

Exercise walk-through

# 5.1.3

## Balance fuel-cell equations and compare whole pathways

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Pearson Edexcel · International A-Level · Chemistry

## Choose a cell voltage

### Your turn

Reduction potentials are  $+0.80\text{ V}$  and  $+0.34\text{ V}$ . What is spontaneous  $E^\circ_{\text{cell}}$ ?

- A.  $+1.14\text{ V}$
- B.  $+0.46\text{ V}$
- C.  $-0.46\text{ V}$

## Find oxidation state and coordination

### Your turn

$[\text{Cr}(\text{H}_2\text{O})_4\text{Cl}_2]^+$  has which chromium state and coordination number?

- A. +1 and 4
- B. +3 and 6
- C. +3 and 2

## Aspirin transfer calculation

### Your turn

2.76 g salicylic acid,  $M=138$ , gives aspirin  $M=180$  in 1:1 ratio. Dry mass is 2.52 g. What is yield?

- A. 50.0%
- B. 70.0%
- C. 91.3%

## Exercises 2.1·2.3

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**2.1** Write the acidic hydrogen oxidation half-equation for two  $\text{H}_2$  molecules. [2]

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**2.2** Write oxygen reduction to water in acidic conditions. [2]

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**2.3** Explain why describing a fuel cell as having a finite sealed supply of reactants misses its usual operation. [1]

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**2.1** Write the acidic hydrogen oxidation half-equation for two  $\text{H}_2$  molecules. [2]

**2.1**  $2\text{H}_2 \rightarrow 4\text{H}^+ + 4\text{e}^-$ . Atoms and charge/electrons.

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**2.2** Write oxygen reduction to water in acidic conditions. [2]

**2.2**  $\text{O}_2 + 4\text{H}^+ + 4\text{e}^- \rightarrow 2\text{H}_2\text{O}$ . Atoms and charge/electrons.

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**2.3** Explain why describing a fuel cell as having a finite sealed supply of reactants misses its usual operation. [1]

**2.3** Fuel and oxidant continue to enter from outside while the cell operates.

## Exercises 3.1·3.3

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**3.1** Balance alkaline oxygen reduction using  $\text{O}_2$ ,  $\text{H}_2\text{O}$ , electrons and  $\text{OH}^-$ . Combine it with the worked oxidation equation. [4]

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**3.2** Balance complete methanol oxidation in an oxygen fuel cell. Give one operational advantage and one direct emission disadvantage relative to hydrogen. [3]

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**3.3** A hydrogen supplier uses electricity from fossil fuel generation. Evaluate the claim that a water-only cell exhaust proves zero environmental impact. [3]

## Exercises 3.1·3.3

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**3.1** Balance alkaline oxygen reduction using  $\text{O}_2$ ,  $\text{H}_2\text{O}$ , electrons and  $\text{OH}^-$ . Combine it with the worked oxidation equation. [4]

**3.1**  $\text{O}_2 + 2\text{H}_2\text{O} + 4\text{e}^- \rightarrow 4\text{OH}^-$ . Cancel  $4\text{e}^-$  and  $4\text{OH}^-$  and two waters; overall  $2\text{H}_2 + \text{O}_2 \rightarrow 2\text{H}_2\text{O}$ .

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**3.2** Balance complete methanol oxidation in an oxygen fuel cell. Give one operational advantage and one direct emission disadvantage relative to hydrogen. [3]

**3.2**  $2\text{CH}_3\text{OH} + 3\text{O}_2 \rightarrow 2\text{CO}_2 + 4\text{H}_2\text{O}$ . Liquid methanol is easier to store/transport; operation emits  $\text{CO}_2$ .

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**3.3** A hydrogen supplier uses electricity from fossil fuel generation. Evaluate the claim that a water-only cell exhaust proves zero environmental impact. [3]

**3.3** The cell itself produces water, but making hydrogen consumes energy with possible upstream  $\text{CO}_2$  emissions. Storage/transport also require energy, so compare complete production pathways.