

**AQA – Electrode potentials and electrochemical cells – A2 Chemistry P1**

## 1. June/ 2020/Paper\_1/No.11

1 1

This question is about a glucose–oxygen fuel cell.

When the cell operates, the glucose ( $C_6H_{12}O_6$ ) molecules react with water at the negative electrode to form carbon dioxide and hydrogen ions.

Oxygen gas reacts with hydrogen ions to form water at the positive electrode.

1 1 . 1

Deduce the half-equation for the reaction at the negative electrode.

[1 mark]

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1 1 . 2

Deduce the half-equation for the reaction at the positive electrode.

[1 mark]

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1 1 . 3

Give the equation for the overall reaction that occurs in the Glucose–oxygen fuel cell.

[1 mark]

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1 1 . 4

The negative electrode is made of carbon and the positive electrode is made of platinum.

Give the conventional representation for the glucose–oxygen fuel cell.

[2 marks]

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1 1 . 5

State what must be done to maintain the EMF of this fuel cell when in use.

[1 mark]

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## 2. June/ 2021/Paper\_1/No.8

0 8

This question is about electrode potentials and electrochemical cells.

0 8 . 1

State the meaning of the term electrochemical series.

[1 mark]

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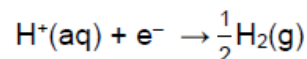
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Table 8 shows some electrode potentials.

Table 8

	$E^\ominus / \text{V}$
$[\text{Fe}(\text{H}_2\text{O})_6]^{2+}(\text{aq}) + 2\text{e}^- \rightarrow \text{Fe}(\text{s}) + 6\text{H}_2\text{O}(\text{l})$	-0.44
$\text{H}^+(\text{aq}) + \text{e}^- \rightarrow \frac{1}{2}\text{H}_2(\text{g})$	0.00
$[\text{Co}(\text{NH}_3)_6]^{3+}(\text{aq}) + \text{e}^- \rightarrow [\text{Co}(\text{NH}_3)_6]^{2+}(\text{aq})$	+0.11
$[\text{Fe}(\text{H}_2\text{O})_6]^{3+}(\text{aq}) + \text{e}^- \rightarrow [\text{Fe}(\text{H}_2\text{O})_6]^{2+}(\text{aq})$	+0.77
$\text{VO}_2^+(\text{aq}) + 2\text{H}^+(\text{aq}) + \text{e}^- \rightarrow \text{VO}^{2+}(\text{aq}) + \text{H}_2\text{O}(\text{l})$	+1.00
$[\text{Co}(\text{H}_2\text{O})_6]^{3+}(\text{aq}) + \text{e}^- \rightarrow [\text{Co}(\text{H}_2\text{O})_6]^{2+}(\text{aq})$	+1.81

0 8 . 2

State **two** conditions needed for the following half-cell to have  $E^\ominus = 0.00 \text{ V}$ 

[1 mark]

0 8 . 3

Identify the weakest reducing agent in **Table 8**.

[1 mark]

- 0 8 . 4 Use half-equations from **Table 8** to deduce an equation for the reduction of  $\text{VO}_2^+$  to form  $\text{VO}^{2+}$  in aqueous solution by iron. [2 marks]

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- 0 8 . 5 Use data from **Table 8** to explain why  $[\text{Co}(\text{H}_2\text{O})_6]^{3+}(\text{aq})$  will undergo a redox reaction with  $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}(\text{aq})$

Give an equation for this reaction.

[2 marks]

Explanation \_\_\_\_\_

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Equation

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- 0 8 . 6 Suggest why the **two** cobalt(III) complex ions in **Table 8** have different electrode potentials. [1 mark]

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## 3. June/ 2021/Paper\_1/No.9

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This question is about the development of lithium cells.  
The value of  $E^\ominus$  for lithium suggests that a lithium cell could have a large EMF.

**Table 9** shows some electrode potential data.

Table 9

	$E^\ominus / \text{V}$
$\text{Li}^+(\text{aq}) + \text{e}^- \rightarrow \text{Li}(\text{s})$	-3.04
$2\text{H}_2\text{O}(\text{l}) + 2\text{e}^- \rightarrow \text{H}_2(\text{g}) + 2\text{OH}^-(\text{aq})$	-0.83
$\frac{1}{2}\text{I}_2(\text{s}) + \text{e}^- \rightarrow \text{I}^-(\text{aq})$	+0.54

0 9 . 1

Use data in **Table 9** to explain why an aqueous electrolyte is **not** used for a lithium cell.

[2 marks]

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0 9 . 2

In the 1970s lithium-iodine cells became a common power source for heart pacemakers. Lithium iodide is the final product of the cell reaction.

Use the data in **Table 9** to calculate the cell EMF of a standard lithium-iodine cell.

[1 mark]

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0 9 . 3

An EMF value for a commercial lithium-iodine cell is 2.80 V

Suggest why this value is different from the value calculated in Question 09.2.

[1 mark]

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0 9 . 4 In some lithium cells, lithium perchlorate ( $\text{LiClO}_4$ ) is used as the electrolyte.

Deduce the oxidation state of chlorine in  $\text{LiClO}_4$

[1 mark]

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In other lithium cells, lithium cobalt oxide electrodes **and** lithium electrodes are used.

0 9 . 5 Give an equation for the reaction that occurs at the positive lithium cobalt oxide electrode.

[1 mark]

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0 9 . 6 Give an equation for the reaction that occurs at the negative lithium electrode.

[1 mark]

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