UNIT 7 Speed of Reaction

Recommended Prior Knowledge This unit is best taught towards the middle of the course. Students must have studied energy profile diagrams (Syllabus learning outcome 5(b)) from Unit 4.

The ideas themselves are not difficult, but the unit can be used to revise and consolidate learning from other units e.g. the writing of equations and calculations involving reacting masses and gas volumes (Unit 3), energy profile diagrams (Unit 4), metal reactivity (Unit 6) and reactions of metal carbonates with acids (Unit 8).

Context This unit can be taught either as a preparatory unit for Units 6 and 8, or as a summative unit to consolidate ideas about reactions from these units.
Outline The unit has a strong emphasis on practical chemistry. Students should carry out extensive experimental work to generate data about speed of reaction under variable conditions. There is opportunity for ICT in the use of data loggers and spreadsheets. Suitable reactions for studying speeds of reaction include the reactions of metals with acids (Unit 6) and metal carbonates with acids (Unit 8).

A list of mathematical requirements for the examination is provided in Appendix 1 of the syllabus. The questions used to assess this syllabus area assume that candidates are familiar with using graphs.

	Summary of learning Outcomes (see syllabus for full detail)	**Suggested Teaching Activities**	**Further teacher guidance**	**Online resources**
6.1 a	**Speed of Reaction** describe the effect of concentration, pressure, particle size and temperature on speeds of reactions and explain these effects in terms of particle collision theory	Suggested experiment: The reaction between limestone/marble chips and dilute hydrochloric acid can be used to show the effects of all the variables listed with the exception of pressure.	See appendix 1 of the current syllabus for advice about graphs. Students should present their data using graphs where possible. More able students should realise that the gradient of the slope of the graph is related to the rate.	http://www.crocodile-clips.com/absorb/AC4/m3.htm go to 'rates of reaction' and click on 'view unit'
e	suggest suitable methods for investigating rates of reactions	Students collect the carbon dioxide evolved in a gas syringe or over water into a measuring cylinder. Trial runs should be used to determine the appropriate concentration and quantities to use. Students should investigate the effects of changing the concentration of acid, particle size of limestone and temperature of acid.		www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiments 29, 64, 65.
f	interpret data about speed of reaction	Students need to use particle diagrams to explain these effects in terms of frequency	Students should be able to interpret the relative shape of graphs to identify what variables have changed e.g. how the shape changes when the rate is faster/slower. What happens	www.s-cool.co.uk/contents.asp click on 'GCSE revision' then 'Chemistry' then choose topic: 'Rates of Reaction'

		of successful collisions. It is important when considering temperature effects to discuss ideas about the numbers of reactant particles with the minimum activation energy needed for successful collisions to occur. Students should realise that not all collisions are successful. Students should be given the opportunity to experiment with different ways of measuring speed of reaction (see 1.1 below) Alternative reactions: Iodine Clock. Reaction of sodium thiosulphate with hydrochloric acid.	to the shape when the temperature, surface area or concentration of acid changes. The effect of pressure should be discussed in theory. This concept is visited again in the industrial preparation of ammonia, Unit 8. The reaction of sodium thiosulphate with acid can be followed using the 'disappearing cross' method or using a light sensor linked to a computer/calculator.	Use the 'Quick learn' section. www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Rates of Reaction' http://www.gcsechemistry.com/rc.htm http://teachers.cie.org.uk/teacher_support/pdf/0620_noss_3.html (to access this simulation you will need your school's user name and password for the CIE teacher's support site)
1.1 b	**Experimental Design** name apparatus for the measurement of time, temperature, mass and volume (measuring cylinders and gas syringes) suggest apparatus for collection of gases and measurement of rate of reaction	Students should be familiar with the full range of apparatus through their experimental work in this Unit. They should collect gases over water and using measuring cylinders. They should also measure rate by monitoring mass lost during a reaction in which a gas is evolved. If available, a data logger attached to a computer can collect mass changes from an electronic balance.	If available, students should have the opportunity of processing their data using a spreadsheet to produce tables and graphs.	www.wpbschoolhouse.btinternet.co.uk/page10/page10.htm Click on 'Methods of preparing and collecting gases'
6.1 b,c	**Speed of reaction continued…** define and describe the action of catalysts on speeds of reaction in terms of activation energy pathways	An appropriate reaction to use is the decomposition of hydrogen peroxide using manganese(IV) oxide as a catalyst. The volume of oxygen evolved can be measured against time.	This links to Syllabus Learning Outcome 5(b) from Unit 3	www.chemsoc.org/networks/learnnet/classic_exp.htm Look at experiment 58 http://www.gcsechemistry.com/rc11.htm

d	state that transition elements and their compounds act as catalysts and that enzymes are biological catalysts	Students can investigate different metal oxides as catalysts for the hydrogen peroxide experiment (See above). Examples to try: magnesium oxide, aluminium oxide, copper oxide, manganese(IV) oxide, other transition metal oxides. This will enable students to see that only transition metal oxides act as catalysts. Biological catalysts can also be used e.g. small amounts of liver or vegetables (celery and potatoes both work).	This links to Syllabus Learning Outcome 8.3 from Unit 2 The use of transition element compounds as catalysts is reinforced in industrial processes in Units 8 and 10. Students can be told that our liver metabolises hydrogen peroxide as it is a poison.	www.activescience-gsk.com/miniweb/content/enzymes/whyare.cfm