C10: Using Resources 1

ANSWER KEY

24.1	What do humans typically use resources for?	Warmth, shelter and food
24.2	**What are finite resources?**	**Resources that will run out e.g. fossil fuels, metal ores**
24.3	**What is sustainable development?**	**Using resources sensibly, to meet the needs of the current generation without compromising the needs of future generations**
24.4	Give an example of a natural product that has been replaced by a synthetic product	• Paper replaced by polyethene (bags) • Wood replaced by pvc (window frames) • Cotton replaced by polyester (clothing)
24.5	**What is potable water?**	**Water that is safe to drink**
24.6	**How is potable water produced from fresh water/ground water?**	• **Filtering (to remove solid materials)** • **Sterilising (to kill bacteria/microbes)**
24.7	**How is water sterilised?**	**Using chlorine, ozone or ultraviolet light**
24.8	**What is pure water?**	**Water that contains no dissolved substances, and is made up from only water molecules**
24.9	**How can we test that water is pure?**	**Test its boiling point, and it should boil at exactly 100°C**
24.10	**What is the difference between pure water and potable water?**	**Potable water may still contain dissolved substances**
24.11	What is desalination?	Removal of dissolved salt from water
24.12	**In what two ways can desalination be carried out?**	**Distillation and reverse osmosis**
24.13	**What is the main disadvantage of desalination methods?**	**They both requires a large amount of energy**
24.14	**What is the purpose of the semi-permeable membrane in reverse osmosis?**	**The small holes only let the small water molecules pass through (and trap the salt)**
24.15	In what kinds of locations is desalination carried out?	Ones where there is limited supply of fresh water

C10: Using Resources 2

ANSWER KEY

25.1	What needs to be removed from sewage, agricultural waste water and industrial waste water?	Organic matter and harmful microbes and harmful chemicals
25.2	How is sewage treated?	• Screening • Sedimentation • Anaerobic digestion • Aerobic biological treatment
25.3	**Why is sewage and waste water more difficult to treat?**	**The water is more heavily contaminated, and the treatment requires more steps**
25.4	**(HT) Name two ways of extracting copper from low-grade ores**	**Phytomining and bioleaching**
25.5	(HT) What is a low grade ore?	Rock with only a small amount of metal compound in it
25.6	**(HT) How is phytomining carried out?**	**Plants absorb metal compounds, are harvested and then burned to produce ash which is treated with sulfuric acid**
25.7	**(HT) How is bioleaching carried out?**	**Bacteria are used to produce a leachate solution**
25.8	**(HT) How can copper be produced from the products of phytomining or bioleaching?**	**Electrolysis or displacement with scrap iron**
25.9	What is a life cycle assessment (LCA)?	A way of assessing the environmental impact of a product across its entire life cycle
25.10	What are the four stages in a product's life cycle?	• Extracting and processing raw materials • Manufacturing • Use and operation • Method of disposal
25.11	**Why is it important to recycle and reuse products?**	• **Reduces the use of limited resources** • **Lowers energy requirements** • **Lowers environmental impact** • **Less waste**
25.12	Give an example of a product that can be reused	Glass
25.13	Give an example of a product that can be recycled	Metal, glass, plastics

FOUNDATION TIER

Q1. A student tested a sea water sample for dissolved solids. **Figure 1** shows the apparatus.

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

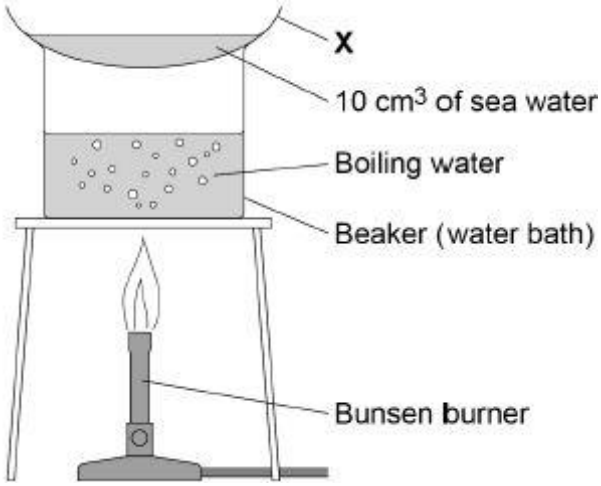
Tick **one** box.

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.

_____

_____

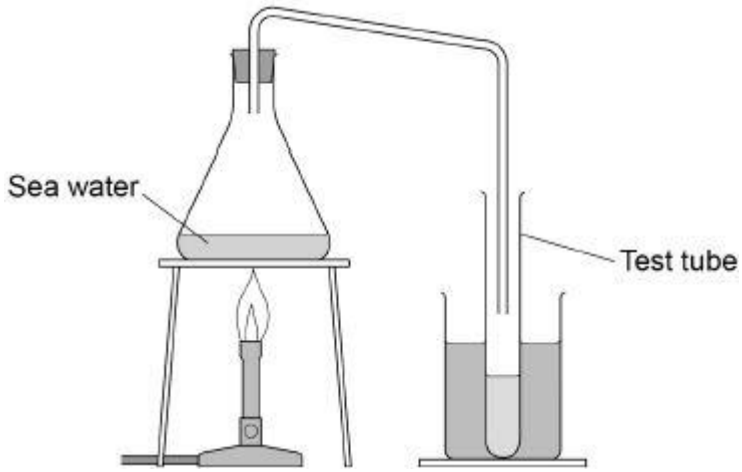
_____

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. Industries use the Earth's resources to produce useful products.

Copper is produced from copper ore and from recycling waste copper.

(a) The energy needed to produce 1 kg of copper from copper ore is 70 MJ.

The energy needed to produce 1 kg of recycled copper is 27 MJ.

Calculate the energy saved if 100 kg of copper is produced from recycled copper and **not** from copper ore.

Energy saved = _____ MJ

(3)

(b) Producing copper from recycling waste copper reduces emissions of sulfur dioxide.

Why is reducing emissions of sulfur dioxide important?

(1)

(c) Copper is used to make coins.

A coin of mass 8 g contains 75% copper.

Calculate the mass of copper in the coin.

Mass of copper = _____ g

(2)

(d) Iron and glass are both produced from the Earth's resources.

Some processes can reduce the use of limited resources.

Draw **one** line from the description of the process to the name of the process.

Description of process	**Name of process**
	Extraction
Scrap steel is added to iron from a blast furnace	Quarrying
	Reacting
A glass bottle is refilled	Recycling
	Reusing

(2)

(e) Life cycle assessments are used to assess the environmental impact of producing iron nails and glass bottles.

There are four stages, **A**, **B**, **C** and **D**, in a life cycle assessment.

The stages are **not** in the correct order.

Stage **A**	Disposal
Stage **B**	Extracting and processing raw materials
Stage **C**	Manufacturing and packaging
Stage **D**	Use and operation

What is the correct order of stages **A**, **B**, **C**, and **D**? Tick (✓) **one** box.

C, **D**, **B**, **A** ☐

D, **B**, **C**, **A** ☐

B, **C**, **D**, **A** ☐

(1)

(Total 9 marks)

Q3. Water that is safe to drink contains dissolved substances.

(a) What do we call water that is safe to drink?

Tick (✓) **one** box.

Desalinated ☐

Filtered ☐

Fresh ☐

Potable ☐

(1)

(b) Describe a test for pure water.

Give the result of the test if the water is pure.

Test _____

Result _____

_____

_____

(2)

(c) Describe a method to determine the mass of dissolved solids in a 100 cm^3 sample of river water.

_____

_____

_____

_____

_____

_____

_____

_____

_____

(4)

(d) A sample of river water contains 125 mg per dm^3 of dissolved solids.

Calculate the mass of dissolved solids in grams in 250 cm^3 of this sample of river water.

Give your answer to 2 significant figures.

Mass of dissolved solids = _____ g

(4)

(e) A water company allows a maximum of 500 mg per dm^3 of sulfate ions in drinking water.

A sample of drinking water contains 44 mg per dm^3 of sulfate ions.

Calculate the percentage (%) of the maximum allowed mass of sulfate ions in the sample of drinking water.

Percentage (%) of the maximum allowed mass = _____ %

(2)

(Total 13 marks)

Q4. Ethene is used to make poly(ethene).

Poly(ethene) is used to make plastic bags.

the table below shows data from a Life Cycle Assessment (LCA) for a plastic bag and a paper bag.

	Plastic bag	**Paper bag**
Raw materials	Crude oil or natural gas	Wood
Energy used in MJ	1.5	1.7
Mass of solid waste in g	14	50
Mass of CO_2 produced in kg	0.23	0.53
Volume of fresh water used in dm^3	255	4 520

A company stated: 'A Life Cycle Assessment shows that using plastic bags has less environmental impact than using paper bags'.

Evaluate this statement. Use your knowledge and the information from above the table above.

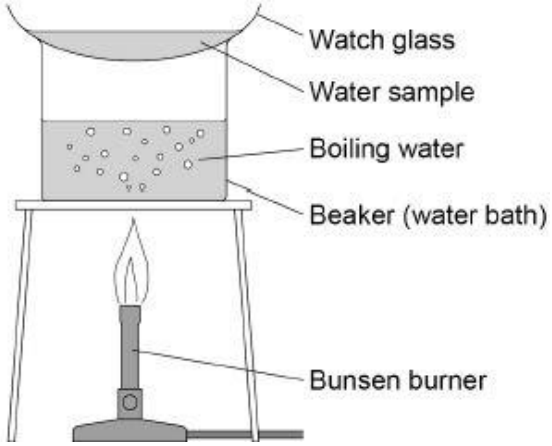
(6)

(Total 6 marks)

HIGHER TIER

Q5. A student investigated the mass of dissolved solids in 5 cm^3 samples of water.

The diagram below shows the apparatus.



The table below shows the student's results.

Type of water	Mass in g			
	Watch glass	**Watch glass and dissolved solids**	**Dissolved solids in 5 cm^3 of water**	**Dissolved solids in 1000 cm^3 of water**
Sea water	9.34	9.48	0.14	28.00
River water	9.15	9.23	0.08	**X**
Rainwater	8.93	8.93	0.00	0.00

(a) Calculate mass **X** in the table above.

_____

_____

Mass **X** = _____ g

(1)

(b) 5 cm^3 is a small volume of water for each experiment.

Give **one** advantage and **one** disadvantage of using a larger volume.

Advantage _____

_____

Disadvantage _____

_____

(2)

(c) Potable water is **not** pure water.

Describe the difference between potable water and pure water.

_____

_____

_____

(1)

(d) Potable water is obtained from both groundwater **and** from sea water.

Describe how groundwater and sea water are treated to produce potable water.

_____

_____

_____

_____

_____

_____

(3)

(e) The percentage by mass of dissolved solids in a 6.50 g sample is 2.2%

Calculate the mass of the dissolved solids.

_____

_____

_____

_____

Mass of dissolved solids = _____ g

(2)

(Total 9 marks)

Q6. This question is about copper and fuels.

(a) Copper is extracted from low-grade ores by phytomining.

Describe how copper metal is produced by phytomining.

(4)

(b) Another method of extracting copper from low-grade ores is bioleaching.

A solution of copper sulfate ($CuSO_4$) produced by bioleaching has a concentration of 0.319 g/dm^3

Relative atomic masses (A_r): Cu = 63.5 O = 16 S = 32

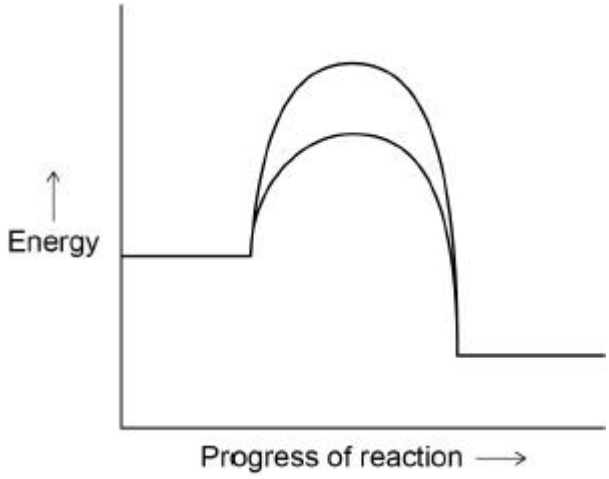
Calculate the number of moles of copper that can be produced from 1 dm^3 of this solution.

Number of moles of copper = _____ mol

(3)

Copper is used as a catalyst.

The diagram shows reaction profiles for a reaction with and without a catalyst.



(c) How do the reaction profiles show that using a catalyst does not affect the overall energy change for the reaction?

Tick (✓) **one** box.

Both reaction profiles show exothermic reactions. ☐

Both reaction profiles start at the same energy level and end at the same energy level. ☐

Both reaction profiles show the activation energy. ☐

The activation energy for the uncatalysed reaction is much lower than for the catalysed reaction. ☐

(1)

(d) Copper is a catalyst in a reaction to produce ethanol from carbon dioxide.

Ethanol (C_2H_5OH) is used as a fuel.

Suggest why producing ethanol from carbon dioxide is sustainable.

_____

_____

_____

_____

(2)

(e) Chemistry plays an important role in sustainable development.

What is sustainable development?

_____

_____

_____

_____

(2)

(Total 12 marks)

Q1.

(a) watch glass

1

(b) identify 0.29 as anomaly

1

$$\frac{0.12 + 0.14 + 0.15}{3}$$

or

$$\frac{0.41}{3}$$

allow $\frac{0.12 + 0.29 + 0.14 + 0.15}{4}$

or

$\frac{0.70}{4}$

1

(=) 0.14 (g)

allow 0.18 (g) if first marking point not awarded

1

*an answer of 0.14 (g) scores **3** marks*

(c) evaporating **or** vaporisation

allow from liquid to vapour / gas

*do **not** accept boiling*

1

(d) pure **or** no salt

allow converse answers relating to seawater
allow not a mixture
allow desalinated

*do **not** accept less salt*
*do **not** accept filtered*

1

(e) uses (a lot of) energy

allow needs heating
allow needs electricity
*allow needs fuel **or** any suitable fuel*

ignore references to equipment
ignore references to time

1

(f) filtering removes particles

*allow solids **or** suitable named solids*

1

sterilising kills bacteria / microbes

allow destroys viruses
allow kills viruses

1

[9]

Q2.

(a) (copper ore)
(70 × 100 =) 7000

1

(recycled copper)
(27×100 =) 2700

1

(7000 – 2700 =) 4300 (MJ)

allow correct use of incorrectly determined values for MP1 (copper ore) and/or MP2 (recycled copper)

1

(b) any **one** from:

- reduces acid rain

  allow sulfur dioxide causes acid rain

- reduces respiratory problems (in humans)

  allow sulfur dioxide causes respiratory problems (in humans)

1

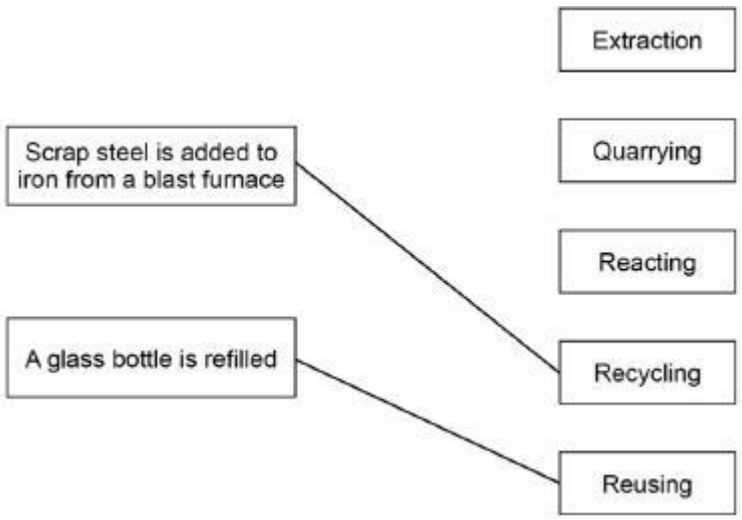
(c) $\frac{75}{100} \times 8$

1

= 6 (g)

1

(d)



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

1
1

(e) **B**, **C**, **D**, **A**

1

[9]

Q3.

(a) potable

1

(b) boil (water)

ignore heat

*do **not** accept filter*

*do **not** accept incorrect test*

1

(boils) at 100°C

***alternative approach** freeze (water) (1)*

(freezes) at 0°C (1)

*if no other mark awarded, allow 1 mark for evaporate or distil water **and** no solid left*

1

*allow boils at 100°C for **2** marks*

(c) **Level 2:** The design/plan would lead to the production of a valid outcome. All key steps are identified and logically sequenced.

3–4

Level 1: The design/plan would not necessarily lead to a valid outcome. Some steps are identified, but the plan may not be logically sequenced.

1–2

No relevant content

0

Indicative content

- weigh container.
- measure volume (100 cm^3) of water into container.
- evaporate / heat until dry.
- weigh container and remaining solids.
- determine mass of dissolved solids

to access Level 2 there should be an indication of using a known volume of water, heating until dry and determining the mass of solid.

(d)

*an answer of 0.031 (g) scores **4** marks*

(conversion of cm^3 to dm^3)

(250 cm^3 =) $\frac{250}{1000}$ or 0.25 (dm^3)

1

(conversion of mg to g)

(125 mg =) $\frac{125}{1000}$ or 0.125 (g)

1

(0.25 × 0.125) = 0.03125

allow correct calculation from incorrect attempt(s) at conversion

1

=0.031 (g)

allow an answer correctly rounded to 2 significant figures from an incorrect calculation that uses the values in the question

1

(e) $\frac{44}{500} \times 100$

1

= 8.8 (%)

allow 9 (%)

1

*an answer of 8.8 (%) or 9 (%) scores **2** marks*

[13]

Q4.

Level 3 (5–6 marks):
A logically structured evaluation with links involving several comparisons. Nearly all points made are relevant and correct.

Level 2 (3–4 marks):
Some valid comparisons made between the two types of bag. There may be some incorrect or irrelevant points.

Level 1 (1–2 marks):
A vague response with few correct and relevant points and with no direct comparisons.

0 marks:
No relevant content

Indicative content

Accept converse in terms of plastic bags for all statements

- Paper bags are made from a renewable resource
- Plastic bags are made from a finite resource
- Paper bags require more energy to manufacture
- Paper bags produce more waste
- Paper bags are biodegradable
- Paper bags create more CO_2
- CO_2 created by paper bags offset by photosynthesis in growing wood
- Paper bag requires much more fresh water
- Paper bags cannot be recycled
- Agree because non-renewability less important than other factors **or** disagree because of converse **or** can't say because data inconclusive / incomplete

6

[10]

Q5.

(a) 16(.0)

1

(b) advantage: more accurate result

*do **not** accept reliable*

1

disadvantage: takes a long(er) time, more energy needed (to heat more water)

ignore expensive

1

(c) pure: no dissolved solids / impurities
or no (dissolved) chlorine

allow only water / H_2O
ignore safe to drink

and
potable: has dissolved solids / impurities
or has (dissolved) chlorine

ignore safe to drink

1

a clear comparative statement referring to solutes gains the mark

(d) groundwater:
- filtered

allow acceptable method of filtration

1

- sterilised

allow acceptable method of sterilisation

1

groundwater:
- distilled **or** reverse osmosis

allow desalination
ignore salt removed
ignore boiling alone
ignore filtering
*do **not** accept fractional distillation*

1

(e) $\frac{2.2}{100} \times 6.50$

1

(=) 0.143 (g)

1

*an answer of 0.143 (g) **or** 0.14 (g) scores **2** marks*

[9]

Q6.

(a) growing plants (on low-grade ore)

allow named plant

1

plants are burnt (to produce ash)

1

(ash dissolved in acid to produce) solution of a copper compound

allow named copper compound

1

electrolysis (of solution of a copper compound)
or
displacement (by adding scrap iron to a solution of a copper compound)

allow addition of scrap iron (to a solution of a copper compound)

1

(b)

*an answer of 0.002 or 2 × 10^{-3} (mol) scores **3** marks*

M_r $CuSO_4$ = 159.5

1

$$\frac{0.319}{159.5}$$

allow correct use of incorrectly calculated value for M_r

1

= 0.002 (mol)

allow 2 × 10^{-3} (mol)

1

(c) both reaction profiles start at the same energy level and end at the same energy level.

1

(d) the amount of carbon dioxide used to produce the ethanol

1

is the same as the amount of carbon dioxide given off when the ethanol is burned

1

alternative approach

there is sufficient carbon dioxide (in the atmosphere) (1)

because carbon dioxide is constantly produced from burning fossil fuels (1)

if no other mark awarded allow for 1 mark burning ethanol produces carbon dioxide

(e) meets needs of current generation

1

without compromising needs of future generations

allow so there are enough resources for future generations

ignore references to harming / damaging planet / environment

1

[12]