

Exercise walk-through

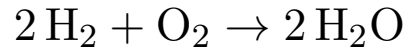
6.11

Hydrogen Fuel Cell

AP Environmental Science

Biomass, hydrogen, conservation

Biomass burns stored
chemical energy; ferment crops to
ethanol . A **hydrogen fuel**
cell makes only water:

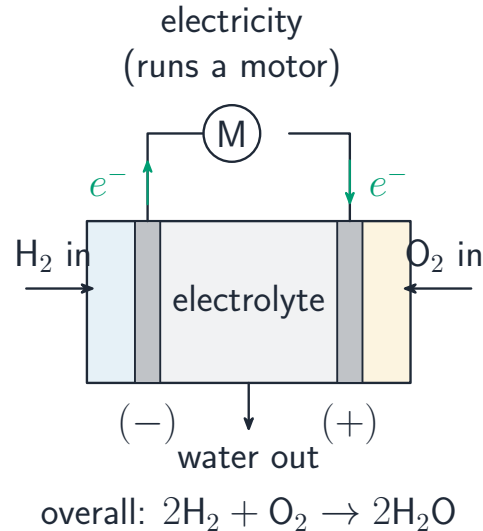


The cleanest energy is the
energy we never use – **energy**
conservation .



Conservation + renewables: efficiency first

A hydrogen-oxygen fuel cell makes electricity



A hydrogen-oxygen fuel cell makes electricity, with water as the only product

Check yourself

- 1 About what share of world energy is fossil fuels?
- 2 What process powers a nuclear plant?
- 3 Why do solar and wind need backup?
- 4 What is the only byproduct of a hydrogen fuel cell?



80%

Answers 1. about 80% 2. nuclear fission 3. they are intermittent 4. water

Exercises 2.1-2.3

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]

Exercises 2.1-2.3

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

2.1

- Hydrogen and oxygen
-

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

2.2

- Water
-

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

2.3

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

Exercise 3.1

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

[1]

☐

A carbon dioxide

B water

C methane

D nitrogen oxides

Exercise 3.1

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

[1]

☐

A carbon dioxide

B water

C methane

D nitrogen oxides

3.1 B

- water

Exercise 3.2 (a)

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]

Exercise 3.2 (a)

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]

(a)

- At the point of use it only produces water, no CO_2

Exercise 3.2 (b)

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

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

[2]

Exercise 3.2 (b)

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

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

[2]

(b)

- Making the hydrogen often uses fossil-fuel energy, so CO_2 is emitted during production
– the emissions are shifted, not removed

Exercise 3.3

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

[2]

Exercise 3.3

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

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