2021 ASSESSMENT MATERIALS

GCSE
CHEMISTRY

Chemistry Test 5: Chemical analysis and Using resources (Higher)

Total number of marks: 35

0 2 This question is about water.

0 2 . 1 In the UK, potable (drinking) water is produced from different sources of fresh water.

Explain how potable water is produced from fresh water.

[4 marks]

Fresh water collects in rivers, lakes and rocks underground. This fresh water is harvested and purified to produce potable water. The fresh water is passed through filter beds to remove any insoluble particles, and then sterilised with chlorine or ozone to kill microbes.

0 2 . 2 A different country has:

- very little rainfall
- a long coastline
- plentiful energy supplies.

Suggest **one** process this country could use to obtain most of its potable water.

[1 mark]

Distillation

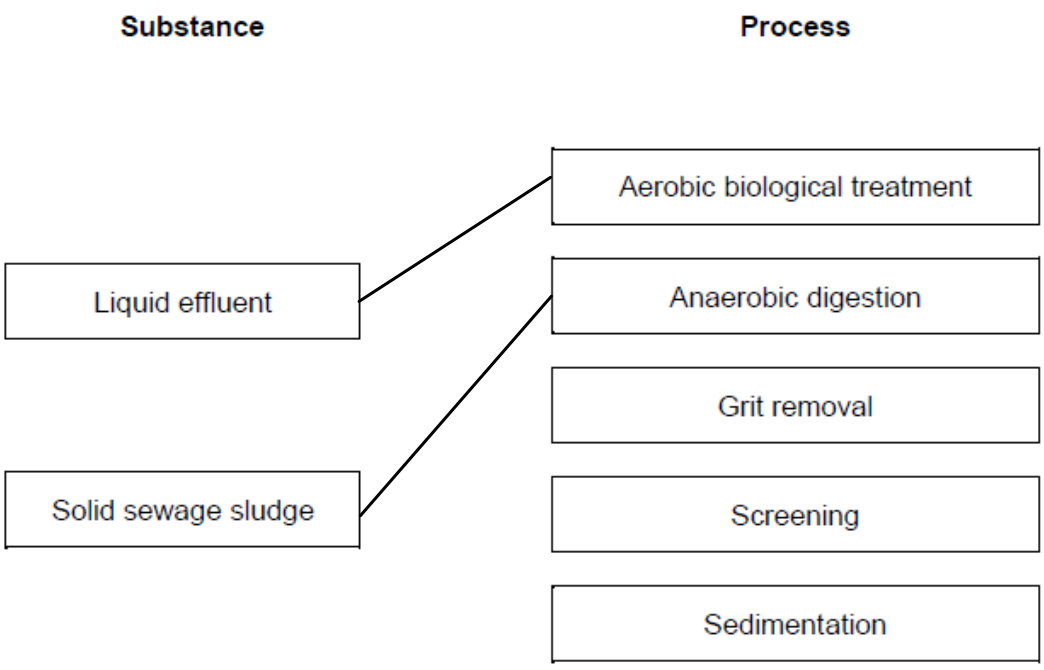
0 2 . 3 Waste water is not fit to drink.

Treatment of waste water produces two substances:

- liquid effluent
- solid sewage sludge.

Draw **one** line from each substance to the way the substance is processed.

[2 marks]



0 2 This question is about lithium carbonate.

Lithium carbonate is used in medicines.

Figure 2 shows a tablet containing lithium carbonate.

Figure 2

0 2 . 1 Lithium carbonate contains lithium ions and carbonate ions.

A student tested the tablet for lithium ions and for carbonate ions.

The student used:

- a metal wire → Li^+
- dilute hydrochloric acid → CO_3^{2-}
- limewater.

Plan an investigation to show the presence of lithium ions **and** of carbonate ions in the tablet.

You should include the results of the tests for the ions.

[6 marks]

First crush the tablet into a fine powder using a pestle and mortar. Pour the powder into a glass beaker and add 100 cm^3 of distilled water, and stir until all of the powder has dissolved. Dip the metal wire into the solution and hold above a blue Bunsen burner flame. If lithium ions are present, then the flame will glow a red colour.

Next, add hydrochloric acid to the remaining liquid in the beaker and stir. Bubble the gas that is produced through limewater and if carbonate ions are present, the limewater will turn cloudy due to the CO_2 gas produced.

0 2 . 2 The tablet also contains other substances.

The substances in tablets are present in fixed amounts.

What name is given to mixtures like tablets?

[1 mark]

formulations

0 2 . 3 The tablet has a mass of 1.20 g and contains 700 mg of lithium carbonate.

Calculate the percentage by mass of lithium carbonate in this tablet.

[3 marks]

700 mg = 0.7 g

$\left(\frac{0.7}{1.20}\right) \times 100 = 0.583 \times 100 = 58.3\%$

Percentage by mass of lithium carbonate = 58.3 %

0 4 This question is about ink.

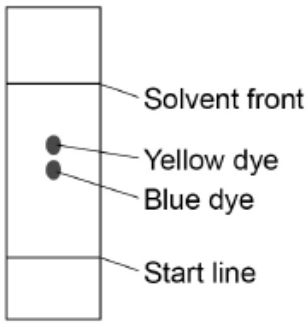
A student investigated green ink using paper chromatography in a beaker.

The student used water as the solvent.

Figure 2 shows the chromatogram obtained.

Figure 2

Diagram not to scale



0 4 . 1 The R_f value of the yellow dye = 0.60

The distance moved by the yellow dye = 5.7 cm

Calculate the distance moved by the solvent.

[3 marks]

$R_f = \frac{\text{distance moved by solute}}{\text{distance moved by solvent}}$

$0.60 = \frac{5.7}{\text{solvent}} \Rightarrow \text{solvent} = 5.7 \div 0.6$

$= 9.5$ cm

Distance moved by the solvent = 9.5 cm

0 4 . 2 The green ink contains more than two compounds.

Suggest **one** reason why only two spots are seen on **Figure 2**.

[1 mark]

the other compounds travelled the same distance up the paper as either the yellow or blue spots

0 4 . 3 On the student's chromatogram, the yellow and blue spots are very close together.

Which **two** ways could increase the distance between the spots?

[2 marks]

Tick (✓) **two** boxes.

- [✓] Allow the solvent front to travel further.
- [ ] Dry the chromatogram more slowly.
- [✓] Use a different solvent.
- [ ] Use a larger beaker.
- [ ] Use a larger spot of green ink.

0 4 . 4 The manufacturers of the green ink always use the same proportions of yellow dye and blue dye.

Suggest **one** reason why.

[1 mark]

using more of one of the colours would make the green ink a different viscosity

0 4 . 5 The R_f value of a dye depends on:

- the solubility of the dye in the solvent
- the attraction of the dye to the paper.

Which will **definitely** produce a smaller R_f value if the solvent and paper are both changed?

[1 mark]

Tick (✓) **one** box.

- [ ] The dye is less soluble in the new solvent and less attracted to the new paper.
- [✓] The dye is less soluble in the new solvent and more attracted to the new paper.
- [ ] The dye is more soluble in the new solvent and less attracted to the new paper.
- [ ] The dye is more soluble in the new solvent and more attracted to the new paper.

1 0 Disposable cups are made from coated paper or poly(styrene).

Table 6 shows information on the life cycle assessments (LCAs) of disposable cups.

Table 6

	Coated paper cups	Poly(styrene) cups
Raw materials	Wood	Crude oil
Mass of 1 cup in g	8.3	1.9
Energy to produce 1 cup in kJ	550	200
Energy released when 1 cup is burned in kJ	166	76
Biodegradable	Yes	No
Recyclable	No	Yes

1 0 . 1 Evaluate the use of coated paper compared with poly(styrene) to make disposable cups.

Use **Table 6** and your knowledge and understanding of LCAs.

[6 marks]

(see next page)

1 0 . 2 Calculate the energy needed to produce 1.00 kg of coated paper cups.

Use **Table 6**.

Give your answer in standard form.

[2 marks]

1 cup = 8.3 g = 550 kJ

1 g = 66.2 kJ

1000 g = 66265 kJ

Energy = 6.63×10^4 kJ

1 0 . 3 Melamine is a polymer used to make non-disposable cups.

Melamine does **not** melt when it is heated.

Explain why.

[2 marks]

melamine has very strong covalent bonds between the polymer chains, which do not break despite high temperatures being applied to it.

10.1 Evaluate the use of coated paper compared with poly(styrene) to make disposable cups.

Use **Table 6** and your knowledge and understanding of LCAs.

[6 marks]

Coated paper cups are made from wood, which is a renewable energy source, whereas poly(styrene) is made from crude oil, which is non-renewable resource that requires lots of energy and expensive equipment to extract and separate into its different components.

The energy to produce one coated paper cup is 350kJ more than to produce one poly(styrene)cup, and the energy released when burned is 90kJ more for paper cups.

Coated paper cups are also not recyclable, whereas polystyrene cups are, and felling trees damages habitats.

In conclusion, poly(styrene) cups are more economically efficient to produce, own and use than coated paper cups, because even though they're produced from a non-renewable source, they last longer, release less energy when burned and require less energy to manufacture, so do less damage to the environment than coated paper cups.