AQA GCSE Chemistry | 8462

SPECIFICATION POINT 4.5.2.2

Fuel cells

Past-paper questions

Tier	**Foundation**
Question groups	**7**
Available paper years	**2009–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

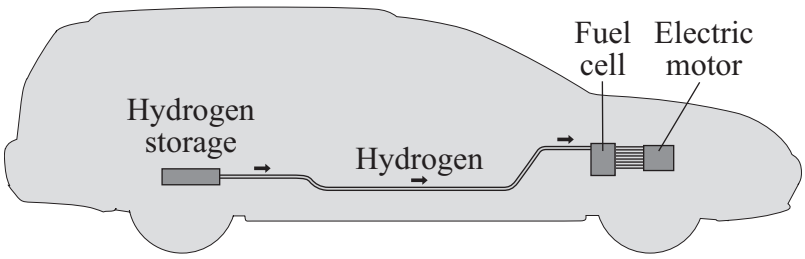
4.5.2.2 Fuel cells

Question 01

June 2009 | CHY2F | Original Q6 | Legacy

6 Read the article and then answer the questions that follow.

Hydrogen fuel for cars?



Hydrogen is an excellent fuel. On combustion it reacts with oxygen from the air to release a large amount of energy. The only product of combustion is water which does not cause pollution. Hydrogen gas can be stored under pressure in a cylinder but a leak of the gas could cause an explosion.

It has been found that lithium nitride can absorb and then release large volumes of hydrogen. Hydrogen stored in lithium nitride will not explode.

The problem is that the rate at which hydrogen is absorbed and then released from normal sized particles of lithium nitride is slow.

Recently scientists have made 'nanosized' particles of lithium nitride. The 'nanosized' particles have the advantage that they absorb and release the hydrogen much faster when needed in the fuel cell.

4.5.2.2 Fuel cells

Question 01 · continued

for mark

6 (a) Use information from the article to help you to answer these questions.

6 (a) (i) Give **two** reasons why hydrogen is an excellent fuel.

1 .....

.....

2 .....

.....

(2 marks)

6 (a) (ii) Hydrogen stored in lithium nitride is safer in an accident than a cylinder full of hydrogen gas.

State why.

.....

.....

(1 mark)

6 (a) (iii) What is the advantage of using 'nanosized' particles of lithium nitride instead of normal sized particles for storing hydrogen?

.....

.....

(1 mark)

Question 6 continues on the next page

4.5.2.2 Fuel cells

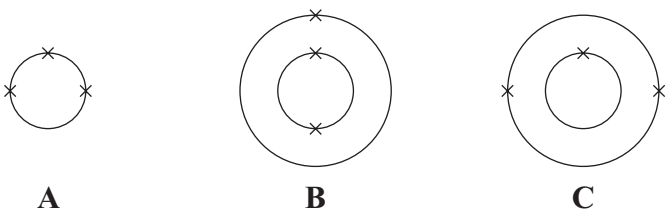
Question 01 · continued

for mark

6 (b) Lithium nitride is an ionic compound that contains lithium ions (Li^+) and nitride ions (N^{3-}).

6 (b) (i) The periodic table on the Data Sheet may help you to answer this question.

Which diagram, **A**, **B** or **C**, represents the electronic structure of a lithium atom?
Write your answer in the box.



A **B** **C**

Diagram ☐

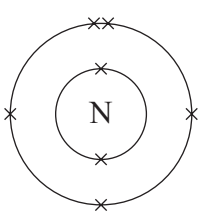
(1 mark)

6 (b) (ii) Tick (✓) the statement which describes how a lithium atom (Li) changes into a lithium ion (Li^+).

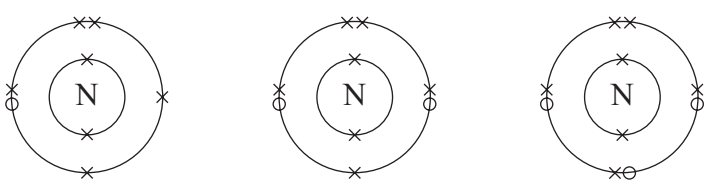
Statement	Tick (✓)
A lithium atom loses a neutron.	
A lithium atom loses an electron.	
A lithium atom loses a proton.	

(1 mark)

6 (b) (iii) The diagram shows the electronic structure of a nitrogen atom.



Which diagram, **A**, **B** or **C**, represents the electronic structure of a nitride ion (N^{3-})?
Write your answer in the box.



A **B** **C**

Diagram ☐

(1 mark)

4.5.2.2 Fuel cells

Question 01 · continued June 2009 | CHY2F | Original Q6 | Legacy

for mark

6 (c) The equation for the reaction of lithium nitride with hydrogen is:

$$Li_3N + 2H_2 \rightleftharpoons LiNH_2 + 2LiH$$

What does the $\rightleftharpoons$ symbol mean?

Draw a ring around your answer.

reversible reaction **endothermic reaction** **neutralisation**

(1 mark)

6 (d) Draw a ring around the correct answer in each box to complete the sentences.

6 (d) (i) 'Nanosized' particles of lithium nitride will be

much larger
a little larger
much smaller

than normal sized particles of lithium nitride. *(1 mark)*

6 (d) (ii) One of the reasons why 'nanosized' particles have different properties from normal sized particles is that they have a greater

density
mass
surface area

than normal sized particles of lithium nitride. *(1 mark)*

10

4.5.2.2 Fuel cells

Question 02

5 Some cars are powered by hydrogen fuel cells.

Figure 5



5 (a) What type of energy is released by hydrogen fuel cells?

Draw a ring around the correct answer.

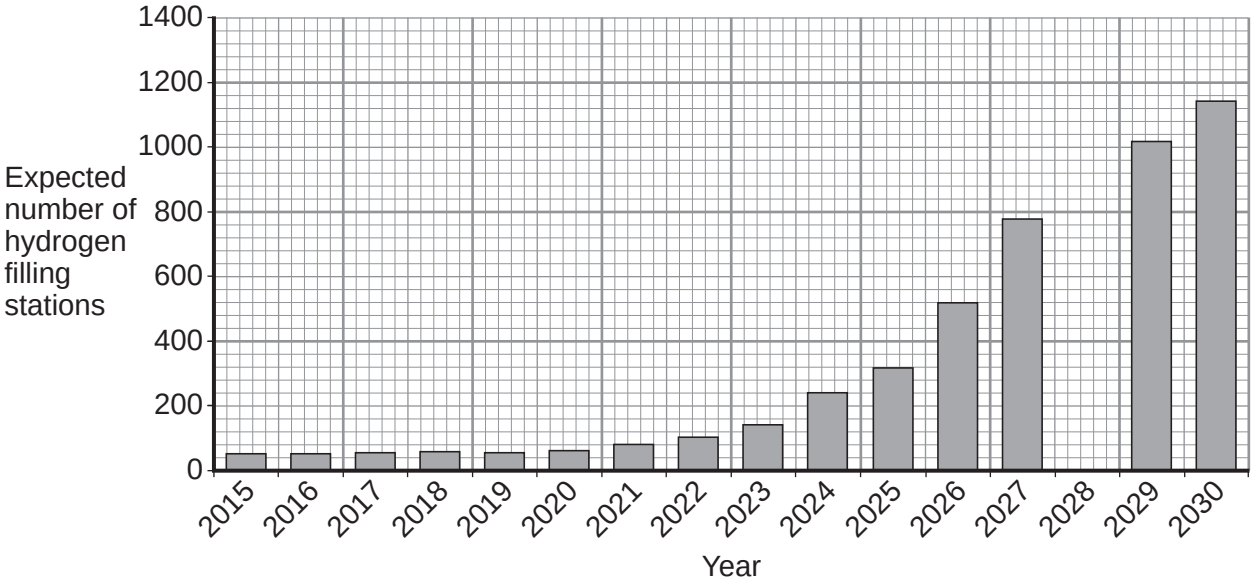
[1 mark]

chemical **electrical** **light**

5 (b) Owners of cars powered by fuel cells buy hydrogen from hydrogen filling stations.

Figure 6 shows how the number of hydrogen filling stations in the UK is expected to increase up to the year 2030.

Figure 6



4.5.2.2 Fuel cells

Question 02 · continued

5 (b) (i) Suggest the total number of hydrogen filling stations expected in 2028.

[1 mark]

.....

5 (b) (ii) The number of hydrogen filling stations will still be very low compared with the number of petrol filling stations.

Suggest **one** reason why.

[1 mark]

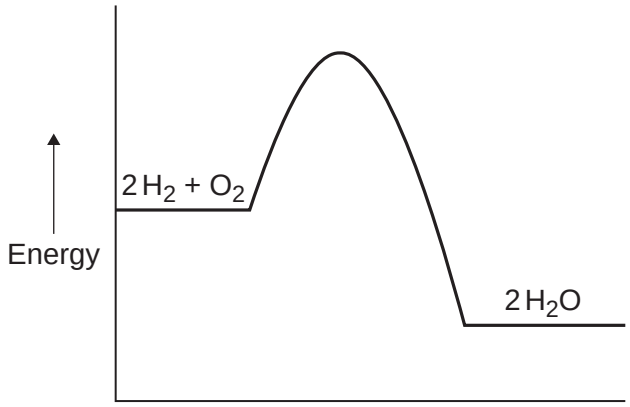
.....

.....

5 (c) Hydrogen reacts with oxygen to produce water.

The energy level diagram for this reaction is shown in **Figure 7**.

Figure 7



Mark clearly with a cross (×) on **Figure 7** where bond breaking happens.

[1 mark]

4

4.5.2.2 Fuel cells

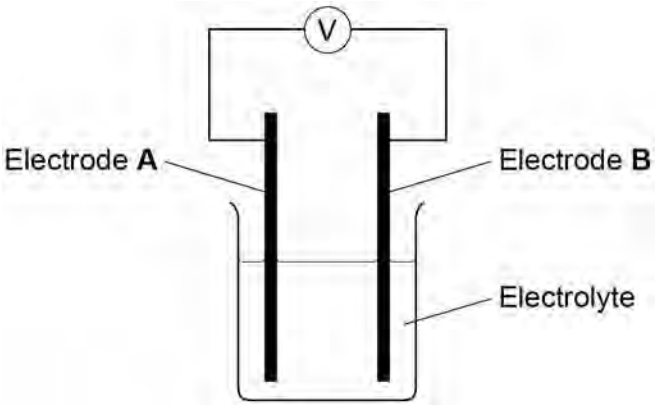
Question 03

June 2018 | 8462/1F | Original Q10

1 0 Chemical reactions can produce electricity.

1 0 . 1 **Figure 13** shows a simple cell.

Figure 13



Which of these combinations would **not** give a zero reading on the voltmeter in **Figure 13**?

[1 mark]

Tick **one** box.

Electrode A	Electrode B	Electrolyte	
Copper	Copper	Sodium chloride solution	☐
Zinc	Zinc	Water	☐
Copper	Zinc	Sodium chloride solution	☐
Copper	Zinc	Water	☐

4.5.2.2 Fuel cells

Question 03 · continued

Alkaline batteries are non-rechargeable.

10.2 Why do alkaline batteries eventually stop working?

[1 mark]

10.3 Why can alkaline batteries **not** be recharged?

[1 mark]

Question 10 continues on the next page

Question 03 · continued

Hydrogen fuel cells and rechargeable lithium-ion batteries can be used to power electric cars.

10.4 Complete the balanced equation for the overall reaction in a hydrogen fuel cell.

[2 marks]

_____ H_2 + _____ → _____ H_2O

10.5 **Table 7** shows data about different ways to power electric cars.

Table 7

	Hydrogen fuel cell	Rechargeable lithium-ion battery
Time taken to refuel or recharge in minutes	5	30
Distance travelled before refuelling or recharging in miles	Up to 415	Up to 240
Distance travelled per unit of energy in km	22	66
Cost of refuelling or recharging in £	50	3
Minimum cost of car in £	60 000	18 000

Evaluate the use of hydrogen fuel cells compared with rechargeable lithium-ion batteries to power electric cars.

Use **Table 7** and your own knowledge.

[6 marks]

4.5.2.2 Fuel cells

Question 03 · continued

June 2018 | 8462/1F | Original Q10

11

4.5.2.2 Fuel cells

Question 04

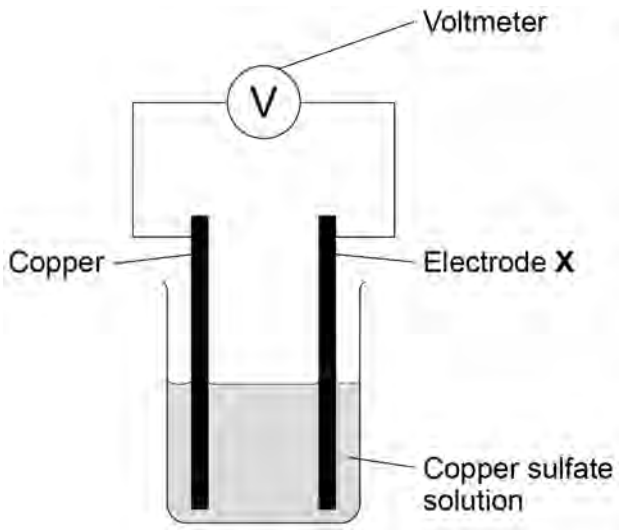
June 2019 | 8462/1F | Original Q4

0 4 This question is about chemical cells and batteries.

A student investigated the voltage produced by different chemical cells.

Figure 7 shows the apparatus.

Figure 7



This is the method used.

1. Use cobalt metal as electrode **X**.

2. Record the cell voltage.

3. Repeat steps 1 and 2 using different metals as electrode **X**.

0 4 . 1 Suggest **two** variables the student should keep the same to make the investigation valid.

[2 marks]

1 _____

_____

2 _____

_____

4.5.2.2 Fuel cells

Question 04 · continued

Table 1 shows the student's results.

Table 1

Electrode X	Voltage of the cell in volts
cobalt	0.62
magnesium	2.71
zinc	1.10

0 4 . 2 Write the three metals used for electrode **X** in order of reactivity.

Use **Table 1**.

[1 mark]

Most reactive _____

_____

Least reactive _____

0 4 . 3 Copper is used as electrode **X** in **Figure 7**.

Predict the voltage of this cell.

Give **one** reason for your answer.

[2 marks]

Voltage = _____ volts

Reason _____

_____

4.5.2.2 Fuel cells

Question 04 · continued

0 4 . 4 Describe how to make a 12 V battery using 1.5 V cells.

[2 marks]

0 4 . 5 Which is the most suitable use for a non-rechargeable cell?

[1 mark]

Tick (✓) **one** box.

- Electric toy ☐
- Laptop computer ☐
- Mobile phone ☐

0 4 . 6 Hydrogen fuel cells or rechargeable cells can be used to power electric vehicles.

Suggest **one** advantage and **one** disadvantage of using a hydrogen fuel cell compared with a rechargeable cell.

[2 marks]

Advantage of hydrogen fuel cell _____

Disadvantage of hydrogen fuel cell _____

10

4.5.2.2 Fuel cells

Question 05

November 2020 | 8462/1F | Original Q3

0 3 This question is about chemical reactions and energy.

Hydrogen reacts with oxygen to produce water.

This reaction releases energy.

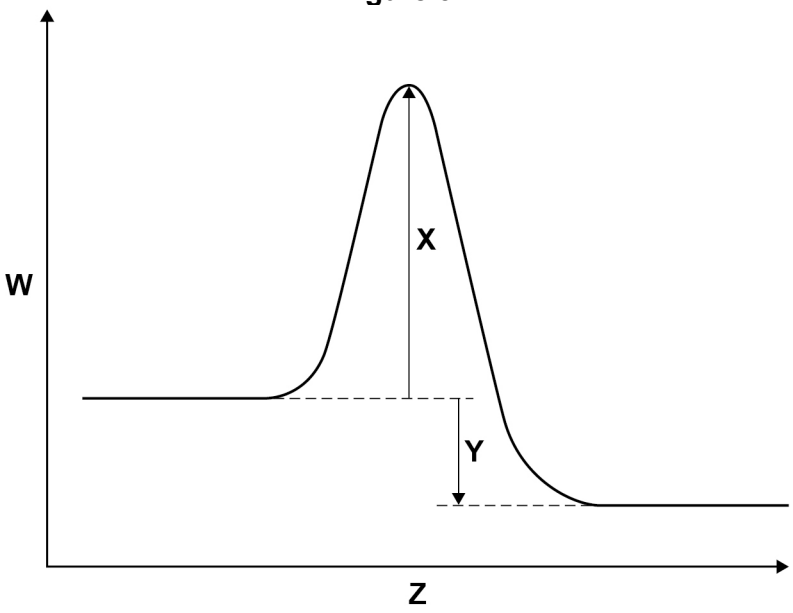
0 3 . 1 Complete the word equation for the reaction.

[1 mark]

hydrogen + oxygen → _____

0 3 . 2 **Figure 3** shows a reaction profile for the reaction between hydrogen and oxygen.

Figure 3



What do the labels **W**, **X**, **Y** and **Z** represent?

Choose answers from the box.

[4 marks]

activation energy	**energy**	**overall energy change**
products	**progress of reaction**	**reactants**

W _____

X _____

Y _____

Z _____

4.5.2.2 Fuel cells

Question 05 · continued

0 3 . 3 The reaction between hydrogen and oxygen is used in a hydrogen fuel cell.

What is the reason for using this reaction in a fuel cell?

[1 mark]

Tick (✓) **one** box.

To produce a change of state ☐

To produce a potential difference ☐

To produce a temperature change ☐

0 3 . 4 A student investigated the voltage produced by a chemical cell.

The student used different metals as the electrodes in the cell.

The metals used were:

- copper
- iron
- magnesium.

Which **two** metal electrodes would produce the greatest voltage when used in the chemical cell?

Give **one** reason for your answer.

[2 marks]

Metals _____ and _____

Reason _____

_____

8

4.5.2.2 Fuel cells

Question 06

0 2 This question is about chemical cells and batteries.

0 2 . 1 Three different types of battery can be used to power a TV remote control.

Table 1 gives information about these batteries.

Table 1

	Zinc-carbon battery	Alkaline battery	Nickel-metal hydride battery
Cost of battery in £ (pounds)	0.17	0.50	1.50
Rechargeable?	No	No	Yes
Time before needing to replace or recharge in months	5	12	8

Give **one** advantage of each type of battery.

[3 marks]

Zinc-carbon _____

_____

Alkaline _____

_____

Nickel-metal hydride _____

_____

0 2 . 2 **Figure 3** shows a symbol printed on batteries.

Figure 3



This symbol shows that batteries should not be put in household waste.

Suggest why batteries should **not** be put in household waste.

[1 mark]

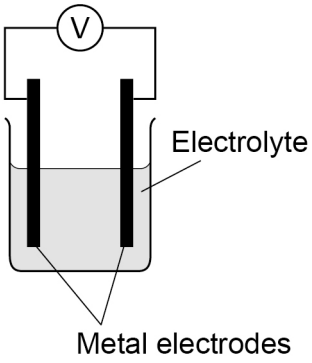
_____

_____

4.5.2.2 Fuel cells

Figure 4 shows a chemical cell.

Figure 4



0 2 . 3 The order of reactivity of three metals is shown below.

Iron	(Most reactive)
Tin	↑
Copper	(Least reactive)

Which combination of metal electrodes would give the highest voltage in the chemical cell in **Figure 4**?

[1 mark]

Tick (✓) **one** box.

Copper and iron ☐

Iron and tin ☐

Tin and copper ☐

0 2 . 4 The voltage produced by the cell in **Figure 4** depends on the type of electrodes and the type of electrolyte.

Suggest **one** other factor that could affect the voltage produced.

[1 mark]

4.5.2.2 Fuel cells

Question 06 · continued

0 2 . 5 Water is produced in a hydrogen fuel cell.

Complete the word equation to show the reaction that produces water in a hydrogen fuel cell.

[2 marks]

_____ + _____ → water

8

4.5.2.2 Fuel cells

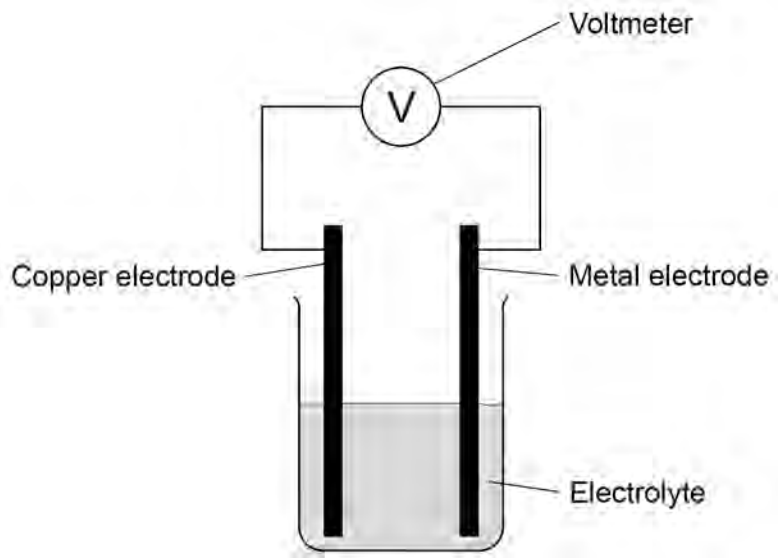
Question 07

0 3 Cells contain chemicals that react to produce electricity.

A student investigated the voltage produced by four different cells.

Figure 3 shows the apparatus.

Figure 3



This is the method used.

1. Measure the voltage produced by the cell using metal **A** as the metal electrode.
2. Repeat using different metals as the metal electrode.

Table 2 shows the results.

Table 2

Metal electrode	Voltage in volts
A	1.1
B	0.0
C	0.8
D	2.7

4.5.2.2 Fuel cells

Question 07 · continued

0 3 . 1 Which substance could be used as the electrolyte in the cell in **Figure 3**?

[1 mark]

Tick (✓) **one** box.

Pure water ☐

Sodium chloride solution ☐

Solid potassium bromide ☐

0 3 . 2 Which metal **A**, **B**, **C** or **D** was copper?

Give **one** reason for your answer.

Use **Figure 3** and **Table 2**.

[2 marks]

Metal _____

Reason _____

_____

0 3 . 3 Write the four metals **A**, **B**, **C** and **D** in order of reactivity.

Use **Table 2**.

[1 mark]

Most reactive _____

_____

_____

Least reactive _____

4.5.2.2 Fuel cells

Question 07 · continued

0 3 . 4 A battery consists of several cells connected together in series.

Each cell has a voltage of 3.6 V.

Calculate the number of cells needed to make a battery of voltage 14.4 V.

[2 marks]

Number of cells = _____

0 3 . 5 Fuel cells can be used to power electric cars.

Complete the sentence.

Choose the answer from the box.

[1 mark]

ammonia	**methane**	**water**

The overall reaction in a hydrogen fuel cell involves the oxidation of hydrogen to produce _____.

0 3 . 6 Rechargeable cells can be recharged when an external electrical current is supplied.

Complete the sentence.

[1 mark]

When an external electrical current is supplied to a rechargeable cell, the chemical reaction is _____.

8