

# Effect of Changing Surface Area on Rate of Reaction Worksheet

Combined Science - Chemistry - Key Stage 4

The Rate and Extent of Chemical Change

Dr Deng



# Which of the following marble chips has the greatest surface area to volume ratio?

A

One large piece with a volume of  $27\text{cm}^3$

B

Two medium pieces with a total volume of  $27\text{cm}^3$

C

4 small pieces with a total volume of  $27\text{cm}^3$

D

Powder with a total volume of  $27\text{cm}^3$



# Which of the following is NOT a factor affecting rate of reaction?

A

Pressure of reacting gases

B

Colour of the reactant

C

Temperature

D

Presence of catalysts



# Why is the rate for reactions using powder reactants greater than when larger lumps are used?

A

Smaller surface area to volume ratio

B

Smaller volume

C

Larger volume

D

Larger surface area to volume ratio



**From a graph, how can we tell when the rate of reaction is the greatest?**

**A**

Steepest gradient

**B**

Constant gradient

**C**

Changing gradient

**D**

None of the above



# Why do reactions slow down and eventually stop?

A

All products are used up

B

All the gas has been released

C

All reactants are used up

D

None of the above



# Multiple choice quiz answers



**Which of the following marble chips has the greatest surface area to volume ratio?**

**D**

Powder with a total volume of  $27\text{cm}^3$





**Which of the following is NOT a factor affecting rate of reaction?**

**B**

Colour of the reactant



**Why is the rate for reactions using powder reactants greater than when larger lumps are used?**

D

Larger surface area to volume ratio



**From a graph, how can we tell when the rate of reaction is the greatest?**

**A**

Steepest gradient



# Why do reactions slow down and eventually stop?

C

All reactants are used up



# Graph plotting task



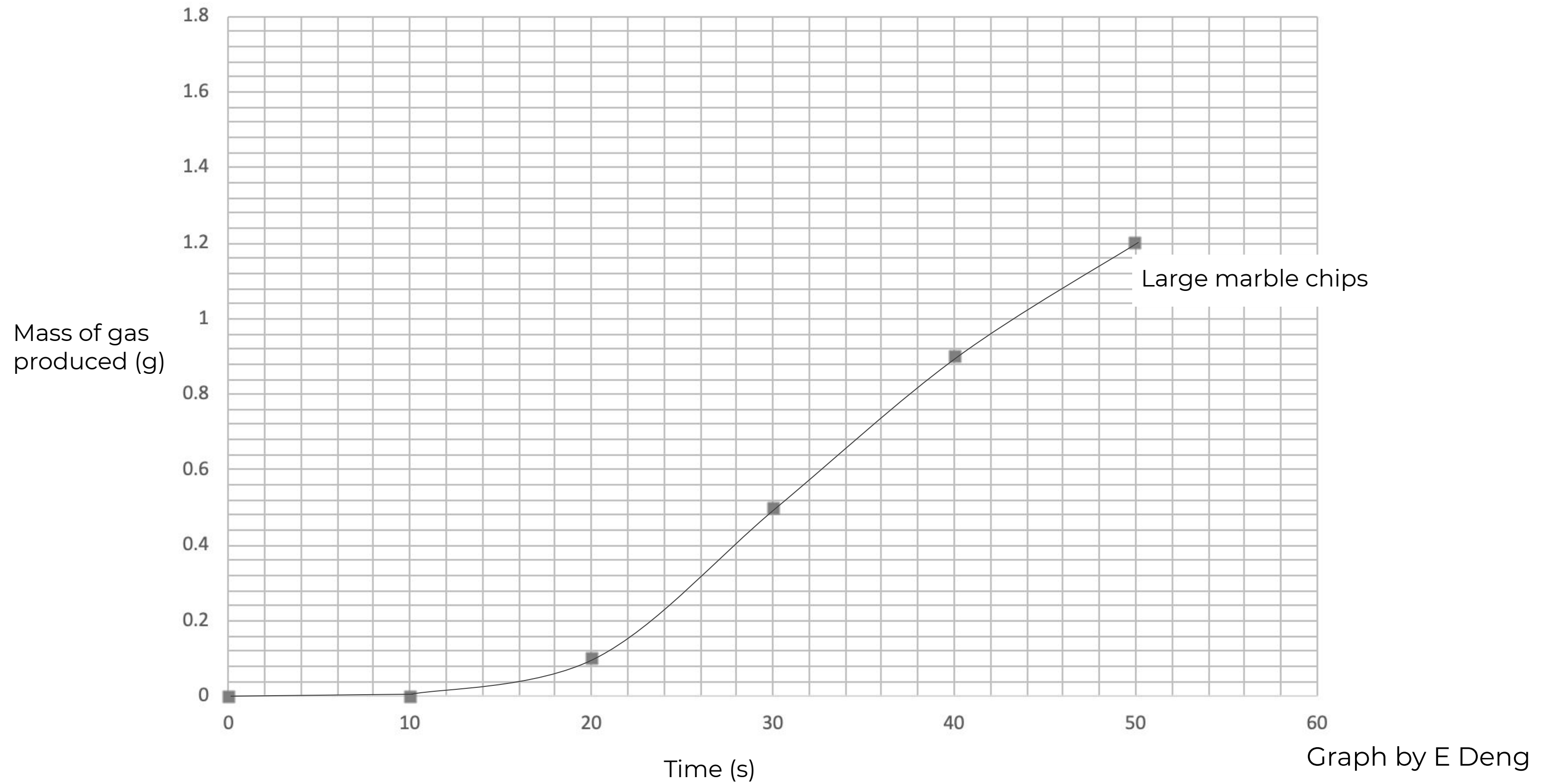
# Table of results

Task: Plot a graph using the data points for small and medium marble chips. The graph for the reaction using large marble chips has been done for you.

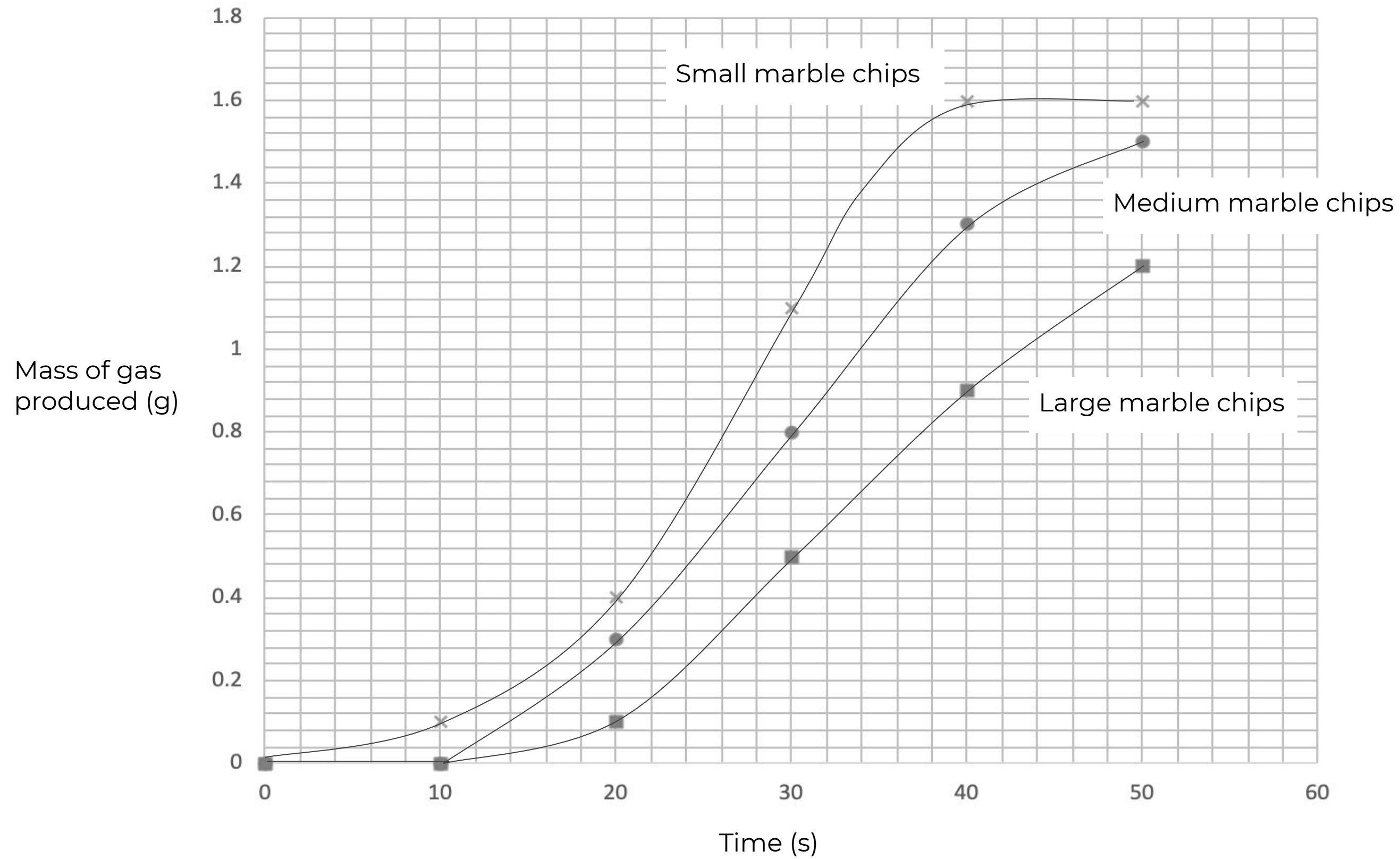
Time (s)	Mass of gas produced (g)		
	Small marble chips	Medium marble chips	Large marble chips
0	0.0	0.0	0.0
10	0.1	0.0	0.0
20	0.4	0.3	0.1
30	1.1	0.8	0.5
40	1.6	1.3	0.9
50	1.6	1.5	1.2



# Task: Plot graph for medium and large marble chips



# Check your graph



Graph by E Deng





# Exam style questions



# Task 1

A student investigated the effect of different sizes of marble chips on the rate of reaction between marble chips and hydrochloric acid. The student measured the volume of gas produced every 10 seconds using a gas syringe. Identify the:

Independent variable -

Dependent variable -

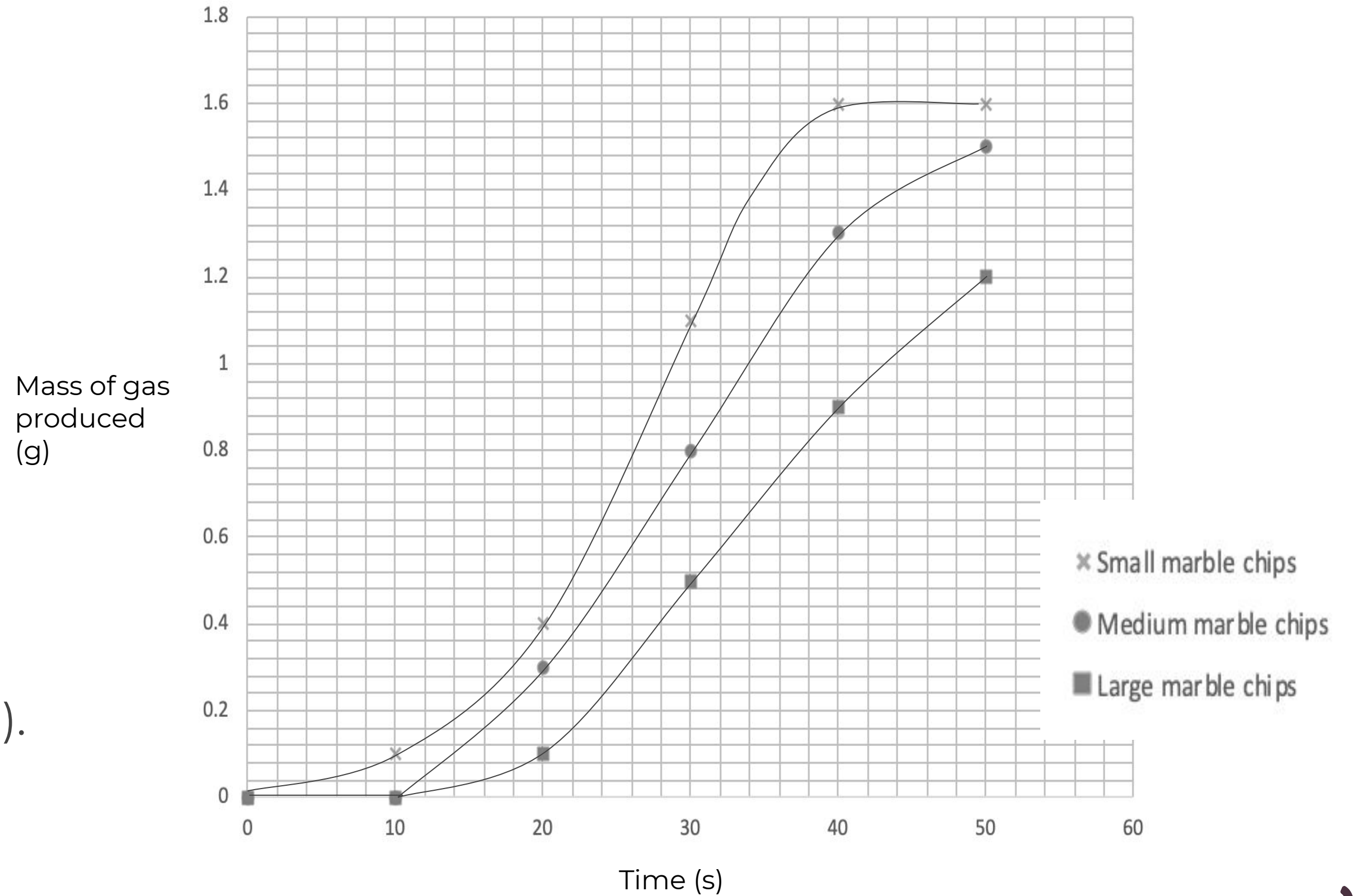
Control variables -



# Task 2

a) Calculate the mean rate of reaction between 20 s and 30 s for the reaction using small marble chips.

b) What is the unit for the mean rate of reaction calculated from question (a).



# Task 3

The figure shows a large marble chip and 27 small marble chips. The large marble chip has the same total volume as the 27 small marble chips, but a different surface area.

Explain why do the 27 small marble chips react faster than the large marble chip?

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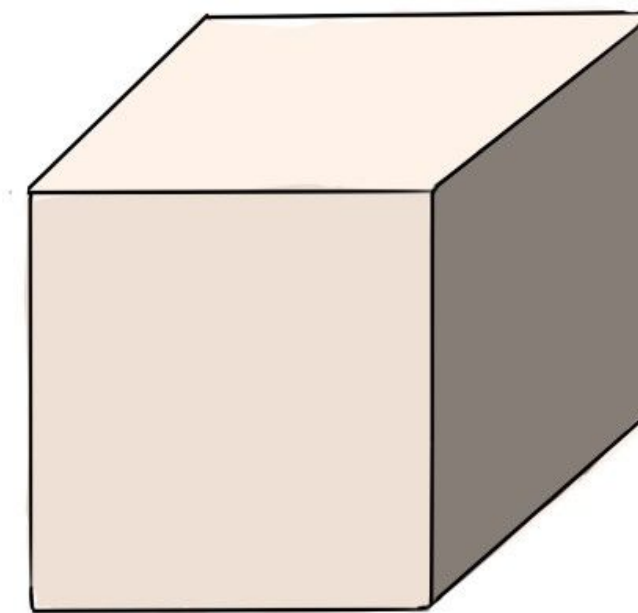
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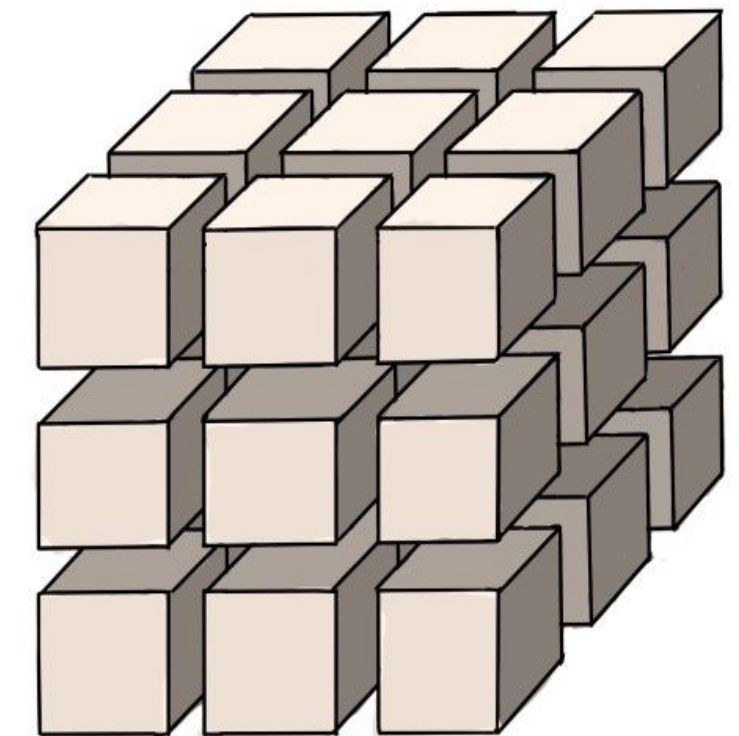
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Large marble chip



27 small marble chips

Source: EltontheArtist



# Task 1 answer

A student investigated the effect of different sizes of marble chips on the rate of reaction between marble chips and hydrochloric acid. The student measured the volume of gas produced every 10 seconds using a gas syringe. Identify the:

Independent variable - *Size of marble chips*

Dependent variable - *Volume of gas produced ( $\text{cm}^3$ )*

Control variables - *Concentration of hydrochloric acid*  
- *Volume of hydrochloric acid*  
- *Temperature*



# Task 2 answer

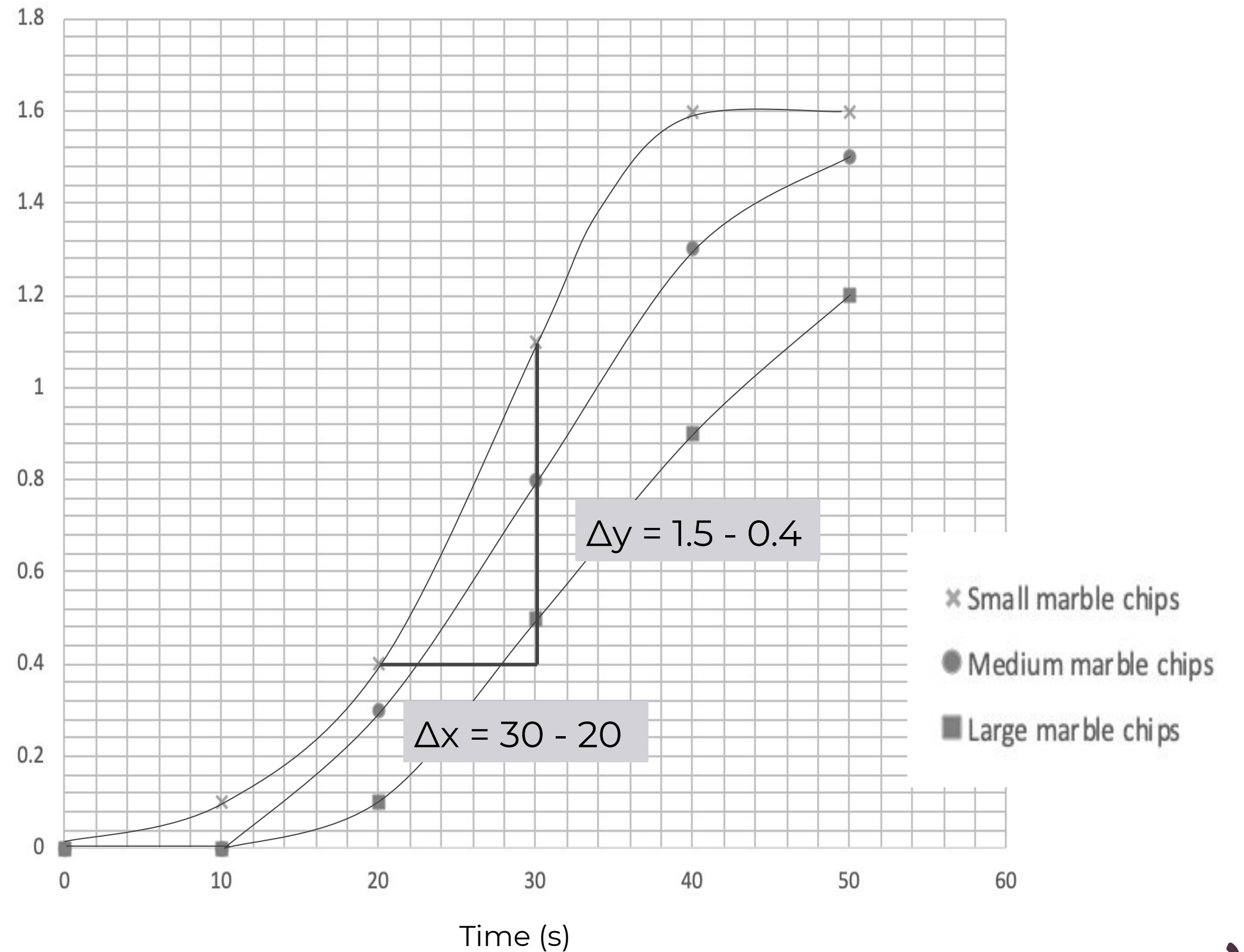
a) Calculate the mean rate of reaction between 20 s and 30 s for the reaction using small marble chips.

$$\begin{aligned}\text{Rate} &= \Delta y / \Delta x \\ &= (1.5 - 0.4) / (30 - 20) \\ &= 1.1 / 10 \\ &= 0.11\end{aligned}$$

b) What is the unit for the mean rate of reaction calculated from question (a).

$g/s$

Mass of gas produced (g)



Graph by E Deng

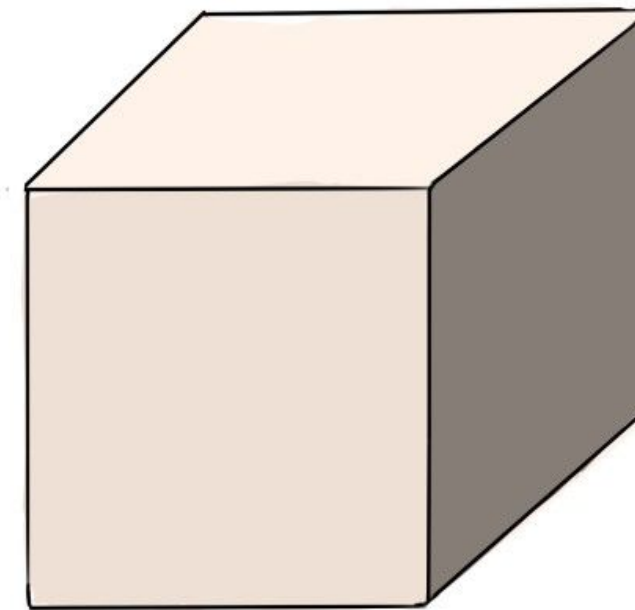


# Task 3 answer

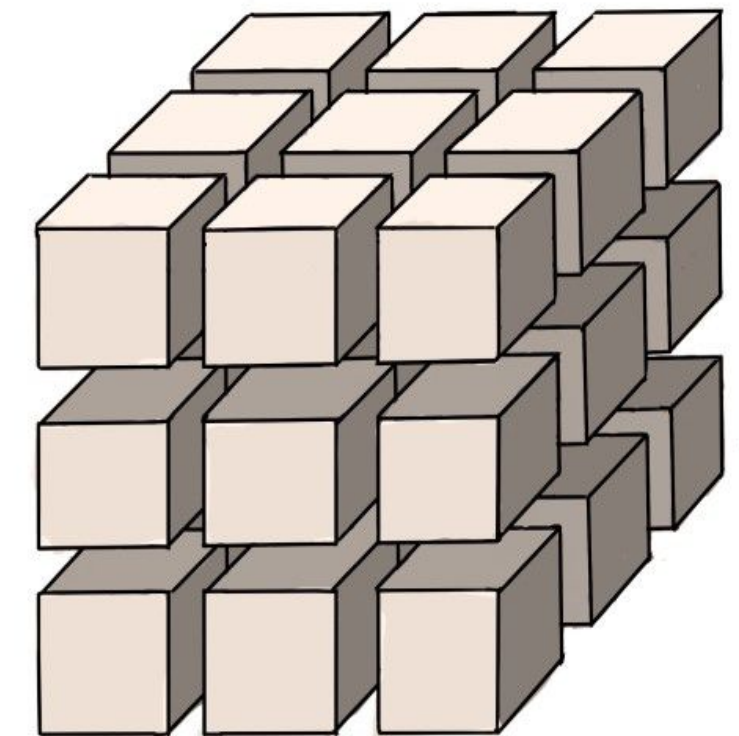
The figure shows a large marble chip and 27 small marble chips. The large marble chip has the same total volume as the 27 small marble chips, but a different surface area.

Explain why do the 27 small marble chips react faster than the large marble chip?

The 27 small marble chips have a larger surface area to volume ratio, so more frequent collisions and faster rate of reaction.



Large marble chip



27 small marble chips

Source: EltontheArtist

