The rate of a chemical reaction measures:

The change in over .

Rate =

Units of rate=

Measuring rates

The rate of a reaction can be determined by measuring the concentration of a reactant at timed intervals throughout an experiment.

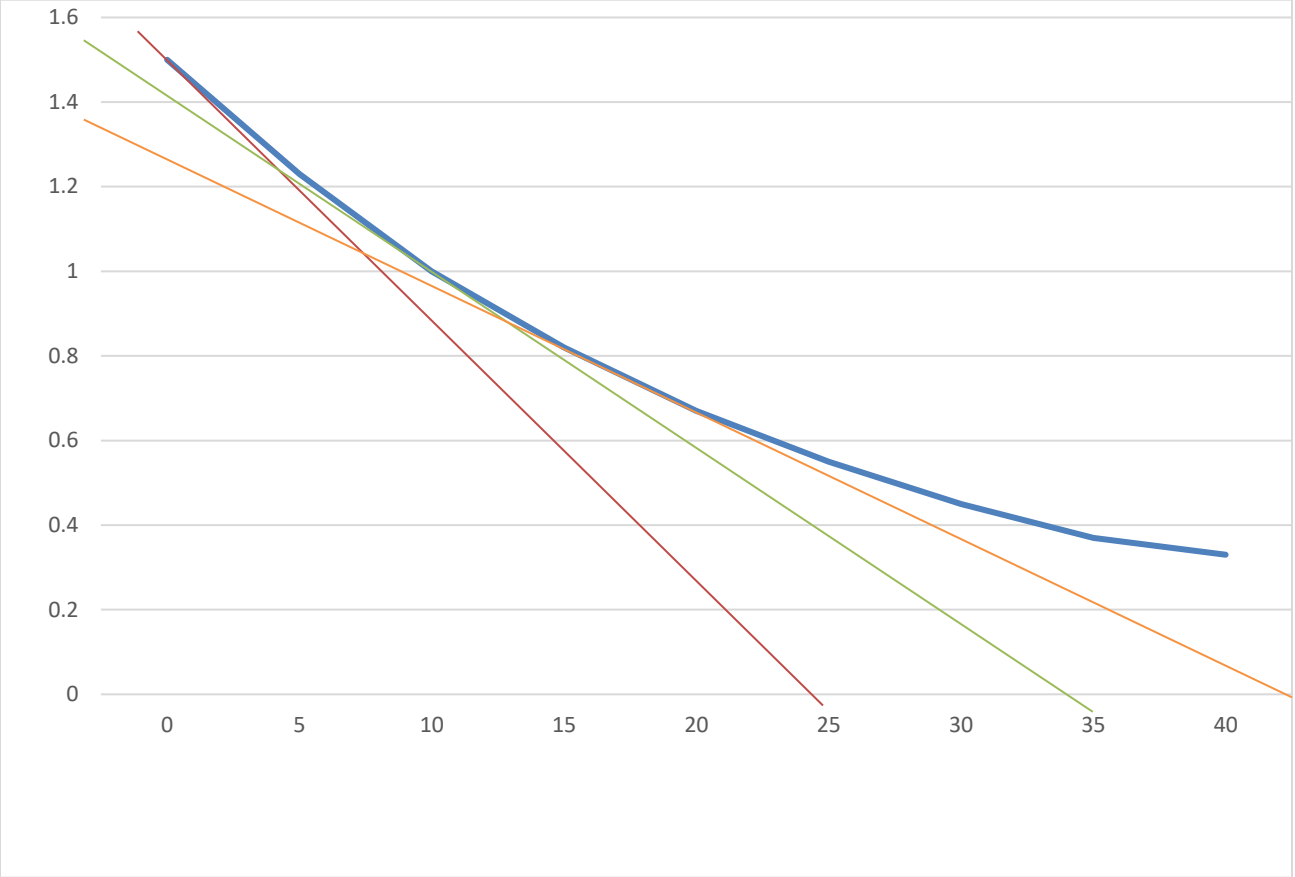
Concentration/time graphs are used to calculate the rate of a reaction.

The rate of the reaction is equal to the of the curve.

To calculate the slope of the curve a line is drawn to the curve at this particular time.

The gradient of the tangent is then calculated.

Example: Measuring the rate for a decrease in concentration of a reactant



Measuring the rate of reaction from a concentration-time graph:

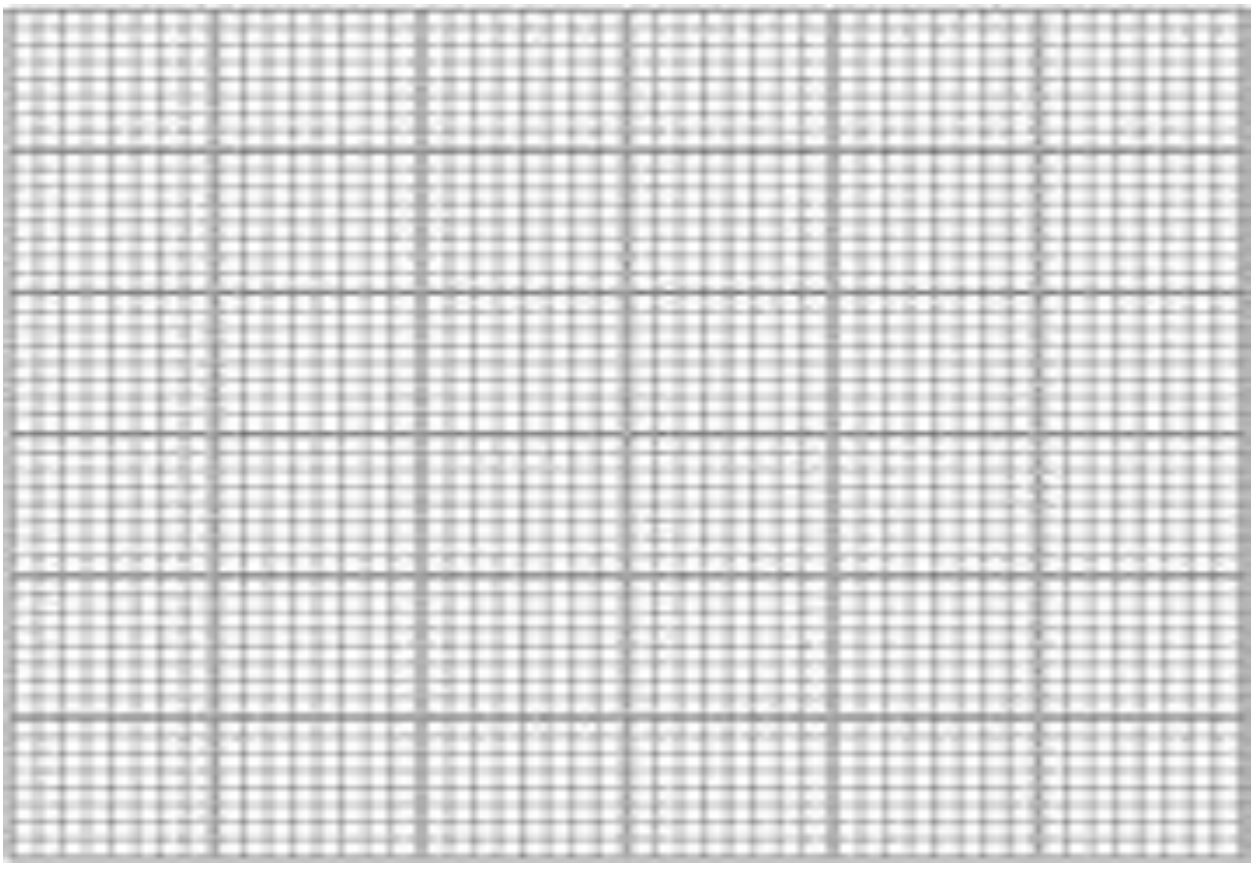
Sulphur dichloride dioxide, SO_2Cl_2 decomposes to produce sulphur dioxide and chlorine

Write an equation for the above reaction:

In an experiment, the concentration of the reactant was measured over a period of time.

Time t/s	0	500	1000	2000	3000	4000
Concentration of SO_2Cl_2 $moldm^{-3}$	0.50	0.43	0.37	0.27	0.20	0.15

Draw a graph of concentration against time from the above data



a) **Calculate the initial rate of reaction**

HINT: The initial rate of reaction =

a) **Calculate the rate of the reaction after 3000s**

Orders of a reaction

What information can be deduced from the equation below?

Each reactant can affect the rate of a reaction in different ways. This means that the concentration of each reactant can have a significant effect on the rate.

Why do the concentrations of some reactants affect the rate more than others?

This is because not all reaction pathways are straight forward. Some reaction mechanisms have a slow step and a fast step as shown below.

This means that the concentration of the is the main determinant of the rate of the reaction.

How the concentration of a particular reactant affects the rate of a reaction is given the term .

The rate constant:

Orders of reaction:

Zero order:

Experiments indicate that the of ammonia has affect on the of the reaction.

First order:

Experiments indicate that the as the of is the of the reaction also . The concentration is proportional to the concentration.

Second order:

Experiments indicate that as the of nitrogen dioxide the rate of reaction by a factor of . As the concentration triples the rate of reaction increase by a factor of . Therefore the rate of reaction depends directly on the of the .

The total order of the reaction:

up the orders of reaction for each reactant.

The rate equation is therefore:

How do we find out with respect to a particular reactant what order it is?

the concentrations of each reactant and the initial rate. Try to keep all the other concentrations of reactants the (if possible). The initial rate method is used when a reaction is too and therefore would be too time consuming to carry out all of the experiments.

e.g.

Experiment	[HCl]moldm^{-3}	[propanone]10^{-3} moldm^{-3}	[iodine]10^{-3} moldm^{-3}	initial rate 10^{-6} moldm^{-3}s^{-1}
1	1.25	0.50	1.25	10.9
2	0.625	0.50	1.25	5.4
3	1.25	0.25	1.25	5.1
4	1.25	0.50	0.625	10.7

Calculate the order of reaction with respect to HCl

Analysing experiments and . The is
while all other reactant concentrations remain the . The initial rate is
also . The is to the rate
the order of reaction to is .

Calculate the order of reaction with respect to propanone

Analysing experiments and . The is
while all other reactant concentrations remain the . The initial rate is
also . The is to the rate
the order of reaction to is .

Calculate the order of reaction with respect to iodine

Analysing experiments and . The is
while all other reactant concentrations remain the . The initial rate is
does not . The does not affect the of reaction
is w.r.t to .

Total order of reaction:

Calculating the rate constant and units

Rate constants can have different units

Affect of temperature and catalyst on the value of k

An in temperature will the value of . In general an increase in temperature of will the rate. The concentration of will not . This means that:

A catalyst will the value of .

The rate constant is only if the is changed. Altering the or adding a will change the .

Predicting mechanisms from a rate equation

It is possible to predict a mechanism for a reaction given the rate equation if these guidelines are followed. Take the below example.

1. The involved in the rate equation must be the step or .

2. Try to form as many of the as possible in each .

3. Make sure any products are used in corresponding steps.

4. Make sure all and are used in the mechanism along with the corresponding .