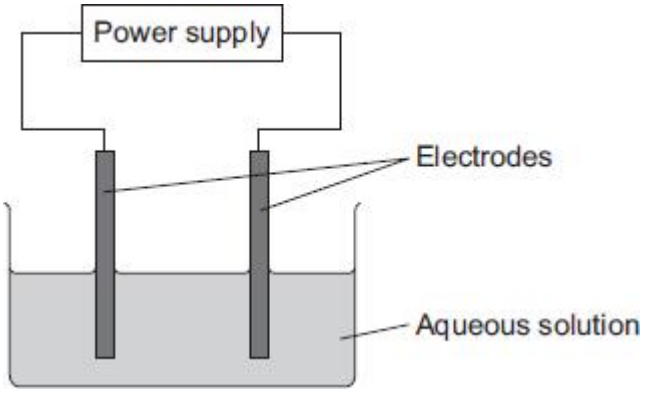
C6.2 Electrolysis Homework task 2

Q1.

This question is about electrolysis.

A student investigated the electrolysis of aqueous solutions using inert electrodes.

The figure below shows the apparatus used.



(a) The electrodes are made of graphite.

Which element is graphite a form of?

Tick (✓) **one** box.

Aluminium	☐
Carbon	☐
Copper	☐
Silicon	☐

(1)

(b) The electrodes are inert.

What does 'inert' mean?

_____

_____

(1)

(c) What is meant by an 'aqueous solution'?

_____

(1)

The student electrolysed four aqueous solutions.

The table below shows some of the results.

Aqueous solution	**Product at negative electrode**	**Product at positive electrode**
Copper bromide		bromine
Copper chloride	copper	chlorine
Sodium bromide	hydrogen	
Sodium sulfate		oxygen

(d) Complete the table above.

Choose answers from the box.

bromine	**chlorine**	**copper**	**hydrogen**	**oxygen**	**sodium**

(3)

(e) An aqueous solution of copper chloride was electrolysed.

Give **one** observation seen at the:

- negative electrode
- positive electrode.

Use the table above.

Negative electrode _____

_____

Positive electrode _____

_____

(2)

(f) What would you use to test for chlorine gas?

Tick (✓) **one** box.

A burning splint ☐

A glowing splint ☐

Damp litmus paper ☐

(1)

(g) Complete the sentence.

Choose the answer from the box.

gaseous	**molten**	**solid**

Copper chloride can conduct electricity when in aqueous solution or when

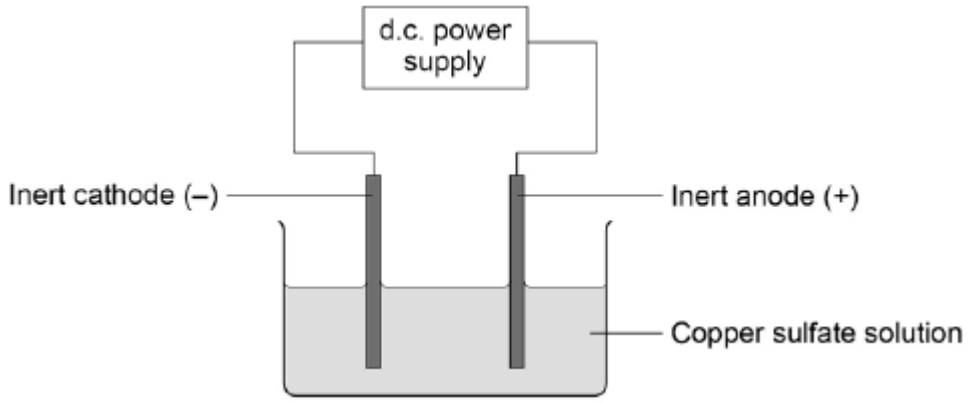
_____ .

(1)

(Total 10 marks)

Q2.

The figure below shows an apparatus to produce elements from a solution of an ionic compound.



(a) What is the name of the process in the figure?

Tick **one** box.

Combustion ☐

Crystallisation ☐

Distillation ☐

Electrolysis ☐

(1)

(b) The table below shows the products formed from three experiments using different compounds and the apparatus shown in the figure above.

Compound	State	Product at cathode	Product at anode
Copper chloride	Molten	Copper	Chlorine
Copper chloride	Aqueous solution	Copper	Chlorine
Potassium bromide	Molten	Potassium	Bromine

Use the table above to name the products formed at each electrode if using an aqueous solution of potassium bromide.

At cathode _____ At anode _____

_____

(2)

(c) Explain why copper is formed at the cathode during the electrolysis of its salts.

_____

_____

_____

_____

_____

(2)

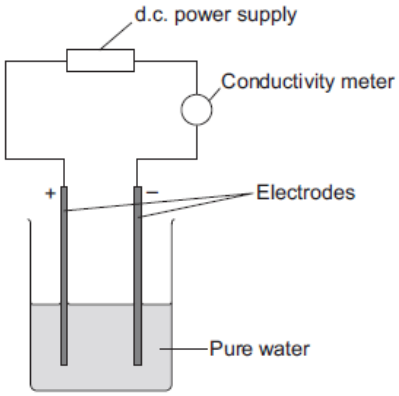
(Total 5 marks)

HIGHER TIER QUESTIONS

Q3.

A student investigated the conductivity of different concentrations of sodium chloride solution.
The student set the apparatus up as shown in **Figure 1**.

Figure 1



The student measured the conductivity of the pure water with a conductivity meter.

The reading on the conductivity meter was zero.

(a) The student:

- added sodium chloride solution one drop at a time
- stirred the solution
- recorded the reading on the conductivity meter.

The student's results are shown in the table below.

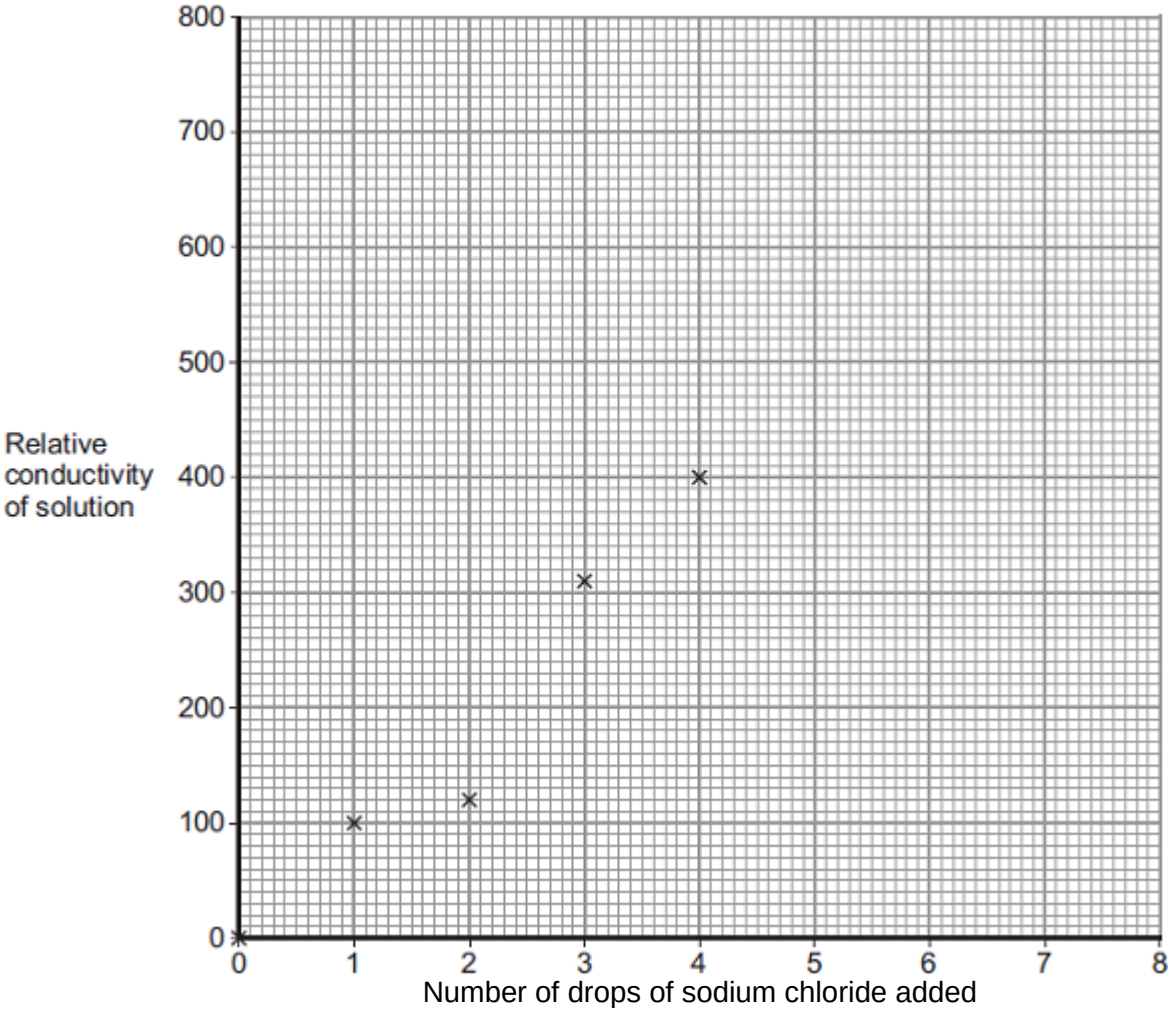
Number of drops of sodium chloride solution added	Relative conductivity of solution
0	0
1	100
2	120
3	310
4	400
5	510
6	590
7	710
8	800

(i) The student plotted the results on the grid shown in **Figure 2**.

Plot the four remaining results.

Draw a line of best fit, ignoring the anomalous result.

Figure 2



(3)

(ii) One of the points is anomalous.

Suggest **one** error that the student may have made to cause the anomalous result.

_____

_____

(1)

(iii) The student wanted to compare the conductivity of sodium chloride solution with the conductivity of potassium chloride solution.

State **one** variable he should keep constant when measuring the conductivity of the two solutions.

_____

(1)

(b) (i) Explain, in terms of bonding, why pure water does **not** conduct electricity.

_____

_____

_____

_____

(2)

(ii) Explain why sodium chloride solution conducts electricity.

_____

_____

_____

_____

(2)

(iii) After he had added sodium chloride solution, the student noticed bubbles of gas at the negative electrode.

Complete the sentence.

The gas produced at the negative electrode is _____

(1)

(Total 10 marks)

Q4.

This question is about electrolysis.

(a) Some metals are extracted from molten compounds using electrolysis.

Why is electrolysis used to extract some metals?

_____

_____

(1)

(b) Aluminium is produced by electrolysis of a molten mixture.

What **two** substances does the molten mixture contain?

1 _____

2 _____

(2)

(c) Copper and chlorine are produced when molten copper chloride is electrolysed.

Complete the half equation for the reaction at each electrode.

Half equation at negative electrode

Cu^{2+} _____ → _____

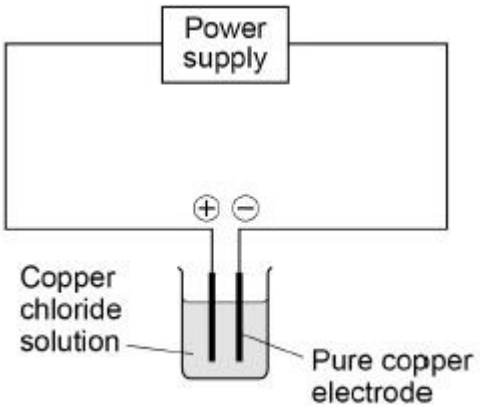
Half equation at positive electrode

$2\ Cl^{-}$ → _____

(2)

The **Figure 1** shows the apparatus a student used to electrolyse copper chloride solution.

Figure 1



The student:

- measured the mass of copper deposited on the negative electrode after 60 minutes
- compared the mass deposited with the expected value.

(d) Suggest **two** reasons why the mass deposited was different from the expected value.

1 _____

_____

2 _____

_____

(2)

(Total 7 marks)

Q1.

(a) carbon

1

(b) does not react
or
unreactive

1

(c) salt / solid / substance (dissolved) in water

1

(d)

copper	bromine
copper	chlorine
hydrogen	**bromine**
hydrogen	oxygen

1
1
1

(e) (negative electrode)
(pink / orange / red / brown) solid (deposited on electrode)
ignore copper

1

(positive electrode) bubbles / effervescence / fizzing
allow (chlorine) gas is produced

1

(f) damp litmus paper

1

(g) molten

1

[10]

Q2.

(a) electrolysis

1

(b) Cathode – hydrogen

1

Anode – bromine

1

(c) copper ions are positive

1

so the copper ions are attracted to the negative cathode

allow so the copper ions gain electrons from the cathode to form copper atoms

1

[5]

Q3.

(a) (i) points correctly plotted (± ½ small square)

*four points = **2** marks*

*three points = **1** mark*

Max 2

straight line of best fit using full range of points from 0,0

1

(ii) any **one** from:

must explain why the point is below the line

- the solution may not have been properly stirred
- the electrodes may have been a larger distance apart
- the drop of sodium chloride may have been a smaller volume / smaller

allow not enough sodium chloride added

allow smaller amount of sodium chloride

*do **not** allow too few drops added*

ignore the student may have misread the conductivity meter

1

(iii) any **one** from:

- the volume of pure water

  allow amount
- the concentration (of the solutions added)
- the volume (of the drops) of solution added

  ignore number of drops
- the distance between the electrodes
- the same electrodes **or** electrodes made of the same material
- same depth **or** surface area of electrodes in the water
- constant power supply

  ignore current
- stirred

1

(b) (i) because (pure) water is covalent / molecular (simple) **or** contains molecules

1

therefore (pure) water has no free / mobile electrons **or** ions

*molecules do not have a charge **or** molecules do not contain ions gains **2** marks*

1

(ii) because there are <u>ions</u> in sodium chloride

*allow Na^+ and / or Cl^-(ions) **or** ionic bonding.*

Ignore particles other than ions for MP1.

1

which can move **or** carry the current / charge

MP2 must be linked to ions only.

1

(iii) Hydrogen

allow H_2 / H

1

[10]

Q4.

(a) metal is too reactive to be extracted using carbon

or

metal reacts with carbon

allow metal is more reactive than carbon

1

(b) aluminium oxide

*ignore bauxite **or** aluminium ore*

1

cryolite

1

either order

(c)

allow multiples

negative electrode:

$Cu^{2+} + 2e^- \longrightarrow Cu$

1

positive electrode:

$2\ Cl^- \longrightarrow Cl_2 + 2e^-$

allow $2\ Cl^- - 2e^- \longrightarrow Cl_2$

1

(d) any **two** from:

- concentration / volume of solution was different
- impurities in solution
- error in timing
- copper falls off (electrode)

  allow copper at bottom of beaker
- copper removed when drying electrode
- electrode not dry (when weighed)
- voltage / current was different

ignore power supply ignore recorded mass inaccurately

2

[7]