AQA GCSE CHEMISTRY (HIGHER) · 8462

CHEMISTRY



EXAM QUESTION PACK

4.5.2 CHEMICAL CELLS AND FUEL CELLS

SCORE	PERCENTAGE
/55	%

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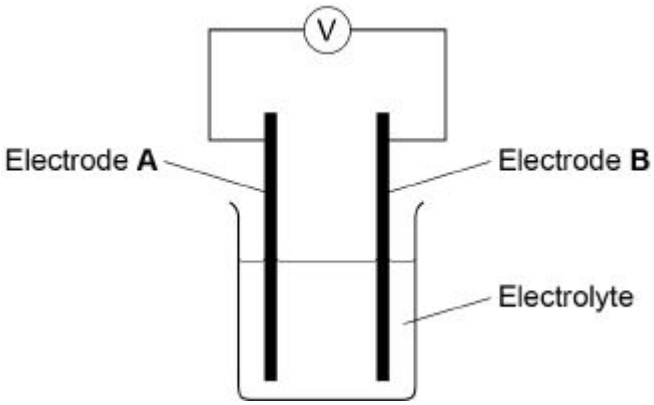
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Q1.

Chemical reactions can produce electricity.

(a) The diagram below shows a simple cell.



Which of these combinations would not give a zero reading on the voltmeter in the diagram above?

Tick **one** box.

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

(1)

Alkaline batteries are non-rechargeable.

(b) Why do alkaline batteries eventually stop working?

_____

_____

(1)

(c) Why can alkaline batteries **not** be recharged?

_____

_____

(1)

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

(d) Complete the balanced equation for the overall reaction in a hydrogen fuel cell.

$$_____ H_2 + _____ \longrightarrow _____ H_2O$$

(2)

(e) The table below shows data about different ways to power electric cars.

	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 the table above and your own knowledge.

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_____

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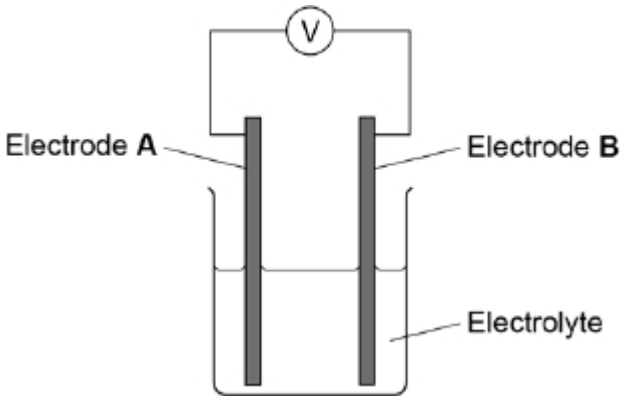
(6)

(Total 11 marks)

Q2.

A student investigated the voltage produced by simple cells.

The diagram shows the apparatus used.



The table shows the voltage produced with different metal electrodes.

Electrode A	Electrode B	Voltage in V
Copper	Copper	0.00
Copper	Iron	0.78
Copper	Magnesium	2.71
Copper	Tin	0.48
Copper	Zinc	1.10

(a) List the metals in the table in order of reactivity.

Most reactive _____

_____

_____

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_____

Least reactive Copper

(2)

(b) Batteries consist of cells.

Describe how a 6.0 V battery can be made from cells of voltage 1.5 V

_____

_____

_____

_____

(2)

(c) Why do non-rechargeable cells stop producing electricity?

_____

_____

_____

_____

(2)

(d) Complete the word equation for the reaction in a hydrogen fuel cell.

hydrogen + _____ ⟶ water

(1)

(e) Give **two** reasons why using a hydrogen fuel cell is seen as non-polluting.

Use the equation in part (d).

1. _____

_____

2. _____

_____

(2)

(Total 9 marks)

Q3.

Cells contain chemicals which react to produce electricity.

(a) Why can a rechargeable cell be recharged?

_____

_____

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(1)

(b) Give **two** factors that affect the voltage produced by a cell.

1. _____

2. _____

(2)

(c) Balance the half-equation for the reaction occurring at an electrode in one type of hydrogen fuel cell.

$$H_2 \quad + \quad OH^- \quad \longrightarrow \quad H_2O \quad + \quad e^-$$

(1)

(d) Why is the fuel cell in Question (c) described as an alkaline fuel cell?

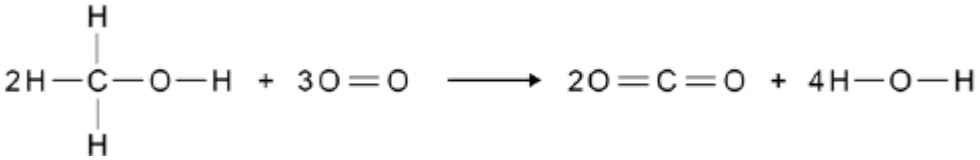
_____

_____

(1)

(e) Another type of fuel cell uses methanol instead of hydrogen.

The diagram represents the reaction in this fuel cell.



The table shows the bond energies for the reaction.

	C–H	C–O	O–H	O=O	C=O
Bond energy in kJ / mol	412	360	464	498	805

Calculate the overall energy change for the reaction.

Use the diagram and the table above.

_____

_____

_____

_____

_____

_____

Overall energy change = _____ kJ / mol

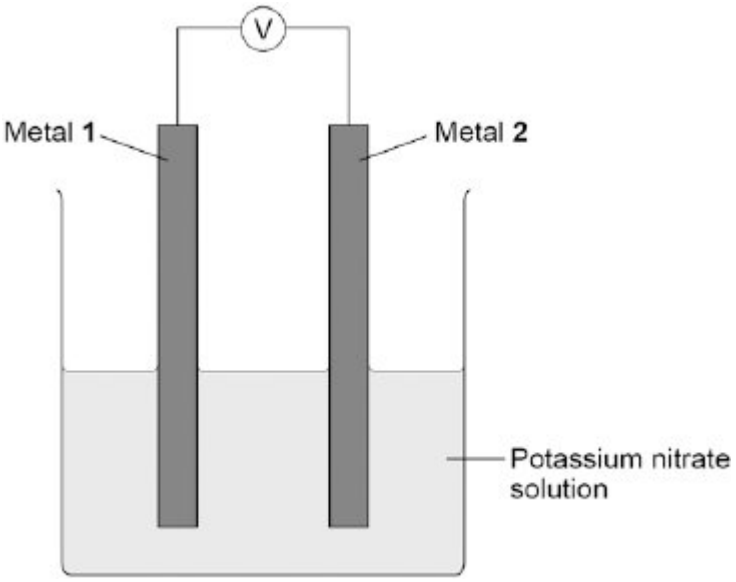
(3)

(Total 8 marks)

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Q4.

A student investigated simple cells using the apparatus shown in the figure below.



- If metal **2** is more reactive than metal **1** then the voltage measured is positive.
- If metal **1** is more reactive than metal **2** then the voltage measured is negative.
- The bigger the difference in reactivity of the two metals, the larger the voltage produced.

The student's results are shown in the table below.

Metal 2 / Metal 1	Chromium	Copper	Iron	Tin	Zinc
Chromium	0.0 V				
Copper	1.2 V	0.0 V			
Iron	0.5 V	not measured	0.0 V		
Tin	0.8 V	-0.4 V	0.3 V	0.0 V	
Zinc	0.2 V	-1.0 V	-0.3 V	-0.6 V	0.0 V

(a) The ionic equation for the reaction occuring at the zinc electrode in the simple cell made using copper and zinc electrodes is:

$$Zn \rightarrow Zn^{2+} + 2e^{-}$$

Zinc is oxidised in this reaction.

Give a reason why this is oxidation.

_____

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_____

(1)

(b) Look at the table above.

Which **one** of the metals used was the least reactive?

Give a reason for your answer.

Metal _____

Reason _____

_____

_____

(2)

(c) Predict the voltage that would be obtained for a simple cell that has iron as metal **1** and copper as metal **2**.

Explain your answer.

_____

_____

_____

_____

_____

_____

_____

_____

(3)

(d) Hydrogen fuel cells have been developed for cars.

Write a word equation for the overall reaction that takes place in a hydrogen fuel cell.

_____

(1)

(e) Write the **two** half equations for the reactions that occur at the electrodes in a hydrogen fuel cell.

_____

_____

_____

_____

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(2)
(Total 9 marks)

Q5.

Some cars are powered by hydrogen fuel cells.

Figure 1



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

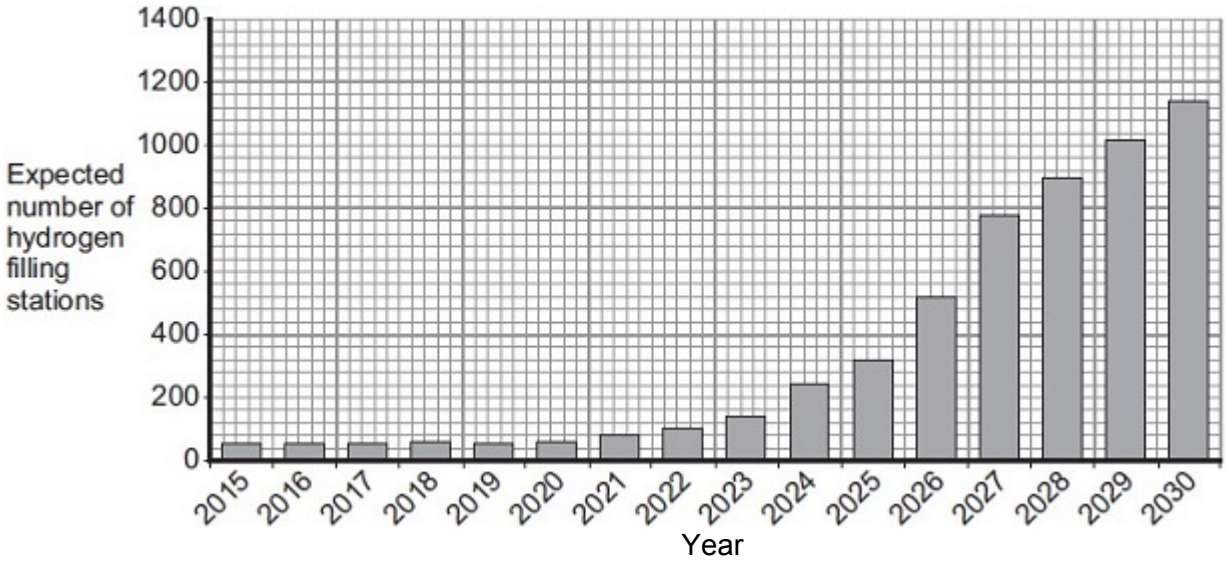
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(1)

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

Figure 2 shows how the number of hydrogen filling stations in the UK is expected to increase up to the year 2030.

Figure 2



Use the information in **Figure 2** and your own knowledge to answer this question.

Suggest **two** reasons why the UK government might encourage the building of more hydrogen filling stations.

_____

_____

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_____

_____

_____

(2)

(c) The equation for the reaction of hydrogen with oxygen is:

$$2\ H_2 \ + \ O_2 \longrightarrow 2\ H_2O$$

During the reaction, energy is used to break the bonds of the reactants.

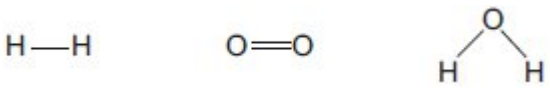
Energy is released when new bonds are made to form the product.

Bond energies for the reaction are given in the table below.

Bond	Bond energy in kJ
H—H	436
O=O	498
O—H	464

The structures of the reactants and product are shown in **Figure 3**.

Figure 3



hydrogen oxygen water

(i) Calculate the energy change for the reaction:

$$2\ H_2 \ + \ O_2 \longrightarrow 2\ H_2O$$

_____

_____

_____

_____

_____

_____

Energy change = _____ kJ

(3)

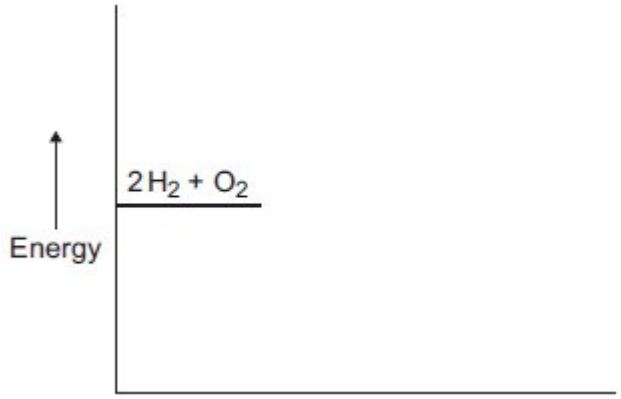
(ii) The reaction of hydrogen with oxygen is exothermic.

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Complete the energy level diagram for this reaction on **Figure 4**.

Clearly label the activation energy.

Figure 4

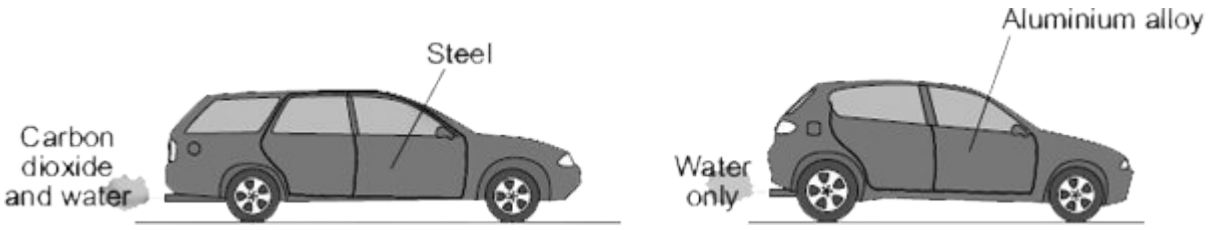


(3)

(Total 9 marks)

Q6.

The picture shows two different cars.



(a) Some properties of aluminium are given below.

Tick (✓) **two** reasons why aluminium is better than steel for car bodies.

Reason	Tick (✓)
Aluminium is not a transition metal.	
Aluminium has a low density.	
Aluminium is expensive to extract.	
aluminium is resistant to corrosion.	

(2)

(b) Each car body is made from an *alloy*.

(i) What is an *alloy*?

_____

_____

(1)

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(ii) An alloy is used to make a car body. A pure metal is **not** used to make a car body.

Suggest why.

_____

_____

(1)

(c) The car with a steel body uses petrol for fuel.

Draw a ring around the correct answer to complete each sentence.

(i) Petrol is made from

air.
crude oil.
metal ores.

(1)

(ii) Petrol is a mixture of

carbonates
hydrocarbons
polymers

including C_8H_{18}

(1)

(iii) In the car engine petrol reacts with

argon
nitrogen
oxygen

to produce carbon dioxide and water.

(1)

(d) Look at the substances coming out of each car's exhaust.

(i) Suggest the name of the fuel used in the car with the aluminium alloy body.

Name of fuel _____ .

(1)

(ii) Why is the fuel burned in the car with the aluminium alloy body better for the environment than petrol?

_____

_____

(1)

(Total 9 marks)

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