Using Resources 3

Name: _____

Class: _____

Date: _____

Time: **76 minutes**

Marks: **70 marks**

Comments:

1. Humans use many different resources.

Water is an important natural resource.

(a) What is meant by ‘potable water’?

Tick (✓) **one** box.

- Water from the ground ☐
- Water that is pure ☐
- Water that is safe to drink ☐

(1)

(b) Waste water needs treatment before the water is put back into rivers and the sea.

The first stage of waste water treatment is to pass the waste water through metal grids.

Why is the waste water passed through metal grids?

Tick (✓) **one** box.

- To remove dissolved salts ☐
- To remove large solid objects ☐
- To remove microbes ☐
- To remove oxygen gas ☐

(1)

Clothes can be made from different materials.

Some clothes are made from wool and some clothes are made from poly(propene).

(c) One sheep produces 4.5 kg of wool.

50 g of wool is needed to make a hat.

Calculate the number of hats that can be made from the wool of one sheep.

1 kg = 1000 g

Number of hats = _____

(3)

(d) The table below gives information about poly(propene) and wool.

	Poly(propene)	**Wool**
Source of material	Crude oil	Sheep
Level of insulation	High	Medium
Cost	Low	High
Durability	High	Medium

Explain the advantages of using poly(propene) and of using wool for clothing.

(4)

(e) After being used, clothes can be:

- given to other people to wear
- used to make insulation blocks for buildings.

Complete the sentences.

Choose answers from the box.

recycled	**reduced**	**released**	**reused**	**reversed**

When clothes are given to other people to wear,

the clothes are _____.

When clothes are used to make insulation blocks for buildings,

the clothes are _____.

(2)

Poly(propene) is made from an alkene.

Alkenes are produced by cracking alkanes.

(f) A high temperature is used for cracking alkanes.

Which **two** of the following can also be used to crack alkanes?

Tick (✓) **two** boxes.

A catalyst ☐

A solvent ☐

Carbon dioxide ☐

Steam ☐

Sulfuric acid ☐

(2)

(g) Which chemical is used to test for alkenes?

Tick (✓) **one** box.

Ammonia ☐

Bromine water ☐

Copper sulfate ☐

Nitrogen ☐

(1)

(Total 14 marks)

2. Crude oil is a finite resource found in rocks.

(a) What is meant by a ‘finite’ resource?

_____

_____

(1)

(b) Most of the compounds in crude oil are hydrocarbons.

Define the term ‘hydrocarbon’.

_____

_____

(1)

(c) Crude oil found in different areas has different compositions.

The table below shows the percentage (%) composition of crude oil from one area.

Fraction	**Percentage (%) of fraction**
Petrol	31.3
Kerosene	13.4
Diesel oil	14.4
Heavy fuel oil	40.9

The volume of crude oil is measured in a unit called 'barrels'.

1 barrel = 159 dm^3

Calculate the volume of **petrol** in dm^3 in 90 barrels of crude oil.

Give your answer to 3 significant figures.

Volume of petrol (3 significant figures) = _____ dm^3

(4)

(d) Fractions from crude oil can be processed to produce many useful materials by the petrochemical industry.

Which is a useful material produced by the petrochemical industry?

Tick (✓) **one** box.

Alloys ☐

Ceramics ☐

Fertilisers ☐

Lubricants ☐

(1)

(e) Catalytic cracking is used to crack hydrocarbons.

Name **one** other method of cracking hydrocarbons.

_____

(1)

(f) Alkanes are produced by cracking.

Hydrocarbon **Z** is a different type of hydrocarbon to alkanes.

Hydrocarbon **Z**:

- is also produced by cracking
- can be used to produce polymers.

Describe a test for hydrocarbon **Z**.

Give the result of the test.

Test _____

_____

Result _____

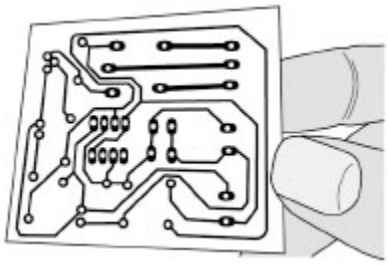
_____

(2)

(Total 10 marks)

3. Gold is used in the printed circuit boards found in smartphones.

The figure below shows a printed circuit board.



A type of smartphone contains 1.73×10^{-4} moles of gold.

(a) In one year, a manufacturer sold 2.48 million of this type of smartphone.

Calculate the total mass of gold contained in 2.48 million of these smartphones.

Give your answer in kilograms.

Relative atomic mass (A_r): Au = 197

Total mass of gold = _____ kg

(5)

(b) What is the total number of gold atoms in one of this type of smartphone?

The Avogadro constant = 6.02×10^{23} per mole

Tick (✓) **one** box.

2.87×10^{-28} ☐

1.04×10^{20} ☐

3.48×10^{27} ☐

(1)

(c) The materials in printed circuit boards can be recycled.

Bioleaching is one method used to extract gold from printed circuit boards.

Describe how bioleaching is used to extract gold.

_____

_____

_____

_____

_____

_____

(3)

(d) Copper is also extracted using bioleaching.

Copper can also be extracted from low-grade ores using phytomining.

Phytomining has **not** been widely used to extract copper.

Suggest **two** reasons why.

1 _____

_____

2 _____

_____

(2)

(Total 11 marks)

4. Tap water must be safe to drink.

(a) What name is given to water that is safe to drink?

Tick (✓) **one** box.

Ground water	☐
Potable water	☐
Waste water	☐

(1)

(b) Water is sterilised to make the water safe to drink.

Which **two** of the following are used to sterilise drinking water?

Tick (✓) **two** boxes.

Carbon dioxide	☐
Electrolysis	☐
Filtration	☐
Ozone	☐
Ultraviolet light	☐

(2)

A student investigated the mass of dissolved solids in samples of river water, sea water and tap water.

This is the method used.

1. Weigh an evaporating basin.

2. Measure 100 cm^3 of river water.

3. Pour the river water into the evaporating basin.

4. Heat the evaporating basin until all the water has evaporated.

5. Weigh the evaporating basin and dissolved solids.

6. Calculate the mass of dissolved solids in the water.

7. Repeat steps 1 to 6 with sea water and then with tap water.

(c) Which is the most suitable equipment to measure 100 cm^3 of water?

Tick (✓) **one** box.

Beaker ☐

Conical flask ☐

Measuring cylinder ☐

(1)

(d) **Table 1** shows the results.

Table 1

Type of water	**Mass in grams**		
	Evaporating basin	**Evaporating basin and dissolved solids**	**Dissolved solids**
River	112.1	113.1	1.0
Sea	110.5	114.0	**X**
Tap	115.3	115.4	0.1

Calculate value **X** in **Table 1**.

_____

X = _____ g

(1)

(e) Identify the variables used in the investigation.

Draw **one** line from each variable to the example of the variable.

Variable	Example of variable
	Mass of dissolved solids
	Mass of evaporating basin
Control	
	Room temperature
Dependent	
	Type of water
	Volume of water

(2)

Table 2 shows the mass of different types of ions dissolved in 1 dm^3 of sea water.

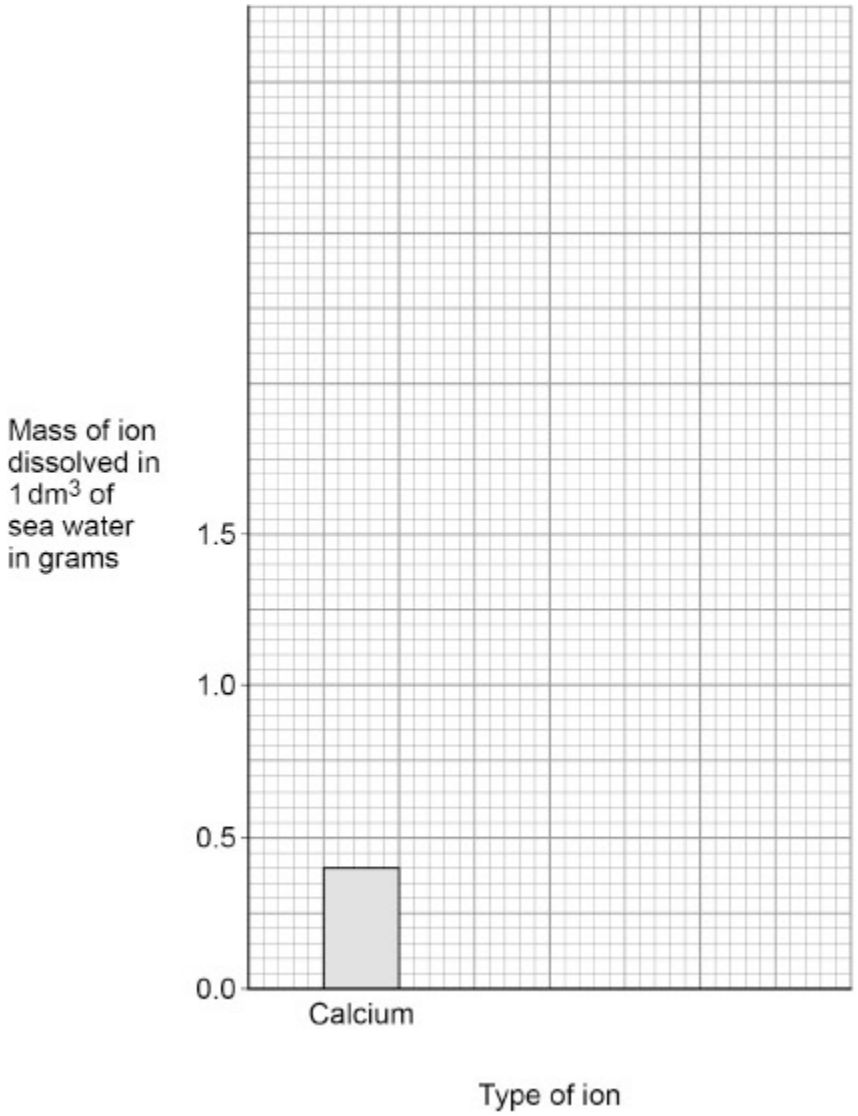
Table 2

Type of ion	**Mass of type of ion dissolved in 1 dm^3 of sea water in grams**
Calcium	0.4
Magnesium	1.3
Sulfate	2.7

(f) Complete the figure below.

You should:

- complete the scale for the *y*-axis
- plot the data from **Table 2** as a bar chart.



(3)

(Total 10 marks)

5. Life cycle assessments (LCAs) are used to assess the environmental impact of different products.

(a) 212 million kilograms of aluminium is used for packaging in the UK each year.

68.0% of aluminium packaging is recycled.

Calculate the mass of aluminium packaging that is recycled in the UK each year.

_____

_____

_____

Mass of aluminium recycled = _____ million kg

(2)

(b) Drinks cans are made from aluminium.

An aluminium can has a mass of 15.8 g.

1000 g = 1 kg

Calculate the **whole number** of aluminium cans that can be made from 4.00 kg of aluminium.

Whole number of cans = _____

(4)

(c) The table below shows three methods used to dispose of wood and steel after use.

	Percentage (%) of material disposed of by each method		
	As waste	**Recycled**	**Burnt**
Wood	58	36	6
Steel	15	85	0

Evaluate the sustainability of the disposal of wood and steel.

(4)
(Total 10 marks)

6. The Earth's natural resources are used to manufacture useful products.

One useful product is potable water.

Potable water can be produced from sea water by distillation.

(a) Give **one disadvantage** of using distillation to produce potable water.

(1)

(b) Describe **one** other method to produce potable water from sea water.

(2)

A student investigated the mass of dissolved solids in a 100 cm^3 sample of sea water.

This is the method used.

1. Weigh an evaporating basin.

2. Measure 100 cm^3 of sea water.

3. Pour the sea water into the evaporating basin.

4. Heat the evaporating basin.

5. Weigh the evaporating basin and contents.

6. Calculate the mass of dissolved solids in the sea water.

(c) Explain how repeating steps 4 and 5 would improve this method.

_____

_____

_____

_____

(2)

(d) The total mass of dissolved solids in a 100 cm^3 sample of sea water is 3.50 g.

The percentage of sodium chloride in the dissolved solids is 77.8%.

Calculate the mass of sodium chloride dissolved in the 100 cm^3 sample of sea water.

_____

_____

_____

Mass of sodium chloride = _____ g

(2)

Biological methods are used to extract metal compounds from metal ores.

(e) One method of producing copper from low-grade copper ores is by using bacteria.

The bacteria produce leachate solutions that contain copper compounds.

Give **two** methods that can be used to extract copper from these leachate solutions.

1 _____

_____

2 _____

_____

(2)

Phytomining uses plants to absorb metal compounds from low-grade ores.

(f) Describe how the metal compounds are obtained from the plants.

_____

_____

_____

_____

_____

_____

(3)

(g) Nickel is produced by phytomining.

One hectare of plants produces 215 kg of nickel.

Determine the area required to produce 750 kg of nickel.

Give your answer in m^2.

One hectare = 10 000 m^2

Area required = _____ m^2

(3)

(Total 15 marks)

1. (a) water that is safe to drink

1

(b) to remove large solid objects

1

(c) (conversion 4.5 kg =) 4500 (g)

1

$$(\text{number of hats} =)\ \frac{4500}{50}$$

allow correct use of incorrect / no conversion

1

= 90

alternative approach

(conversion 50 g =) 0.05 (kg) (1)

$$(\text{number of hats} =)\ \frac{4.5}{0.05}(1)$$

allow correct use of incorrect / no conversion

= 90 (1)

1

(d) **Level 2:** Relevant points (reasons / causes) are identified, given in detail and logically linked to form a clear account

3-4

Level 1: Points are identified and stated simply, but their relevance is not clear and there is no attempt at logical linking.

1-2

No relevant content

0

Indicative content

(poly(propene) has)

- higher level of insulation
  - (so) keeps the wearer warmer
- lower cost
  - (so) the clothes are cheaper
- higher durability
  - (so) the clothes last longer

(wool is)

- sheep are a renewable resource
  - so are sustainable

for **Level 2** there must be an advantage for both poly(propene) and wool plus a linked explanation

(e) reused

1

recycled

1

must be in this order

(f) a catalyst

1

steam

1

(g) bromine water

1

[14]

2. (a) (a resource that) will run out

allow (a resource that) is non-renewable

1

(b) (a compound / molecule) made up of carbon and hydrogen (atoms) only

1

(c) (volume of petrol =)

$90 \times 159 \times \frac{31.3}{100}$

or

(volume of petrol =)

$14310 \times \frac{31.3}{100}$

or

(volume of petrol =)
90 × 49.767

or

(volume of petrol =)
28.17 ×159

*allow **1** mark for*

90 ×159

or

$159 \times \frac{31.3}{100}$

or

$90 \times \frac{31.3}{100}$

2

= 4479.03

1

= 4480 (dm^3)

allow an answer correctly rounded to 3 significant figures from an incorrect calculation which uses 90 barrels, 159 dm^3 and a fraction percentage

1

(d) lubricants

1

(e) steam cracking

1

(f) (test)
add bromine water

1

(result)
(bromine) changes (from orange) to colourless

allow (bromine) is decolourised

1

[10]

3. (a) (mass in one phone =)

$1.73 \times 10^{-4} \times 197$

1

= 0.034081 (g)

1

(total mass =)

$0.034081 \times 2.48 \times 10^{6}$

allow (total mass =) 0.034081 × 2 480 000

allow correct use of an incorrectly determined mass in one phone

1

= 84520.88 (g)

1

(conversion 84520.88 g =) 84.5 (kg)

allow 84.52088 (kg) correctly rounded to at least 2 significant figures

allow conversion at MP2, MP3

allow correct conversion of an incorrectly determined mass using all numbers from the question

alternative approach

(total moles =)

$1.73 \times 10^{-4} \times 2.48 \times 10^{6}$ (1)

allow (total moles =)

$1.73 \times 10^{-4} \times 2\ 480\ 000$

= 429.04 (1)

(total mass =) 429.04 × 197 (1)

allow correct use of an incorrectly determined total moles

= 84520.88 (g) (1)

(conversion 84520.88 g =) 84.5 (kg) (1)

allow 84.52088 (kg) correctly rounded to at least 2 significant figures

allow correct conversion of an incorrectly determined mass using all numbers from the question

1

(b) 1.04×10^{20}

1

(c) uses bacteria

1

to produce leachate / solutions containing gold compounds

1

from which gold is obtained by displacement / electrolysis

1

(d) any **two** from:

- high-grade ores still available
- land not available
- phytomining takes a long time
- very small yields produced
- new technology

2

[11]

4. (a) potable water

1

(b) ozone

1

ultraviolet light

1

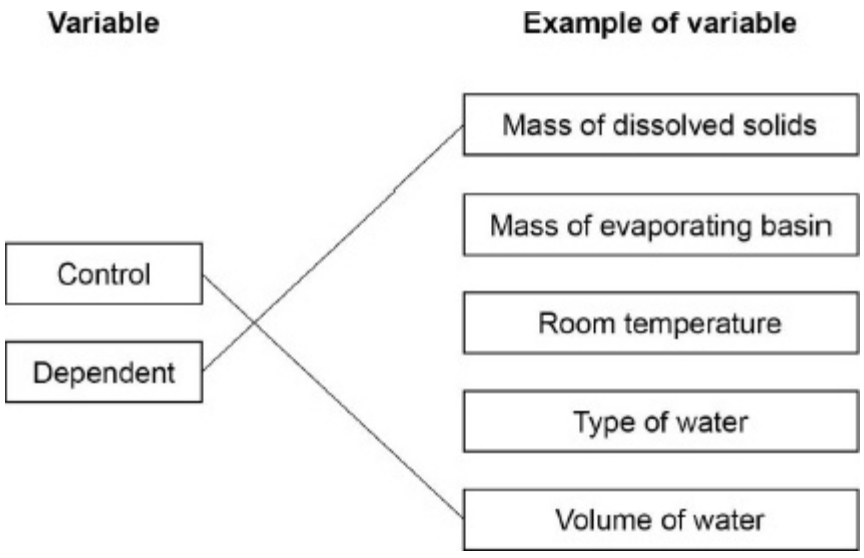
(c) measuring cylinder

1

(d) 3.5 (g)

1

(e)



do **not** accept more than one line from a box on the left

2

(f) complete the scale on the *y*-axis at 2.0, 2.5, 3.0

ignore intermediate values

1

plotting and labelling magnesium ion

1

plotting and labelling sulfate ion

*allow **1** mark if magnesium ion and sulfate ion plotted correctly but not labelled*

allow a tolerance of ± ½ a small square throughout

1

[10]

5. (a)

$$\text{(mass of aluminium recycled =)}\ \frac{212 \times 68.0}{100}$$

1

= 144 (million kg)

allow 144.16 (million kg)

*allow for **1** mark only an answer of*
144 000 000 (million kg)
or
144 160 000 (million kg)

1

(b) (unit conversion 4 kg =) 4000 g

1

$$\text{(number of cans =)}\ \frac{4000}{15.8}$$

allow correct use of an incorrect / no conversion

1

= 253.16

1

= 253

allow correct whole number from an incorrectly determined number of cans using the values from the question

alternative approach 1

(unit conversion 15.8 g =) 0.0158 kg (1)

(number of cans =) $\frac{4}{0.0158}$ (1)

allow correct use of an incorrect / no conversion

= 253.16 (1)

= 253 (1)

allow correct whole number from an incorrectly determined number of cans using the values from the question

alternative approach 2

(number of cans from 1000 g =) $\frac{1000}{15.8}$ (1)

= 63.29 (1)

(number of cans from 4000 g) = 63.29 × 4 (1)

allow correct use of an incorrectly determined number of cans from 1000 g

(= 253.16) = 253 (1)

allow correct whole number from an incorrectly determined number of cans using the values from the question

1

(c) **Level 2:** A judgement, strongly linked and logically supported by a sufficient range of correct reasons, is given.

3–4

Level 1: Relevant points are made. They are not logically linked.

1–2

No relevant content

0

Indicative content

- less steel (than wood) goes to waste
- (so) less space taken up in landfill

- more steel (than wood) is recycled
- (so) less non-renewable resources are needed

- no steel is burnt
- (so) no carbon dioxide produced
- (so) no contribution to climate change

- most wood is disposed of as waste
- (so) more space taken up in landfill

- least wood is disposed of by burning
- (but) still produces carbon dioxide
- (which) contributes to climate change

- most steel is disposed of by recycling
- (so) less non-renewable resources are needed

- judgement

[10]

6. (a) large amounts of energy required

ignore references to time and/or cost

1

(b) reverse osmosis

ignore desalination

1

using membranes

1

(c) (heat) until the mass is constant

1

to ensure that all the water has evaporated

1

(d)

$$(\text{mass} =) \frac{77.8}{100} \times 3.50$$

1

= 2.72 (g)

allow 2.723 (g)

1

(e) displacement using (scrap) iron

1

electrolysis

1

(f) plants are harvested

1

and burned

1

to produce ash (that contains metal compounds)

1

(g)

$(\text{area} =) \frac{750}{215}$

1

= 3.49 (hectares)

allow 3.488372093 correctly rounded to at least 2 significant figures

1

(conversion = 3.49 × 10 000 =) 34 900 (m^2)

allow 3.49 × 10^4 (m^2)

allow a correct conversion of an incorrectly determined area

alternative approach

(conversion = $\frac{215}{10000}$ =)
0.0215 (kg/m^2) (1)

$(\text{area} =) \frac{750}{0.0215}$ (1)

allow correct use of an incorrect conversion

= 34 900 (m^2) (1)

1

[15]