C14 Rates of Reaction

Lesson sequence

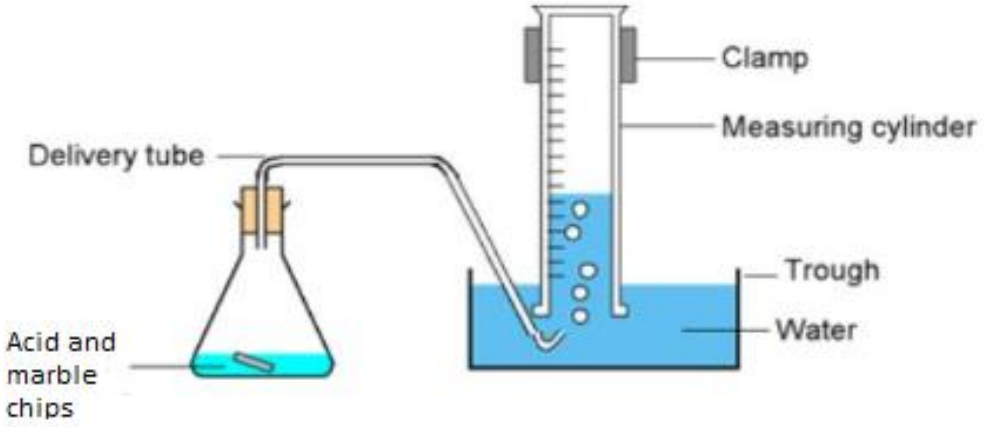
1. Rates of reaction
2. Collision theory
3. Core practical – rates of reaction (CP11)
4. Catalysts

1. Rates of reaction	
***Rate of reaction**	The rate at which reactants are used up or products are made.
***Reactants vs time graph**	Starts high and curves downward, decreasing rapidly at first and then more gently. Steeper line = faster rate.
***Products vs time graph**	Starts low and curves upwards, increasing rapidly at first and then more gently. Steeper line = faster rate.
****Measuring rates – reactions that produce gas**	- Collect gas in a gas syringe and measure the volume every 30 secs. - Collect gas over water (up-turned measuring cylinder full of water) and measure volume every 30 secs. - Do reaction on a balance and record the change in mass every 30 secs.
****Measuring rates – reactions that go cloudy**	Do the reaction in a beaker placed on piece of paper with a cross marked on it. Looking down through the beaker, time how it takes for the cross to disappear.

2. Collision theory	
***Collision theory**	States that for two particles to react they must: - Collide with each other - Collide with enough energy to react
***Activation energy**	The minimum energy that two particles must have when they collide in order to react.

****Effect of concentration on rate**	• Increased concentration means that there are more particles **in the same volume** • So there are more collisions **per second**. • So a faster reaction
****Effect of surface area on rate**	• Increased surface area means that there are more particles **at the surface able to collide** • So there are more collisions **per second**. • So a faster reaction
****Effect of pressure on rate**	• Increased gas pressure means that there are more particles **in the same volume** • So there are more collisions **per second**. • So a faster reaction
****Effect of temperature on rate**	• Increased temperature means that that particles have a higher kinetic energy and **move faster** • So there are more collisions **per second**. • But these collisions **also are at higher energy** so more collisions result in reactions • So a faster reaction

3. Core practical – rates of reaction (CP11)	
***CP11 – Aim**	To explore how particle size and concentration affect the rate of reaction
***CP11 – Gas collection – setup**	See diagram
***CP11 – Gas collection – measurements**	Record the volume of gas collected few seconds until it stops.
***CP11 – Gas collection – independent variable**	Repeat with a different size of marble chips.
***CP11 – Gas collection – results**	The amount of gas collected increases quickly at first and then more slowly. The smaller marble chips produce gas more quickly, but the same amount in total.
***CP11 – similar experiments**	You could keep the chip size the same and use different temperatures, or different concentrations
***CP11 – common problems**	Gas escaping, so the reaction looks slower than it really is
***CP11 – improvements**	Use a gas syringe (CO_2 dissolves in water so you don't get a perfect reading)



***CP11 – Colour change – setup**	Draw a cross on a piece of paper and place a beaker on it. Measure out 50 cm^3 of sodium thiosulfate solution and 5 cm^3 of hydrochloric acid into two test tubes and leave to warm in a water bath at 30^{O}C.
***CP11 – Colour change – run the experiment**	Quickly pour both test tubes into the beaker, mix and start the stopwatch. Looking down through the beaker, stop when you can no longer see the cross.
***CP11 – Colour change – independent variable**	Repeat with water baths set to 35^{O}C, 40^{O}C, 45^{O}C and 50^{O}C.
***CP11 – Colour change – results**	The cross disappears most quickly at 50^{O}C and least quickly at 30^{O}C.

4. Catalyst	
***Catalyst**	A substance that speeds up a chemical reaction without being used up.
****Effect of catalysts on rate**	Catalysts increase the rate of reaction by reducing the activation energy so that a greater proportion of collisions lead to reactions.
****Reaction profile**	A graph that shows the changes in energy during a reaction. Starts with large 'hump' that represents the activation energy.
****Effect of catalysts on reaction profiles**	The 'hump' representing the activation energy is smaller.
***Enzyme**	A protein that works as a catalyst to speed up the reactions in our cells.
***Enzymes in alcohol production**	Alcoholic drinks are produced using enzymes found in yeast which catalyse a reaction that turns glucose into ethanol.