EXOTHERMIC REACTIONS, ENDOTHERMIC REACTIONS & BOND ENERGIES 5

Q1. Calcium carbonate breaks down when heated to above 1500 °C.

(i) Write a word equation to show what happens.

..... → ..... + ...

(2 marks)

(ii) What is the name of this type of chemical reaction?

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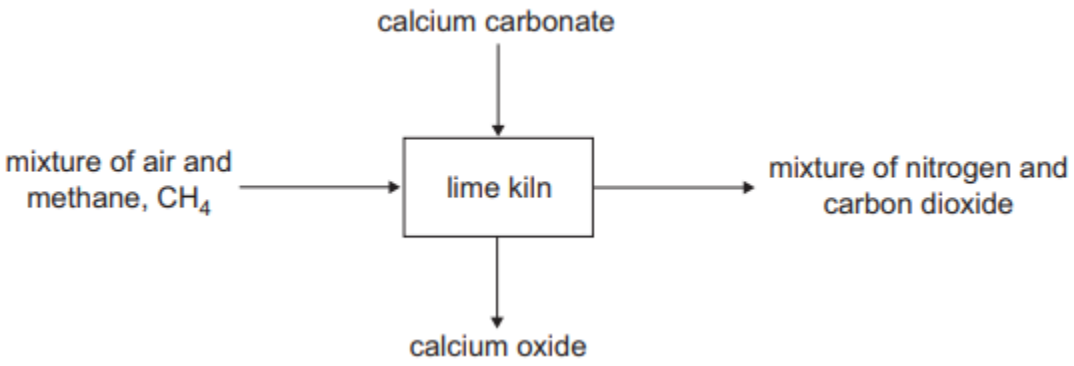
(1 mark)

Q2. Limestone is mainly calcium carbonate, $CaCO_3$. The flow diagram represents how calcium oxide (quicklime) is made when calcium carbonate (limestone) is heated in a lime kiln.



(a) The main gases leaving the lime kiln are nitrogen and carbon dioxide. Explain why.

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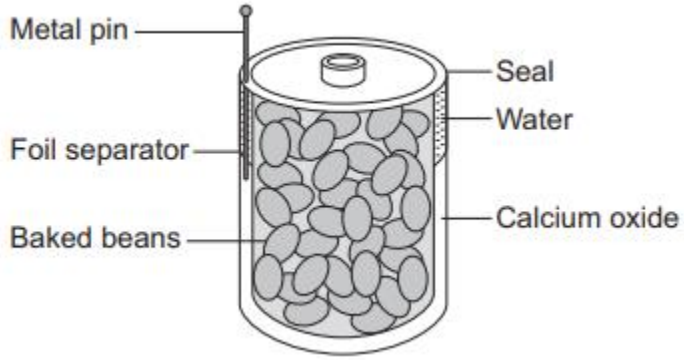
(3 marks)

(b) Calcium oxide (quicklime) is used in self-heating cans. The diagram shows a self-heating can made to warm baked beans.



To warm the baked beans the metal pin is pushed through the seal and foil separator. The foil separator breaks allowing water to mix with the calcium oxide (quicklime). Describe what happens when water mixes with calcium oxide.

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(2 marks)

Q3. A student wanted to find out how much calcium oxide can be obtained by heating 4.00 grams of calcium carbonate.

The student:

- heated 4.00 grams of calcium carbonate in a test tube with a Bunsen burner for a total of 5 minutes
- calculated the mass of the contents in the test tube after each minute
- repeated the experiment three times.

The results are shown in the table.

	Time in minutes	0	1	2	3	4	5
Mass of the contents of the test tube in g	Test 1	4.00	3.41	3.10	2.74	2.56	2.41
	Test 2	4.00	3.39	3.06	2.70	2.52	2.36
	Test 3	4.00	3.43	3.17	2.80	2.59	2.43
	Test 4	4.00	2.97	2.81	2.65	2.36	2.01

(a) One variable that is difficult to control in these tests is . . .

1 the mass of the test tube.

2 the mass of the calcium carbonate put into the test tube.

3 the temperature of the Bunsen burner flame.

4 the number of times the experiment is repeated.

(1 mark)

(b) What is the correct mean value for the student's results after heating for 5 minutes?

1 2.36 g

2 2.40 g

3 2.42 g

4 9.21 g

(1 mark)

The maximum mass of calcium oxide that can be obtained from 4.00 grams of calcium carbonate is 2.24 grams.

(c) What mass of carbon dioxide will be obtained by complete decomposition of 4.00 grams of calcium carbonate?

1 1.76 g

2 1.79 g

3 6.24 g

4 8.96 g

(1 mark)

(d) There is a mistake in the way that the student did the experiment. The mistake is that the student . . .

1 did not heat the calcium carbonate until there was no further loss in mass.

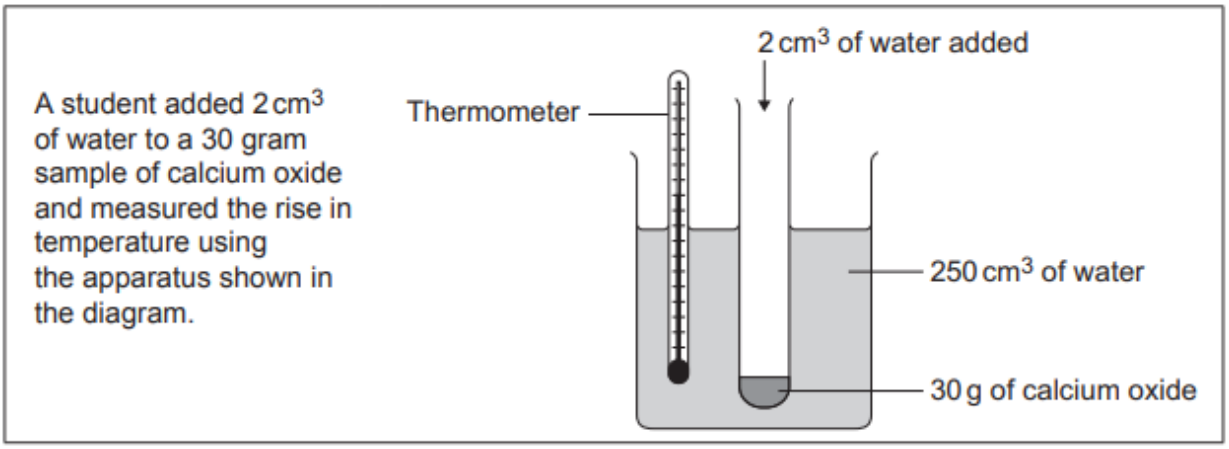
2 used a mass of calcium carbonate that was too small.

3 used a test tube that was too large.

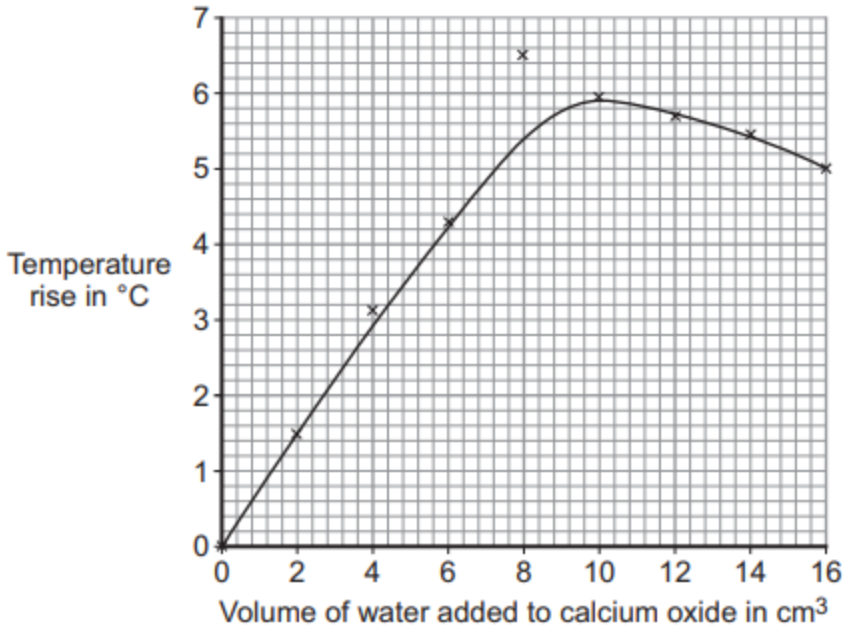
4 did not find the mass of the contents of the tube every 30 seconds

(1 mark)

Q4. When water is added to calcium oxide, heat energy is released.



The student repeated the experiment but added different volumes of water to new 30-gram samples of calcium oxide. The student's results are shown in the graph.



(a) There is a decrease in temperature rise when more than 10 cm3 of water has been added. The reason for this is that . . .

1 the calcium oxide has completely reacted to produce calcium carbonate.

2 there is excess water.

3 no calcium oxide can react.

4 a different chemical reaction happens.

(1 mark)

(b) The graph has a 'line of best fit'.

Using the information on the graph, the temperature rise for 8 cm^3 of water is . . .

1 5.2 °C

2 5.4 °C

3 6. 0 °C

4 6.5 °C

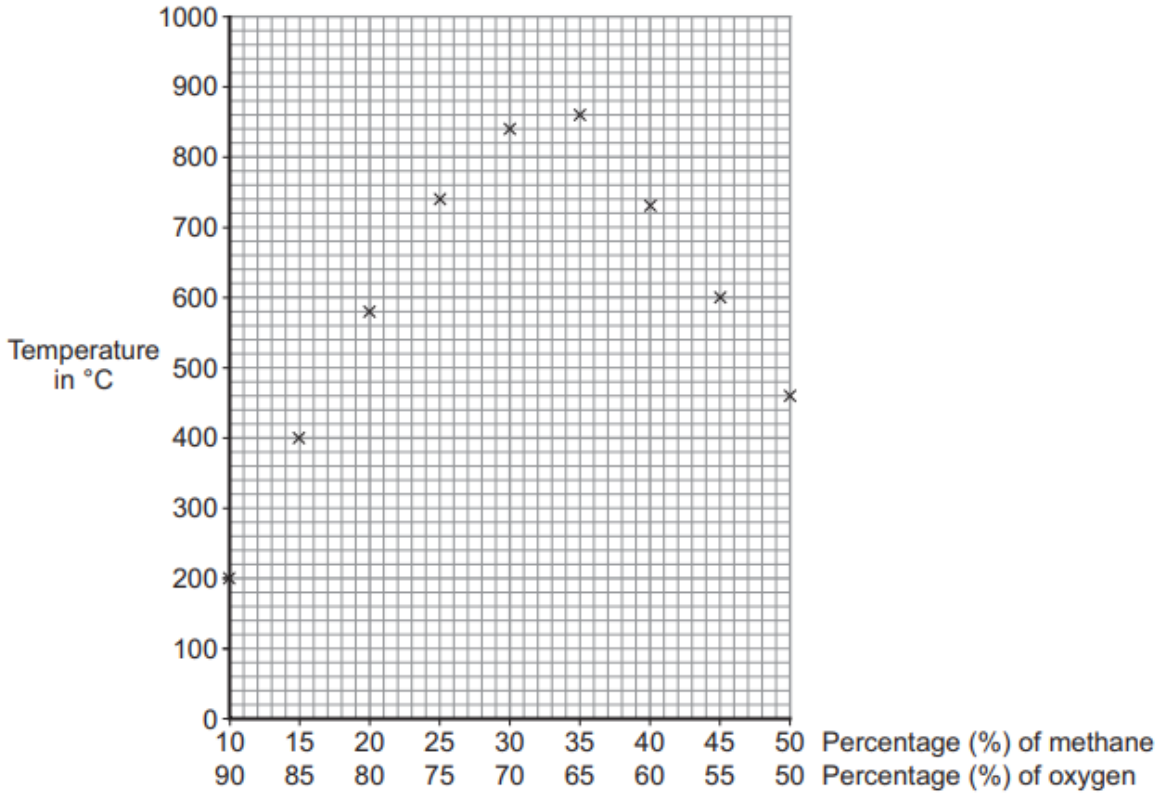
(1 mark)

(c) Which row in the table correctly identifies some of the variables in this experiment?

	Independent	Dependent	Control
1	Final temperature in the beaker	Volume of water added to the calcium oxide	Volume of water in the beaker
2	Temperature rise in the beaker	Volume of water added to the calcium oxide	Mass of calcium oxide
3	Volume of water added to the calcium oxide	Temperature rise in the beaker	The same apparatus
4	Mass of calcium oxide	Final temperature in the beaker	Temperature rise in the beaker

(1 mark)

Q5. The graph below shows the temperatures reached when different mixtures of methane gas and oxygen are burned.



(a) What is the maximum temperature that can be reached by burning methane and oxygen?

1 840 °C

2 890 °C

3 980 °C

4 1000 °C

(1 mark)

(b) The maximum temperature value could be found more accurately if . . .

1 all the readings were repeated.

2 the readings close to the maximum were repeated.

3 readings at smaller percentage intervals were recorded.

4 a thermometer with smaller scale divisions was used.

(1 mark)

The equation for the combustion of methane can be written as:

$$CH_4 + nO_2 \rightarrow CO_2 + 2H_2O$$

(c) What value of n is needed to balance the equation?

1 1.5

2 2

3 3

4 4

(1 mark)

(d) The equation below shows the complete combustion of propane.

$$C_3H_8 + 5O_2 \rightarrow 3CO_2 + 4H_2O$$

To completely burn 100 cm^3 of propane requires 500 cm^3 of oxygen.

What volume of oxygen is required to completely burn 100 cm^3 of butane, C_4H_{10}?

1 550 cm^3

2 600 cm^3

3 650 cm^3

4 666 cm^3

(1 mark)

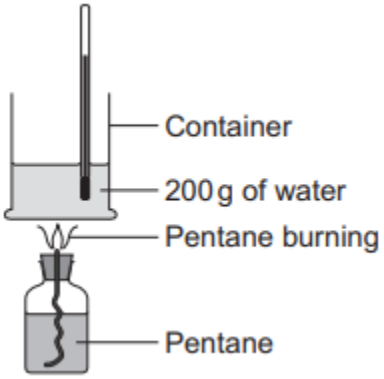
Q6. This question is about pentane.

The true value for the energy released when the alkane pentane (C_5H_{12}) burns is 48.6 kJ per gram.

A student used the apparatus in the figure to check this value.

The student:

- heated 200 grams of water by burning pentane
- recorded the mass of pentane that burned
- recorded the rise in temperature of the water.



From these results, the student calculated the energy released to be 27.9 kJ per gram of pentane.

(a) The main reason why this result is different from the true value is that . . .

1 the mass of pentane burned was too large.

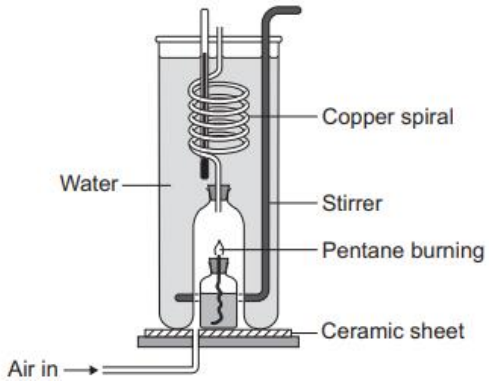
2 the mass of water heated was too small.

3 the container and surroundings were heated.

4 the thermometer was not directly above the burning pentane.

(1 mark)

The student then used the apparatus shown in the figure and obtained a result much closer to the true value.



(b) This result was more . . .

1 accurate.

2 precise.

3 reliable.

4 systematic.

(1 mark)

(c) One reason why this result was closer to the true value is that . . .

1 the pentane was burning in a sealed container.

2 the copper spiral has a large surface area.

3 the stirrer was very large.

4 the container for the water was made of glass

(1 mark)

Total marks (22)