Summary Revision - Reaction Rate

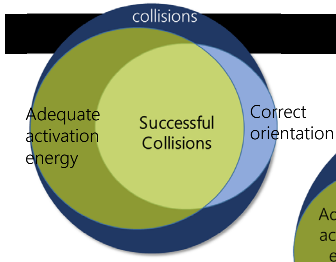
What needs to occur for a collision to be successful?

- ❑ Particles must collide with enough energy – to overcome activation energy requirements
- ❑ Collide in the correct orientation

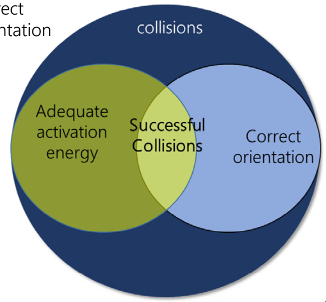
Factor (increased)	Does it increase frequency of collisions	Does it increase the % of successful collisions?
1. Concentration	Yes More particles in a given area, therefore more chance of colliding	No But more successful collisions (per unit time) – as more frequent collisions
2. Surface Area	Yes More particles in a given area, therefore more chance of colliding	No But more successful collisions(per unit time) – as more frequent collisions
3. Temperature	Yes Particles have more kinetic energy – move faster therefore more chance of colliding	Yes More particles have required energy to overcome activation energy therefore result in successful collision
4. Catalyst	No	Yes A lower activation energy pathway available – "lowers the bar' and a greater proportion of collisions become successful. So catalysts also assist orientation

Link answers to increase / decrease in reaction rate

Reaction rates



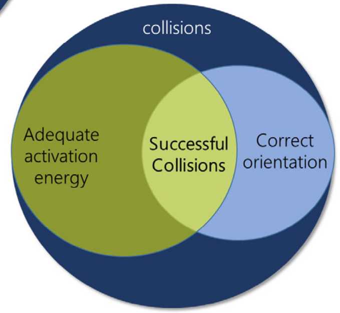
Catalyst
- ❑ Frequency of collisions not changed
- ❑ Increase in % of successful collisions
- ❑ Due to lowering activation energy pathway
- ❑ Some catalysts also 'align' reactants for collision



Concentration
Surface Area
- ❑ Frequency of collisions increased
- ❑ Overall % of successful collisions not changed BUT RATE of successful collisions is

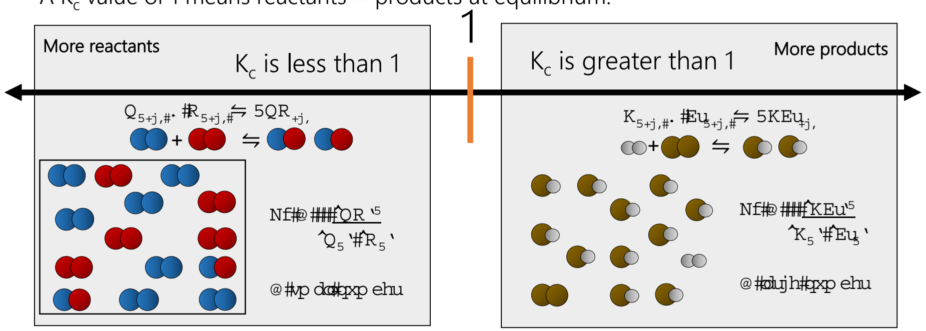
Temperature
- ❑ Frequency of collisions increased

ALSO
- ❑ Increase in % of successful collisions



Analysing the K_c value

If the K_c is less than 1 then there will be more (higher concentration) reactants than products at equilibrium. If the K_c is greater than 1 then there will be more products than reactants at equilibrium.
A K_c value of 1 means reactants = products at equilibrium.

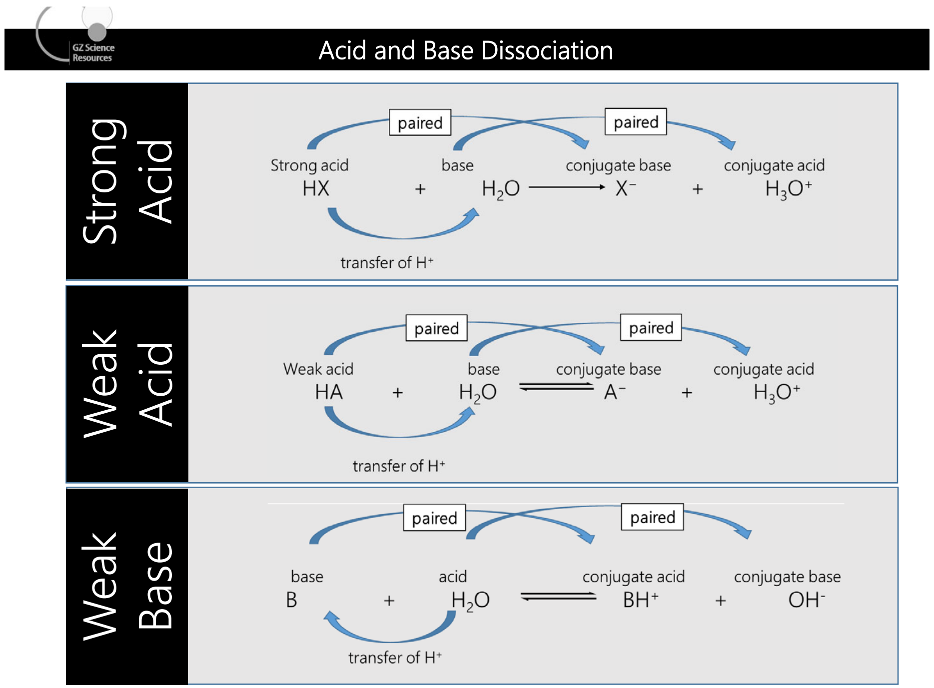


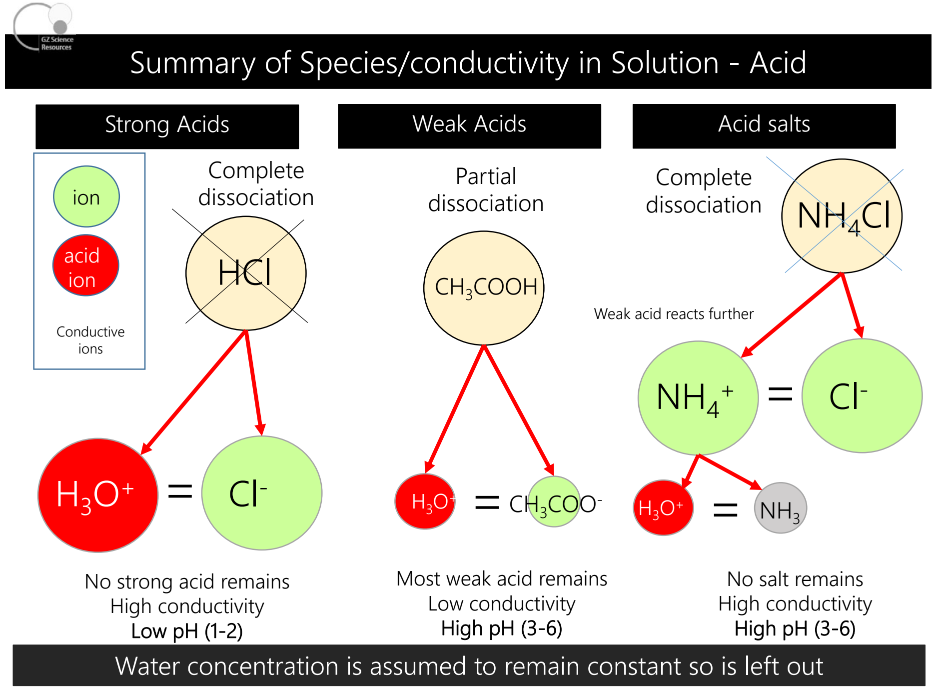
Some questions will ask you to calculate a value (Q) using the equilibrium constant and provided concentrations [ ]
You then need to compare this value to K_c (at a particular temperature). Use the scale above to compare positions of Q to K_c to see if that value indicates the reaction is at equilibrium (they are the same) or more reactants/products

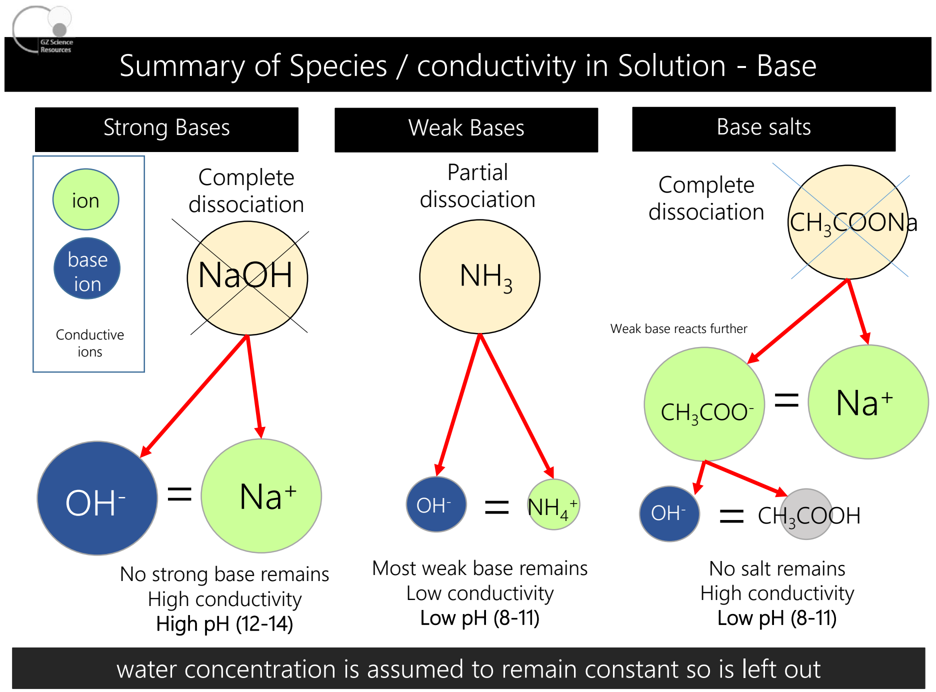
Le Chatelier's Principle

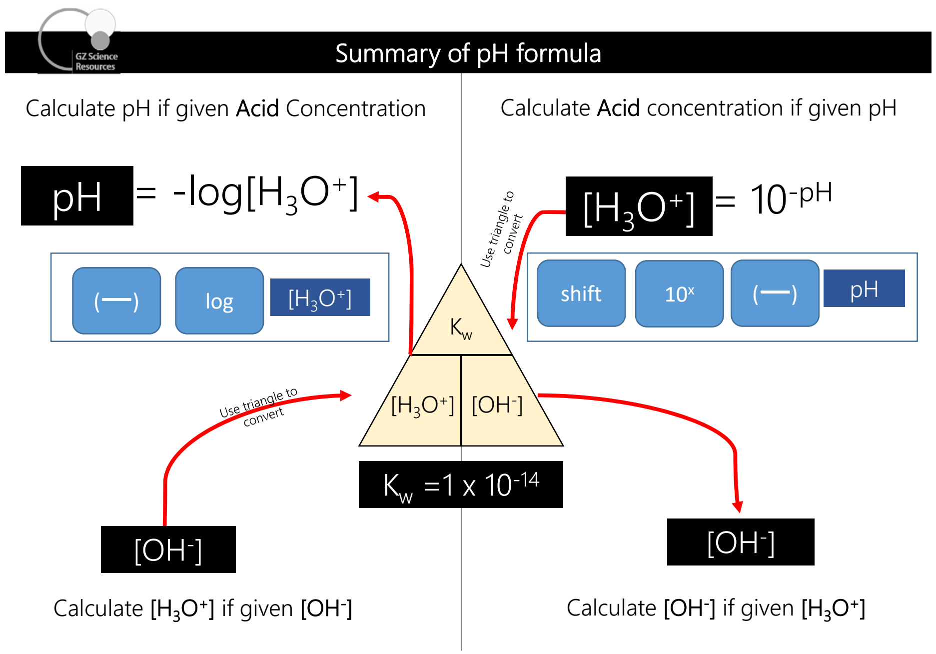
When a change is applied to a system at equilibrium, the system responds so that the effects of the change are minimised

Change in conditions	Direction of change in equilibrium position
Concentration - increase products	In the reverse direction
- decrease products	In the forward direction
- increase reactants	In the forward direction
- decrease reactants	In the reverse direction
Pressure Increase	In the direction with the least no. of moles of gas
Decrease	In the direction with the greater no. of moles of gas
Temperature Increase	In the direction of the endothermic reaction
Decrease	In the direction of the exothermic reaction
Catalyst added	No change in equilibrium position or in K_c Equilibrium is reached more quickly (ie reaction rate changes)


Acid and Base Dissociation
Strong Acid
paired
paired
Strong acid HX + base H_2O → conjugate base X^- + conjugate acid H_3O^+
transfer of H^+
Weak Acid
paired
paired
Weak acid HA + base H_2O ⇌ conjugate base A^- + conjugate acid H_3O^+
transfer of H^+
Weak Base
paired
paired
base B + acid H_2O ⇌ conjugate acid BH^+ + conjugate base OH^-
transfer of H^+


Summary of Species/conductivity in Solution - Acid
Strong Acids
Weak Acids
Acid salts
ion
acid ion
Conductive ions
Complete dissociation
HCl
H_3O^+ = Cl^-
No strong acid remains
High conductivity
Low pH (1-2)
Partial dissociation
CH_3COOH
H_3O^+ = CH_3COO^-
Most weak acid remains
Low conductivity
High pH (3-6)
Complete dissociation
NH_4Cl
Weak acid reacts further
NH_4^+ = Cl^-
H_3O^+ = NH_3
No salt remains
High conductivity
High pH (3-6)
Water concentration is assumed to remain constant so is left out


Summary of Species / conductivity in Solution - Base
Strong Bases
Weak Bases
Base salts
ion
base ion
Conductive ions
Complete dissociation
NaOH
OH^- = Na^+
No strong base remains
High conductivity
High pH (12-14)
Partial dissociation
NH_3
OH^- = NH_4^+
Most weak base remains
Low conductivity
Low pH (8-11)
Complete dissociation
CH_3COONa
Weak base reacts further
CH_3COO^- = Na^+
OH^- = CH_3COOH
No salt remains
High conductivity
Low pH (8-11)
water concentration is assumed to remain constant so is left out


Summary of pH formula
Calculate pH if given Acid Concentration
Calculate Acid concentration if given pH
pH = $-\log[H_3O^+]$
(—) log $[H_3O^+]$
$[H_3O^+] = 10^{-pH}$
shift 10^x (—) pH
Use triangle to convert
K_w
$[H_3O^+]$ $[OH^-]$
$K_w = 1 \times 10^{-14}$
Use triangle to convert
$[OH^-]$
$[OH^-]$
Calculate $[H_3O^+]$ if given $[OH^-]$
Calculate $[OH^-]$ if given $[H_3O^+]$