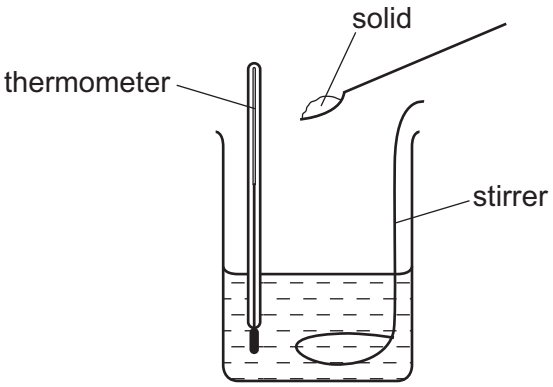
1 A student measures the maximum temperature changes when five different solids, **P**, **Q**, **R**, **S** and **T**, are dissolved separately in water. She uses the apparatus shown below.



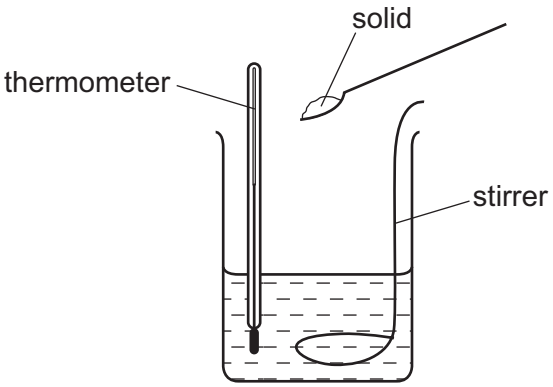
Suggest **two** factors which should be kept the same to make the experiment a fair test.

1. .....

2. ..... [2]

[Total: 2]

2 A student measures the maximum temperature changes when five different solids, **P**, **Q**, **R**, **S** and **T**, are dissolved separately in water. She uses the apparatus shown below.



The student stirs the mixture as each solid is added.

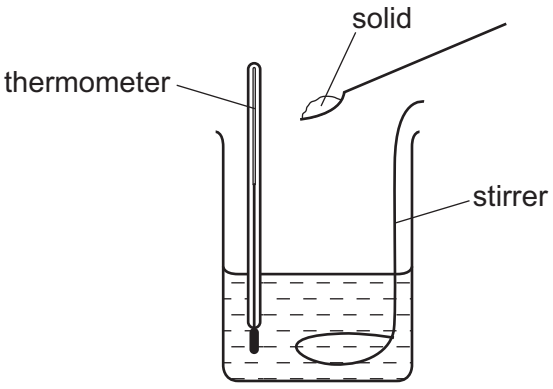
Suggest why she does this.

.....

..... [1]

[Total: 1]

3 A student measures the maximum temperature changes when five different solids, **P**, **Q**, **R**, **S** and **T**, are dissolved separately in water. She uses the apparatus shown below.



The table of results is shown below.

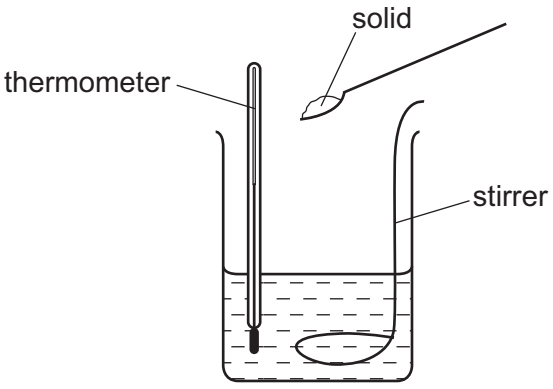
solid added	initial temperature of the water / °C	highest temperature of the solution / °C
P	20	24
Q	18	23
R	19	16
S	22	23
T	20	18

Which solid gave the greatest temperature change when dissolved in water?

..... [1]

[Total: 1]

4 A student measures the maximum temperature changes when five different solids, **P**, **Q**, **R**, **S** and **T**, are dissolved separately in water. She uses the apparatus shown below.



The table of results is shown below.

solid added	initial temperature of the water / °C	highest temperature of the solution / °C
P	20	24
Q	18	23
R	19	16
S	22	23
T	20	18

Which solids gave an endothermic energy change when dissolved in water?

..... and .....

[2]

[Total: 2]

5 Is burning an exothermic or an endothermic reaction?
Give a reason for your answer.

..... [1]

[Total: 1]

6 Household waste can be burned to produce energy.

Which **one** of the following words best describes the energy change when a substance is burned?
Tick **one** box.

endothermic ☐

neutralisation ☐

exothermic ☐

reduction ☐

[1]

[Total: 1]

7 Household waste can be burned to produce energy.
The table shows the energy released by different materials when the waste is burned.

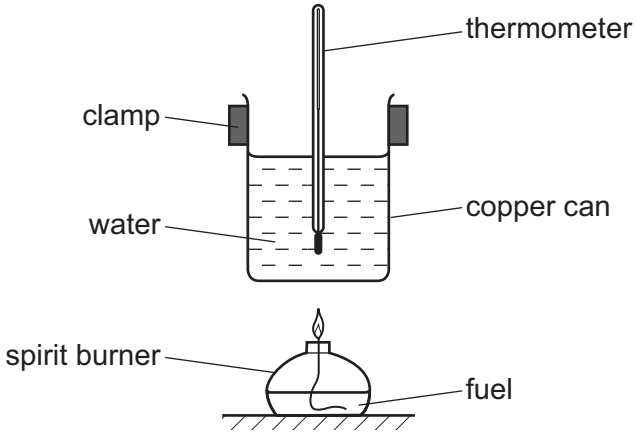
material burned	mass burned / kg	energy released / kJ
metals	1.0	1 000
organic matter	0.5	8 000
paper	2.0	40 000
plastics	1.0	30 000
cloth	1.0	15 000

Which material releases the most energy per kilogram when burned?

..... [1]

[Total: 1]

8 A student measured the highest temperature reached when four different fuels were burned. He used the apparatus shown below.



The table below shows the results.

fuel	molecular formula	initial temperature / °C	initial temperature / °C
ethanol	C_2H_6O	23	44
hexane	C_6H_{14}	17	46
pentane	C_5H_{12}	22	48
propanol	C_3H_8O	21	45

(a) Which fuel gave the highest temperature change?

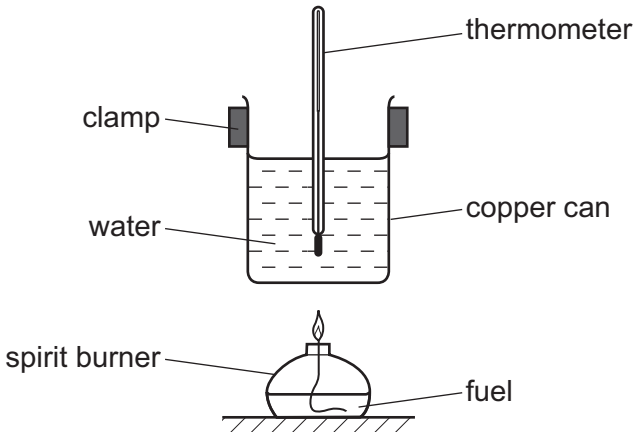
..... [1]

(b) Which fuel has the highest relative molecular mass?
You are not expected to do any calculations.

..... [1]

[Total: 2]

9 A student measured the highest temperature reached when four different fuels were burned. He used the apparatus shown below.



The same amount of each fuel was burned.

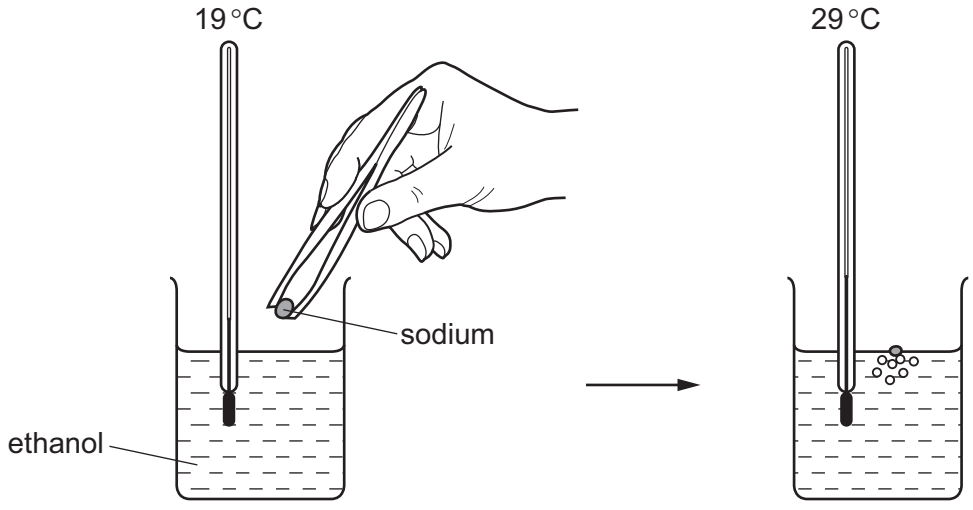
Suggest **two** other things which the student should keep constant to make the experiment a fair test.

1 .....

2 ..... [2]

[Total: 2]

10 A small piece of sodium is added to some ethanol. The temperature was measured before and after the sodium was added.

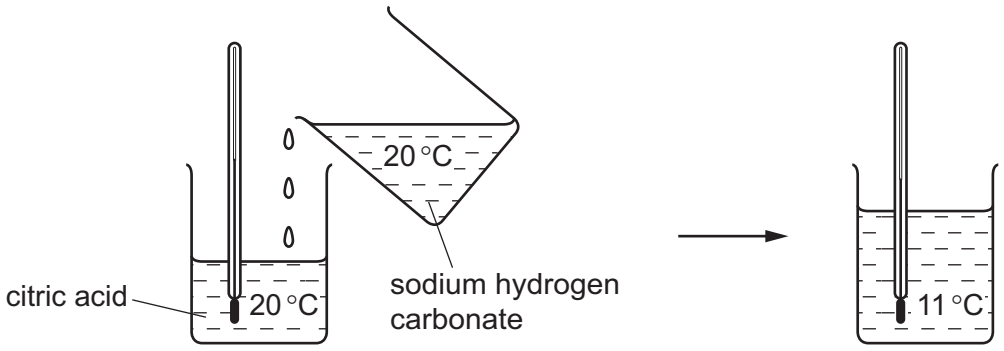


Explain how this experiment shows that the reaction is exothermic.

..... [1]

[Total: 1]

11 An aqueous solution of sodium hydrogen carbonate is added to an aqueous solution of citric acid. The mixture is stirred. The temperature is measured before and after the addition.

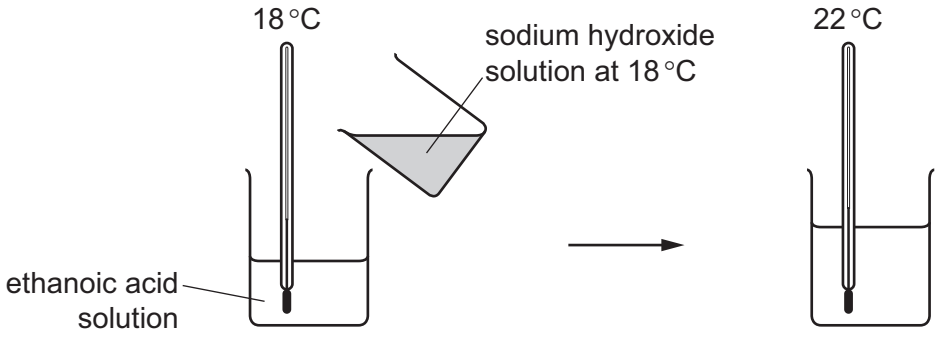


Explain how this experiment shows that the reaction is endothermic.

..... [1]

[Total: 1]

12 A student adds an aqueous solution of sodium hydroxide to an aqueous solution of ethanoic acid. She measures the temperature before and after the addition of sodium hydroxide.



Explain how this experiment shows that the reaction is exothermic.

..... [1]

[Total: 1]

13 When ammonium chloride dissolves in water, the temperature of the solution decreases.

What is the name for a reaction where the temperature of the solution decreases?

..... [1]

[Total: 1]

14 Limestone can be changed into slaked lime in two chemical reactions.

1. When limestone, $CaCO_3$, is heated it decomposes into lime, CaO.

2. Water is slowly dripped into the cooled lime. The lime appears to expand and steam is produced. Slaked lime, $Ca(OH)_2$, is formed.

Which row shows the correct description of each of the chemical reactions?

	reaction 1	reaction 2
A	endothermic	endothermic
B	endothermic	exothermic
C	exothermic	endothermic
D	exothermic	exothermic

[1]

[Total: 1]

15 When metals react with hydrochloric acid, the temperature of the reaction mixture increases.
Which **one** of the following words best describes this reaction?
Draw a ring around the correct answer.

endothermic **exothermic** **isotopic** **radioactive**

[1]

[Total: 1]

16 Some white anhydrous copper(II) sulfate powder is put into a beaker of water and stirred.

What would show that the process was exothermic?

A A blue solution is formed.

B The beaker feels cooler.

C The beaker feels warmer.

D The powder dissolves in the water.

[1]

[Total: 1]

17 Ammonia is used in the manufacture of nitric acid.

(a) Balance the chemical equation for the first step in the process.

$$4NH_3 + 5O_2 \rightarrow .....NO + 6H_2O$$

[1]

(b) The reaction is exothermic.

What is meant by the term *exothermic*?

.....

..... [1]

(c) The NO produced in the first step then reacts with oxygen to produce nitrogen dioxide, NO_2.

$$2NO + O_2 \rightarrow 2NO_2$$

How does this equation show that NO is oxidised?

.....

..... [1]

(d) Is nitrogen dioxide an acidic oxide or a basic oxide?
Give a reason for your answer.

.....

..... [1]

[Total: 4]

18 The reaction of sodium with water is exothermic.

What is meant by the term *exothermic*?

.....

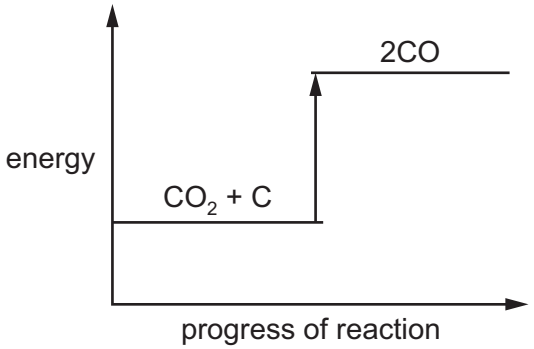
..... [1]

[Total: 1]

19 Carbon dioxide can be reduced by carbon.

$$CO_2 + C \rightarrow 2CO$$

The energy level diagram for this reaction is shown.



Explain how this diagram shows that the reaction is endothermic.

.....

..... [1]

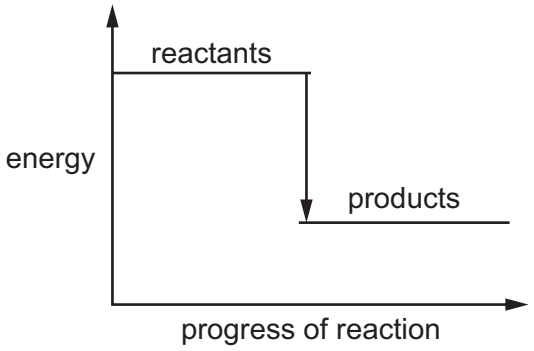
[Total: 1]

20 Bromine reacts with hydrogen sulfide, H_2S.

(a) Complete the chemical equation for this reaction.

..... + H_2S → .....HBr + S [2]

(b) The energy level diagram for this reaction is shown.



Explain how this diagram shows that the reaction is exothermic.

.....

..... [1]

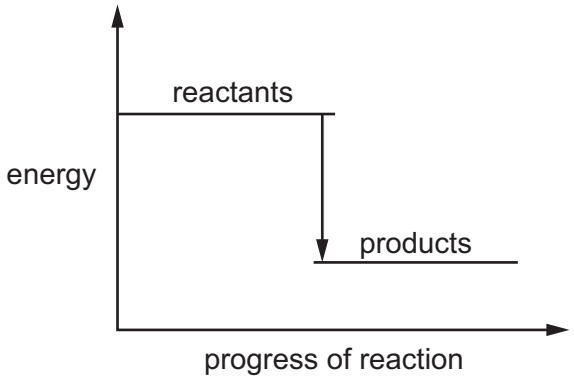
[Total: 3]

21 Iodine reacts with aqueous sodium thiosulfate, $Na_2S_2O_3$.

(a) Balance the chemical equation for this reaction.

$$.....Na_2S_2O_3 + I_2 \rightarrow Na_2S_4O_6 + ...NaI$$ [2]

(b) The energy level diagram for this reaction is shown.



Explain how this diagram shows that the reaction is exothermic.

.....

..... [1]

[Total: 3]

22 Chromium can be manufactured by the reduction of chromium(III) oxide, Cr_2O_3, with aluminium.

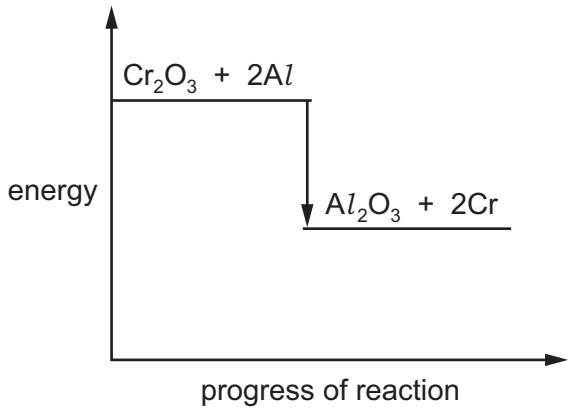
$$Cr_2O_3 + 2Al \rightarrow Al_2O_3 + 2Cr$$

(a) How does this equation show that chromium(III) oxide is reduced?

.....

..... [1]

(b) The energy level diagram for this reaction is shown.



Explain how this diagram shows that the reaction is exothermic.

.....

..... [1]

[Total: 2]

23 Sodium carbonate can be manufactured by the reaction between limestone and sodium chloride. The reaction is endothermic.

What is meant by the term *endothermic*?

..... [1]

[Total: 1]

24 Solid hydrated copper(II) sulfate decomposes to anhydrous copper(II) sulfate when it is continuously heated.

Is this an endothermic or an exothermic reaction?
Explain your answer.

.....

..... [1]

[Total: 1]

25 Charcoal (carbon) can be burned in an excess of clean, dry air to provide the heat needed to make glass.

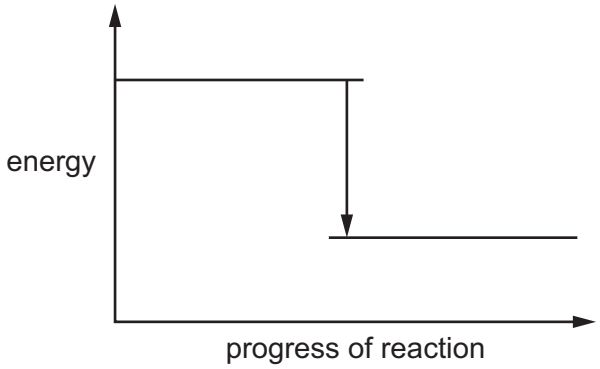
(a) Which gas is 21% of clean, dry air?

..... [1]

(b) Write a word equation for carbon burning in an excess of air.

..... [1]

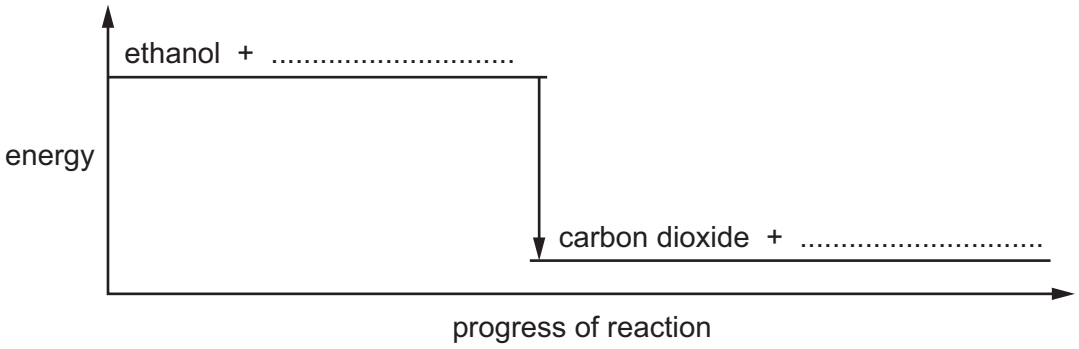
(c) Complete the energy level diagram for this reaction by adding these **two** words:
- reactants
- product.



[1]

[Total: 3]

26 The energy level diagram for the complete combustion of ethanol is shown.



(a) Complete the diagram by filling in the missing reactant and the missing product.

[2]

(b) Is the complete combustion of ethanol exothermic or endothermic?

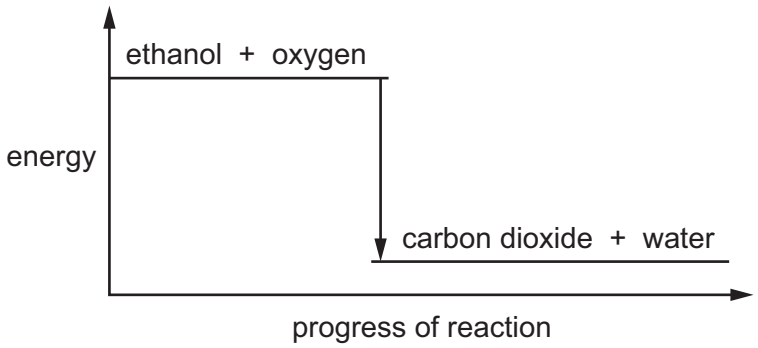
Use the information in the diagram to explain your answer.

.....

..... [1]

[Total: 3]

27 The energy level diagram for the complete combustion of ethanol is shown.



Explain how this diagram shows that the reaction is exothermic.

.....

..... [1]

[Total: 1]

28 The reaction of ethanoic acid with sodium hydroxide is exothermic.

What is meant by the term *exothermic*?

..... [1]

[Total: 1]

29 Refinery gas contains methane, ethane and propane.

(a) Draw the structure of a molecule of ethane showing all of the atoms and all of the bonds.

[1]

(b) Methane can be converted to hydrogen by reaction with steam.

Balance the chemical equation for this reaction.

$CH_4 + H_2O \rightarrow CO + ...H_2$ [1]

(c) This reaction is endothermic.

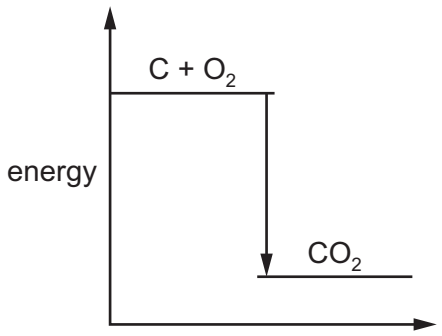
What is meant by the term *endothermic*?

..... [1]

[Total: 3]

30 Carbon is an element in Group IV of the Periodic Table. It reacts with oxygen to form carbon dioxide.

The energy level diagram for this reaction is shown.



Explain how this diagram shows that the reaction is exothermic.

.....

..... [1]

[Total: 1]

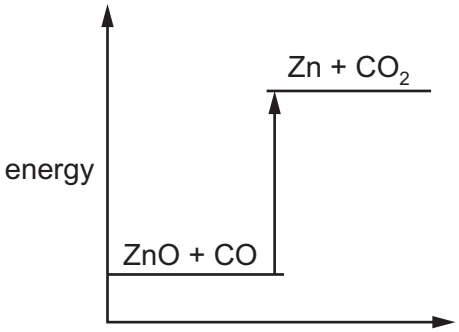
31 Zinc is extracted from zinc oxide by heating zinc oxide with carbon monoxide.

$$ZnO + CO \rightarrow Zn + CO_2$$

(a) How does this equation show that zinc oxide is reduced?

..... [1]

(b) The energy level diagram for this reaction is shown.



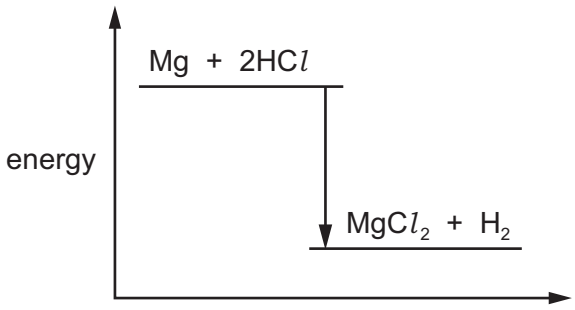
Explain how this diagram shows that the reaction is endothermic.

.....

..... [1]

[Total: 2]

32 The energy level diagram for the reaction between magnesium and hydrochloric acid is shown.



Which statement about the reaction is **not** correct?

A Energy is given out during the reaction.

B The products are at a lower energy level than the reactants.

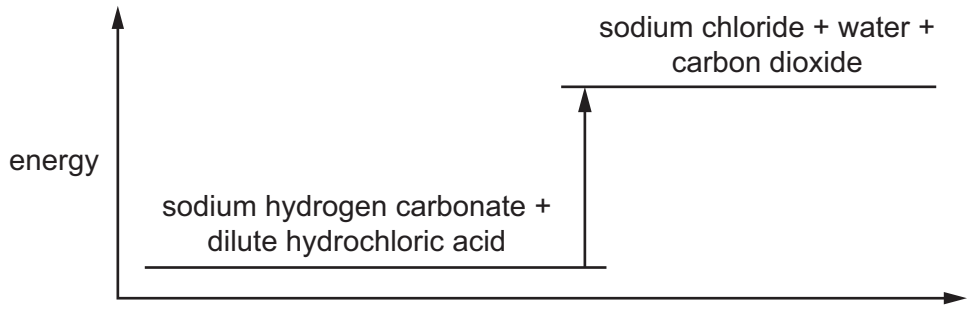
C The reaction is endothermic.

D The temperature increases during the reaction.

[1]

[Total: 1]

33 The energy level diagram for the reaction between sodium hydrogen carbonate and dilute hydrochloric acid is shown.



Which row correctly describes the type of reaction and the energy of the reactants and products?

	type of reaction	energy of the reactants and products
A	endothermic	the products have more energy than the reactants
B	endothermic	the reactants have more energy than the products
C	exothermic	the products have more energy than the reactants
D	exothermic	the reactants have more energy than the products

[1]

[Total: 1]

34 Which reaction is endothermic?

A acid neutralising alkali causing a temperature increase

B adding magnesium to hydrochloric acid

C calcium carbonate decomposing when heated

D combustion of fossil fuels

[1]

[Total: 1]

35 Which row correctly describes whether the reaction is exothermic or endothermic?

	reaction	exothermic	endothermic
A	calcium carbonate → calcium oxide + carbon dioxide	✓	✗
B	carbon + oxygen → carbon dioxide	✓	✗
C	methane + oxygen → carbon dioxide + water	✗	✓
D	sodium + water → sodium hydroxide + hydrogen	✗	✓

[1]

[Total: 1]

36 Some reactions are endothermic.

How does the temperature and energy change in an endothermic reaction?

	temperature change	energy change
A	decreases	energy taken in
B	decreases	energy given out
C	increases	energy taken in
D	increases	energy given out

[1]

[Total: 1]

37 Solutions of two chemicals are mixed.

A reaction occurs and the temperature change is measured.

Which statement is correct?

A If the reaction is endothermic, the temperature decreases and energy is taken in.

B If the reaction is endothermic, the temperature increases and energy is given out.

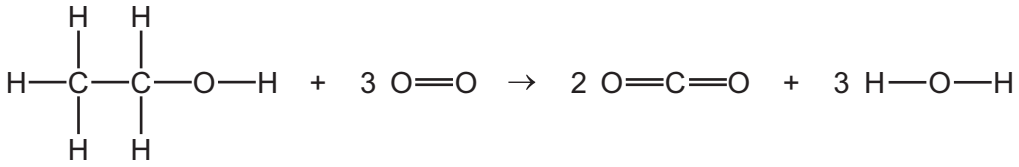
C If the reaction is exothermic, the temperature decreases and energy is given out.

D If the reaction is exothermic, the temperature increases and energy is taken in.

[1]

[Total: 1]

38 The equation for the complete combustion of ethanol is shown.



Use the bond energies in the table to calculate the energy change, in kJ / mol, for the complete combustion of ethanol

bond	bond energy in kJ / mol
C–C	347
C–H	413
C–O	358
C=O	805
O–H	464
O=O	498

(a) Energy needed to break bonds.

..... kJ [1]

(b) Energy released when bonds are formed.

..... kJ [1]

(c) Energy change for the complete combustion of ethanol.

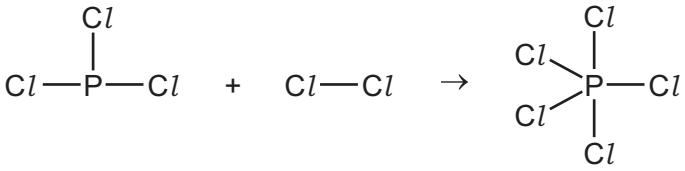
energy change = ... kJ / mol [1]

[Total: 3]

39 Gaseous phosphorus(III) chloride, PCl_3, reacts with gaseous chlorine to form gaseous phosphorus(V) chloride, PCl_5.

$$PCl_3(g) + Cl_2(g) \rightarrow PCl_5(g)$$

The chemical equation for this reaction can be represented as shown.



Use the bond energies in the table to calculate the energy change, in kJ / mol, of the reaction.

bond	bond energy in kJ / mol
P–Cl	326
Cl–Cl	243

(a) Energy needed to break bonds.

..... kJ [1]

(b) Energy released when bonds are formed.

..... kJ [1]

(c) Energy change of reaction.

energy change = ... kJ / mol [1]

(d) Deduce whether the energy change for this reaction is exothermic or endothermic.
Explain your answer.

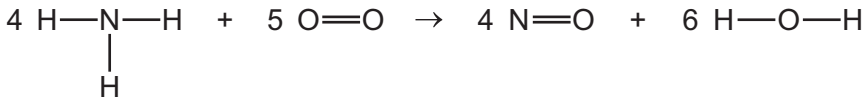
.....

..... [1]

[Total: 4]

40 Ammonia reacts with oxygen.

The chemical equation for the reaction can be represented as shown.



Use the bond energies in the table to calculate the energy change, in kJ / mol, which occurs when **one** mole of NH_3 reacts.

bond	N–H	O=O	N=O	O–H
bond energy in kJ / mol	391	498	587	464

(a) Energy needed to break bonds.

..... kJ [1]

(b) Energy released when bonds are formed.

..... kJ [1]

(c) Energy change when **one** mole of NH_3 reacts.

energy change = ... kJ / mol [2]

[Total: 4]