

Chemistry Topic C8: Rates of Reaction

1. Rate is...

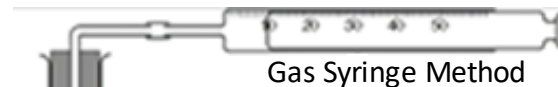
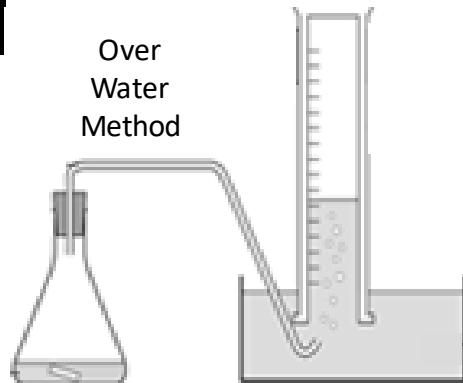
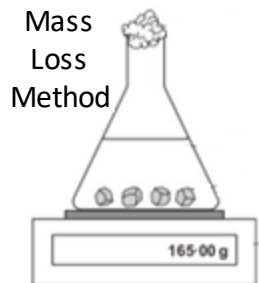
...the speed of a reaction

Fast reactions = short time

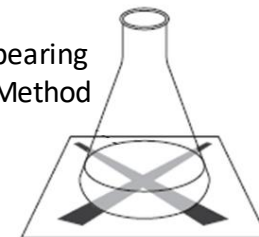
$$\text{Rate} = \frac{\text{product made}}{\text{time taken}}$$

Units e.g. cm^3/s

2. Measuring Rate

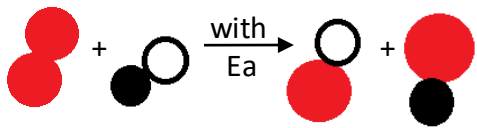


Disappearing Cross Method

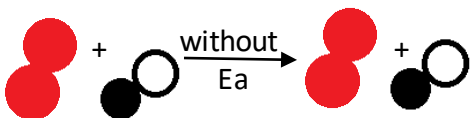


3. Collision Theory

For chemicals to react, the reacting particles must collide with enough energy to make the product. This is the activation energy (E_a).

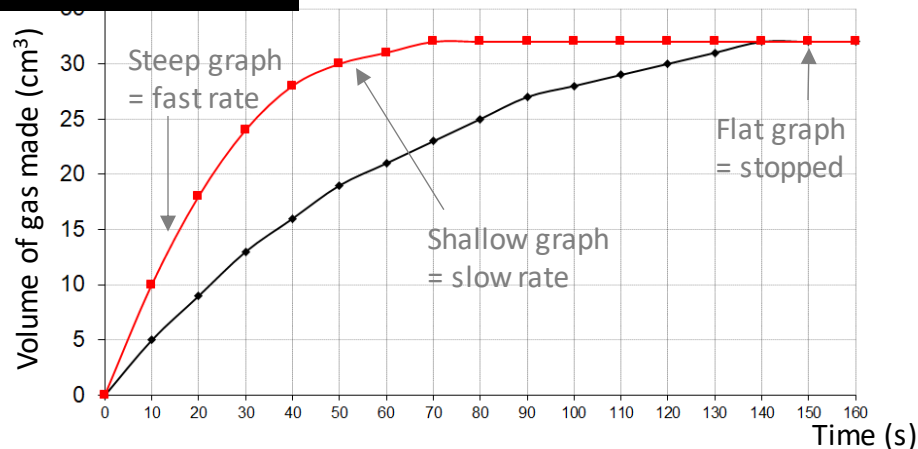


Collisions without enough energy are not successful and don't make products.



The more successful collisions there are per second, the faster the product is made, so the higher the rate.

4. Calculating Rate



Initial rate = fastest
= $\Delta y \div \Delta x$

Red
= $10 \div 10$
= $1 \text{ cm}^3/\text{s}$

Rate between ___ and ___ s
= slower

e.g. Black reaction rate between 50 and 80 s
= $\Delta y \div \Delta x$
= $(25 - 19) \div (80 - 50)$
= $6 \div 30$
= $0.2 \text{ cm}^3/\text{s}$

Rate at ___ s
Draw a tangent and calculate the gradient of the straight line

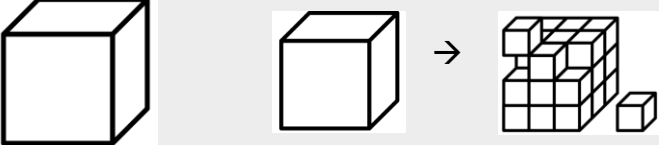
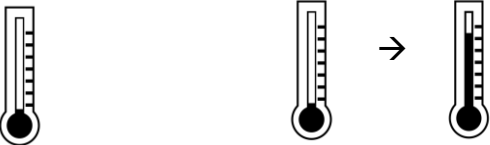
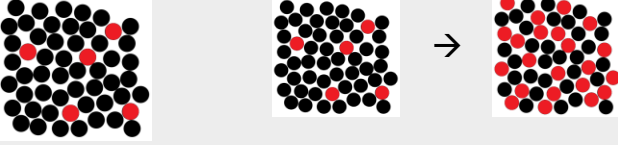
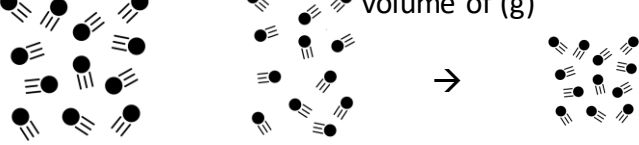
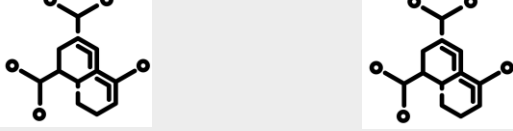
Key Terms – Part A

Collision	Particles hit each other
Activation Energy	Energy needed for a collision to work
Gradient	The steepness of a graph.
Mean	Sum of numbers \div number of numbers
cm^3/s	Centimetres cubed per second
Surface area	Total area of all the exposed sides
Particle size	How big a solid particle is
SA:V ratio	Surface area to volume ratio

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5. Factors Affecting Rate

Key Terms – Part B

Factor	Increase rate by...	Increase number of collisions per second?	Increase the collisions that have E_a ?	If increased, the equilibrium moves to...	Temperature	A measurement of how hot a substance is
Surface area 	Increase SA, decrease particle size	Yes	No	NA	Concentration	Number of particles in a given volume
Temperature 	Increase temperature	Yes	Yes	The side with the endothermic products	Pressure	The force of gas particles colliding with surfaces
Concentration 	Increase concentration	Yes	No	The opposite side to the increased concentration chemical	Catalyst	A substance that speeds up a reaction without being used up
Pressure 	Increase pressure, decrease volume of (g)	Yes	No	The side with the fewest moles of gas	Reversible Reaction	A reaction that can go both ways (\rightleftharpoons)
Catalyst 	Add catalyst suitable for reaction	Yes	Yes	NA	Closed system	A sealed unit where no particles can enter or leave
					Dynamic equilibrium	Forward and backward reactions happening at the same rate
					Le Chatelier's principle	Equilibrium moves to act against the change in conditions