Teacher notes
Topic B

Temperature stays constant during a phase transition

A piece of solid ice is provided thermal energy and the ice melts into water. During melting the temperature of the ice-water mixture stays constant. We explain this by saying that the energy provided goes into intermolecular potential energy and none goes into kinetic energy so that the temperature does not change.

At the melting temperature, changing from a solid to a liquid means that the average distance between the molecules increases. Increasing the separation of the molecules requires work (because there are attractive forces between the molecules that need to be overcome). The thermal energy supplied increases the intermolecular potential energy and not the kinetic energy of the molecules. So the temperature stays the same but the internal energy increases since the potential energy increases. It is an interesting question, of course, to ask what, if anything, *prevents* energy from going into kinetic energy during a phase change.

Consider thermal energy provided to melting ice and water at 0 °C. Microscopically, some thermal energy will inevitably go to a small quantity of water raising its temperature slightly above zero. This slightly warmer water is surrounded by ice and water at 0 °C and so thermal energy will now be transferred away from this warmer water reducing its temperature back down to 0 °C. If this thermal energy is transferred to ice, it will cause the ice to melt. If thermal energy transfers back into water at 0 °C, the process repeats. The end result is that more and more ice melts and the overall equilibrium temperature stays constant at 0 °C.