WJEC Chemistry GCSE

8: Energy Changes in Chemistry

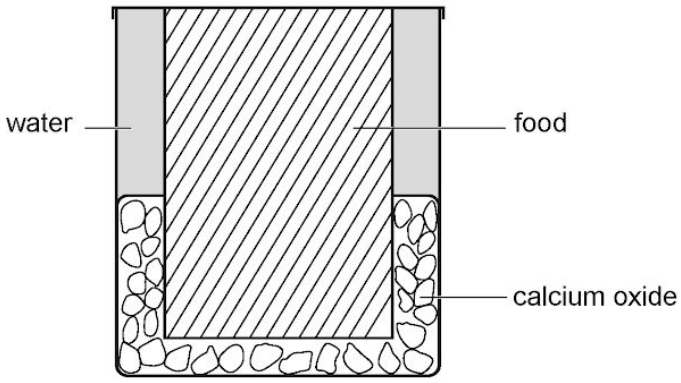
Practice Questions

England Specification

1. *(a)* 'Hot cans' are designed to heat the food inside them when it is to be eaten. The heat is generated by mixing calcium oxide with water.

Source: Amazon

The following diagram shows the cross-section of a 'hot can'.



During a trial reaction, the temperature reached 50 °C but a temperature of 70 °C is required to properly heat the food.

Suggest a change that could have been made and explain how this would lead to the can reaching the higher temperature. [2]

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(b) When chemical reactions take place bonds are broken and new bonds are formed.

Explain, in terms of bond making and breaking, why some reactions are **exothermic**.

[2]

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2. Propane gas can be used as a fuel.

(a) Balance the following equation that shows the combustion of propane. [2]

$$C_3H_8 + \square O_2 \longrightarrow \square CO_2 + 4H_2O$$

(b) Hydrogen gas can also be used as a fuel. The following equation shows what happens when it burns.

$$H-H \quad H-H + O=O \longrightarrow H-O-H \quad H-O-H$$

The table below shows the bond energies involved in the reaction.

Bond	Energy (kJ)
H — H	436
O = O	495
H — O	463

The energy required to break all the bonds in the reactants can be calculated as shown below:

$2 \times$ H — H bonds $= 2 \times 436 = 872$

$1 \times$ O = O bond $= 495$

Energy required to break all the bonds in the reactants = 872 + 495 = 1 367 kJ

(i) Calculate the energy produced when all the bonds in the products are made. [2]

Energy produced when all the bonds in the products are made = ... kJ

(ii) Use the information given and your answer to part (i) to explain why the overall reaction is exothermic. [2]

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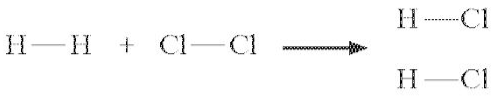
3. The reaction between hydrogen and chlorine to give hydrogen chloride can be represented by the following equation.



The relative amounts of energy needed to break the bonds shown are given in the table below.

Bond	Amount of energy needed to break the bond (kJ)
H—H	436
Cl—Cl	242
H—Cl	431

NOTE: *The amount of energy* ***released*** *in making a bond is equal and opposite to that* ***needed*** *to break the bond.*

(a) Using the bond energy values in the table, calculate

(i) the relative energy needed to break all the bonds in the **reactants**. [2]

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(ii) the relative energy given out when all the bonds in the **product** are formed. [2]

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(b) Using your answers to part *(a)*, state whether the reaction between hydrogen and chlorine is exothermic or endothermic and give a reason for your answer. [1]

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4. Many car companies are manufacturing hydrogen-fuelled cars.
Describe and explain the advantages and disadvantages of hydrogen as a replacement for petrol and diesel to fuel cars. [6 *QWC*]

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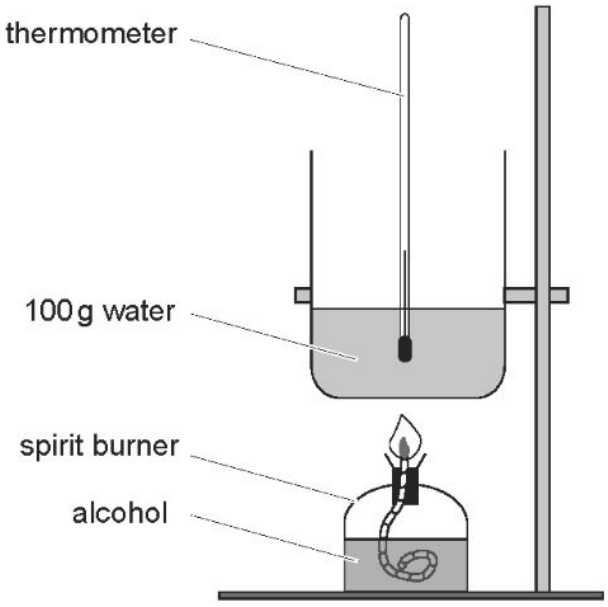
5.

Methanol, ethanol, propanol and butanol belong to the alcohol family.

An experiment was carried out to discover which alcohol gives out the most energy when burned
The diagram below shows the apparatus used.



1 g of each alcohol was used to heat 100 g of water. The results are shown below.

Alcohol	Initial temperature of water (°C)	Final temperature of water (°C)	Temperature change (°C)	Energy given out (J / g)
methanol	18	31	13	5460
ethanol	20	45	25	10500
propanol	19	48	29	12180
butanol	20	50	30	

(a) The energy given out by each alcohol can be calculated using the formula:

energy given out = mass of water × 4.2 × temperature change

Calculate the energy given out in burning 1 g of butanol. [2]

Energy given out = ... J / g

(b) Apart from using 1 g of each alcohol and 100 g of water, give **one** other step that should be taken to ensure a fair test. [1]

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(c) The theoretical values for the energy given out by each alcohol are given in the table below.

Alcohol	Theoretical value for energy given out (J / g)
methanol	22 700
ethanol	29 700
propanol	33 600
butanol	36 100

Compare the experimental and theoretical values and give the **main** reason for the difference between them. [3]

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(d) Some people are opposed to the large-scale use of bioethanol as a fuel. Describe briefly why someone could take this view. [2]

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The electrolysis of water can be used to produce hydrogen. The following table shows the results of an experiment carried out to determine the effect of current on the volume of hydrogen produced after 30 seconds.

	Volume of hydrogen produced after 30 seconds (cm^3)			
Current (mA)	Experiment 1	Experiment 2	Experiment 3	Mean
100	0.7	0.2	0.6	.....
200	1.0	0.8	1.0	0.93
300	1.4	1.3	1.2	1.30
400	1.6	1.6	1.6	1.60
500	2.3	2.2	2.1	2.20

(a) Using only the reliable results, calculate the mean volume of hydrogen produced using a current of 100 mA. [1]

Mean volume of hydrogen = ... cm^3

(b) Describe the relationship between the current and the mean volume of hydrogen produced. [1]

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(c) Using the results for a current of 300 mA and the following equation, calculate the percentage error in these measurements. [2]

$$\text{percentage error} = \frac{\text{furthest volume from mean volume} - \text{mean volume}}{\text{mean volume}} \times 100\%$$

Percentage error = ... %

(d) Balance the following electrode equations showing the electrolysis of water. [2]

$$\square\ H^+ + \square\ e^- \longrightarrow H_2$$

$$\square\ O^{2-} - \square\ e^- \longrightarrow O_2$$

(e) In your opinion, do the advantages of using hydrogen as a fuel outweigh the disadvantages? Give reasons to support your answer. [2]

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