

6.11 Hydrogen Fuel Cell

Name: _____ Class: _____ Date: _____

Total: 9 marks

Objective

Build the skills to answer exam questions on the **hydrogen fuel cell**.

You must be able to:

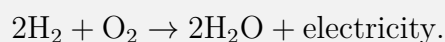
- describe a **hydrogen fuel cell** 氢燃料电池 (hydrogen + oxygen → water + electricity)
- state that the only emission is **water**
- explain why hydrogen is only as clean as its source

1 Worked examples

Study these first. Each one shows the method for a question type used later —follow the steps and you can do the Practice and Exam-style questions yourself.

■ How it works

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



■ Advantages

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

■ 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.

■ 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.

2 Practice

Now apply the methods above.

2.1 What are the inputs to a hydrogen fuel cell? [1]

2.2 What is the only by-product at the point of use? [1]

2.3 Why might hydrogen not be fully clean? [1]

3 Exam-style questions

3.1 The only emission from a hydrogen fuel cell during use is [1]

- **A** carbon dioxide
 - **B** water
 - **C** methane
 - **D** nitrogen oxides
-

3.2 A car company markets hydrogen fuel-cell cars as "zero emission".

(a) Explain why this is true at the point of use. [1]

(b) Explain why the full process may still cause emissions. [2]

3.3 Explain how hydrogen could be produced with no net carbon emissions. [2]

4 Go further

You are now ready for the real exam questions on this subtopic:

- work through the **6.11 Hydrogen Fuel Cell** lesson on the **Learn** page;
- read the **Hydrogen Fuel Cell** section of the AP Environmental Science handout on the **Know** page.

Solutions

2.1 Hydrogen and oxygen.

2.2 Water.

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

3.1 B —water.

3.2 (a) At the point of use it only produces water, no CO_2 . (b) Making the hydrogen often uses fossil-fuel energy, so CO_2 is emitted during production —the emissions are shifted, not removed.

3.3 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.