All questions are for both separate science and combined science students

Q1.

This question is about ionic compounds and electrolysis.

Calcium chloride is an ionic compound.

(a) Calcium and chlorine react to produce calcium chloride.

Describe what happens to calcium atoms and chlorine atoms when the ionic compound calcium chloride is formed.

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(4)

(b) Solid calcium chloride **cannot** be electrolysed.

Give **one** reason why.

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(1)

(c) Name the product formed at the negative electrode when aqueous calcium chloride solution is electrolysed.

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(1)

(d) What is the half equation for the reaction at the positive electrode when aqueous calcium chloride solution is electrolysed? **(HT only)**

Tick (✓) **one** box.

$2\ Cl^- \rightarrow Cl_2 + 2\ e^-$ ☐

$Cl_2 + 2\ e^- \rightarrow 2\ Cl^-$ ☐

$4\ OH^- \rightarrow O_2 + 2\ H_2O + 4\ e^-$ ☐

$O_2 + 2\ H_2O + 4\ e^- \rightarrow 4\ OH^-$ ☐

(1)

(e) A student investigated the electrolysis of green copper chromate solution.

Figure 1 shows the apparatus.

Figure 1

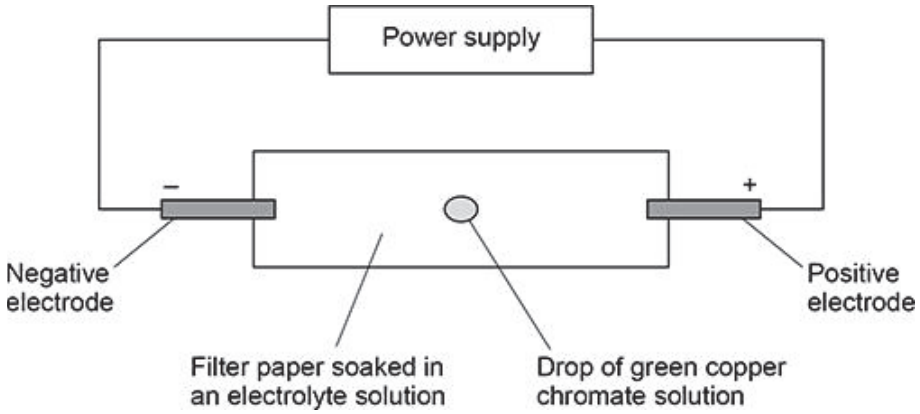
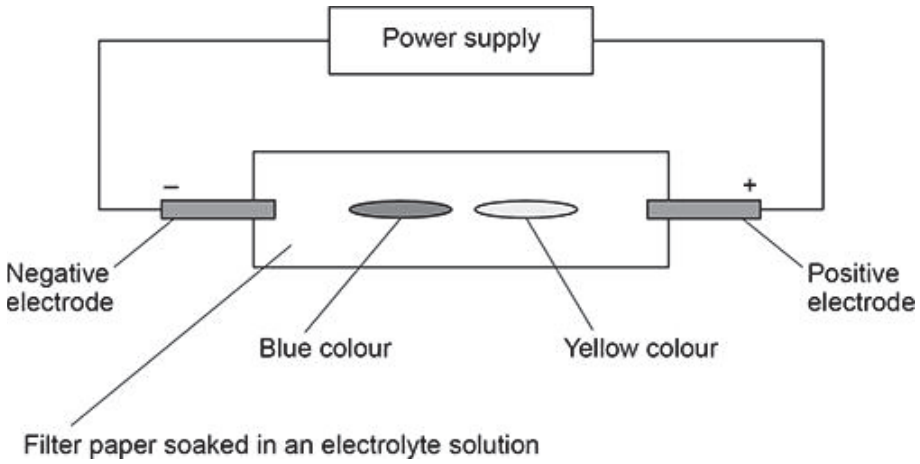


Figure 2 shows the results.

Figure 2



Copper chromate solution contains the ions Cu^{2+} and CrO_4^{2-}

Explain the results shown in **Figure 2**.

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(3)

(Total 10 marks)

Q2.

This question is about electrolysis.

Aluminium is manufactured by electrolysing a molten mixture of aluminium oxide (Al_2O_3) and cryolite (Na_3AlF_6).

(a) Complete the half equation for the reaction occurring at the negative electrode. **(HT only)**

$$Al^{3+} + \_\_\_\_\_ e^- \rightarrow Al$$

(1)

(b) Cryolite contains Na^+ ions as well as Al^{3+} ions.

Suggest **one** reason why sodium is **not** a product of the electrolysis.

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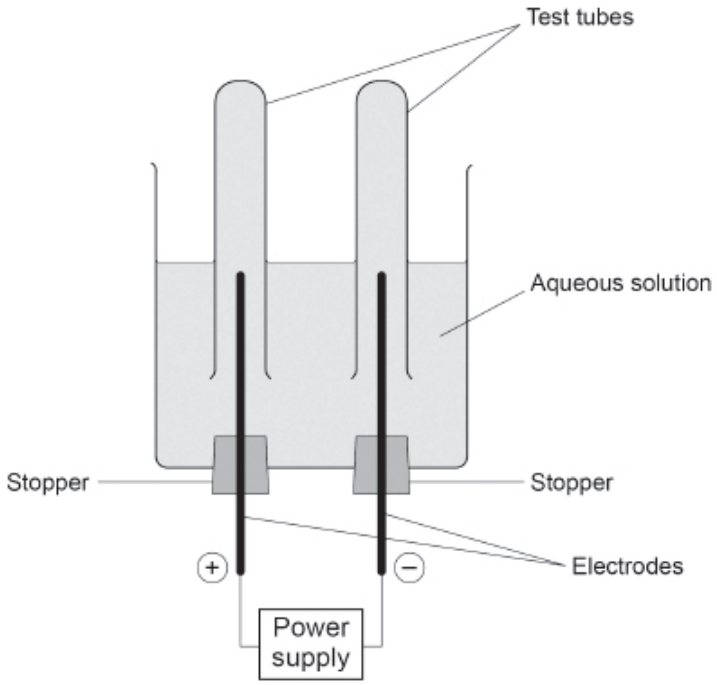
(1)

A student investigated the electrolysis of an aqueous solution of a different compound.

The figure below shows the apparatus.



Hydrogen was produced at the negative electrode and oxygen was produced at the positive electrode.

(c) Explain how oxygen was produced from water during the electrolysis of this aqueous solution.

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(4)

(d) The student compared the volumes of the two gases collected.

How can the student change the apparatus in the figure above to compare the volumes of the two gases produced more accurately?

Give **one** reason for your answer.

Change _____

_____

Reason _____

_____

(2)

(e) The overall equation for the reaction is:

$$2\ H_2O(l) \rightarrow 2\ H_2(g) + O_2(g)$$

What is the volume of oxygen produced when 20 cm^3 of hydrogen has been produced? **(HT only)**

Tick (✓) **one** box.

10 cm^3 ☐ 20 cm^3 ☐ 30 cm^3 ☐ 40 cm^3 ☐

(1)

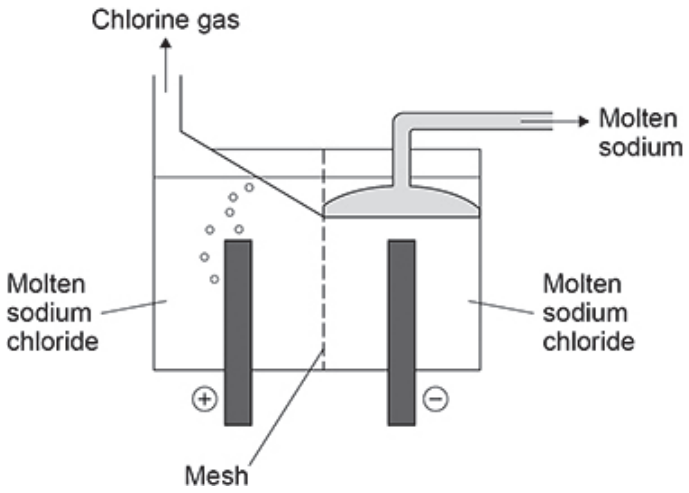
(Total 9 marks)

Q3.

This question is about electrolysis.

Molten sodium chloride is electrolysed in an industrial process to produce sodium.

The figure below shows a simplified version of the electrolysis cell used.



(a) Which is the correct half equation for the production of sodium? **(HT only)**

Tick (✓) **one** box.

$Na + e^- \rightarrow Na^+$ ☐

$Na \rightarrow Na^+ + e^-$ ☐

$Na^+ + e^- \rightarrow Na$ ☐

$Na^+ \rightarrow Na + e^-$ ☐

(1)

A mesh is used to keep the products of the electrolysis apart.

(b) Suggest **one** reason why the products of the electrolysis must be kept apart.

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(1)

(c) Which type of particle passes through the mesh in the electrolysis of molten sodium chloride?

Tick (✓) **one** box.

Atom ☐

Electron ☐

Ion ☐

Molecule ☐

(1)

Aqueous sodium chloride solution is electrolysed in a different industrial process.

Two gases and an alkaline solution are produced.

(d) Which **two** ions are present in aqueous sodium chloride solution in addition to sodium ions and chloride ions?

1 _____

2 _____

(2)

(e) Name the alkaline solution produced.

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(1)

(f) Explain how the alkaline solution is produced.

You should refer to the processes at the electrodes.

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(3)

(Total 9 marks)