Phase transitions in the particle model

The particle model describes the structure of substances. In this model, the substances consist of small particles (atoms, molecules) that have two essential properties: First, the particles have velocity, meaning they are constantly in motion. The particles' velocity can be controlled externally, by adding or removing heat.

Second, the particles exert attractive and repulsive forces on each other – they interact with each other. The degree to which the particles feel the effect of these forces depends on pressure and temperature. At a constant temperature but higher pressure, the particles are closer together and feel the forces to a greater degree, meaning the interaction is strong. At a constant pressure but higher temperature, the particles spend less time together and therefore feel the forces for a shorter amount of time, meaning that the interaction is weaker on the whole. For the pressure and temperature ranges we encounter in everyday life with respect to phase transitions, it is sufficient to take only the attractive forces into account. The repulsive forces can be disregarded.

Assignment

An overview table should show how the addition and removal of heat affects a substance's state in the particle model. To do so, we imagine a closed container filled with water, ice, or steam, and heat is either added to or removed from this container. A thermometer is placed in the container to measure the temperature. Since we will be taking only the temperature into account as a variable in the following assignment, it is always assumed that the phase transition will take place at a suitable pressure.

Fill in the empty cells in the table using the following values:

- State of aggregation:
  s(olid), l(iquid), g(as)
- Attractive force between the particles:
  becomes stronger – becomes weaker – remains constant
- Average velocity of the particles ($\mathbf{v_{average}}$) or temperature (**T**) of the substance:
  increases – decreases – remains constant

Name: _____ Class: _____ Date: _____

Phase transition	From state of aggregation	To state of aggregation	Attractive force	$v_{average}$ or T in the container
Vaporization				
Condensation				
Evaporation*				
Melting				
Sublimation				
Freezing				

* Without the addition of heat

Additional questions

1. In the melting or vaporization process, what is the added heat used for?

2. How can the temperature behavior during evaporation be explained?

3. Do particles in a solid have velocity? If yes, describe the type of motion.

4. Can a substance reach a state where the particles no longer have any velocity?