The Rate and Extent of Chemical Change: Review 1 Worksheet

Combined Science - Chemistry - Key Stage 4

The Rate and Extent of Chemical Change

Dr Deng

Calculate mean rate of reaction

Question 1

A student investigated the rate of reaction between calcium carbonate (marble chips) and hydrochloric acid.

The student had collected 30 cm^3 of gas produced after 15 seconds. Calculate the mean rate of reaction from 0 to 15 seconds.

Question 2

A student investigated the rate of reaction between calcium carbonate (marble chips) and hydrochloric acid.

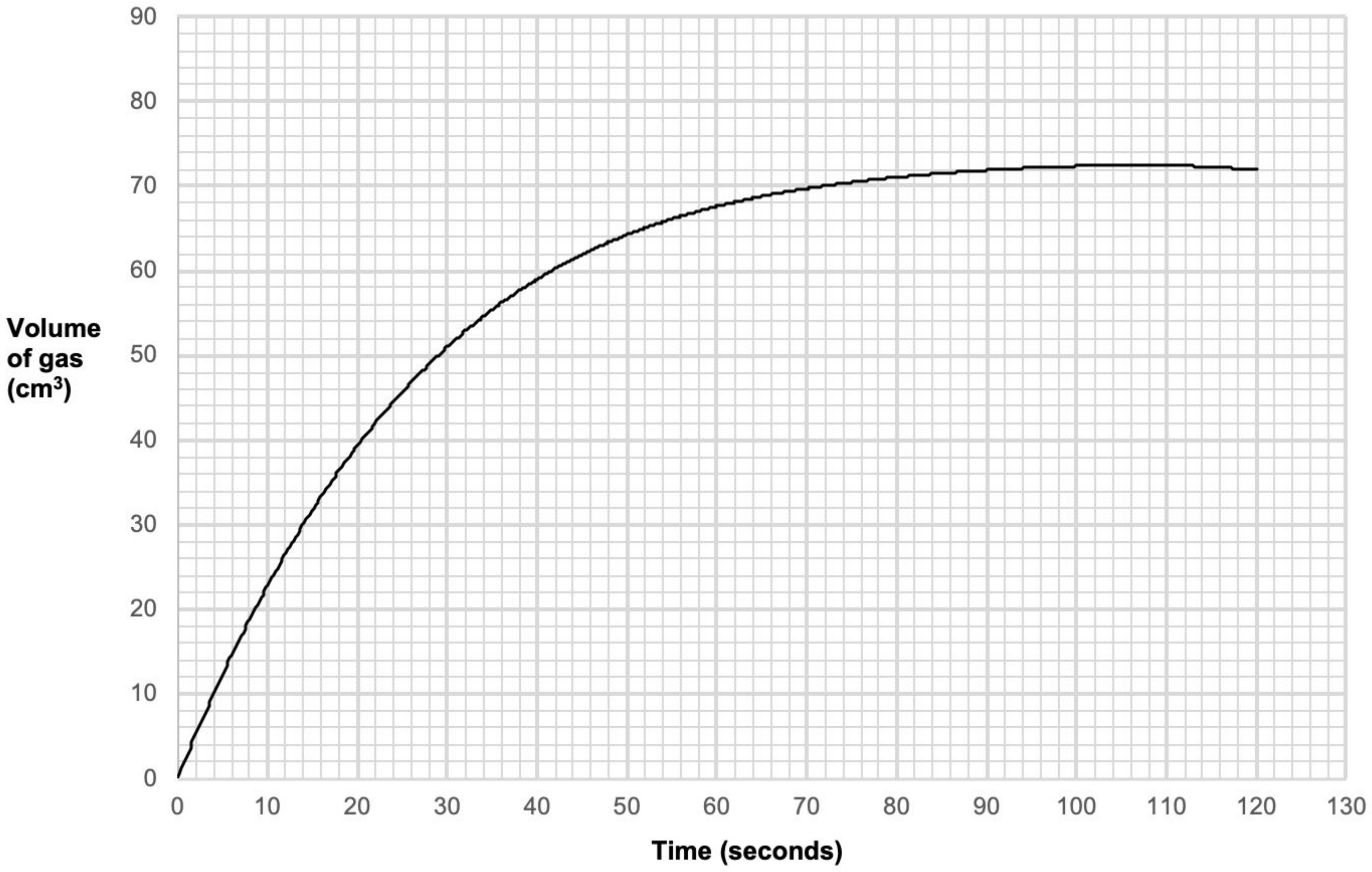
The student had recorded an initial reactant mass of 27 g. The mass of the product recorded was 24.9 g after 30 seconds. Calculate the mean rate of reaction from 0 to 30 seconds.

Calculate mean rate of reaction from graphs

If time is on the x axis, the **gradient** represents the rate

$$\text{Gradient} = \frac{\Delta y}{\Delta x}$$

Find mean rate of reaction in the first 18 seconds



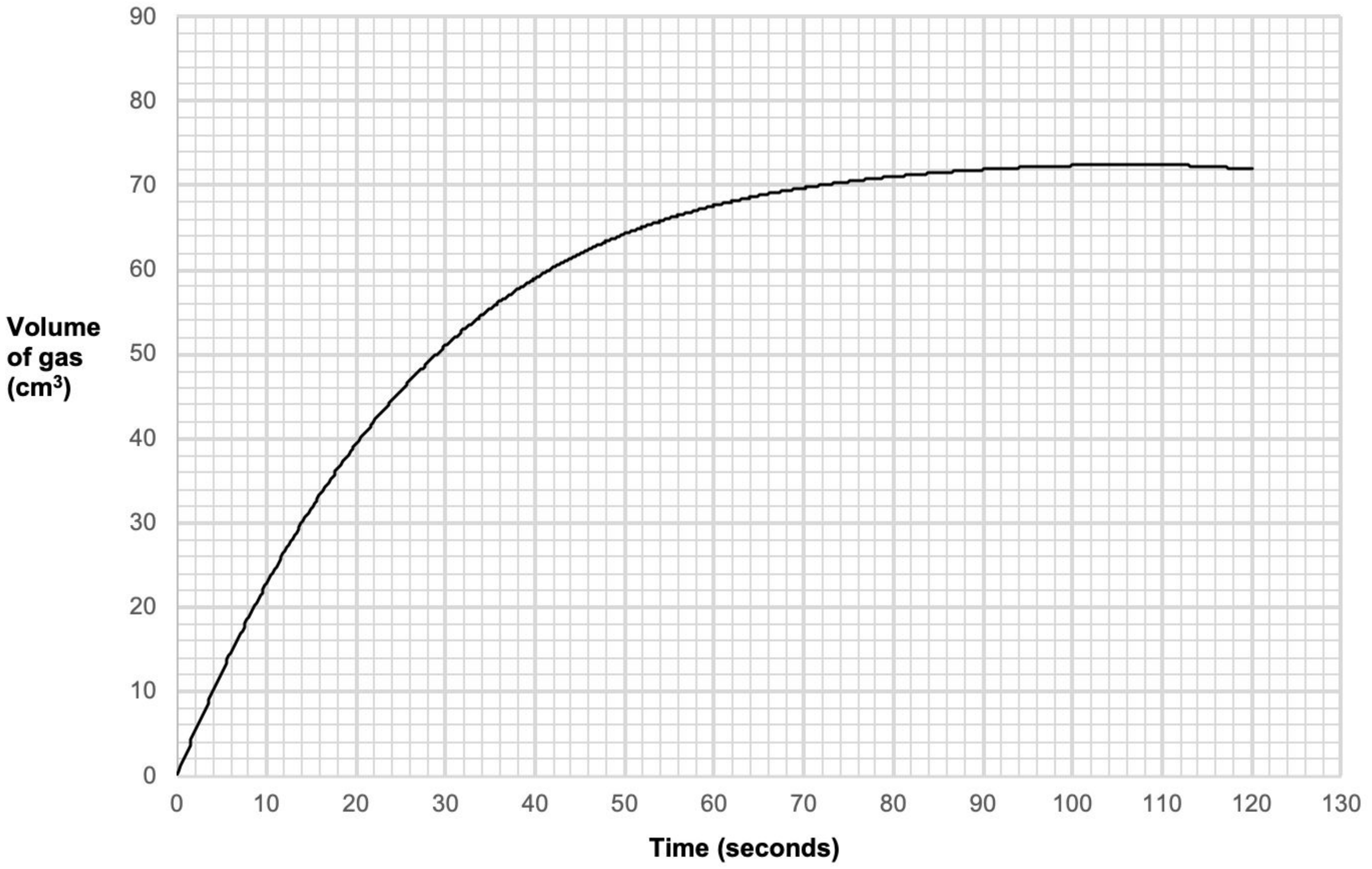
Rate of reaction graph, E Deng

Calculate mean rate of reaction from graphs

If time is on the x axis, the **gradient** represents the rate

$$\text{Gradient} = \frac{\Delta y}{\Delta x}$$

Find mean rate of reaction between 30 to 50 seconds



Rate of reaction graph, E Deng

Calculate mean rate of reaction answers

Question 1 answer

A student investigated the rate of reaction between calcium carbonate (marble chips) and hydrochloric acid.
The student had collected 30 cm^3 of gas produced after 15 seconds. Calculate the mean rate of reaction from 0 to 15 seconds.

$$\textbf{Mean rate of reaction} = \frac{\textbf{quantity of product formed}}{\textbf{time taken}}$$

$$\textbf{Mean rate of reaction} = \frac{30\ cm^3}{15\ s}$$

$$\textbf{Mean rate of reaction} = 2\ cm^3/s$$

Question 2 answer

A student investigated the rate of reaction between calcium carbonate (marble chips) and hydrochloric acid.
The student had recorded an initial reactant mass of 27 g. The mass of the product recorded was 24.9 g after 30 seconds. Calculate the mean rate of reaction from 0 to 30 seconds.

$$\textbf{Mean rate of reaction} = \frac{\textbf{quantity of reactant used}}{\textbf{time taken}}$$

$$\textbf{Mean rate of reaction} = \frac{27 - 24.9\ \text{g}}{30\ \text{s}}$$

Mean rate of reaction = 0.07 g/s

Answer

If time is on the x axis, the **gradient** represents the rate

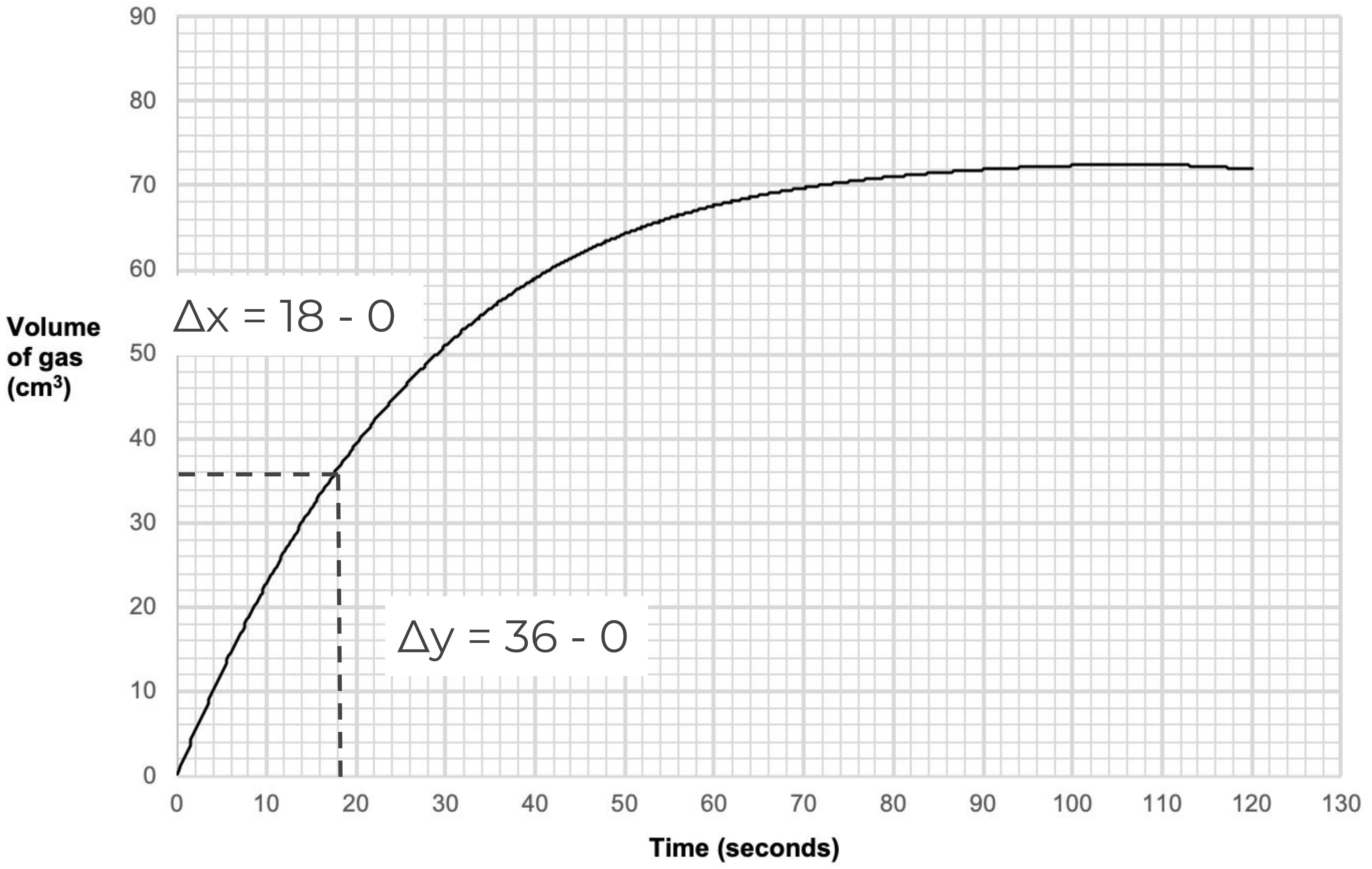
Gradient = $\frac{\Delta y}{\Delta x}$

Find mean rate of reaction in the first 18 seconds

$= \frac{\Delta y}{\Delta x}$

$= \frac{36\ cm^3}{18\ s}$

$= 2\ cm^3/s$



Rate of reaction graph, E Deng

Answer

If time is on the x axis, the **gradient** represents the rate

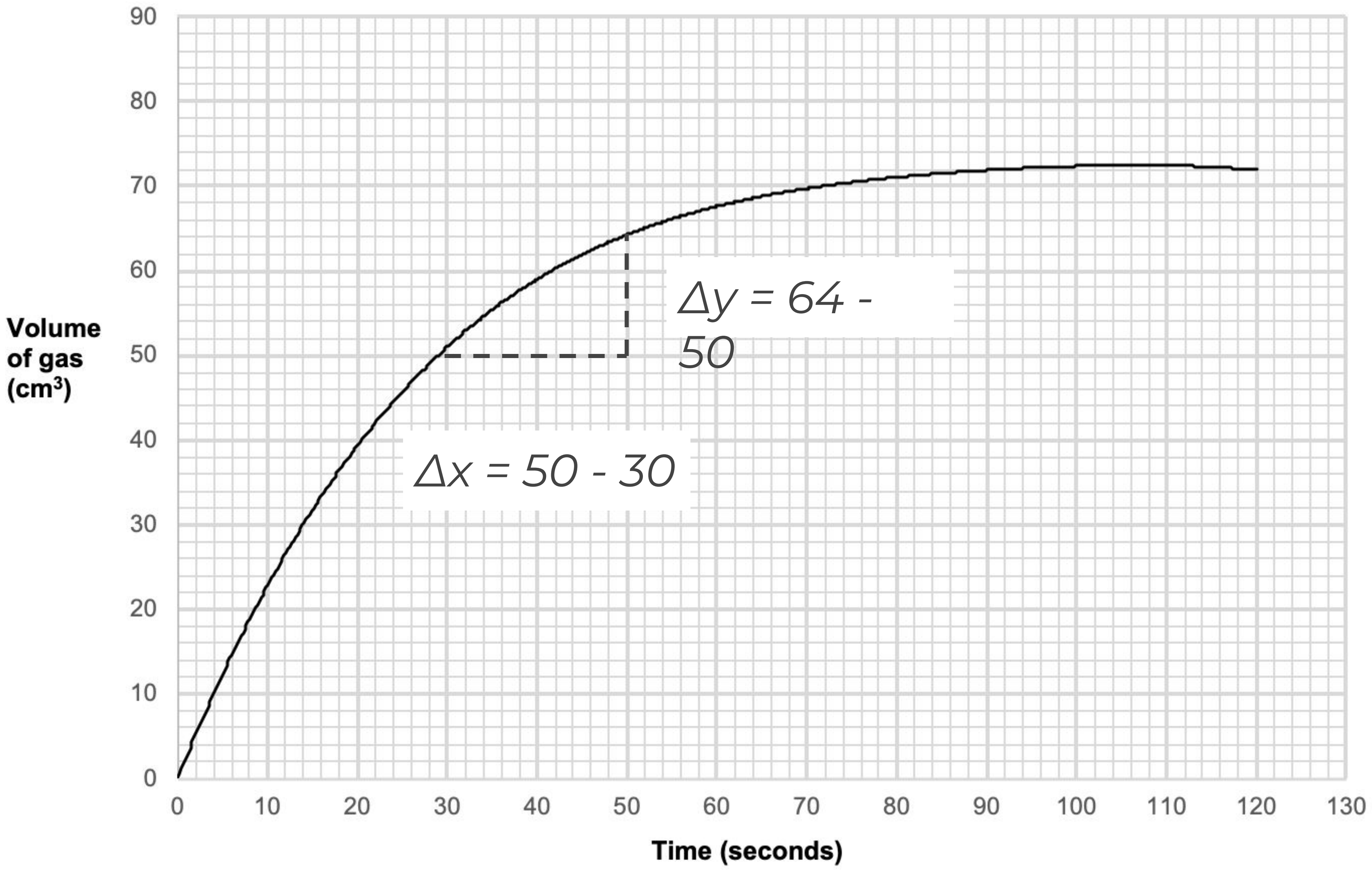
Gradient = $\frac{\Delta y}{\Delta x}$

Find mean rate of reaction between 30 to 50 seconds

$= \frac{\Delta y}{\Delta x}$

$= \frac{64 - 50 \text{ cm}^3}{50 - 30 \text{ s}}$

$= 0.7 \text{ cm}^3\text{/s}$



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Multiple choice quiz

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

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

B

Constant gradient

C

Changing gradient

D

None of the above

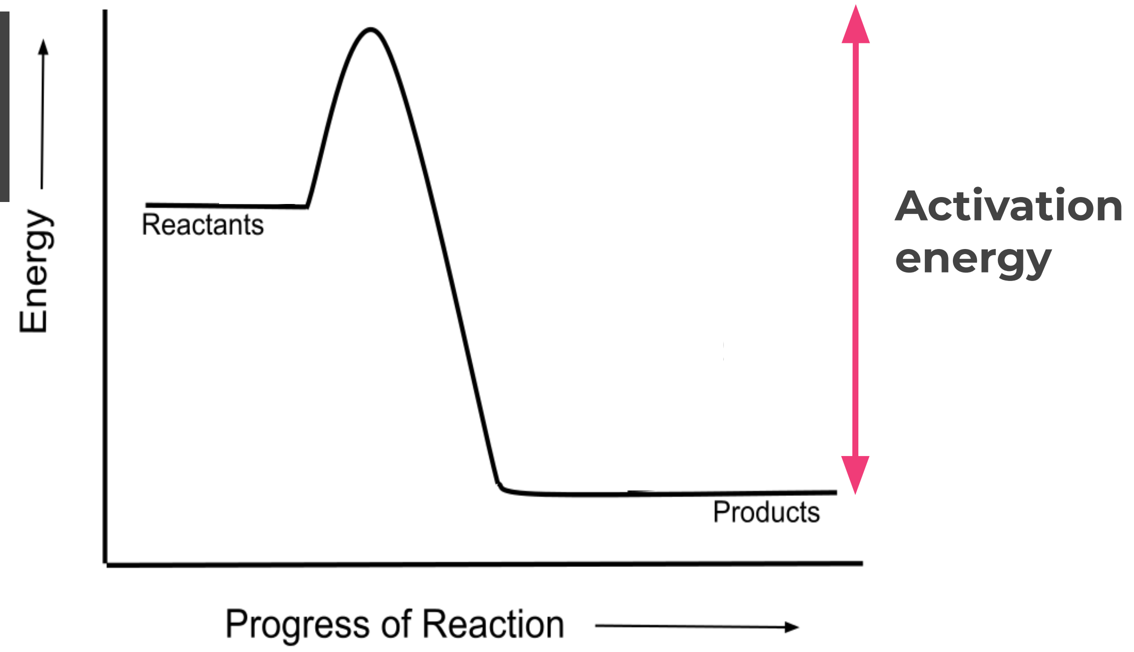
From a graph, how can we tell when the rate of reaction is the greatest?

A

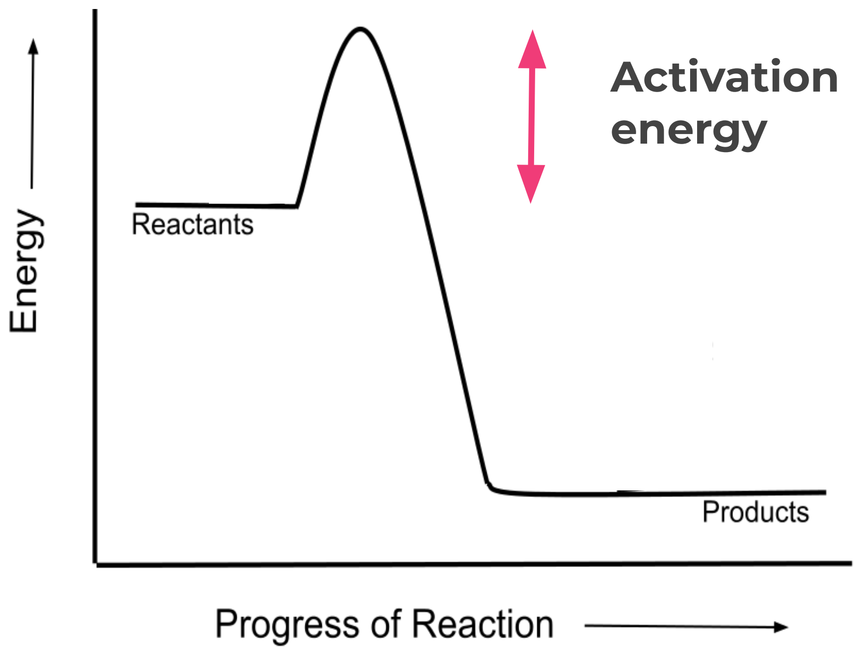
Steepest gradient

In which of the following reaction profile diagrams is activation energy labelled correctly?

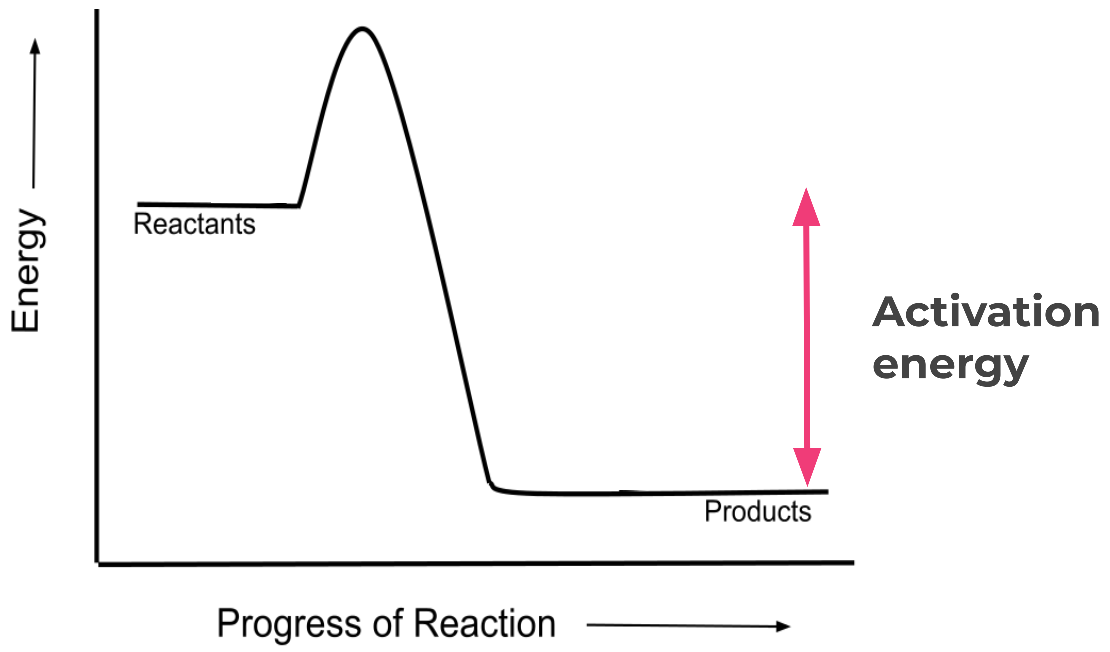
A



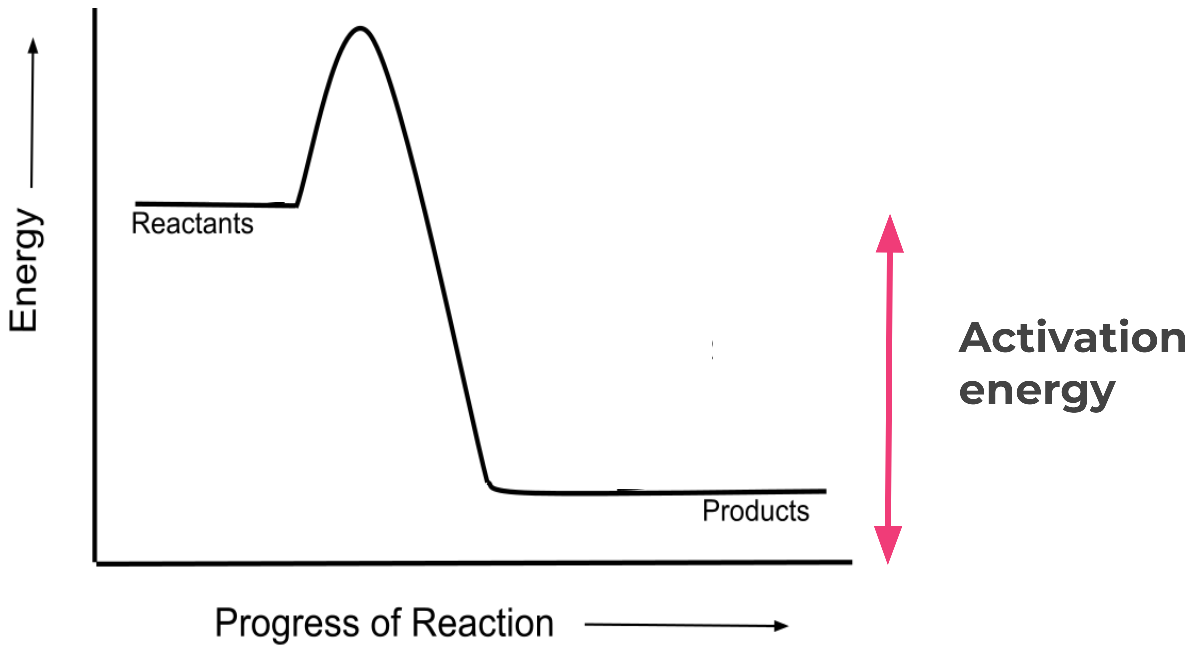
B



C



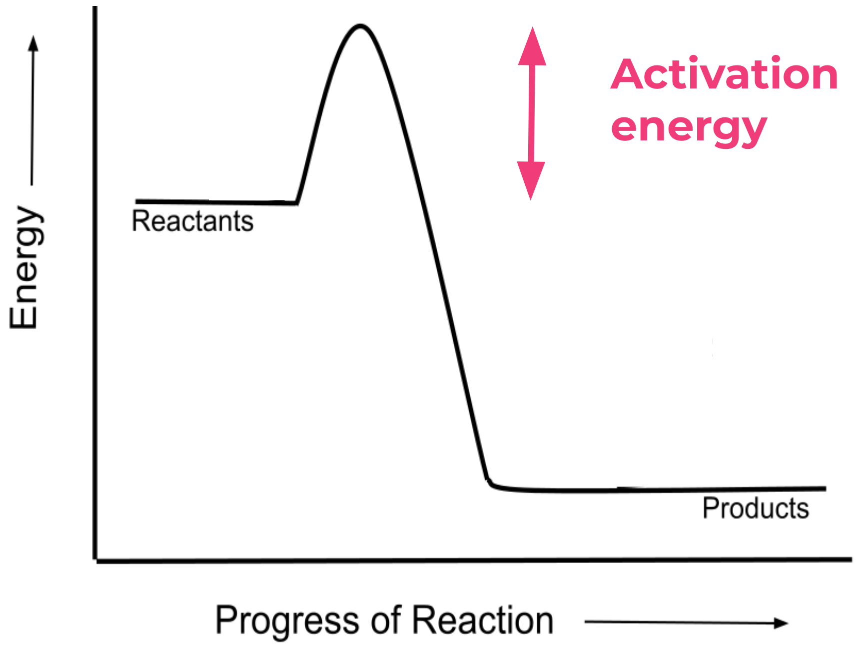
D



Source: Exergonic Reaction, Provenzano15, Wikimedia Commons

In which of the following reaction profile diagrams is activation energy labelled correctly?

B



Source: Exergonic Reaction, Provenzano15, Wikimedia Commons

In an endothermic reaction, energy is…

A

Given out to the surroundings

B

Taken in from the surroundings

C

The same

D

Measured in °C

In an endothermic reaction, energy is…

B

Taken in from the surroundings

What is ‘dynamic equilibrium’?

A

The point where forward and reverse reactions happen at the same time in a closed system

B

The point where forward and reverse reactions happen at the same rate in a closed system

C

The point where forward and reverse reactions happen at the same temperature

D

The point where forward and reverse reactions happen at the same rate in an open system

What is ‘dynamic equilibrium’?

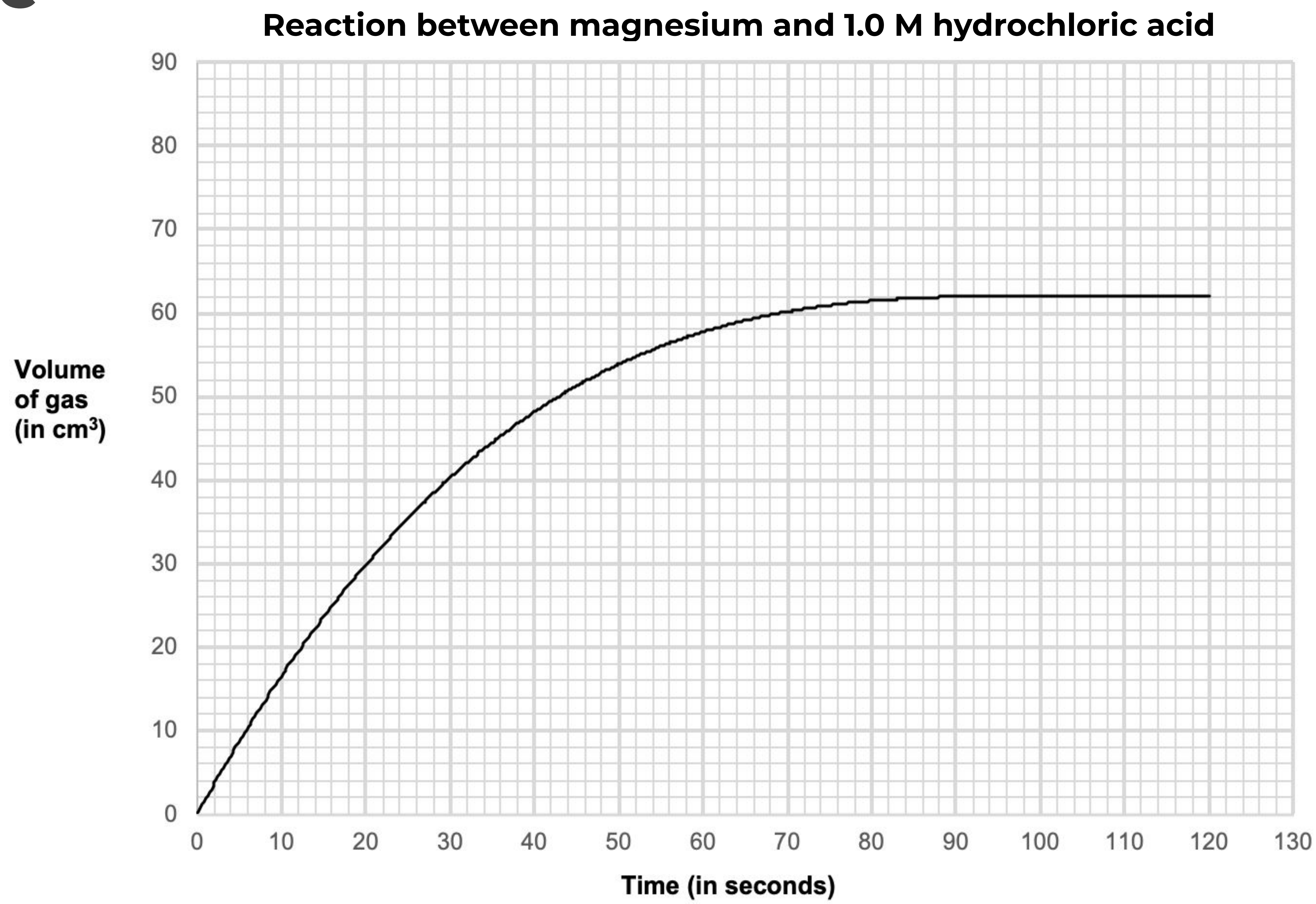
B

The point where forward and reverse reactions happen at the same rate in a closed system

Independent practice

Independent practice

1) Using the graph, calculate the mean rate of reaction in the first 20 seconds. (3)
2) Describe what is happening to rate of reaction in the first 20 seconds. (2)
3) Suggest why the volume of gas produced between 90 and 120 seconds did not change. (2)
4) Explain, in terms of collision theory, how increasing concentration of hydrochloric acid increases rate of reaction with magnesium. (2)



Rate of reaction graph, E Deng

Independent practice 2

$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$

Hypothesis: Increasing the concentration of hydrochloric acid increases the rate of reaction with sodium thiosulphate.

Question 1: Identify the following (4)

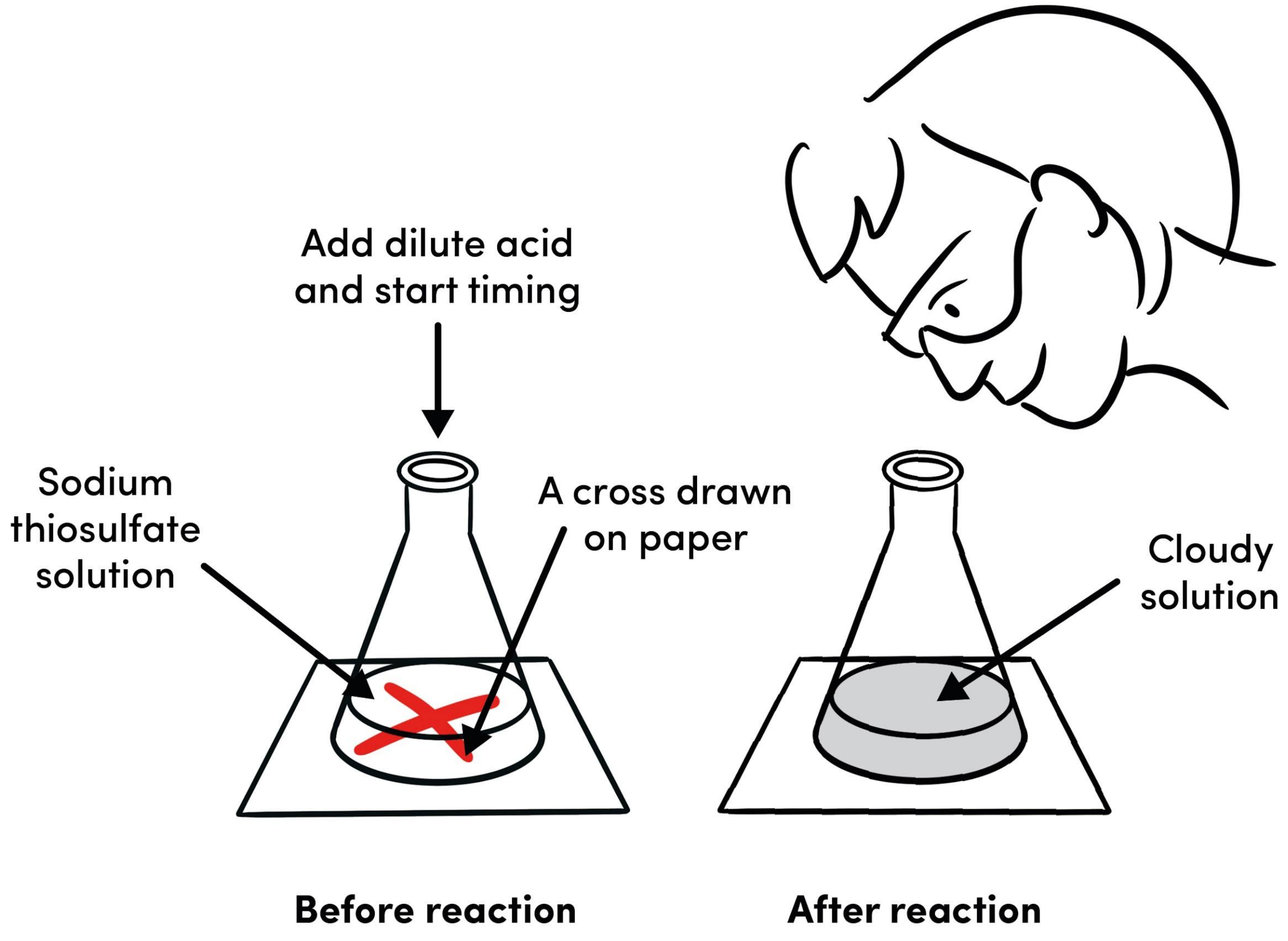
Independent variable:

Dependent variable:

Two control variables:

Question 2:

Explain why the solution went cloudy (2)



Source: Oak

Independent practice 3

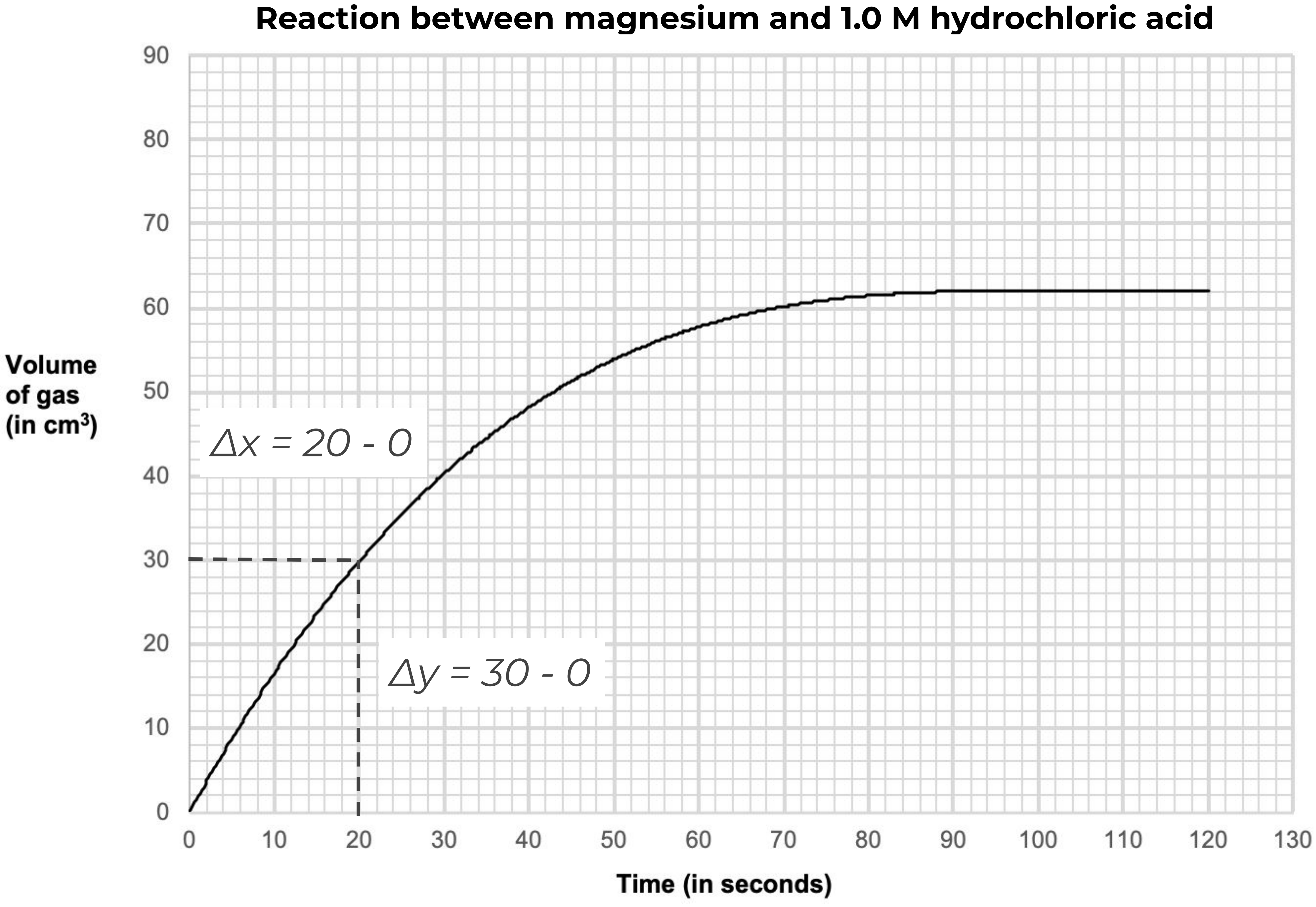
Ethanol is manufactured from ethene and water as shown below:

$$C_2H_4(g) + H_2O(g) \ \boxed{} \ C_2H_5OH(g)$$

1) Write the correct symbol in the equation above to show that it is a reversible reaction.
2) The temperature of the reaction can be changed to increase the formation of ethanol at equilibrium. Explain what equilibrium means.
3) A catalyst can be added to increase the rate of reaction. Explain how the presence of catalysts increases the rate reaction.

Independent practice answers

1) Rate = $\Delta y / \Delta x$ = 30/20 = 1.5 cm^3/s
2) Rate of reaction increased quickly as the gradient of the graph is very steep. 30 cm^3 of gas was produced in the first 20 seconds.
3) No gas was produced between 90 and 120 seconds as the reaction had stopped. All the reactants have been used up.
4) Increasing concentration of hydrochloric acid increases rate of reaction with magnesium because there are more reacting particles per unit volume. Particles collide more frequently.



Rate of reaction graph, E Deng

Independent practice 2 answers

$$Na_2S_2O_3(aq) + 2HCl(aq) \rightarrow 2NaCl(aq) + H_2O(l) + SO_2(g) + S(s)$$

Question 1: Identify the following (4)

Independent variable:

Concentration of hydrochloric acid

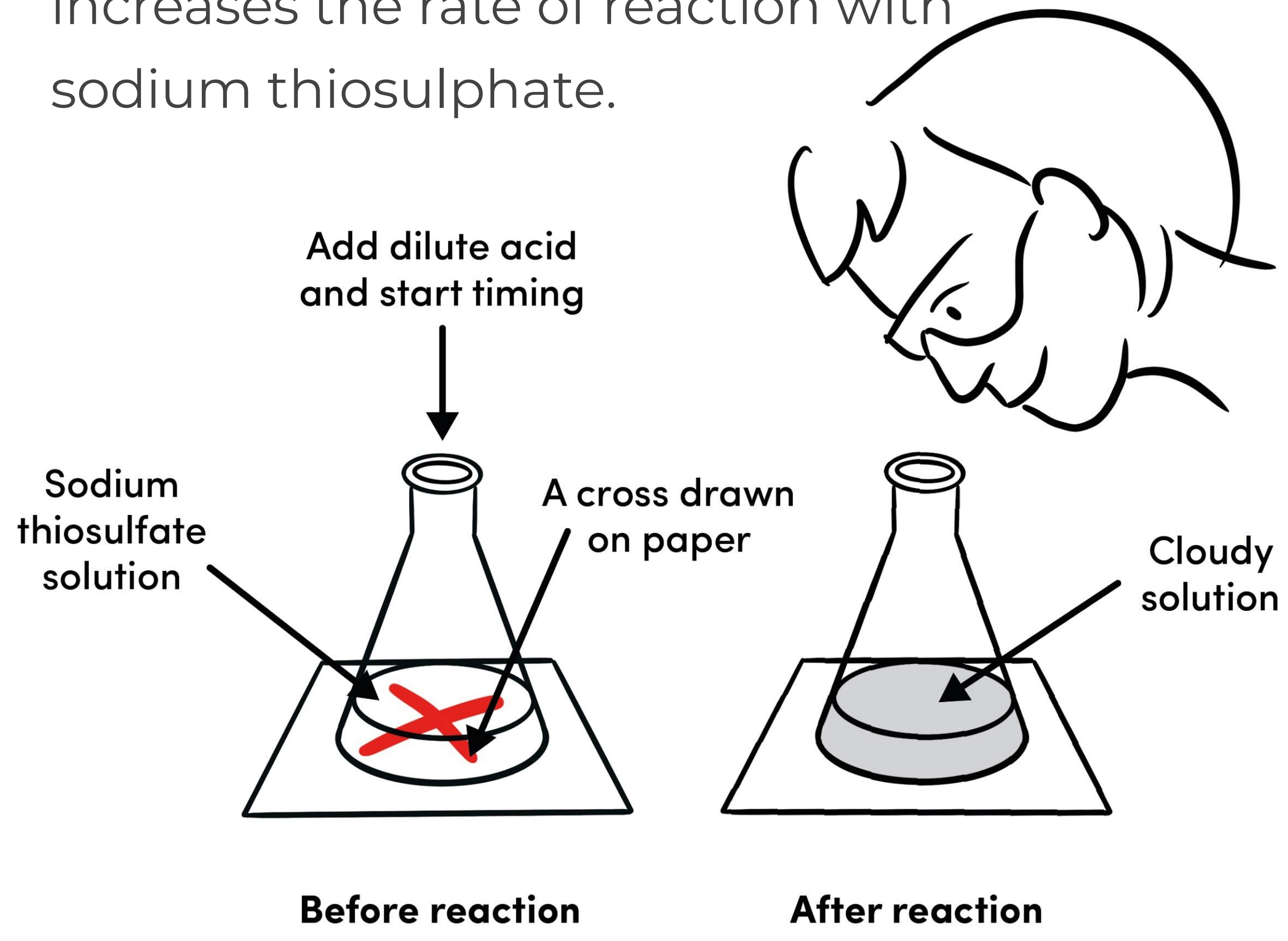
Dependent variable:

Time taken for cross to disappear

Two control variables: *Volume of hydrochloric acid; volume of sodium thiosulphate; concentration of sodium thiosulphate, temperature*

Question 2: *The solution went cloudy because sulphur is formed, which is an insoluble solid*

Hypothesis: Increasing the concentration of hydrochloric acid increases the rate of reaction with sodium thiosulphate.



Source: Oak

Independent practice 3 answers

Ethanol is manufactured from ethene and water as shown below:

$$C_2H_4(g) + H_2O(g) \; \boxed{\rightleftharpoons} \; C_2H_5OH(g)$$

1) Write the correct symbol in the equation above to show that it is a reversible reaction.
2) *Equilibrium is reached when the <u>forward and reverse</u> reactions occur at exactly the <u>same rate</u> in a <u>closed system</u>.*
3) *A catalyst <u>lowers the activation energy</u> and <u>provides an alternative pathway</u> so less energy is needed for particles to react.*