Reversible reactions

A reversible reaction is one where the products of the reaction can themselves react to produce the original reactants – the reaction can go in either direction, e.g.

Hydrated copper sulphate **blue** $\xrightleftharpoons[\text{+ WATER}]{\text{HEAT}}$ anhydrous copper sulphate white

$CuSO_4.5H_2O \rightleftharpoons CuSO_4 + 5H_2O$

Reversible reaction

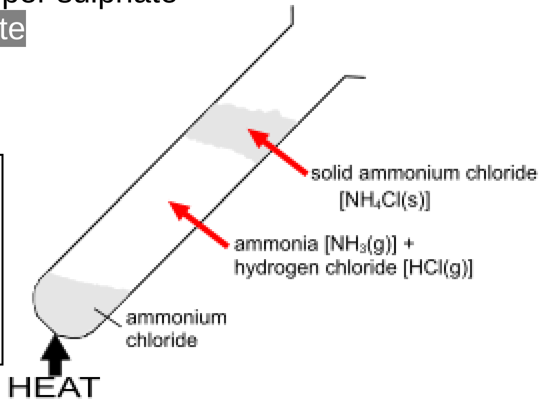
$NH_4Cl \rightleftharpoons NH_3 + HCl$

$NH_4Cl \rightarrow NH_3 + HCl$
thermal decomposition

$NH_3 + HCl \rightarrow NH_4Cl$
neutralisation

NH_3 is a base, HCl is an acidic gas

If the white solid ammonium chloride is heated in a test tube it decomposes to ammonia and hydrogen chloride (both colourless gases). When these re-combine on the cooler parts of the test tube ammonium chloride is formed again.



Reversible reactions can reach a state of ***dynamic equilibrium*** in a ***sealed container***.

So reactants/products can't escape – if a product was a gas and the container was not sealed the gas would escape so the reverse reaction could not occur and equilibrium could not be attained.

- ***Dynamic***: the reactions are still continuing,
  RATE OF FORWARD REACTION = RATE OF REVERSE REACTION.
- ***Equilibrium***: the concentrations of all species present are ***constant***.

Not equal!

In general, if a system at equilibrium is subjected to some change the position of equilibrium shifts in order to minimise the effect of the change.

Increase pressure	reaction involves an increase in the number of moles of gas from left to right	$2X(g) \rightleftharpoons 3Y(g)$	position of equilibrium shifts to left – to side with fewer moles of **gas**	more reactants
	reaction involves an decrease in the number of moles of gas from left to right	$3Y(g) \rightleftharpoons 2X(g)$	position of equilibrium shifts to right - to side with fewer moles of **gas**	more products

Increase temperature	exothermic reaction	$2X(g) \rightleftharpoons 3Y(g)$ ΔH -ve	position of equilibrium shifts to left – position of equilibrium shifts in the endothermic *direction*	more reactants
	endothermic reaction	$2X(g) \rightleftharpoons 3Y(g)$ ΔH +ve	position of equilibrium shifts to right – position of equilibrium shifts in the endothermic *direction*	more products

A catalyst has ***no effect on the position of equilibrium*** – it speeds up the forward and reverse reactions ***equally***.

A catalyst speeds up a reaction by providing an alternative pathway of lower activation energy – the amount the activation energy is lowered is the same for forward and reverse reactions.

A catalyst will just reduce the time taken to reach equilibrium.