WJEC Chemistry GCSE

2.4: Chemical Reactions and Energy

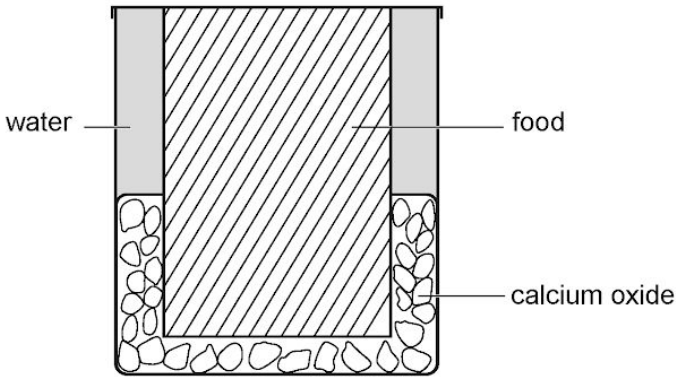
Practice Questions

Wales 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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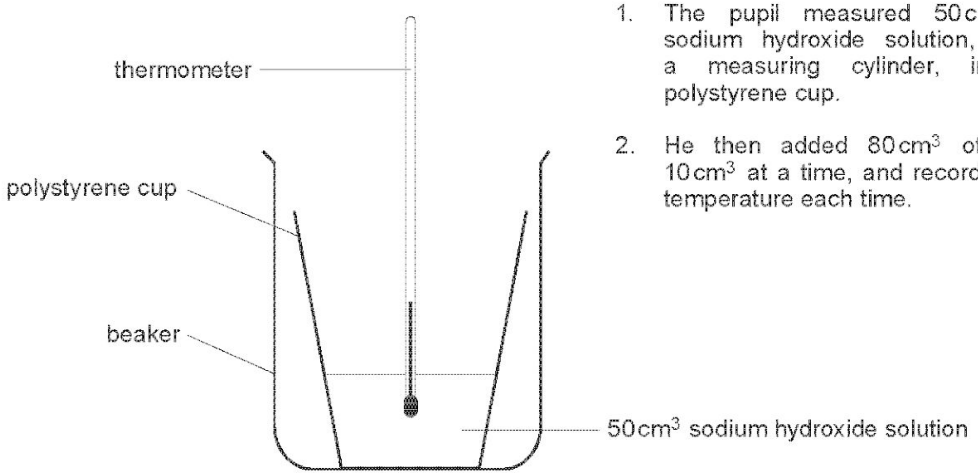
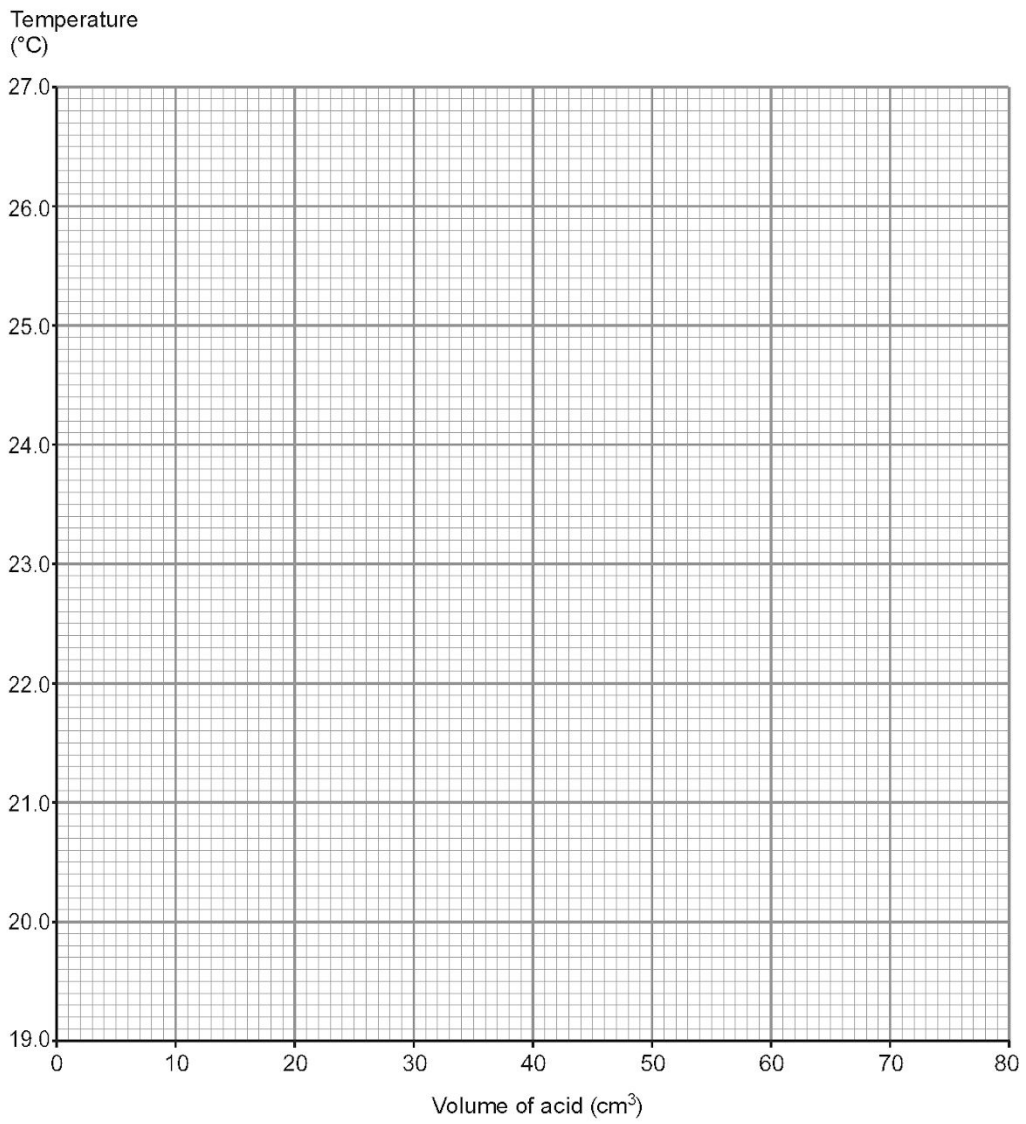
2. A pupil used the apparatus below to carry out an investigation to find the temperature change which occurs when dilute hydrochloric acid reacts with dilute sodium hydroxide solution.



1. The pupil measured 50 cm^3 of sodium hydroxide solution, using a measuring cylinder, into a polystyrene cup.
2. He then added 80 cm^3 of acid, 10 cm^3 at a time, and recorded the temperature each time.

Volume of acid added (cm^3)	Temperature (°C)
0	21.0
10	22.7
20	24.0
30	25.1
40	26.0
50	26.5
60	26.0
70	25.0
80	24.0

(a) On the grid opposite plot the volume of acid added against the temperature and draw a suitable line. [3]



(b) Use the graph to find the

(i) maximum temperature **rise** during the experiment, ... °C [1]

(ii) volume of acid needed to neutralise **all** the alkali. ..... cm^3 [1]

(c) It is important to reduce heat lost during this experiment. State how the amount of heat lost was reduced during the experiment. Suggest what else could be done to reduce heat lost if the experiment was repeated. [2]

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(d) Choose from the box below a term that could be used to describe this reaction. [1]

combustion	exothermic	endothermic	oxidation

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3.

Propane gas can be used as a fuel.

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

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

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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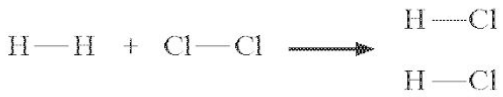
4.

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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5.

(a) Ammonia is made industrially from nitrogen and hydrogen by the Haber process.

The table below shows the yield of ammonia under different pressure and temperature conditions.

Pressure (atmospheres)	Temperature (°C)				
	100	200	300	400	500
	Yield of ammonia (%)				
10	88.2	50.7	14.7	3.9	1.2
50	94.5	75.0	39.5	15.3	5.6
100	96.7	81.7	52.5	25.2	10.6
200	98.4	89.0	66.7	40.0	18.3
400	99.4	94.6	79.7	55.4	31.9
1000	99.9	98.3	92.6	79.8	57.5

(i) Using **only** the data in the table suggest the conditions that should be chosen for the process. [1]

Pressure ..... atmospheres *Temperature* ..... °C

(ii) Give the disadvantage of using a low temperature in the process and state how this problem is overcome. [2]

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(iii) The actual pressure used in the process is 200 atmospheres. Apart from safety issues, suggest a disadvantage of using a higher pressure. [1]

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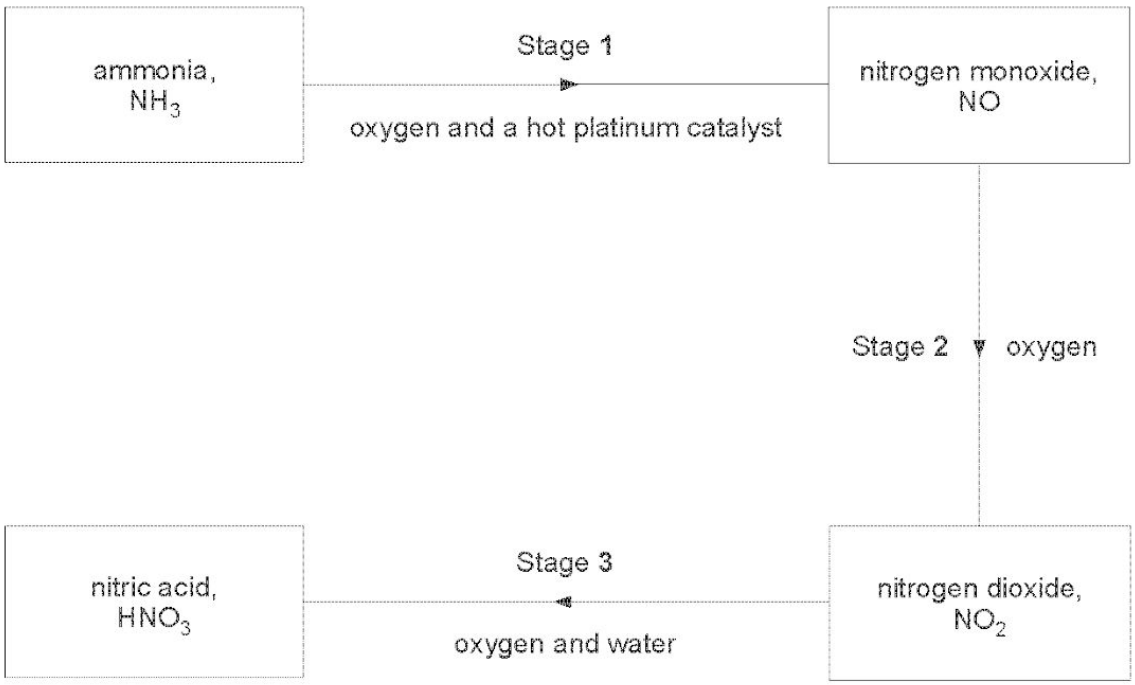
(b) Ammonia is used to form nitric acid in a three-stage reaction.



(i) Once the reaction in stage 1 has started there is sufficient heat to maintain the reaction. Give the term used to describe a reaction that produces heat. [1]

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(ii) Balance the symbol equation below that represents the reaction taking place in stage 3. [1]

$$\square\ NO_2 + O_2 + 2H_2O \longrightarrow \square\ HNO_3$$

(iii) Write a balanced symbol equation for the reaction that occurs when nitric acid is added to copper(II) carbonate. [2]

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