**21 Quantitative kinetics**

**Topic summary**

**•**  The **rate** of a reaction is given by the following expressions:

http://reader.dynamic-learning.co.uk/epub_content/9781471840494/OEBPS/images/ts_21-1.jpg

**•**  The units of rate are mol dm−3 s−1.

**•**  The order of the reaction with respect to a reactant shows how the concentration of that reactant affects the rate of the reaction. The order for each reactant is found by experiment, and these orders are combined together in a rate equation.

**•**  The proportionality constant in the rate equation is called the **rate constant**. The rate constant does not vary with concentration but it does vary with temperature.

**•**  A **homogeneous catalyst** does not appear in the overall stoichiometric equation, but its concentration does appear in the rate equation.

**•**  If the reactants and their coefficients in the rate equation are the same as those in the stoichiometric equation, the reaction may take place in a single step.

**•**  If the reactants and their coefficients in the rate equation differ from those in the stoichiometric equation, the reaction takes place in more than one step.

**•**  The step with the highest activation energy is the **rate-determining step**. The number of species that take part in the rate-determining step is known as the **molecularity** of the reaction.

**•**  Reactants whose concentrations appear in the rate equation react before or at the rate-determining step. Reactants whose concentrations do not appear in the rate equation but do appear in the stoichiometric equation react after the rate-determining step.

**•**  **Transition states** are at the maxima in the energy profile of a reaction.

**•**  **Intermediates** are at the minima in the energy profile of a reaction.

**•**  A **heterogeneous catalyst** is one that is in a different phase from the reactants. Heterogeneous catalysts are important in many well-known industrial reactions.