Reaction rates

reactions can be fast or reactions can be slow

What is the reaction rate ?
Reaction rate tells how fast a reaction happens

We can measure it by

- **how fast reactants are used up**
- **how fast products are formed**

Formula of rate of reaction
Rate of reaction = Amount of reactant used up or product formed / time

How to measure reaction rates

Precipitation method

- **Works when two clear solution mix to make solid that clouds the solution**

Steps are

- **mixed the two solutions**
- **place the container over a mark paper**

- observe how long it takes for the mark to disappear
- faster disappearance means faster reaction

Disadvantage

subjective different people might not agree exactly when the mark disappears

Change in mass (gas produced)

It works when the reaction produces a gas

Steps

- put the reaction on a mass balance
- as the gas is released mass decreases
- faster decrease means faster reaction
- The reaction finishes when mass stop changing
- you can plot a graph mass loss versus time

Volume of gas produced

- Use a gas syringe to measure gas for volume
- More gas in same time means faster reaction

- Reaction finish is when no more gases produced
- plot gas volume vs time to see the rate

Graphs and reaction rates

Faster reactions means steeper slope on a graph

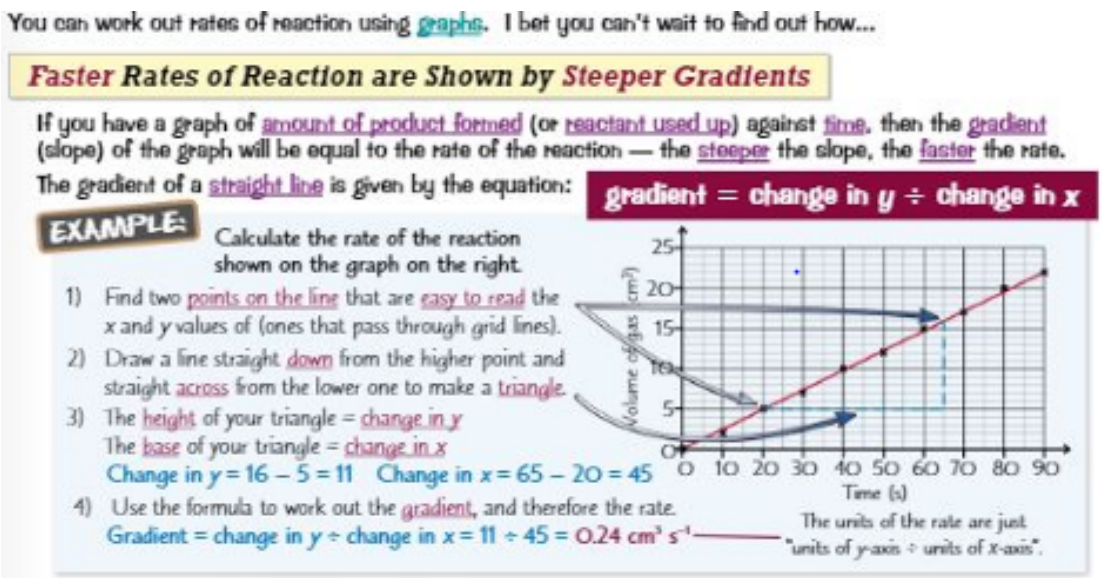
Graphs can be

product formed versus time

reactant used versus time

Formula for gradient

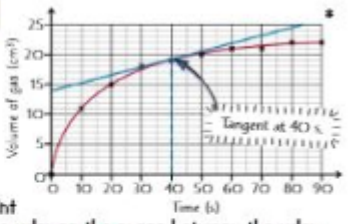
Rate = change in y / change in x



4) Use the formula to work out the gradient, and therefore the rate.
Gradient = change in y ÷ change in x = 11 ÷ 45 = 0.24 cm^3 s^{-1}

The units of the rate are just "units of y-axis ÷ units of x-axis".

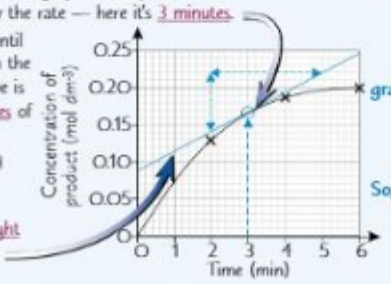
Draw a Tangent to Find the Gradient of a Curve



1) If your graph (or part of it) is a curve, the gradient, and therefore rate, is different at different points along the curve.
2) To find the gradient of the graph at a certain point, you'll have to draw a tangent at that point.
3) A tangent is just a line that touches the curve and has the same gradient as the line at that point.
4) To draw a tangent, place a ruler on the line of best fit at the point you're interested in, so you can see the whole curve. Adjust the ruler so the space between the ruler and the curve is the same on both sides of the point. Draw a line along the ruler to make the tangent.
5) The rate at that point is then just the gradient of the tangent.

EXAMPLE: The graph below shows the concentration of product formed, measured at regular intervals during a chemical reaction. What is the rate of reaction at 3 minutes?

1) Position a ruler on the graph at the point where you want to know the rate — here it's 3 minutes.
2) Adjust the ruler until the space between the ruler and the curve is equal on both sides of the point.
3) Draw a line along the ruler to make the tangent. Extend the line right across the graph.



4) Pick two points on the line that are easy to read. Use them to calculate the gradient of the tangent in order to find the rate:

gradient = change in y ÷ change in x
= (0.22 − 0.14) ÷ (5.0 − 2.0)
= 0.08 ÷ 3.0
= 0.027

So, the rate of reaction at 3 minutes was 0.027 mol dm^{-3} min^{-1}.

