Demonstrate understanding of thermochemical principles and the properties of particles and substances

ENTROPY BASICS

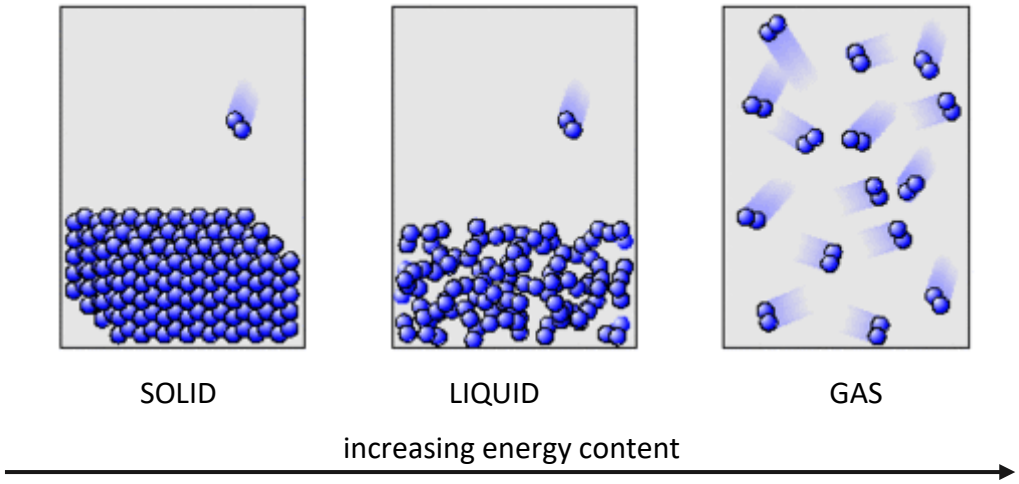
What the standard says

- enthalpy and entropy changes associated with spontaneity in chemical reactions (entropy calculations are not required).

What is entropy?

At L3 Chemistry think of it as a measure of the amount of disorder in particles and then think about what factors might lead to an increase or decrease in the amount of disorder. A system is the reaction or change taking place and the surroundings would be the beaker / test tube/ air in the laboratory. It is the total entropy change that is important (system + surroundings) when making decisions about reactions

Examples – we have met the particle model before.



The solid has the least entropy and the gas has the most.

When solid melts, entropy increases and when liquid freezes, entropy decreases.

Similar for a liquid boiling to form a gas (entropy increase) and a gas condensing to form a liquid (entropy decrease).

Also – if the temperature increases then entropy increases (particles are moving more chaotically with higher energy).

If the number of moles increases during the change – entropy increases (more particles = more possible arrangements so disorder increases.

To tackle NCEA questions – look at the visual clues in any equations or descriptions of the example they want you to explain.

What previous examination questions have looked like with explanatory notes.

Why does NaCl readily dissolve in water, even though the process is slightly endothermic?

$$NaCl(s) \rightarrow Na^+(aq) + Cl^-(aq) \quad \Delta_r H° = +3.90 \text{ kJ mol}^{-1}$$

The mark scheme asked for an understanding that when solid dissolves – **the entropy** (degree of disorder) of the solution **increases** because the dissolved ions are in a less orderly arrangement (compared to the 3D ionic lattice).

This is the dominant factor in deciding the spontaneous dissolving of the crystal. Although the temperature is expected to decrease slightly as the enthalpy change is endothermic (energy will be taken out of solution/surroundings), the increase in disorganisation as the ions are in a more random arrangement is more than enough to make up for this. Matter and energy are less dispersed.

Ammonium nitrate dissociates in an endothermic reaction, as shown in the equation below.

$$NH_4NO_3(s) \rightarrow NH_3(g) + HNO_3(g)$$

Below is a table outlining four statements about changes in entropy that may occur during any reaction. Tick (√) to the left of any statement that is correct for the above reaction.

Tick (✓)	Entropy statement
	The entropy of the system increases
	The entropy of the surroundings increases
	The entropy of the system decreases
	The entropy of the surroundings decreases

System

From the equation a solid (1 mol) forms 2 mol of gas.

The 2 factors here are

(i) increasing number of moles = entropy increases

and

(ii) change of state from solid to gas = entropy increase.

So entropy of the system increases

Surroundings

From the surroundings – the temperature decreases so expect entropy of surrounding (air) to **decrease.** Lower temperature means less random movement of particles.