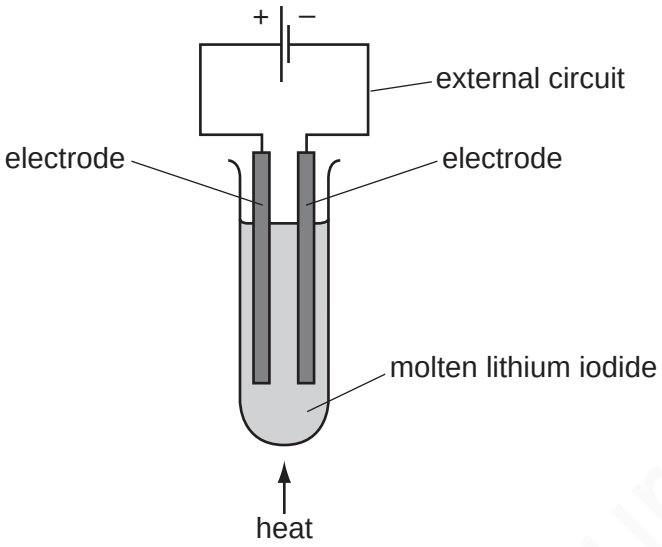
ELECTROLYSIS-MIXED BAG

1 During electrolysis, ions move in the electrolyte and electrons move in the external circuit. Reactions occur at the electrodes.

(a) The diagram shows the electrolysis of molten lithium iodide.



(i) Draw an arrow on the diagram to show the direction of the electron flow in the external circuit. [1]

(ii) Electrons are supplied to the external circuit. How and where is this done?

.....

..... [2]

(iii) Explain why solid lithium iodide does not conduct electricity but when molten it is a good conductor.

.....

..... [1]

(b) The results of experiments on electrolysis are shown in the following table. Complete the table. The first line has been done as an example.

electrolyte	electrodes	product at cathode	product at anode	change to electrolyte
molten lithium iodide	carbon	lithium	iodine	used up
aqueous copper(II) sulfate	platinum		oxygen	
concentrated aqueous potassium chloride	carbon		chlorine	

[4]

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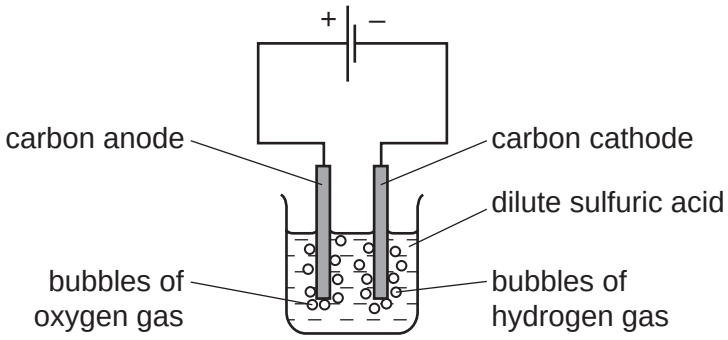
(c) The diagram below shows the electrolysis of dilute sulfuric acid. Hydrogen is formed at the negative electrode (cathode) and oxygen at the positive electrode (anode) and the concentration of sulfuric acid increases.



The ions present in the dilute acid are $H^+(aq)$, $OH^-(aq)$ and $SO_4^{2-}(aq)$.

(i) Write an equation for the reaction at the negative electrode (cathode).

..... [2]

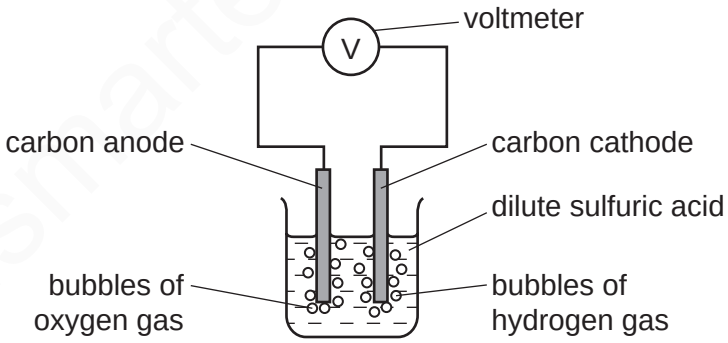
(ii) Complete the equation for the reaction at the positive electrode (anode).

$$4OH^-(aq) \rightarrow O_2(g) + ...H_2O(l) + ...$$ [1]

(iii) Suggest an explanation of why the concentration of the sulfuric acid increases.

..... [1]

(d) In the apparatus used in **(c)**, the power supply is removed and immediately replaced by a voltmeter.



A reading on the voltmeter shows that electrical energy is being produced. Suggest an explanation for how this energy is produced.

.....

.....

..... [3]

[Total: 15]

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MARKING SCHEME:

(a) (i) correct arrow from negative terminal of battery or from anode; [1]

(ii) from battery / power supply / cell; [1]
from negative electrode of battery to external circuit; [1]
or from anode;
from iodide ion losing electron **or** oxidation of anion;

(iii) ions cannot move in solid / ions can move in liquid; [1]

(b) copper; [1]
(changes to) sulfuric acid; [1]

hydrogen; [1]
(changes to) potassium hydroxide; [1]

(c) (i) $2H^+ + 2e \rightarrow H_2$ [2]
not balanced = [1]

(ii) $4OH^- \rightarrow O_2 + 2H_2O + 4e$ [1]

(iii) water used up; [1]

(d) it is a cell; [1]
hydrogen reacts with oxygen; [1]
this reaction produces energy / is exothermic / produces flow of electrons /
changes chemical energy to electrical energy; [1]

[Total: 15]

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