(2) Eg2. The entropy of calcium carbonate is greater than that of calcium oxide

ii) The physical state of the substance is the most significant factor in governing the entropy, however the 'complexity' of the substance also contributes

e) *Demonstrate an understanding that reactions occur due to chance collisions, and that one possible ordered arrangement, eg. In a crystalline solid, can be rearranged into many possible disordered arrangements, eg in a solution, so the probability of disorder is greater than order*

i) A solid is much more ordered (less disordered) than a liquid, which in turn is more ordered than a gas

ii) One possible ordered arrangement in a crystalline solid can be rearranged into many possible disordered arrangements in a solution – the probability of disorder is greater than order in solution (relative to gas)

iii) Therefore, gaseous water has a greater entropy than liquid water, which has a greater entropy than ice

iv) S solid < S liquid < S gas

f) *Interpret the natural direction of change as being in the direction of increasing total entropy (positive entropy change), eg. Gases spread spontaneously through a room*

i) The second law of thermodynamics states that energy spontaneously tends to flow from being concentrated in one place to becoming diffused and spread out

ii) The natural direction of change is in the direction of increasing total entropy – a positive entropy change due to an increase in disorder from an original more ordered state

g) *Carry out experiments and relate the results to disorder and enthalpy changes including*

i) Dissolving a solid, eg adding ammonium nitrate crystals to water

(1) $NH_4NO_3(s) + aq \rightarrow NH_4^+(aq) + NO_3^-(aq)$

(2) Ammonium nitrate should not be heated or ground up because it may explode

(3) Endothermic reaction – the surroundings lost energy as the chemicals returned to room temperature after dissolving

(4) The negative value of $\Delta S_{surroundings}$ must be outweighed by a positive ΔS_{system}

(5) The particles in ammonium nitrate solid are likely to be arranged in an ordered way

(6) The particles in ammonium nitrate solution are likely to be arranged in a random way

ii) Gas evolution, eg reacting ethanoic acid with ammonium carbonate

(1) $(NH_4)_2CO_3(s) + 2CH_3COOH(aq) \rightarrow 2CH_3COONH_4(aq) + H_2O(l) + CO_2(g)$

(2) Ammonium carbonate gives off ammonia and carbon dioxide spontaneously

(3) Bubbles of gas are rapidly produced – appears to be a violent reaction

(4) Endothermic reaction – the surroundings lose energy as the chemicals return to room temperature

(5) The product particles can be classified as less ordered than the reagent particles – considerable increase in entropy of the system because a gas is produced