ANSWERS: Enthalpy changes

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| **2019** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (a) | Endothermic since energy is required to break the intermolecular forces  between the molecules in the liquid state | Correct answer with some  reasoning. | Full explanation. |  |

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| **2018** | **Evidence** | **Achievement** | **Merit** | **Excellence** |
| (i)  (ii) | H2O(*s*) 🡪 H2O*(l)*  The enthalpy of vaporisation is larger than the enthalpy of fusion since  much more heat energy is required to break all the attractive forces between liquid particles to form a gas. When a solid changes into a liquid, only some of the attractive forces are overcome, so less heat energy is required. | Correct equation.  OR  Recognises that attractive forces are broken during state change  OR  that more energy is required. | • Explains that more attractive forces are broken when a liquid  changes to a gas compared to a solid turning into a liquid  using a correct equation. |  |

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| **2017** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| (i)  (ii) | I2(*s*) → I2(*g*)  This is the **heat energy** required to change one mole of a substance from solid state to gaseous state (at a given combination of temperature and pressure). | Correct  OR  Correct definition. |  |  |

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| **2016** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| (i)  (ii)  (iii) | Enthalpy of fusion is the energy required to change 1 mol of a substance (NaCl) from a solid to a liquid.  Fusion of NaCl only requires sufficient heat energy to break / overcome some of the ionic bonds, whereas vaporisation requires much more heat energy to overcome all the ionic bonds, therefore the Δvap*H*° of NaCl is much greater than its Δfus*H*°.  When solid NaCl dissolves in water, there is an increase in the entropy of the system since the ions in solution have greater entropy than in the solid lattice, i.e. more random / disordered arrangement. Although the ions in solution have more energy / energetically less stable than in the solid lattice (since the process is endothermic), the increase in entropy makes the process spontaneous. | * Defines enthalpy of fusion. * Identifies entropy of system increases / positive entropy chang | * Links the difference in Δvap*H*° and Δfus*H*° to the number of bonds broken. * Links an increase in entropy to an increased random arrangement of particles. | * Full explanation for both (ii) an (iii).   (Both enthalpy and entropy discussed with correct conclusion given in (iii)) |

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| **2015** | **Evidence** | **Achievement** | **Achievement with Merit** | **Achievement with Excellence** |
| (a)(i) | H2(g) + ½O2(g) → H2O(l) | * Correct equation including states. |  |  |
| (ii) | The equation for the combustion of hydrogen is the same as the equation for the heat of formation of water. | * Correct explanation. |  |  |
| (b)(i)  (ii) | The ΔfH° (H2O(g)) will be less negative than ΔfH° (H2O(l)).  Making bonds releases energy. As less bonding is present in water as a gas than a liquid then less energy will be released when gaseous water is formed thus the ΔfH° (H2O(g)) will be less negative. | * Less negative. * Correct statement. | * Less negative with a correct statement referring to bonds or energy in both states. | * Justification linking attractive forces between particles to the change of state and difference in energy. |

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