using the Biosand unit instead of SODIS.

1. _________________________________________________________________
   ___________________________________________________________________

2. _________________________________________________________________
   ___________________________________________________________________

(2 marks)

(f) SODIS uses UV light to sterilise water.

Give **one** other method of sterilising water.

___________________________________________________________________
___________________________________________________________________

(1 mark)

(Total 9 marks)
The apparatus in the figure below is used to separate a mixture of liquids in a fuel.

(a) What is apparatus W on above the figure above?

Tick one box.

- Beaker
- Boiling Tube
- Flask
- Jug

(1)
(b) What is the name of this method of separation?

Tick one box.

- Crystallisation
- Electrolysis
- Filtration
- Distillation

(1)

(c) Name the changes of state taking place at A and B in the figure above.

Use words from the box.

<table>
<thead>
<tr>
<th>boiling</th>
<th>condensing</th>
<th>freezing</th>
<th>melting</th>
</tr>
</thead>
</table>

Change of state at A: _________________________________________________

Change of state at B: _________________________________________________

(2)
(d) **Table 1** shows the boiling points of the hydrocarbons in the fuel.

<table>
<thead>
<tr>
<th>Hydrocarbon</th>
<th>Boiling point in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pentane</td>
<td>36</td>
</tr>
<tr>
<td>Hexane</td>
<td>69</td>
</tr>
<tr>
<td>Heptane</td>
<td>98</td>
</tr>
<tr>
<td>Octane</td>
<td>125</td>
</tr>
</tbody>
</table>

Which hydrocarbon will be the last to collect in the beaker?

Tick **one** box.

- Pentane
- Hexane
- Heptane
- Octane
(e) The fuel is a mixture of liquids that has been designed as a useful product.

What name is given to this type of mixture?

Tick one box.

- Catalyst
- Formulation
- Polymer
- Solvent

(f) Describe how this fuel is different from crude oil.

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(2)
A student measured the melting point of a solid hydrocarbon four times.

The student’s results are in Table 2.

<table>
<thead>
<tr>
<th>Trial</th>
<th>Melting point in °C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>35</td>
</tr>
<tr>
<td>2</td>
<td>48</td>
</tr>
<tr>
<td>3</td>
<td>37</td>
</tr>
<tr>
<td>4</td>
<td>37</td>
</tr>
</tbody>
</table>

Calculate the mean melting point of the hydrocarbon, leaving out any anomalous result.

Give your answer to two significant figures.

Mean melting point = __________________ °C

(2)

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.

Describe how water in the United Kingdom is treated.

DADA DANESHANANDA, Man with filtered water from the Mali-Zongo water project. www.amurt.net/africa/ghana/2005

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.

Most water contains dissolved compounds.
The concentrations of these dissolved compounds are higher in sea water than in drinking water.

(a) (i) Draw a ring around the correct answer to complete the sentence.

Pure water can be obtained from sea water by
- distillation.
- filtration.
- neutralisation.

(ii) What is the boiling point of pure water?  

(b) A student wanted to find out how much solid was dissolved in sea water.

This is the method the student used:
- measure the mass of an empty evaporating basin
- measure 25 cm\(^3\) of sea water and pour it into the evaporating basin
- heat the evaporating basin gently until all of the water has evaporated
- measure the mass of the evaporating basin containing the solid residue.

(i) What piece of apparatus would be suitable for measuring 25 cm\(^3\) of sea water?
(ii) How could the student check that all of the water had evaporated?

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(iii) The results the student obtained using 25 cm$^3$ of sea water are:

mass of empty evaporating basin = 23.21 g
mass of evaporating basin and dry solid residue = 24.04 g

Calculate the mass of solid dissolved in 1000 cm$^3$ of the sea water.

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Mass dissolved in 1000 cm$^3$ = ______________ g

(2)

(c) In many countries chlorine is added to drinking water supplies.

Why is chlorine added to drinking water?

________________________________________________________________________

________________________________________________________________________

(1)
Compounds containing fluoride ions are added to some drinking water supplies.

Many scientists have done research into the effects of fluoride ions in drinking water.

**Graphs 1, 2 and 3** show some of the results obtained.

**Graph 1**

- **Percentage of teeth showing decay**
- **Age group in years**

**Graph 2**

- **Percentage of children with decayed teeth**
- **Concentration of fluoride ions in mg per 1000g of water**
Evaluate the advantages and disadvantages of adding fluoride ions to drinking water.

You should support your answer with evidence from all three graphs.

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(6)
(Total 14 marks)
Iron is produced by reacting a mixture of haematite and coke in a blast furnace. Haematite is an ore of iron containing iron oxide (Fe$_2$O$_3$). Coke is made from coal and is almost pure carbon.

(a) (i) The coke burns in air. This reaction heats the furnace to above 1300 °C.

Complete the chemical equation for carbon reacting with oxygen to form carbon dioxide.

\[ \text{___________} + O_2 \rightarrow CO_2 \]  

(1)

(ii) Carbon monoxide is also formed in the furnace. Carbon monoxide reacts with iron oxide to produce iron and carbon dioxide.

\[ \text{iron oxide} + \text{carbon monoxide} \rightarrow \text{iron} + \text{carbon dioxide} \]

Complete and balance the chemical equation for the production of iron.

\[ \text{Fe}_2\text{O}_3 + 3\text{CO} \rightarrow \text{___________} + \text{___________} \]  

(2)

(iii) Iron from a blast furnace is called cast iron and contains about 4% carbon.

Why is pure iron softer than cast iron?

____________________________________________________________________________________

____________________________________________________________________________________  

(1)
Steel is made by reducing the percentage of carbon in cast iron and then adding different metals to form the type of steel required.

In the UK we use about 1.8 billion steel cans every year but only 30% of these are recycled. Recycling reduces waste. Producing steel from recycled cans requires only 25% of the energy needed to make steel from iron ore.

Give **three** environmental benefits of recycling a higher percentage of used steel cans.

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   ___________________________________________________________________

2. ___________________________________________________________________
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3. _________________________________________________________________
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(3) (Total 7 marks)
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](chart.png)
(a) What percentage of cases of cholera reported in 2004 resulted in deaths in 2004?
Give your answer to 2 significant figures.

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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.

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___________________________________________________________________
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(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)
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.

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(5)
Another method of making water safe to drink is to use a portable steriliser.

Figure 3 shows a portable steriliser.

The steriliser emits light.

Explain how the steriliser kills the bacteria in the water.

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(3)
(Total 17 marks)
Read the information about production of copper.

• World demand for copper in 2014 was about 22 million tonnes.

• World reserves of copper are about 700 million tonnes.

• Most of the copper today is obtained from copper ores. The ores are mined.

• Copper ore is heated in a furnace to produce copper sulfide. The furnace is heated by burning fossil fuels. Air is blown through the hot copper sulfide to produce copper and sulfur dioxide.

• Some copper is extracted from low-grade ores by phytomining. Phytomining uses plants to absorb copper compounds. The plants are burned and copper is extracted from the ashes.

A scientist stated:

‘more copper should be extracted by phytomining.’

Use the information to justify the scientist’s statement.

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(Total 6 marks)