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A student investigated the rate of reaction by measuring the mass lost during the reaction.

**Table 3** shows the results from the reaction.

**Table 3**

Mass lost when the reaction was complete	8.30 g
Time taken to complete the reaction	2 minutes 30 seconds

**DON'T FORGET :**  
Always show your working. Even if you calculated the number of seconds incorrectly, you would still get a mark for using the equation correctly. This is called error carried forward (ecf).

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

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

Show your working below and give your answer to two decimal places.

**2 minutes 30 seconds = 150 seconds**

$$\frac{8.30}{150} = 0.055333$$

Mean rate of reaction = **0.06** g / s

**[2 marks]**

0	1	.	2
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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 marks]**

collect the gas in a gas syringe [1]  
and

measured the volume of gas [1]  
(allow carbon dioxide for gas)

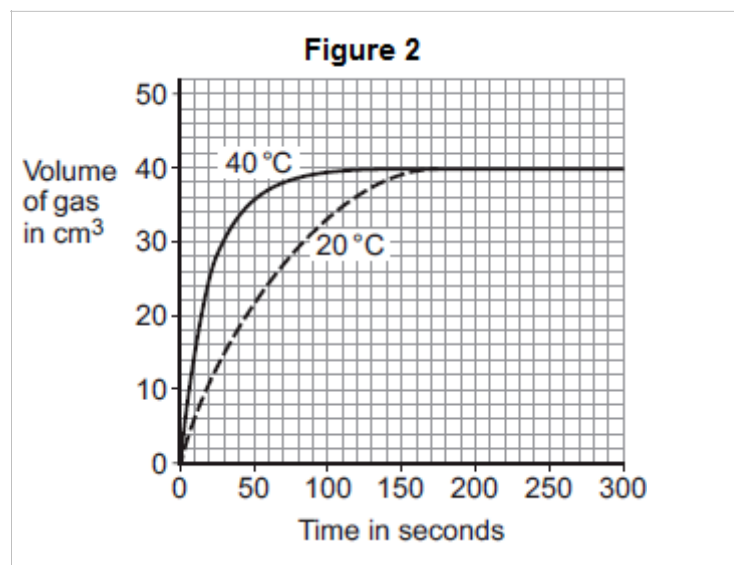
allow for 1 mark  
collected gas or counted bubbles [1]

**The next question continues on the next page.**

0 2

Another student investigated the effect of temperature on the reaction between hydrochloric acid and calcium carbonate.

She plotted the results for the hydrochloric acid at 20 °C and 40 °C on a graph. **Figure 2** shows the student's graph.



0 2

1

Use information from **Figure 2** to answer these questions.

State **one** conclusion the student could make about the effect of temperature on the rate of the reaction. [1 mark]

*the higher the temperature, the greater the rate/faster the reaction*  
 or  
*at 40 °C rate is faster than at 20 °C*

0 2

2

Give **one** reason why the student could make this conclusion. [1 mark]

*40 °C curve is steeper/becomes horizontal sooner/finishes sooner*  
*(accept at higher temperatures the reaction finishes sooner/gas is produced faster)*  
*(accept correct comparison of data from the graph)*

0 2

3

For the hydrochloric acid at 60 °C the student had collected 30 cm<sup>3</sup> after 15 seconds.

Calculate the average rate of reaction from 0 to 15 seconds. [1 mark]

$\frac{30}{15} = 2$

Rate of reaction = .....2..... cm<sup>3</sup> per second

End