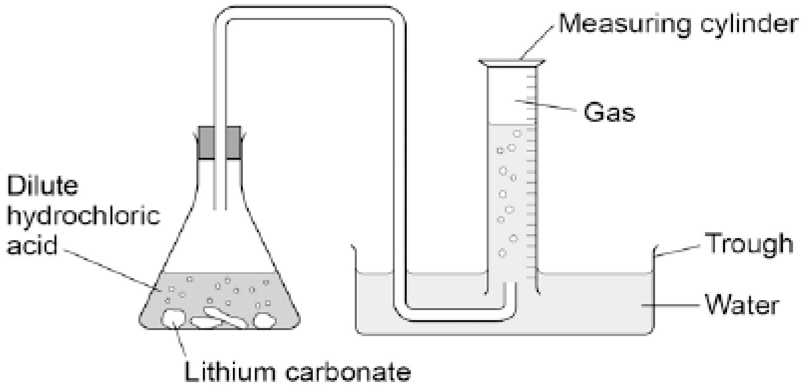
Q1. Lithium carbonate reacts with dilute hydrochloric acid.

A group of students investigated the volume of gas produced.

This is the method used.

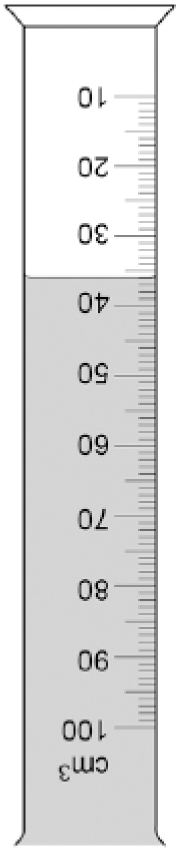
1. Place a known mass of lithium carbonate in a conical flask.
2. Measure 10 cm^3 of dilute hydrochloric acid using a measuring cylinder.
3. Pour the acid into the conical flask.
4. Place a bung in the flask and collect the gas as shown in **Figure 1**.

Figure 1



(a) **Figure 2** shows the measuring cylinder.

Figure 2



What volume of gas has been collected?

Volume = ... cm^3

(1)

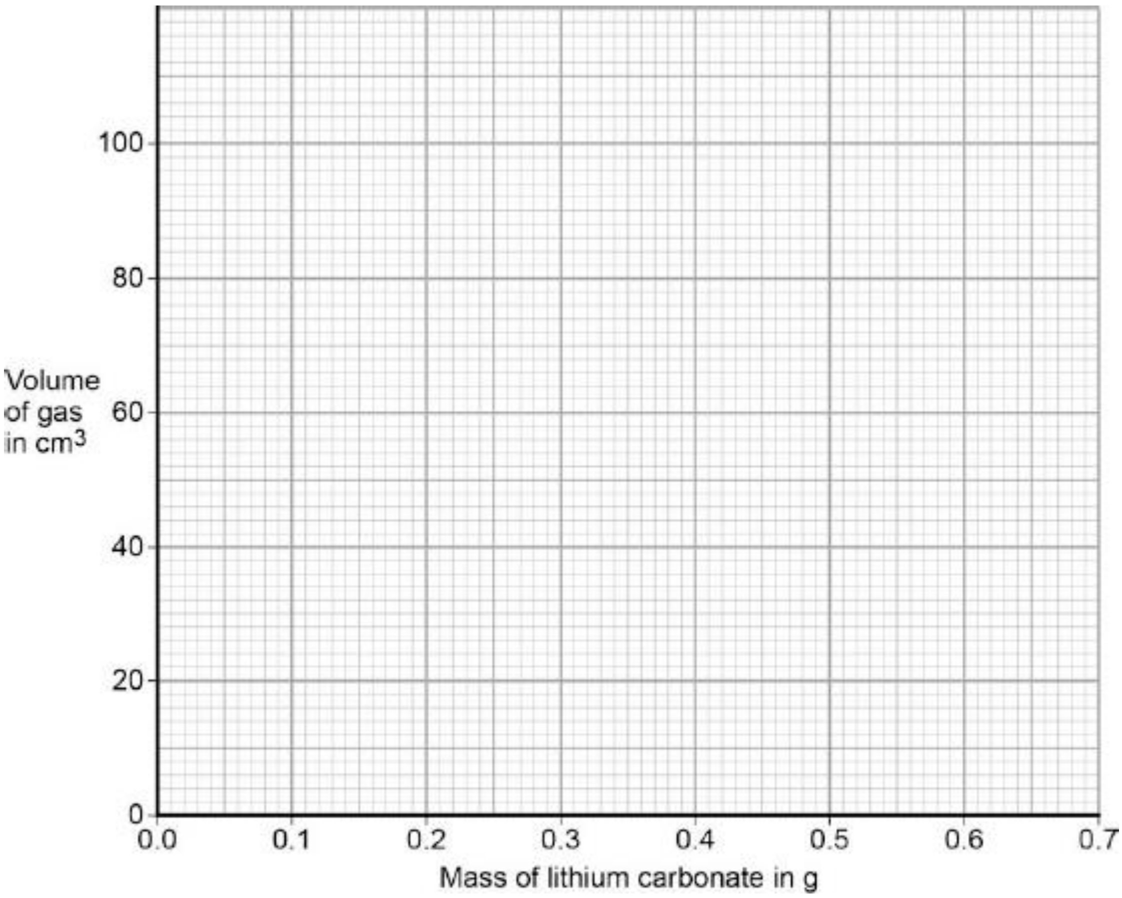
(b) The table below shows the students' results.

Mass of lithium carbonate in g	**Volume of gas in cm^3**
0.0	0
0.1	22
0.2	44
0.3	50
0.4	88
0.5	96
0.6	96
0.7	96

On **Figure 3**:

- Plot these results on the grid.
- Complete the graph by drawing **two** straight lines of best fit.

Figure 3



(4)

(c) What are **two** possible reasons for the anomalous result?

Tick **two** boxes.

Too much lithium carbonate was added.	☐
The bung was not pushed in firmly enough.	☐
There was too much water in the trough.	☐

The measuring cylinder was not completely over the delivery ☐

The conical flask was too small. ☐

(2)

(d) Describe the pattern the graph shows up to 0.4 g of lithium carbonate added.

....

....

....

....

(2)

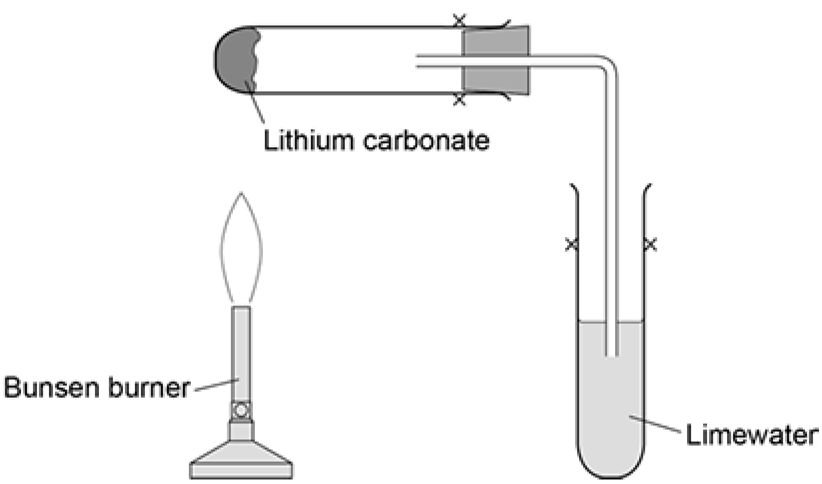
(e) Lithium carbonate decomposes when heated.

The equation shows the decomposition of lithium carbonate.

$Li_2CO_3 (s) \rightarrow Li_2O (s) + CO_2 (g)$

Figure 4 shows the apparatus a student used to decompose lithium carbonate.

Figure 4



Why does the limewater bubble?

....

....

(1)

(f) The student repeated the experiment with potassium carbonate.
The limewater did not bubble.

Suggest why there were **no** bubbles in the limewater.

....

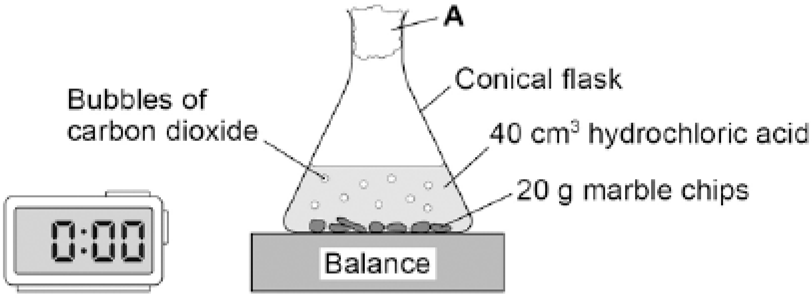
....

(1)
(Total 11 marks)

Q2. A student investigated the rate of reaction between marble chips and hydrochloric acid.

Figure 1 shows the apparatus the student used.

Figure 1



(a) What is **A**?

Tick **one** box.

cotton wool ☐

limestone ☐

poly(ethene) ☐

rubber bung ☐

(1)

(b) **Table 1** shows the student's results for one investigation.

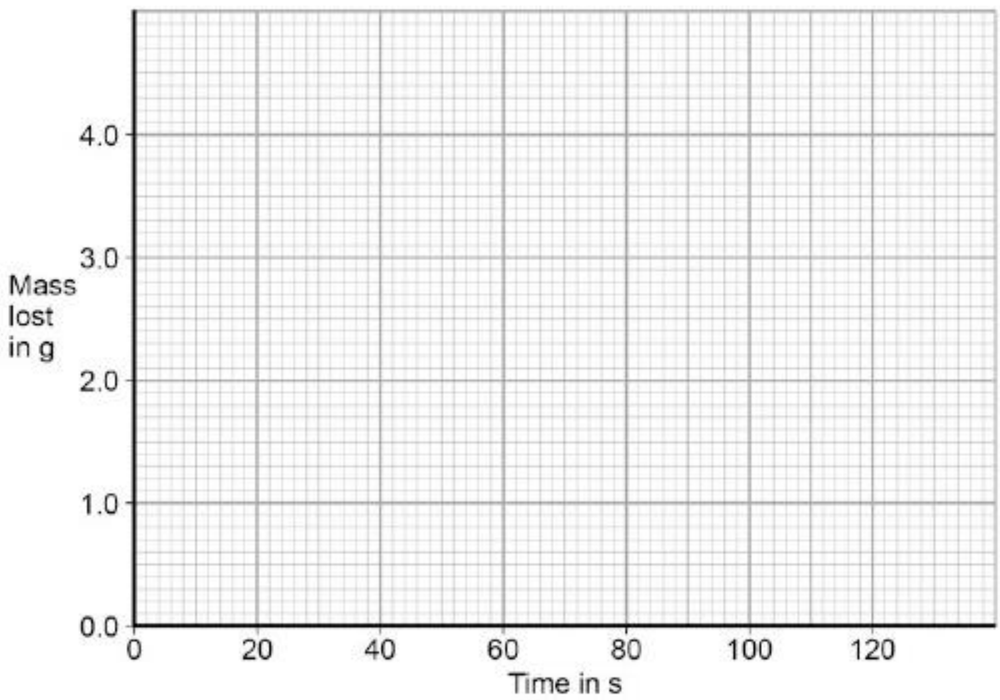
Table 1

Time in s	Mass lost in g
0	0.0
20	1.6
40	2.6
60	2.9

80	3.7
100	4.0
120	4.0

On **Figure 2**:
- Plot these results on the grid.
- Draw a line of best fit.

Figure 2



(3)

(c) Use **Figure 2** to complete **Table 2**.

Table 2

Mass lost after 0.5 minutes	.... g
Time taken to complete the reaction	.... s

(2)

(d) The equation for the reaction is:

$2HCl(aq) + CaCO_3(s) \rightarrow CaCl_2(aq) + H_2O(l) + CO_2(g)$

Explain why there is a loss in mass in this investigation.

....

....

....

....

(2)

(e) Another student investigated the rate of a different reaction.

Table 3 shows the results from the different reaction.

Table 3

Mass lost when the reaction was complete	9.85 g
Time taken to complete the reaction	2 minutes 30 seconds

Calculate the mean rate of the reaction using **Table 3** and the equation:

$$\text{mean rate of reaction} = \frac{\text{mass lost in g}}{\text{time taken in s}}$$

Give your answer to two decimal places.

....

....

Mean rate of reaction = ... g / s

(2)

(f) The student measured the change in mass of the reactants.

Describe another method, other than measuring the change in mass of the reactions, that the student could have used to find the rate of the reaction between marble chips and hydrochloric acid.

....

....

....

....

(2)

(g) Another student planned to investigate the effect of temperature on the rate of reaction. The student predicted that the rate of reaction would increase as the temperature was increased.

Give **two** reasons why the student's prediction is correct.

Tick **two** boxes.

The particles are more concentrated. ☐

The particles have a greater mass. ☐

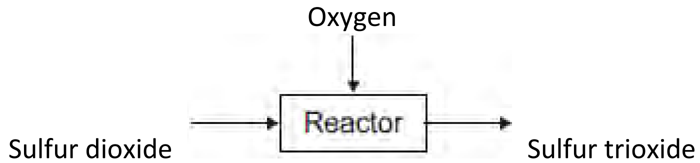
The particles have a larger surface area. ☐

The particles have more energy. ☐

The particles move faster. ☐

(2)
(Total 14 marks)

Q3.(a) The figure below represents the reaction of sulfur dioxide with oxygen.



(i) Complete the word equation for the reaction of sulfur dioxide with oxygen.

sulfur dioxide + ... $\longrightarrow$ ....

(1)

(ii) Draw a ring around the correct answer to complete the sentence.

Sulfur dioxide (SO_2) is	a compound. an element. a mixture.

(1)

(b) The reactants are gases.

When the pressure of the gases is increased, the reaction gets faster.

Complete the sentence.

When the pressure of the gases is increased,

the frequency of the collisions ....

(1)

(c) The particles need energy to react.

Complete the sentence.

The minimum amount of energy that particles need to react is called

the .... energy.

(1)

(d) Give **one** way of increasing the rate of the reaction other than changing the pressure.

....

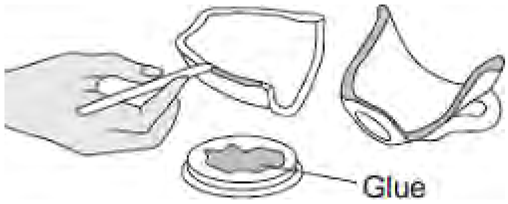
....

(1)
(Total 5 marks)

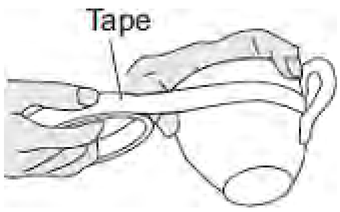
Q4. The following steps show how to use a type of glue.

Step 1 Measure out equal amounts of the liquids from tubes **A** and **B**.

Step 2 Mix the liquids to make the glue.
Put a thin layer of the glue onto each of the surfaces to be joined.



Step 3 Put the pieces together and hold them with tape.



Step 4 Leave the glue to set.

(a) When liquids **A** and **B** are mixed a chemical reaction takes place.

This reaction is *exothermic*.

What does *exothermic* mean?

....

....

....

....

(2)

(b) The time taken for the glue to set at different temperatures is given in the table below.

Temperature in°C	**Time taken for the glue to set**
20	3 days
60	6 hours
90	1 hour

(i) Use the correct answer from the box to complete each sentence.

decreases	**increases**	**stays the same**

When the temperature is increased the time taken for the glue to set

....

When the temperature is increased the rate of the setting reaction

....

(2)

(ii) Tick (✓) **two** reasons why an increase in temperature affects the rate of reaction.

Reason	**Tick (✓)**
It gives the particles more energy	
It increases the concentration of the particles	

It increases the surface area of the particles	
It makes the particles move faster	

(2)
(Total 6 marks)

Q5. Nanoparticles have many uses.

(a) (i) Tick (✔) **one** use of nanoparticles.

In the extraction of iron	☐
In suntan creams	☐
In the test for oxygen	☐

(1)

(ii) How is the size of nanoparticles different from normal-sized particles?

Draw a ring around the correct answer.

much smaller **same size** **much larger**

(1)

(b) Very small amounts of cerium oxide nanoparticles can be added to diesel fuel.

The cerium oxide is a catalyst.

(i) Draw a ring around the correct answer to complete the sentence.

Only a very small amount of cerium oxide nanoparticles is needed because

	are elements.
the nanoparticles	are very reactive.
	have a high surface area to volume ratio.

(1)

(ii) Explain how a catalyst increases the rate of a reaction.

....

....

....

....

....

(2)
(Total 5 marks)

Q6. (a) Ammonia solution is used in cleaning products to remove grease from kitchen surfaces.

Ammonia solution is alkaline.

(i) Draw a ring around the number most likely to be the pH of ammonia solution.

1 **3** **7** **10**

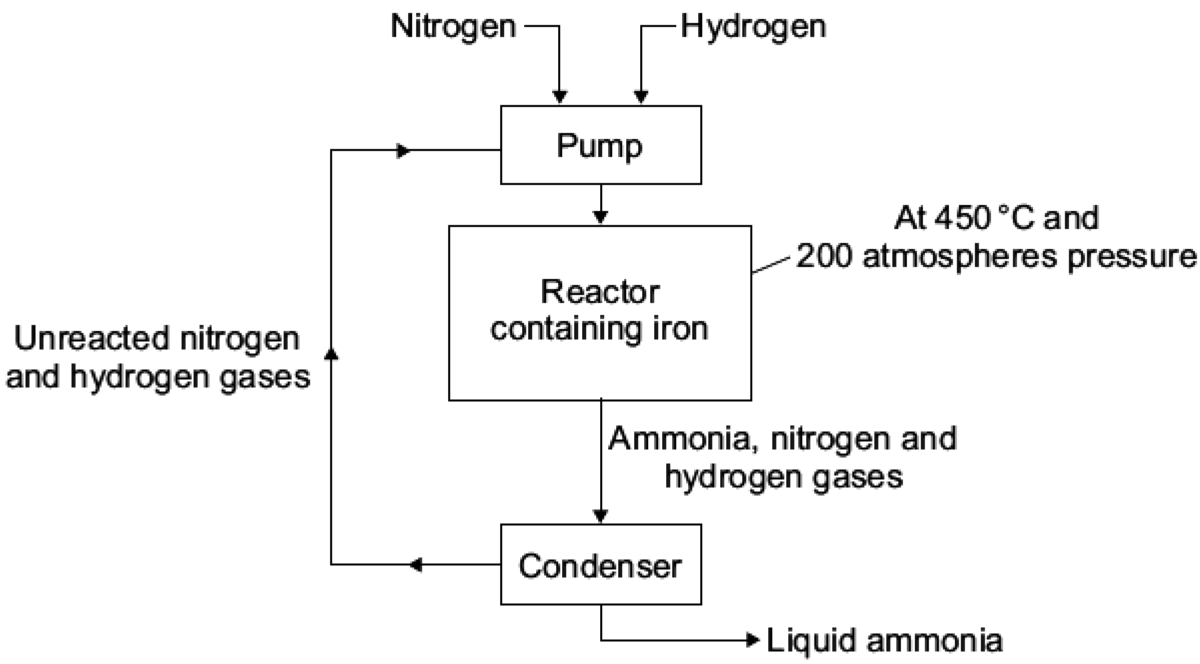
(1)

(ii) Draw a ring around the ion in ammonia solution which makes it alkaline.

$\mathbf{Cl^-}$ $\mathbf{H^+}$ $\mathbf{Na^+}$ $\mathbf{OH^-}$

(1)

(b) Ammonia is made using the Haber process.



(i) Where does the nitrogen used in the Haber process come from?

Draw a ring around your answer.

air **natural gas** **water**

(1)

(ii) A high temperature of 450 °C is used in the reactor.

Tick (✓) **two** reasons in the table which explain why high temperatures make reactions faster.

Reasons	**Tick (✓)**
Particles move faster	
Particles are closer together	
Particles collide more often	
Particles have less energy	

(2)

(iii) The iron in the reactor speeds up the reaction but is not used up.

What is the name given to substances that speed up the chemical reaction but which are not used up during the reaction?

....

(1)

(c) Complete the sentence.

The condenser separates the ammonia from the unreacted nitrogen and hydrogen by

turning the ammonia into a ....

(1)
(Total 7 marks)