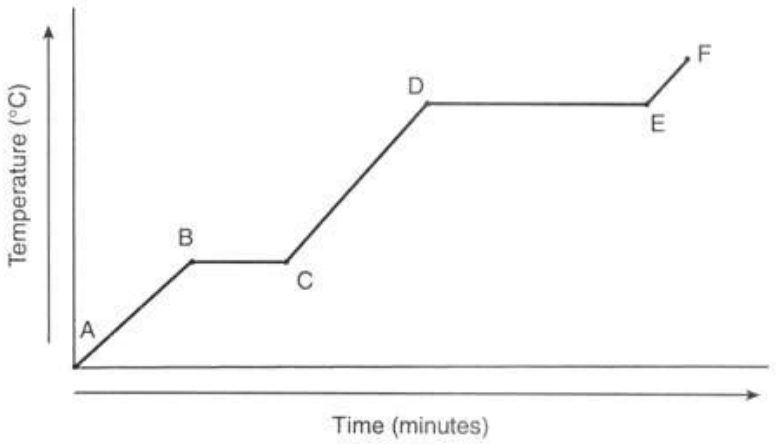
Heating and Cooling Curves (The Basics)

What happens to the temperature of a block of ice when you put a Bunsen burner underneath it? You might think that the temperature goes up smoothly, but that's not what happens. The graph of temperature against time is called a heating curve. Let's look at the heating curve for water.

Heating Curves

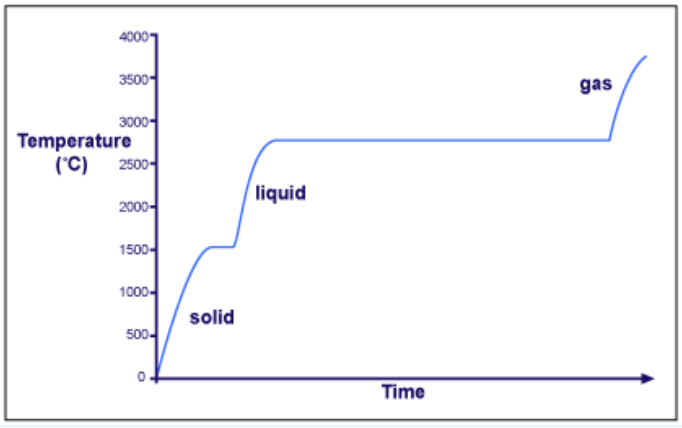


Notice that, in general, the temperature goes up the longer the heating continues. However, there are two horizontal flat parts (segments BC and DE) to the graph. These happen when there is a change of state. The plateaus are also called phase changes.

The first change of state (segment BC) is melting (changing from a solid to a liquid). The temperature stays the same while a substance melts. For water, this temperature is 0°C because the melting point for water is 0°C. Over the course of this line segment, both liquid and solid exist in various ratios, starting at 100% solid and ending at 100% liquid.

The second change of state (segment DE) is boiling (changing from a liquid to a gas). The temperature stays the same while a substance boils. For water, this temperature is 100°C because the boiling point for water is 100°C. Over the course of this line segment, both liquid and gas exist in various ratios, starting at 100% liquid and ending at 100% gas.

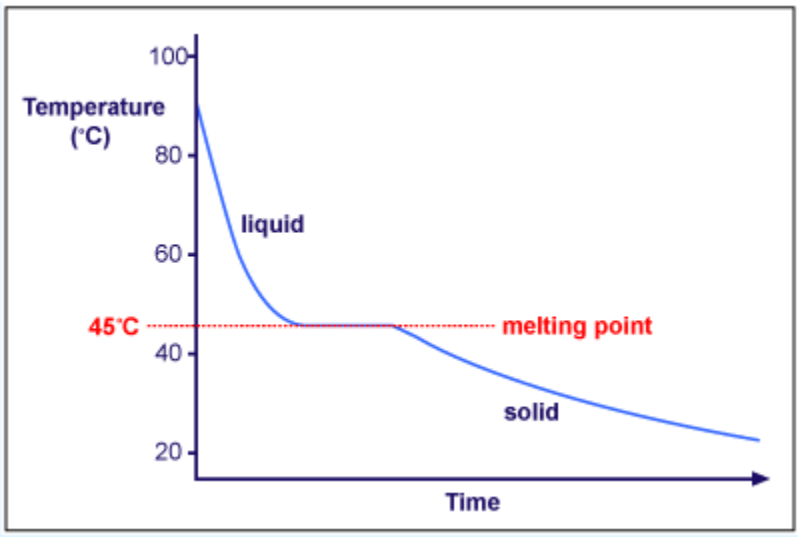
Different substances have different melting points and boiling points, but the shapes of their heating curves are very similar. For example, this is the heating curve for iron, a metal that melts at 1538°C and boils at 2861°C.



Cooling Curves

Heating curves show how the temperature changes as a substance is heated up. Cooling curves are the opposite. They show how the temperature changes as a substance is cooled down. Just like heating curves, cooling curves have horizontal flat parts where the state changes from gas to liquid, or from liquid to solid. These are mirror images of the heating curve.

You will use lauric acid in a school lab to make your own cooling curve. Lauric acid has a melting point of about 45°C and is easily melted in a test tube placed in a beaker of hot water. The temperature can be followed using a thermometer or temperature probe connected to a data logger. The liquid may be cooled by putting the boiling tube in a beaker of cold water or just leaving it in the air.



*****Note- The melting and freezing occur at the same temperature. During freezing, energy is removed and during melting, energy is absorbed.**

Energy Changes

Since Temperature is a measure of "Average Kinetic Energy", any change in temperature is a change in Kinetic Energy. All of the diagonal line segments on a heating or cooling curve show a temperature change and therefore a change in kinetic energy. During these regions, a single state of matter exists and the sample is either getting hotter or cooler.

During the horizontal line segments, there is no change in temperature, so kinetic energy remains constant. However, all the energy that is absorbed or released is related to changes in potential energy.

Remember the 3 Ps:

Plateau, **P**hase change and **P**otential Energy Change.