Graphical Representation

Temperature vs. Energy Added Diagram

Temperature

T_{BP}

T_{MP}

All gas at T_{BP}

All liquid at T_{BP}

All liquid at T_{MP}

Gas phase

All solid at T_{MP}

Mixed phase

Liquid phase

Solid phase

Mixed phase

Energy Added or Removed (at constant pressure)
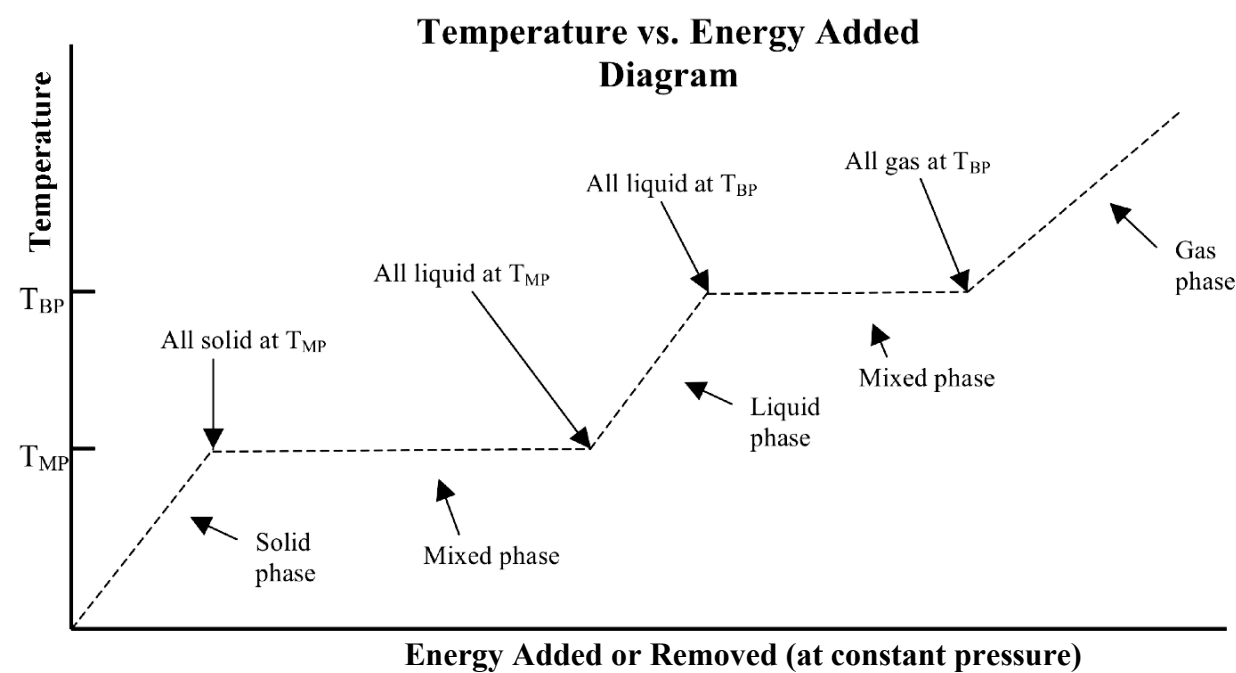
Algebraic Representations

Change in temperature of a substance when heat is added or removed:

$$\Delta T = Q/C$$

Amount of a substance that changes phase when heat is added or removed:

$$|\Delta m| = Q/\Delta H$$

Three-Phase Model of Matter

Constructs	Relationships
Pure substances Three phases Solid, Liquid, Gas Temperature Energy Energy added as heat or work	1) *Pure substances* exist in one of three phases, depending on the temperature and pressure: solid, liquid, and gas. *Non-pure* substances, e.g., solutions and composites, require more complex models for analysis. 2) In order to change either the temperature or phase of a substance, energy must be added or removed. Often this energy is transferred to or from the substance as heat, Q, but can also be transferred as work, W.
Phase change temperature Change of phase Pressure	3) At constant pressure changes of *phase* (solid⇔liquid and liquid⇔gas or at some values of pressure, solid⇔gas (sublimation)) occur at *specific* temperatures, the phase change temperatures (T_{MP}, T_{BP}, and T_{SP}), that have particular values for each pure substance. The values of these temperatures are the same "going through" the phase change in "both directions." Phase change temperatures are, however, dependent on the pressure.
Heat of melting, Heat of vaporization, Heat of sublimation	The amount of energy added or removed at a phase change (usually written as ΔH signifying a constant pressure process) is unique to each substance and has been measured and tabulated for most substances.
Thermal equilibrium Mixed phase	If the substance is in thermal equilibrium (i.e., if the entire substance is at the same temperature) *at* the phase change temperature, both phases will *remain* at the phase change temperature as the phase change occurs. Mixed phases can exist in thermal equilibrium *only* when the temperature has the value of the phase-change temperature.
	4) Changes of *temperature* of a substance occur when energy is added or removed whenever the substance is not at a phase-change temperature.
Heat capacity Specific heat	When the energy added is in the form of heat, the change in temperature, ΔT, is related to the amount of energy added by a property of the substance called heat capacity, C. The specific heat has a particular value for each substance. Specific heats have been measured and tabulated for most substances.