Making useful chemicals – 2022 GCSE 21st Chemistry B

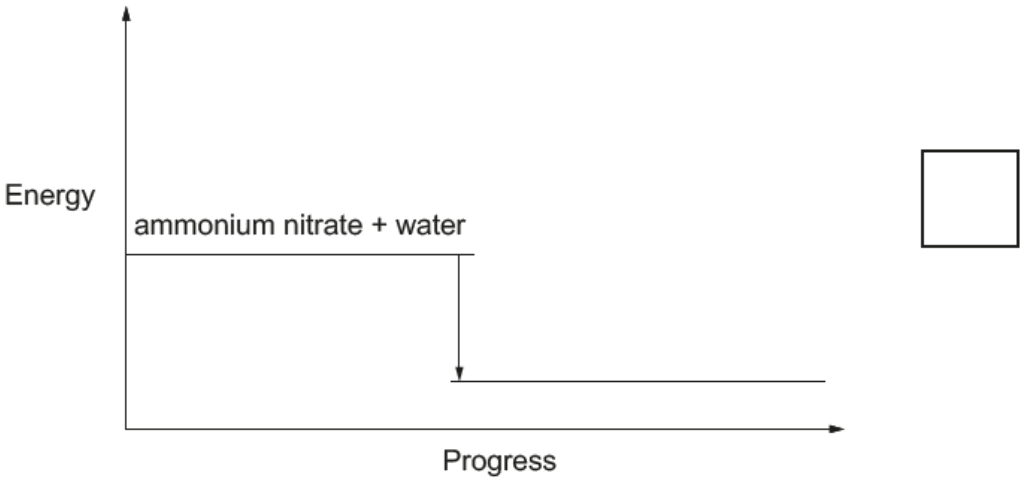
1. May /2022/Paper_ J258/01/No.3

'Cool packs' containing ammonium nitrate are used to treat sports injuries.

(a) Ammonium nitrate absorbs energy when it dissolves in water.
The temperature of the water falls.

(i) Which energy level diagram shows the energy change when ammonium nitrate dissolves in water?

Tick (✓) **one** box.



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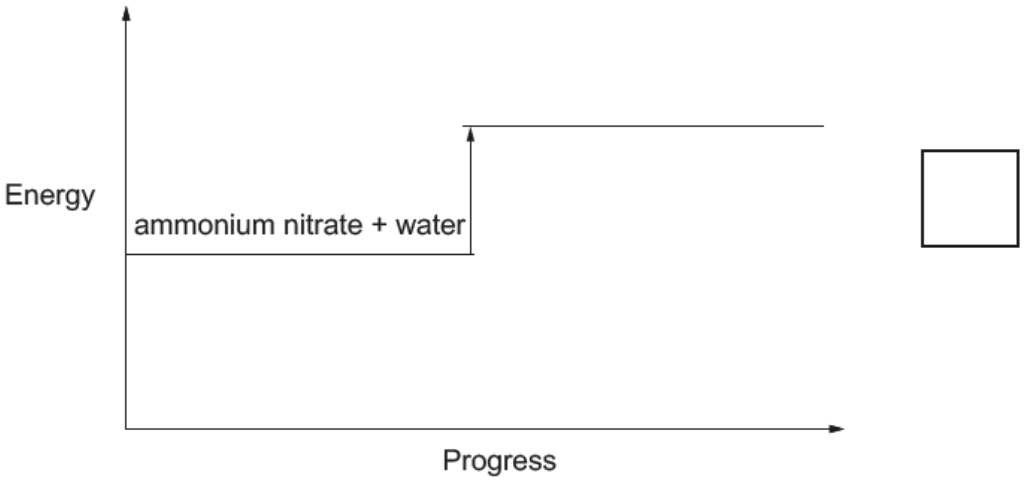

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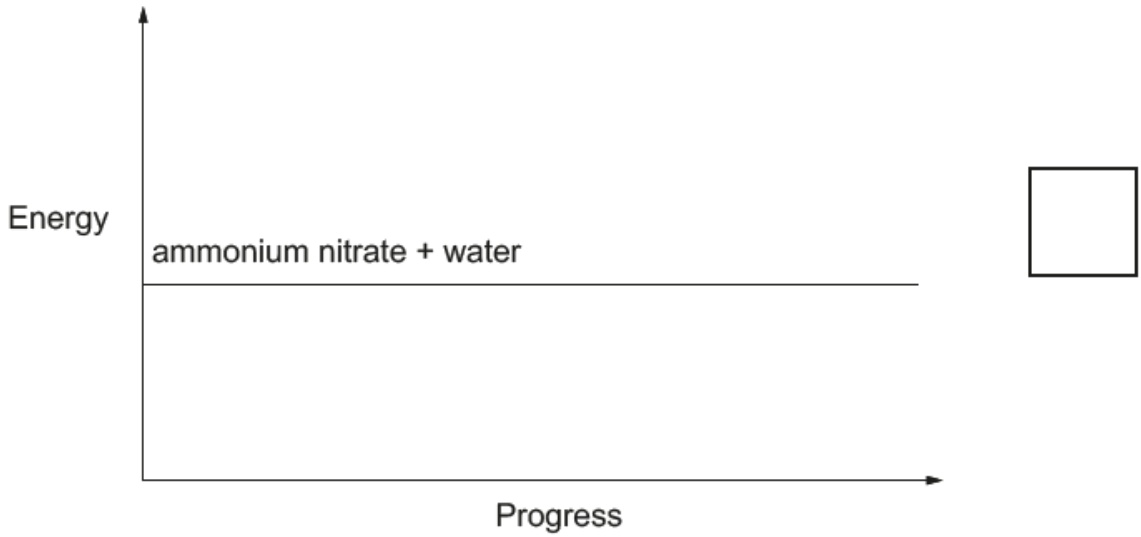

[1]

(ii) Which label should be used for the product of the dissolving process?

Tick (✓) **one** box.

Ammonium nitrate liquid ☐

Ammonium nitrate solution ☐

Ammonium nitrate solvent ☐

[1]

(iii) Which word describes this dissolving process?

Tick (✓) **one** box.

Decomposition ☐

Endothermic ☐

Exothermic ☐

Precipitation ☐

[1]

(b) Eve has some solid ammonium nitrate.

Describe the experiment Eve can do to find out how far the temperature of the water falls when solid ammonium nitrate dissolves in water.

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..... **[3]**

2. May /2022/Paper_ J258/01/No.7(a_ d)

Jack adds the **same** volume of dilute sulfuric acid to three different samples of solid zinc carbonate.

(a) Complete the sentence.

The gas made when the reaction fizzes is called carbon ..... . **[1]**

(b) Here are Jack's results:

Experiment	Mass of zinc carbonate (g)	Type of zinc carbonate	Time to stop fizzing (minutes)
1	2.0	lumps	10
2	2.0	powder	6
3	4.0	lumps	

(i) Jack looks at his results from **Experiment 1** and **Experiment 2**.

How do the results of these two experiments show that the powder reacts faster than the lumps?

.....

..... **[1]**

(ii) Explain why the powder reacts **faster** than the lumps.

Use ideas about particles in your answer.

.....

.....

.....

..... **[2]**

(c) What is the most likely time taken for **Experiment 3**?

Tick (✓) **one** box.

Less than 6 minutes. ☐

6 minutes. ☐

Between 6 and 10 minutes. ☐

10 minutes. ☐

Longer than 10 minutes. ☐

[1]

(d) At the end of **Experiment 2**, the mixture formed contains a solution of zinc sulfate with some unreacted solid zinc carbonate.

Jack filters the mixture to remove the unreacted solid zinc carbonate.

Describe how Jack can obtain a sample of zinc sulfate crystals from the solution.

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..... **[2]**

3. May /2022/Paper_ J258/01/No.11

Mia investigates the rate of reaction when zinc reacts with dilute sulfuric acid.
She adds zinc pieces to dilute sulfuric acid at room temperature.

Fig. 11.1 shows the apparatus she uses:

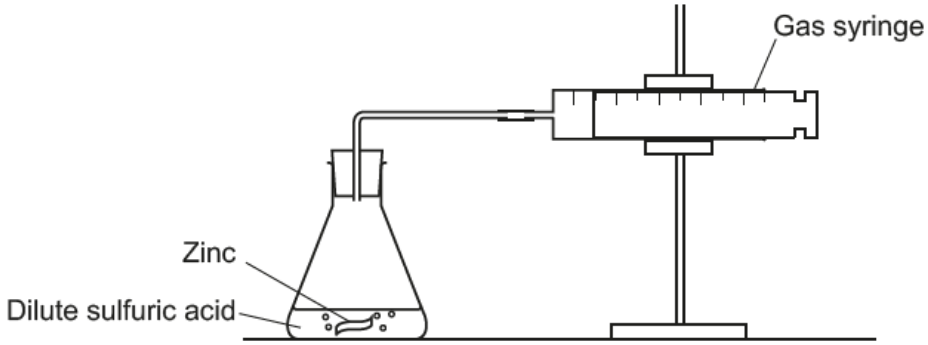


Fig. 11.1

(a) Complete the symbol equation for the reaction.

Include a **state symbol**.

$$Zn(s) + H_2SO_4(aq) \longrightarrow ZnSO_4(aq) + ...$$

[2]

(b) Mia measures the volume of gas in the gas syringe every two minutes.

Fig. 11.2 shows a graph of her results:

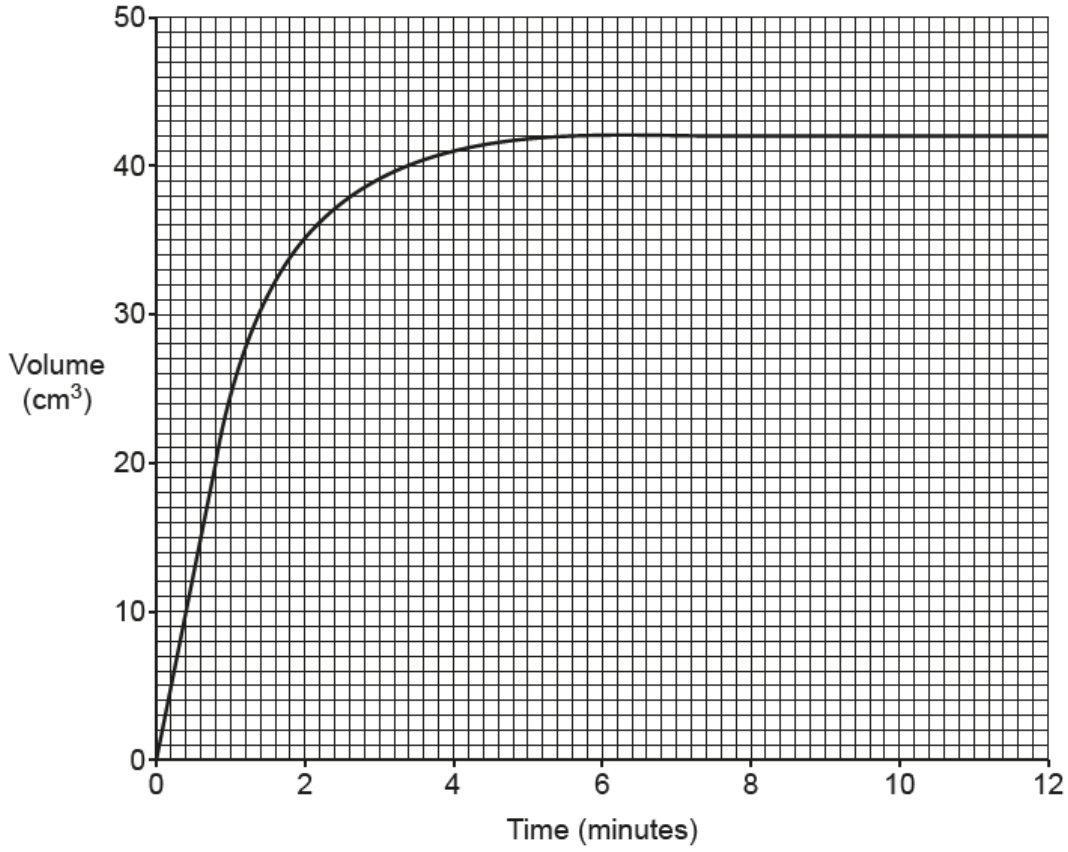


Fig. 11.2

(i) Calculate the rate of reaction during the first minute, using **Fig. 11.2**.

Give your answer in cm^3/s.

Rate of reaction = ... cm^3/s **[3]**

(ii) Explain why the mass of the flask and its contents decreases during the reaction.

.....

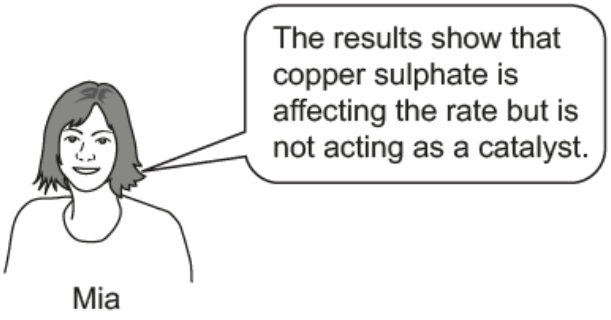
..... **[1]**

(c) Mia repeats the experiment at the same temperature.
She adds a few drops of blue copper sulfate.

Her results show that:

- more gas is produced in the first minute, than in the first experiment.
- the blue colour changes to colourless during the reaction.

Mia makes a statement about the results:



How do the results support Mia's statement?

Explain your answer.

.....

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.....

..... **[3]**

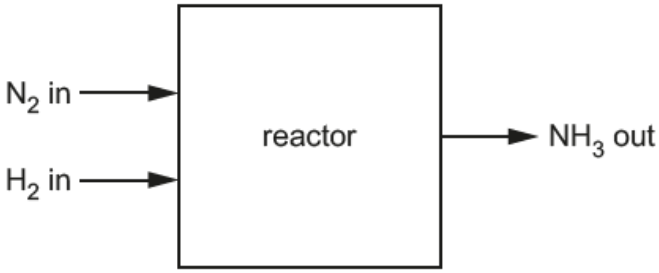
4. May /2022/Paper_ J258/02/No.9

Ammonia is used to make fertilisers. It is produced in a large-scale process.

The equation shows the reaction that happens in the process:

$$N_2 + 3H_2 \rightleftharpoons \underset{\text{ammonia}}{2NH_3}$$

The process happens in a reactor.



(a) The percentage yield of ammonia is usually between 10% and 20%.

(i) Use the equation to explain why it is not possible to get 100% yield of ammonia.

.....

..... **[1]**

(ii) The gas that leaves the reactor contains ammonia mixed with two other gases.

Use the equation to help you to give the names of the other **two** gases.

..... **and** ..... **[1]**

(b) An ammonia factory tests a new reactor.

The table shows the theoretical yield and actual yield for a process in the new reactor.

Theoretical yield (tonnes)	150
Actual yield (tonnes)	19.5

Calculate the percentage yield for the process in the new reactor.

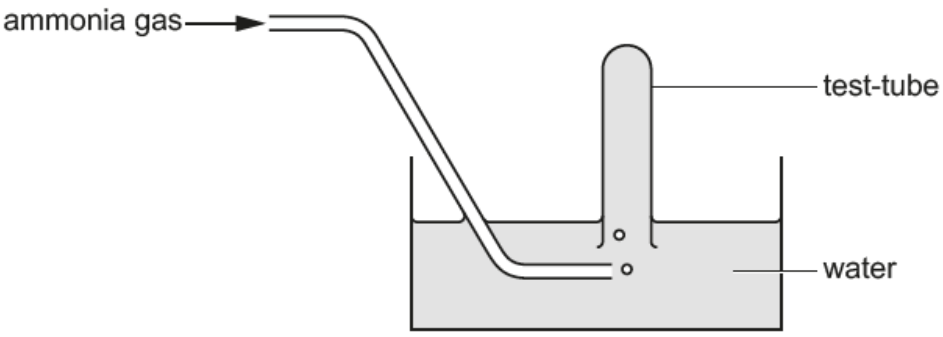
Use the equation: $\text{percentage yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$

percentage yield = ... % **[2]**

(c) Ammonia is very soluble in water.

Kofi does an experiment to make some ammonia.

He tries to collect it using the apparatus shown.



(i) Bubbles of ammonia gas enter the water but no gas collects in the test-tube.

What happens to the ammonia gas when it enters the water?

.....

..... **[1]**

(ii) Which apparatus should Kofi use to collect ammonia?

Tick (✓) **one** box.

burette ☐

gas syringe ☐

measuring cylinder ☐

volumetric flask ☐

[1]

(d) Ammonia is an alkaline gas.

The pH of ammonia solution can be measured using a pH meter.

(i) Predict the pH of ammonia.

pH ..... **[1]**

(ii) Describe another method you could use to measure the pH of ammonia solution.

.....

.....

..... **[2]**

5. May /2022/Paper_ J258/03/No.1

Mia investigates the rate of reaction when zinc reacts with dilute sulfuric acid.
She adds zinc pieces to dilute sulfuric acid at room temperature.

Fig. 1.1 shows the apparatus she uses:

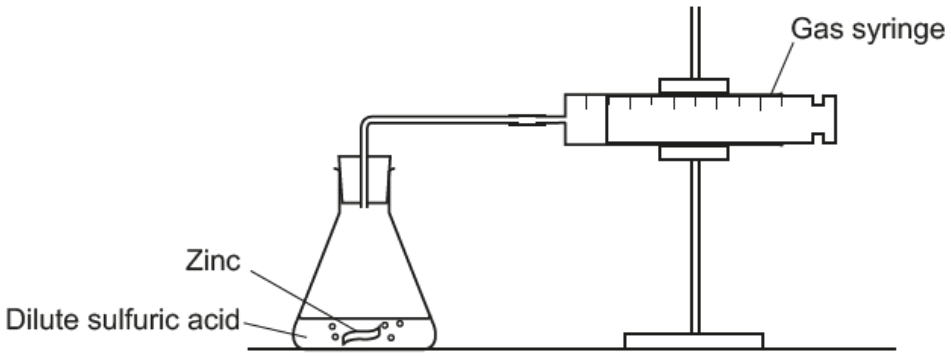


Fig. 1.1

(a) Complete the symbol equation for the reaction.

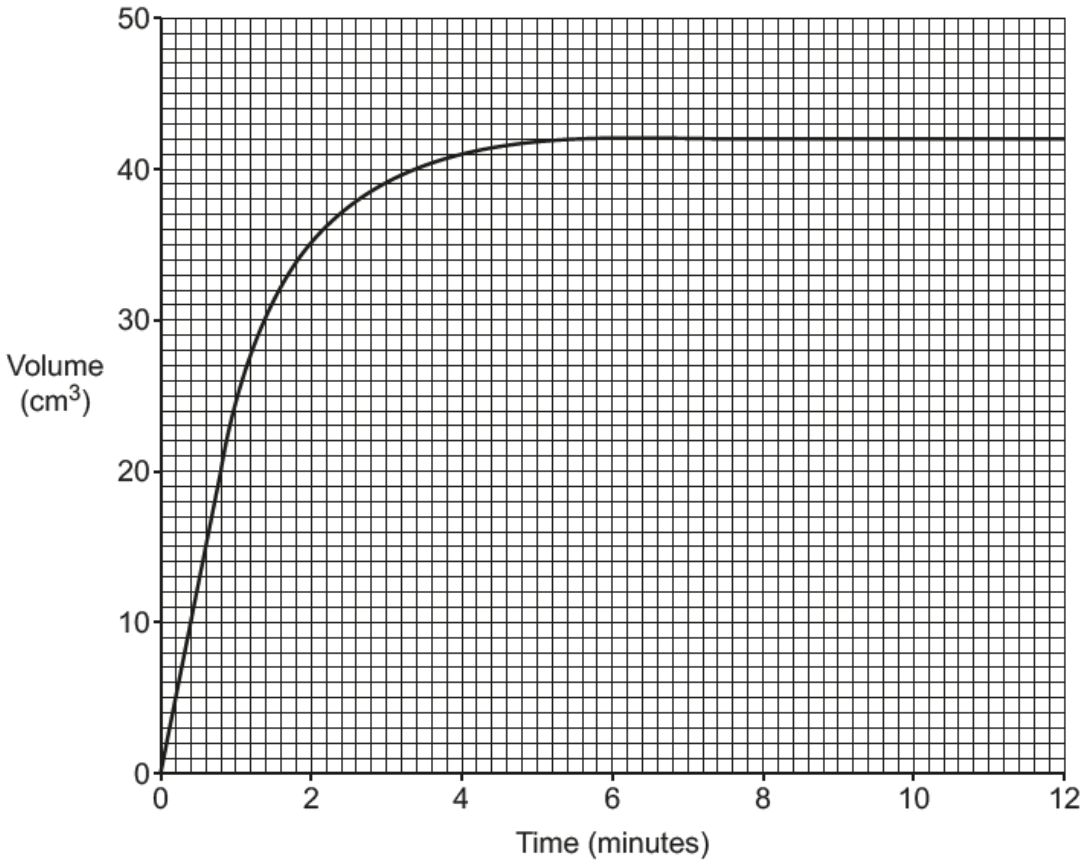
Include a **state symbol**.

$$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + ...$$

[2]

(b) Mia measures the volume of gas in the gas syringe every two minutes.

Fig. 1.2 shows a graph of her results:



(i) Calculate the rate of reaction during the first minute, using **Fig. 1.2**.

Give your answer in cm^3/s.

Rate of reaction = ... cm^3/s **[3]**

(ii) Explain why the mass of the flask and its contents decreases during the reaction.

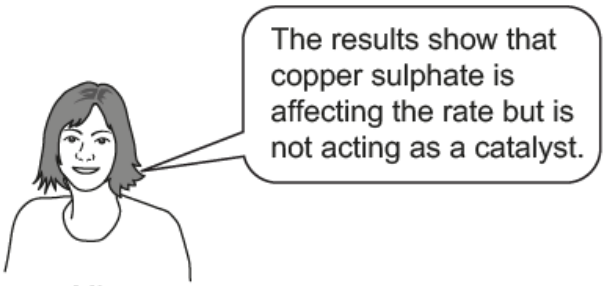
.....

..... **[1]**

(c) Mia repeats the experiment at the same temperature.
She adds a few drops of blue copper sulfate.

Her results show that:
- more gas is produced in the first minute, than in the first experiment.
- the blue colour changes to colourless during the reaction.

Mia makes a statement about the results:



Mia

How do the results support Mia's statement?

Explain your answer.

.....

.....

.....

.....

.....

..... **[3]**

(d) Mia repeats the experiment at a **higher** temperature.

Which statements explain why the reaction is faster at a higher temperature?

Tick (✓) **two** boxes.

- The particles move faster. ☐
- There are more frequent collisions. ☐
- The yield is higher at a higher temperature. ☐
- The particles are closer together. ☐
- The zinc breaks down into smaller pieces. ☐

[2]

6. May /2022/Paper_ J258/3/No.4

When hydrogen burns, energy is transferred to the surroundings.

(a) What word describes a reaction that releases energy to the surroundings?

..... **[1]**

(b) The equation for the reaction is:

$2H_2(g) + O_2(g) \longrightarrow 2H_2O(l)$

Complete **Fig. 4.1** to show the reaction profile for this reaction.
Include on **Fig. 4.1**:

- the formulae of the reactants and products
- a label for the activation energy.

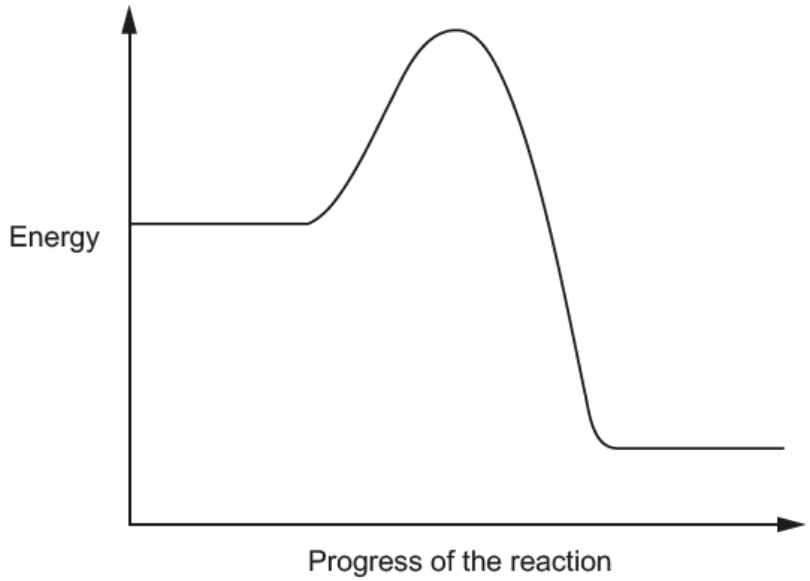


Fig. 4.1

[2]

(c) Which statement describes the activation energy?

Tick (✓) **one** box.

The energy absorbed by the reaction. ☐

The energy given out by the reaction. ☐

The energy needed for a reaction to occur. ☐

The temperature needed to start the reaction. ☐

[1]

(d) **Fig. 4.2** shows what happens when 2 moles of hydrogen burn:

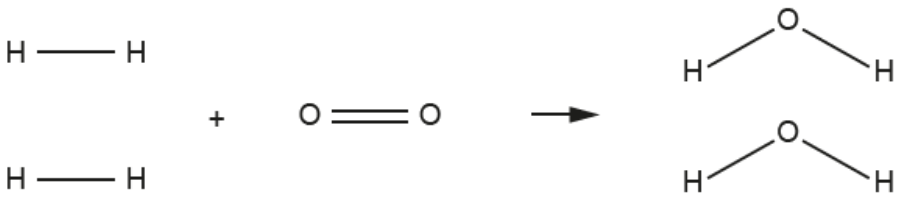


Fig. 4.2

Calculate the energy given out when 2 moles of hydrogen burn.

Use data from the table.

Bond	Energy (kJ/mol)
O–H	464
O=O	498
H–H	436

Bonds broken = ... kJ/mol

Bonds made = ... kJ/mol

Energy given out = ... kJ/mol

[3]

7. May /2022/Paper_ J258/03/No.9

Alex adds the **same** volume of dilute sulfuric acid to different samples of zinc carbonate.
The reaction fizzes.

(a) Name the gas that causes the fizzing.

..... **[1]**

(b) **Table 9.1** shows Alex's results:

Experiment	Mass of zinc carbonate (g)	Concentration of acid (mol/dm^3)	Type of zinc carbonate	Time to stop fizzing (minutes)	Relative average rates
1	2.0	1.0	lumps	10	1
2	2.0	1.0	powder	4	

Table 9.1

(i) Explain why the rates of **Experiment 1** and **Experiment 2** are different in **Table 9.1**.

Use ideas about particles in your answer.

.....

.....

.....

..... **[2]**

(ii) Relative average rate is the number of times faster one reaction is compared to another.

Calculate the relative average rate of **Experiment 2**, compared to **Experiment 1**.

Relative average rate = ... **[2]**

(c) Alex does two more experiments, **Experiment 3** and **Experiment 4**.

The results are shown in **Table 9.2**.

Experiment	Mass of zinc carbonate (g)	Concentration of acid (mol/dm^3)	Type of zinc carbonate	Time to stop fizzing (minutes)	Relative average rates
1	2.0	1.0	lumps	10	1
2	2.0	1.0	powder	4	
3	4.0	1.0	lumps	.....	
4	2.0	2.0	lumps	.....	

Table 9.2

Complete **Table 9.2** by predicting the time taken for the reactions to stop fizzing. **[2]**

8. May /2022/Paper_ J258/04/No.2

Ammonia is used to make fertilisers. It is produced in a large-scale process.

The equation shows the reaction that happens in the process:

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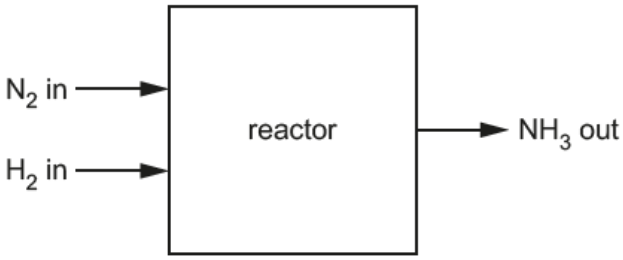
The process happens in a reactor.



(a) The percentage yield of ammonia is usually between 10% and 20%.

(i) Use the equation to explain why it is not possible to get 100% yield of ammonia.

.....

..... **[1]**

(ii) The gas that leaves the reactor contains ammonia mixed with two other gases.

Use the equation to help you to give the names of the other **two** gases.

..... **and** ..... **[1]**

(b) An ammonia factory tests a new reactor.

The table shows the theoretical yield and actual yield for a process in the new reactor.

Theoretical yield (tonnes)	150
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Calculate the percentage yield for the process in the new reactor.

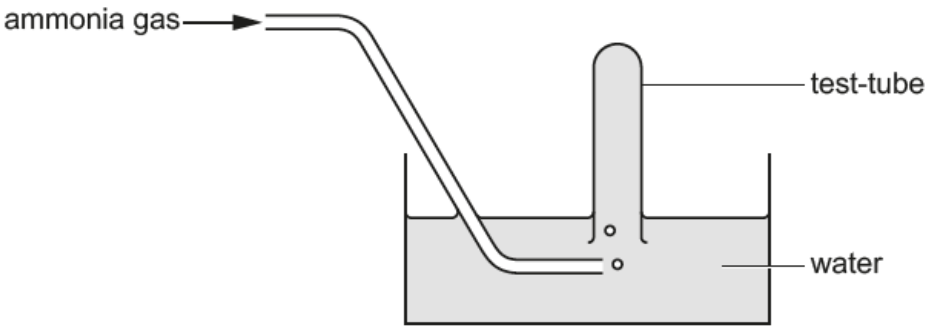
Use the equation: $\text{percentage yield} = \dfrac{\text{actual yield}}{\text{theoretical yield}} \times 100\%$

percentage yield = ... % **[2]**

(c) Ammonia is very soluble in water.

Kofi does an experiment to make some ammonia.

He tries to collect it using the apparatus shown.



(i) Bubbles of ammonia gas enter the water but no gas collects in the test-tube.

What happens to the ammonia gas when it enters the water?

.....

..... **[1]**

(ii) Which apparatus should Kofi use to collect ammonia?

Tick (✓) **one** box.

burette ☐

gas syringe ☐

measuring cylinder ☐

volumetric flask ☐

[1]

(d) Ammonia is an alkaline gas.

The pH of ammonia solution can be measured using a pH meter.

(i) Predict the pH of ammonia.

pH ..... **[1]**

(ii) Describe another method you could use to measure the pH of ammonia solution.

.....

.....

..... **[2]**