Write your name, centre number and candidate number in the boxes below.

Surname	Other names

Centre number | | | | | |

Candidate number | | | | |

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Electrochemistry

Time allowed: 1 hour 30 minutes

Subject code **0620**

Chemistry

Questions from Paper 3, Paper 4 and Paper 6

You must have: a ruler marked in centimetres and millimetres, a protractor, compasses, a pen, an HB pencil and an eraser.

Total marks

/ 79

Instructions

- Answer every question in the space provided on this paper.
- Write in black or dark blue ink. Pencil may be used for diagrams and graphs.
- Fill in your name, centre number and candidate number above.
- Show your working: a correct method can earn marks even if the answer is wrong.

Information

- This paper has 10 questions worth 79 marks in total.
- The marks for each question or part are shown in brackets, for example [3].

Advice

- Read every question through once before you write anything.
- Use the marks in brackets to judge how long to spend on each part.
- If you finish early, go back and check your working.

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Print at 100% (Actual size) so diagrams keep their real measurements.

1 **(a)** Molten lead(II) bromide is electrolysed using carbon electrodes.

(i) State the products of this electrolysis at:

the negative electrode .....

the positive electrode. .....

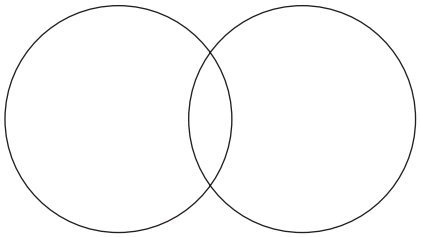
[2]

(ii) State the name of **another** substance which can be used as an inert electrode.

..... [1]

(b) When aqueous magnesium chloride is electrolysed using carbon electrodes, hydrogen gas is produced at the negative electrode.

Complete the dot-and-cross diagram to show the electron arrangement in one molecule of hydrogen.



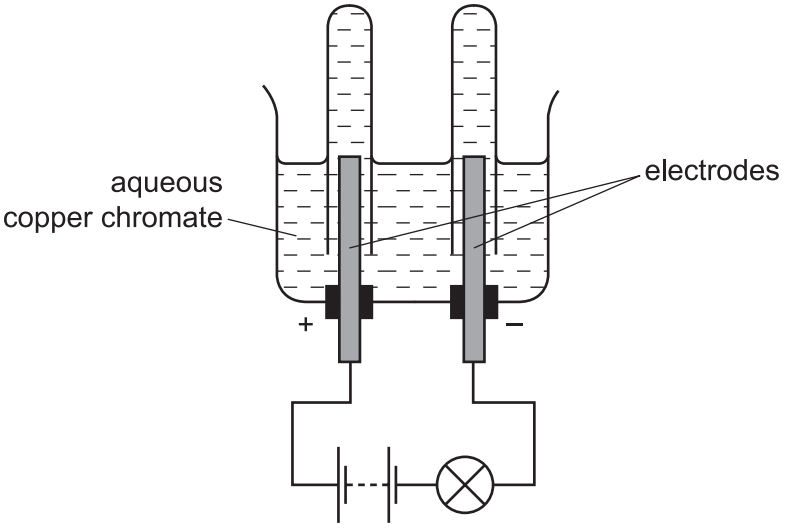
[1]

[Total: 4]

Electrolysis and electroplating Click for more variations

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2 Electricity was used to break down an aqueous solution of copper chromate, $CuCrO_4$, which is green.
The apparatus used is shown.



A brown deposit was seen forming at one electrode and oxygen was evolved at the other electrode.

(a) Suggest a suitable non-metal for the electrodes.

..... [1]

(b) Give **one** other observation expected during this experiment.

..... [1]

(c) Name the brown deposit and identify at which electrode it is formed.

..... [2]

(d) Name the process when electricity breaks down aqueous solutions.

..... [1]

[Total: 5]

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3 Metal spoons can be electroplated with silver.

Describe how a metal spoon can be electroplated with silver. Include in your answer how you could determine the mass of the silver electroplated onto the metal spoon.

You are provided with solid silver nitrate, a metal spoon, a piece of solid silver, distilled water and common laboratory apparatus.

You must include a diagram in your answer.

.....

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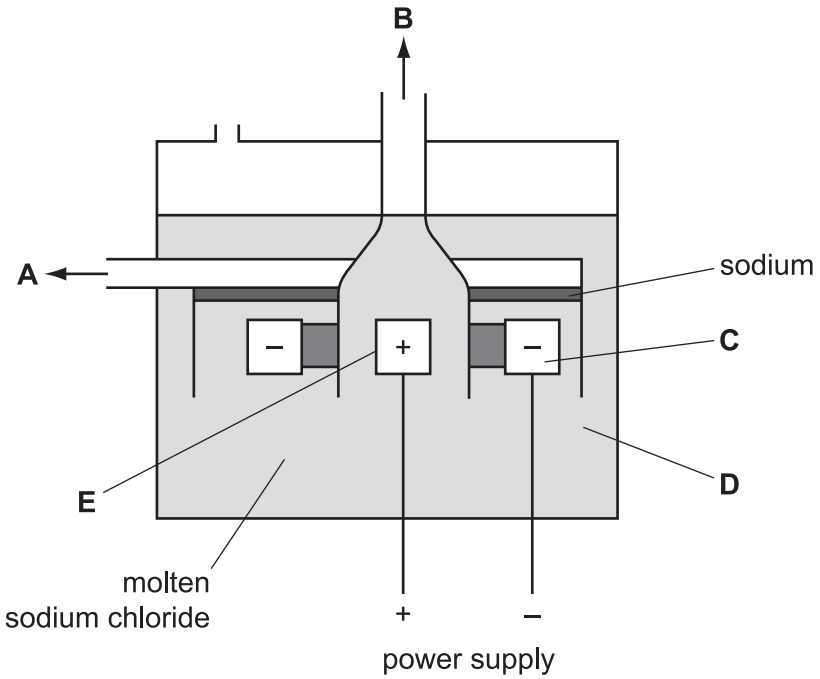
.....

..... [6]

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4 The diagram shows an electrolysis cell for extracting sodium from molten sodium chloride.



(a) **(i)** Which letter on the diagram represents

the electrolyte? .....

the cathode? ..... [2]

(ii) Which one of the following substances is most likely to be used as the anode? Put a ring around the correct answer.

graphite **sodium** **sulfur** **zinc** [1]

(b) What information from the diagram suggests that sodium is less dense than molten sodium chloride?

..... [1]

(c) Predict the product formed at the anode during this electrolysis.

..... [1]

(d) Name the gases formed at the anode and cathode when an **aqueous** solution of sodium chloride is electrolysed.

product at the anode .....

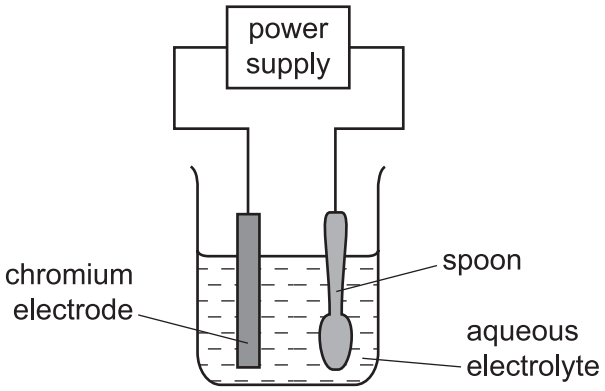
product at the cathode ..... [2]

[Total: 7]

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5 A steel spoon can be coated in chromium using electrolysis. The spoon has to be very clean and free of grease.



(a) Name this process of coating a metal object with another metal.

..... [1]

(b) Suggest **one** advantage of putting a layer of chromium on the spoon.

..... [1]

(c) Which electrode should be the spoon?

..... [1]

(d) Suggest the name of a compound that could dissolve in water to form the electrolyte.

..... [2]

(e) Why must the spoon be very clean and free of grease?

..... [1]

(f) Suggest **one** mistake in the apparatus set up.

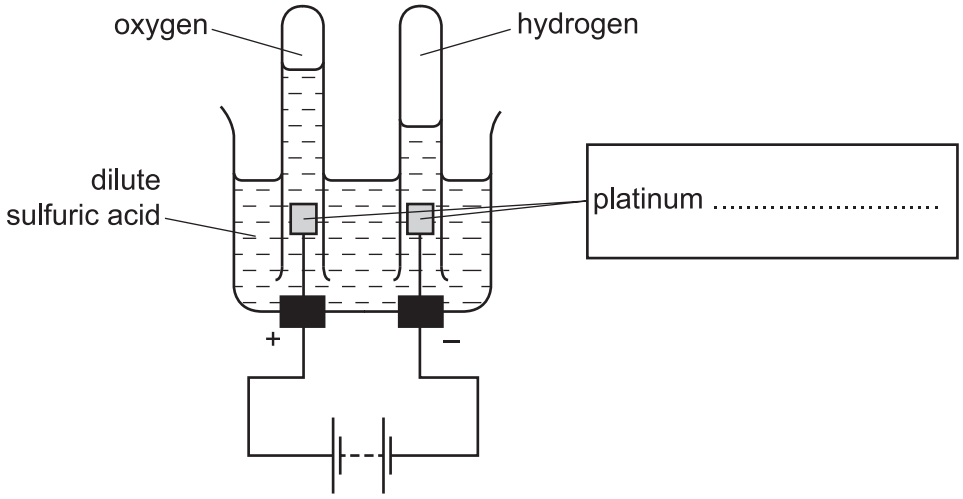
..... [1]

[Total: 7]

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6 The diagram shows the apparatus used to electrolyse dilute sulfuric acid.



(a) Complete the box to show the role of the platinum. [1]

(b) Give **one** observation made during this electrolysis.

..... [1]

(c) **(i)** Compare the volumes of oxygen and hydrogen produced.

.....

..... [2]

(ii) Which substance breaks down to form these gases?

..... [1]

(d) Give **one** test to distinguish between oxygen and hydrogen.

test .....

result with oxygen .....

result with hydrogen .....

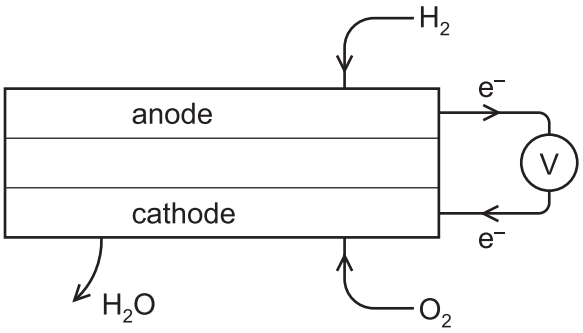
[2]

[Total: 7]

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7 A fuel cell produces electrical energy by the oxidation of a fuel by oxygen.
The fuel is usually hydrogen but methane and methanol are two other fuels which may be used.
A diagram of a hydrogen fuel cell is given below.



(a) When the fuel is hydrogen, the only product is water.
What additional product would be formed if methane was used?

..... [1]

(b) Write the equation for the chemical reaction that takes place in a hydrogen fuel cell.

..... [1]

(c) **(i)** At which electrode does oxidation occur? Explain your choice.

..... [1]

(ii) Write an ionic equation for the reaction at this electrode.

..... [2]

(d) Fuel cells are used to propel cars.
Give **two** advantages of a fuel cell over a gasoline-fuelled engine.

.....

..... [2]

[Total: 7]

Electrolysis and electroplating Click for more variations

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8 Electrolysis of concentrated aqueous sodium chloride using inert electrodes forms chlorine, hydrogen and sodium hydroxide.

(a) What is meant by the term *electrolysis*?

.....

.....

..... [2]

(b) Name a substance that can be used as the inert electrodes.

..... [1]

(c) Write an ionic half-equation for the formation of hydrogen during this electrolysis.

..... [1]

(d) Give the formulae of the **four** ions present in concentrated aqueous sodium chloride.

..... [2]

(e) Explain how sodium hydroxide is formed during this electrolysis.

.....

.....

..... [2]

[Total: 8]

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9 This question is about electrolysis.

(a) State the meaning of the term electrolysis.

.....

..... [2]

(b) Table 2.1 gives some information about the electrolysis of two electrolytes using graphite electrodes.

Table 2.1

	anode (positive electrode)		cathode (negative electrode)	
electrolyte	observation	name of product	observation	name of product
concentrated aqueous potassium iodide			bubbles of colourless gas	
aqueous copper(II) sulfate	bubbles of colourless gas	oxygen	pink-brown solid	

(i) Complete Table 2.1. [4]

(ii) Oxygen is produced at the anode by the electrolysis of aqueous copper(II) sulfate.

Write the ionic half-equation for this reaction.

..... [2]

(c) Aqueous copper(II) sulfate is electrolysed using copper electrodes instead of graphite electrodes.

(i) Explain why the mass of the anode decreases during this electrolysis.

..... [1]

(ii) Name the product formed at the cathode.

..... [1]

(iii) State what change, if any, is observed in the appearance of the aqueous copper(II) sulfate.

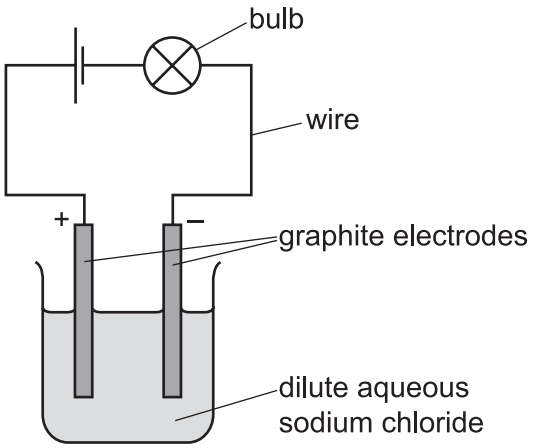
..... [1]

[Total: 11]

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10 A student sets up the following electrolysis experiment.



(a) Define the term *electrolysis*.

.....

..... [2]

(b) The student observes bubbles of colourless gas forming at each electrode.

(i) Name the main gas produced at the positive electrode (anode).

..... [1]

(ii) Describe a test for the gas produced in **(b)(i)**.

test .....

result .....
[2]

(iii) Write the ionic half-equation for the reaction taking place at the negative electrode (cathode).

..... [2]

(c) Charge is transferred during electrolysis.

Name the type of particle responsible for the transfer of charge in

the wires, ...

the electrolyte. .....
[2]

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(d) The student replaces the dilute aqueous sodium chloride with **concentrated** aqueous sodium chloride.

Suggest **two** differences that the student observes.

1 .....

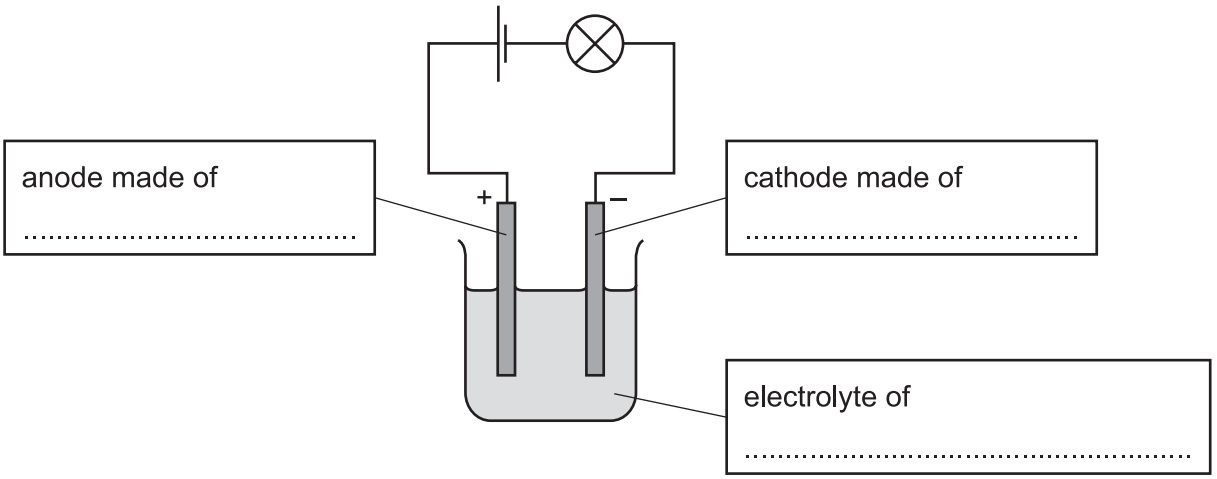
2 .....

[2]

(e) The student has a small piece of impure copper. The main impurities in the copper are small quantities of silver and zinc.

The student uses electrolysis to extract pure copper from the small piece of impure copper.

(i) Complete the labels on the diagram of the student's electrolysis experiment.



[3]

(ii) Use your knowledge of the reactivity series to suggest what happens to the silver and zinc impurities. Explain your answers.

silver impurities .....

.....

.....

zinc impurities .....

.....

.....

[3]

[Total: 17]

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