
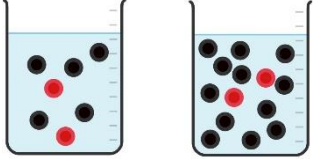
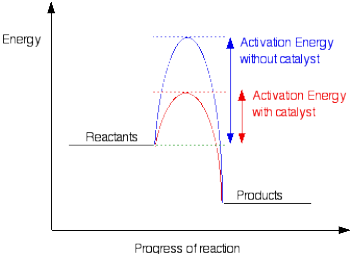
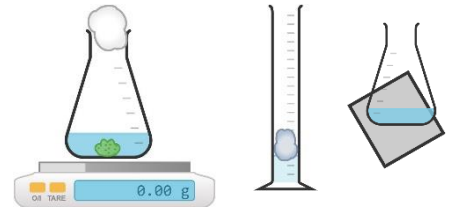
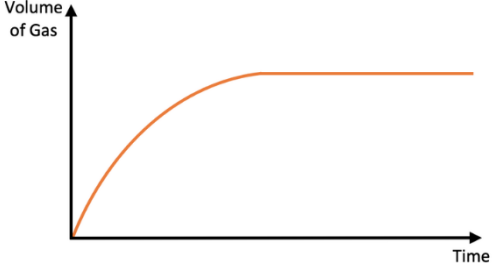
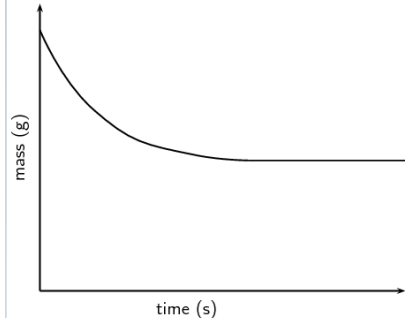
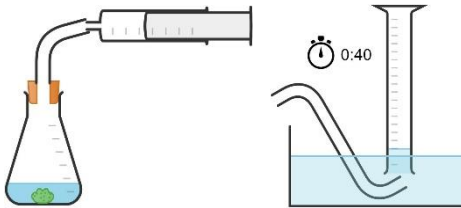


surface area	concentration	temperature	catalyst
 <p>Lump Powder</p> <p>For the same mass of substance.....</p> <ul style="list-style-type: none"> • Powder has more particles exposed to collisions • More collisions/s between particles of A and B • Rate increases as SA increases 	<p>More concentrated (solution) (larger mol L⁻¹) means</p>  <ul style="list-style-type: none"> • More particles of A/mL • More collisions/s between particles of A and B • Rate increases as conc. increases 	<p>As temperature increases, particles of A move faster so more collisions/s AND particles of A have more E_k (kinetic energy) so now more collisions have E_k ≥ E_a so more collisions/s have sufficient energy to overcome the energy barrier</p> <p>Rate increases as more successful / effective collisions/s</p>	<p>Catalysts provide alternative reaction pathway with lower E_a. More particles have E_k ≥ E_a so more particles have sufficient energy to overcome the energy barrier. Rate increases as more successful/effective collisions/s</p> 
<h2>RATES OF REACTION REVISION</h2>			
collision theory	how reaction rate changes as a reaction occurs	ways of measuring rate	
<p>Particles of A and B must collide</p> <ul style="list-style-type: none"> • with correct orientation AND • with sufficient energy for a collision to be *successful / effective* 	<p>Rate of reaction greatest at start. Many particles of A and B so many collisions/s. Rate decreases as reactants are used up – less collisions/s. Reaction ends when one of A or B has run out – volume or mass line goes horizontal. The same mass of solid and conc. and vol of solution will make the same volume/mass of gas.</p>		
activation energy E _a	 		
<p>The minimum energy particles must possess for a collision to be successful/effective. Energy barrier.</p>			

at equilibrium....	equilibrium constant expression	Le Chatelier' s principle	temperature	
$A + 2B \rightleftharpoons C + 3D$ <ul style="list-style-type: none"> Rate of forward and backwards reaction are equal [reactants] and [products] constant 	Equation to K_c ... $2COF_2 \rightleftharpoons CF_4 + CO_2$ $K_c = \frac{[CF_4][CO_2]}{[COF_2]^2}$ K_c to equation $K_c = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$ $2SO_2 + O_2 \rightleftharpoons 2SO_3$ NOTE: $\frac{[P]}{[R]}$, remember [] ^x , no "+"	"When a change is applied to a system at equilibrium, the system reacts in such a way as to counteract the imposed change" $A + 2B \rightleftharpoons C + 3D$ <ul style="list-style-type: none"> If [A] is increased, favours forward reaction <u>to USE UP the added A</u> *. * This is 'using equilibrium principles'. 	<ul style="list-style-type: none"> Temperature is ONLY factor that changes K_c value in an equilibrium An increase in temperature favours the endothermic reaction... <i>as this absorbs the added heat energy... to counteract the temperature increase</i> A dec. in temp. favours the exo reaction... <i>as this releases heat energy... etc</i> 	
equilibrium constant calculation	<h2>ΣQUILIBRIA REVISION</h2>			
<ul style="list-style-type: none"> Put [] values into K_c expression Don't forget any []² etc No UNITS for K_c 	is a reaction at equilibrium?	size of K_c	catalyst	temperature
<ul style="list-style-type: none"> Substitute into K_c expression but calculate 'Q' and not 'K_c'. If $Q = K_c$ reaction is at eqm. If $Q \neq K_c$ it is not. 	<ul style="list-style-type: none"> If $K_c > 1$, more products than reactants / equilibrium favours the products If $K_c < 1$, more reactants 	<ul style="list-style-type: none"> catalyst speeds up forward and back reactions by same amount system reaches eqm. quicker no effect on K_c value / yield of product 	<ul style="list-style-type: none"> If temperature increases, endothermic reaction is favoured... <i>to absorb the added heat</i> E.g. If $K_c \downarrow$ as temperature \uparrow, then $[P] \downarrow$ and $[R] \uparrow$, equilibrium favours reactants, As adding heat favours the reverse (endo) reaction, forward reaction must release heat energy and be exothermic. 	
in industry	concentration	pressure (gases only)	temperature	
<ul style="list-style-type: none"> Want to maximise yield, make as much product as possible \$ 'Compromise' conditions used: <ul style="list-style-type: none"> High pressure = high energy costs / expensive equipment Low temperatures = slow reaction Removing product as it forms favours forward reaction. 	<ul style="list-style-type: none"> Increasing [reactant], favours forward reaction / makes more products - <i>to use up the added reactant</i>. Adding /removing reactants / products has no effect on K_c value. 	<ul style="list-style-type: none"> Dec.vol = inc.pressure. Inc.vol = dec. pressure. Count # mol gas = # mol gas If pressure increases, system shifts towards side with fewer MOLES OF GAS (to minimise imposed change). Changes in pressure have no effect on K_c value. 	<ul style="list-style-type: none"> If $A + 2B \rightleftharpoons C + 3D; \Delta H = -300\text{kJ}$ tells us fwd reaction is exo. Favoured by low temp, 	

Bronsted-Lowry definitions	strong acids	weak acids	strong bases
<p>A proton is a H⁺ ion</p> <ul style="list-style-type: none"> Acids are proton donors Bases are proton acceptors 	<p>Reaction with water is complete / acid ionises completely.</p> <p>Use + H₂O →</p> <ul style="list-style-type: none"> HCl + H₂O → Cl⁻ + H₃O⁺ Have a low pH as [H₃O⁺] >>> [OH⁻] Turn litmus red, UI red Would react faster with Mg or CaCO₃ than a weak acid of same conc. as more H₃O⁺/mL Are very good electrical conductors; total [ions] is HIGH 	<p>Reaction with water is incomplete / acid partially ionises. Use + H₂O ⇌</p> <ul style="list-style-type: none"> CH₃COOH + H₂O ⇌ CH₃COO⁻ + H₃O⁺ pH < 7 as [H₃O⁺] > [OH⁻] but not very low Turn litmus red, UI orange Would react slower with Mg or CaCO₃ than a strong acid of same conc. as less H₃O⁺/mL Are poor electrical conductors; total [ions] is LOW 	<p>Completely dissociate in water. Use → (BUT not + H₂O)</p> <ul style="list-style-type: none"> NaOH → Na⁺ + OH⁻ Have a high pH as [OH⁻] >>> [H₃O⁺]. Turn litmus blue, UI purple Are very good electrical conductors; total [ions] is HIGH
<p>conjugate acid base pairs</p> <p>A conjugate acid–base pair consists of two substances that differ only by a proton (H⁺).</p> <ul style="list-style-type: none"> A conjugate acid is formed when H⁺ is added to a base A conjugate base is formed when H⁺ is removed from an acid HCN + H₂O ⇌ CN⁻ + H₃O⁺ acid base base acid 	<h2>ACIDS AND BASES AND pH</h2>		
<p>pH calculations</p> <p>pH reflects the concentration of H₃O⁺ ions. The higher the pH, the lower the [H₃O⁺].</p> <p>Formulae in resource booklet</p> $K_w = [H_3O^+][OH^-] = 1 \times 10^{-14} \text{ at } 25^\circ\text{C} *$ $pH = -\log[H_3O^+] \quad [H_3O^+] = 10^{-pH}$ $*[H_3O^+] = 10^{-14}/[OH^-]$ $*[OH^-] = 10^{-14}/[H_3O^+]$ <p>You might like to memorise</p> $pOH = -\log[OH^-] \quad [OH^-] = 10^{-pOH}$ $pH + pOH = 14$	<p>amphiprotic substances</p> <p>Substances that can act as an acid (proton donor) AND as a base (proton acceptor)</p> <ul style="list-style-type: none"> E.g. H₂O, HCO₃⁻, HSO₄⁻ as an acid HSO₄⁻ + H₂O ⇌ SO₄²⁻ + H₃O⁺ acid, H⁺ donor as a base HSO₄⁻ + H₂O ⇌ H₂SO₄ + OH⁻ Base, proton acceptor 	<p>salts</p> <p>Fully dissociates in water. Use → (BUT not + H₂O)</p> <p>e.g. NaCl → Na⁺ + Cl⁻</p> $NH_4Cl \rightarrow NH_4^+ + Cl^-$ $CH_3COONa \rightarrow CH_3COO^- + Na^+$ <ul style="list-style-type: none"> Then ion may react with H₂O: as a weak acid NH₄⁺ + H₂O ⇌ NH₃ + H₃O⁺ Since [H₃O⁺] > [OH⁻], pH < 7 as a weak base e.g. CH₃COO⁻ + H₂O ⇌ CH₃COOH + OH⁻ since [OH⁻] > [H₃O⁺], pH > 7 	<p>weak bases</p> <p>Reaction with water is incomplete / base partially ionises. Use + H₂O ⇌</p> <ul style="list-style-type: none"> CH₃NH₂ + H₂O ⇌ CH₃NH₃⁺ + OH⁻ pH > 7 as [OH⁻] > [H₃O⁺] but not very high. Turn litmus blue, UI blue Are poor electrical conductors because total [ions] is LOW <ul style="list-style-type: none"> Na⁺ and Cl⁻ ions do not react further with water. ALL salt solutions are very good electrical conductors; total [ions] is HIGH

