# Specification Mrs Wood Gateways School

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| **Unit:** | 3.1 | | **Title:** | Physical chemistry |
| **Sub-unit:** | | 3.1.9 | **Title:** | Rate equations |

### In rate equations, the mathematical relationship between rate of reaction and concentration gives information about the mechanism of a reaction that may occur in several steps

Prior knowledge:

**AS Chemistry**

- 3.1.5 - Kinetics

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| **Learning Objectives:** By the end of these lessons the pupils should be able to… |
| **3.1.9.1 Rate equations**  The rate of a chemical reaction is related to the concentration of reactants by a rate equation of the form:  *Rate* = *k*[A]*m* [B]*n*  where *m* and *n* are the orders of reaction with respect to reactants A and B and *k* is the rate constant.  The orders *m* and *n* are restricted to the values 0, 1, and 2.  The rate constant *k* varies with temperature as shown by the equation:  *k* = Ae–*E*a/*RT*  where A is a constant, known as the Arrhenius constant, *E*a is the activation energy and *T* is the temperature in K.  **Students should be able to:**  • define the terms order of reaction and rate constant  • perform calculations using the rate equation  • explain the qualitative effect of changes in temperature on the rate constant *k*  • perform calculations using the equation *k* = Ae*–E*a/*RT*  • understand that the equation *k* = Ae*–E*a/*RT* can be rearranged into the form ln *k* = –*E*a /*RT* + ln A and know how to use this rearranged equation with experimental data to plot a straight line graph with slope –*E*a/*R*  These equations and the gas constant, *R*, will be given when required. |
| **3.1.9.2 Determination of rate equation**  The rate equation is an experimentally determined relationship.  The orders with respect to reactants can provide information about the mechanism of a reaction.  **Students should be able to:**  • use concentration–time graphs to deduce the rate of a reaction  • use initial concentration–time data to deduce the initial rate of a reaction  • use rate–concentration data or graphs to deduce the order (0, 1 or 2) with respect to a reactant  • derive the rate equation for a reaction from the orders with respect to each of the reactants  • use the orders with respect to reactants to provide information about the rate determining/limiting step of a reaction.  **Required practical 7**  Measuring the rate of reaction:  • by an initial rate method  • by a continuous monitoring method. |