

Exercise walk-through

Hydrogen Fuel Cell ■ 6.11

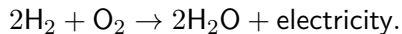
eXercise

You must be able to

- describe a **hydrogen fuel cell** 氢燃料电池 (hydrogen + oxygen $\rightarrow$ water + electricity)
- state that the only emission is **water**
- explain why hydrogen is only as clean as its source

Method — How it works

A **hydrogen fuel cell** combines **hydrogen and oxygen** to produce **electricity**, with **water** as the only by-product:



Method — Advantages

- The only emission at use is **water** — no CO₂ or pollution.
- High efficiency; quiet; useful for vehicles.

Method — The catch: making the hydrogen

Hydrogen must be **produced**. If it comes from **fossil fuels**, the overall process still emits CO₂. If made using **renewable** electricity (splitting water), it is truly clean.

Method — A worked judgement

A fuel-cell car emits only water, but it is only “green” if the hydrogen was made with clean energy — otherwise the emissions are just moved to the production step.

Practice 2.1 ■ 1 mark

What are the inputs to a hydrogen fuel cell?

Solution 2.1

Worked steps

Hydrogen and oxygen **B1**.

Practice 2.2 ■ 1 mark

What is the only by-product at the point of use?

Solution 2.2

Method: How it works

Worked steps

Water **B1**.

Practice 2.3 ■ 1 mark

Why might hydrogen not be fully clean?

Solution 2.3

Worked steps

The hydrogen may be made using fossil fuels, which emit CO_2 **B1**.

Exam-style 3.1 ■ 1 mark

The only emission from a hydrogen fuel cell during use is

A carbon dioxide

B water

C methane

D nitrogen oxides

Solution 3.1

A carbon dioxide

B water



C methane

D nitrogen oxides

Worked steps

B — water.

Exam-style 3.2 ■ 1 mark

A car company markets hydrogen fuel-cell cars as “zero emission”.

- (a) Explain why this is true at the point of use.
- (b) Explain why the full process may still cause emissions.

Solution 3.2

Method: A worked judgement

Worked steps

(a) At the point of use it only produces water, no CO₂ **B1**. (b) Making the hydrogen often uses fossil-fuel energy, so CO₂ is emitted during production — the emissions are shifted, not removed **M1** **A1**.

Exam-style 3.3 ■ 2 marks

Explain how hydrogen could be produced with no net carbon emissions.

Solution 3.3

Worked steps

Use renewable electricity (solar, wind) to split water into hydrogen and oxygen, so no fossil fuels are burned and there are no net carbon emissions **M1** **A1**.