

# WJEC Chemistry A-level

## 3.7: Entropy and Feasibility of Reactions

Detailed Notes

Welsh Specification

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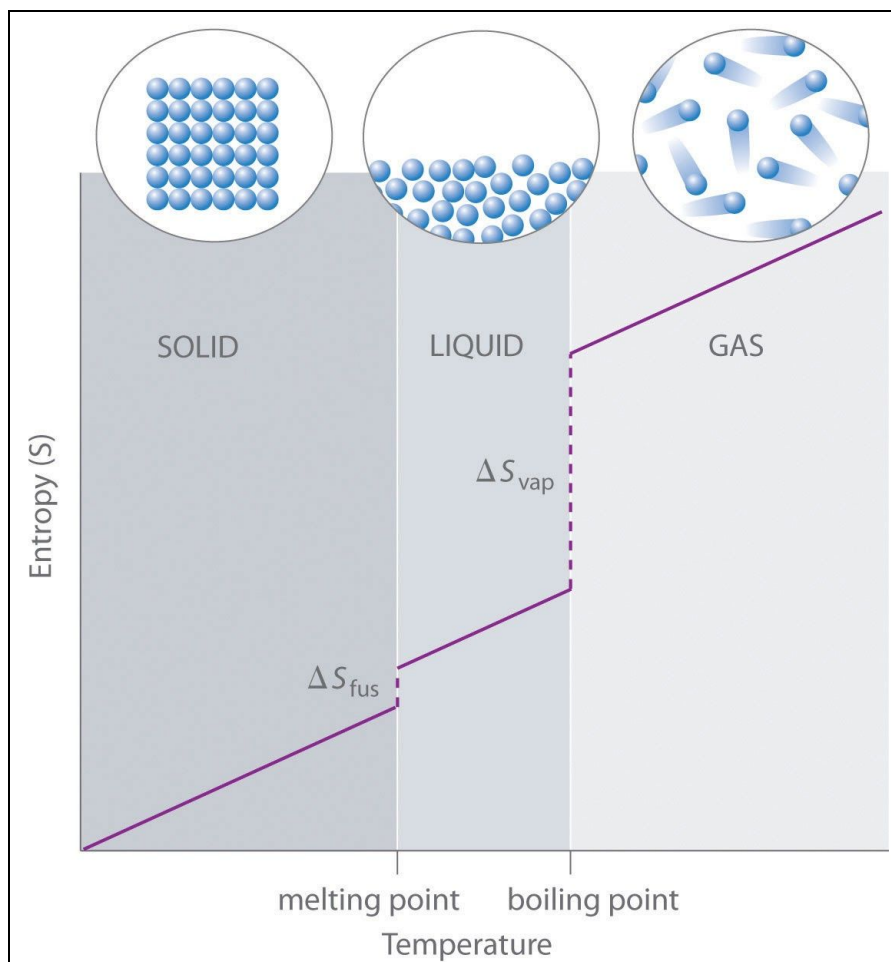
## Entropy ( $\Delta S$ )

In chemistry, things tend towards a **state of disorder**. Entropy is a measure of this disorder,  $\Delta S$ .

The **more disordered** a substance, the **greater its entropy** value. Entropy increases as temperature increases because the particles **gain energy** and move **further apart**, ie. they become **less ordered**.

**Gases** have the **greatest entropy** compared to solids and liquids.

*Example:*



<https://2012books.lardbucket.org/books/principles-of-general-chemistry-v1.0/s22-chemical-thermodynamics.html>  
Principles of General Chemistry / CC BY-SA 3.0

When a substance **melts or evaporates**, there is a **sudden increase** in entropy. The entropy change of **vaporisation** is much greater than that of **fusion** as a gas is much **more disordered** than a liquid or a solid.



The **overall entropy change** for a reaction can be calculated and is measured in  $\text{JK}^{-1}\text{mol}^{-1}$ :

$$\Delta S_{\text{total}} = \Delta S_{\text{final}} - \Delta S_{\text{initial}}$$

Since all things tend towards a state of disorder, all **spontaneous** reactions have a **positive entropy value**, ie. disorder increases.

### Gibbs Free-Energy ( $\Delta G$ )

This quantity allows the **entropy change** of a reaction to be found without needing to measure the effects on the surroundings. It uses the **reaction temperature**, **enthalpy** ( $\Delta H$ ) and **entropy** ( $\Delta S$ ) changes to determine a value for  $\Delta G$ .

*Example:*

$$\Delta G = \Delta H - T\Delta S$$

**Free-energy** is measured in  $\text{kJmol}^{-1}$  so it is important that  $\Delta H$  and  $\Delta S$  are used in the same, standard units.

This equation also takes the form ' $y = mx + c$ ' meaning it can be represented **graphically** as a straight line graph of  $\Delta G$  against  $\Delta S$ .

$\Delta G$  is **negative** for all **spontaneous** reactions. This becomes true at a certain, specific temperature which can be found by putting  **$\Delta G$  equal to zero**. Changing the temperature or the type of reaction occurring will change the **feasibility** and **spontaneity** of the reaction.

$\Delta H$	$\Delta S$	Increasing T...	Feasible?
+ve	+ve	$T\Delta S > \Delta H$	Above a certain T value
-ve	+ve	$\Delta G$ gets more -ve	Always
+ve	-ve	$\Delta G$ always remains +ve	Never
-ve	-ve	Usually $\Delta H > T\Delta S$	Usually

