# Year 13 Science: Melting, boiling, solubility and spontaneity

Name: _____ Date: _____

Try these without your notes first, then check the answer key.

## Practice

1. Butane (a straight chain) and 2-methylpropane (branched) are both $C_4H_{10}$. Which has the higher boiling point?

2. Which is more soluble in water: sodium chloride or iodine?

3. What is the sign of $\Delta S$ (system) for $H_2O(l) \rightarrow H_2O(g)$?

4. What is the sign of $\Delta S$ (system) for $N_2(g) + 3H_2(g) \rightarrow 2NH_3(g)$?

5. A reaction is endothermic and its system entropy decreases. When is it spontaneous?

6. Magnesium oxide melts at 2825 °C and iodine at 114 °C. Explain the difference in terms of the particles and the attractions between them.

7. Explain why iodine dissolves in hexane but hardly at all in water.

8. Hydrogen peroxide decomposes: $2H_2O_2(l) \rightarrow 2H_2O(l) + O_2(g)$, $\Delta rH = -196$ kJ mol$^{-1}$. State the sign of the entropy change of the system, and decide whether the reaction is spontaneous at all temperatures.

9. Dinitrogen tetroxide decomposes: $N_2O_4(g) \rightarrow 2NO_2(g)$, $\Delta rH = +57$ kJ mol$^{-1}$. Using the entropy change of the system and of the surroundings, justify why it happens on its own only at higher temperatures.

## Fix the mistake

10. Correct this statement: "Iodine melts at 114 °C because its covalent I–I bonds are weak."

11. Correct this statement: "Endothermic reactions cannot be spontaneous."

12. Correct this statement: "Iodine does not dissolve in water because iodine is non-polar and repels water."

13. Correct this statement: "$2SO_2(g) + O_2(g) \rightarrow 2SO_3(g)$ has a positive $\Delta S$ because the $SO_3$ molecules are bigger."