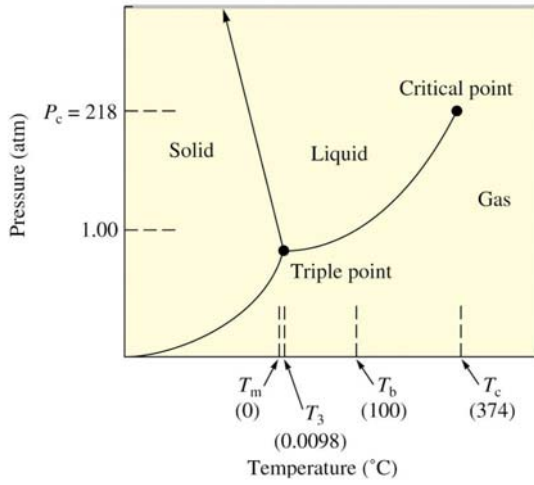


More on Phase Diagrams

A phase diagram is a convenient graphical representation that summarizes the particular phase of a substance as a function of the temperature and pressure conditions. The boundary lines on a phase diagram represent the simultaneous temperature and pressure conditions at which two phases will be at equilibrium. The intersection of three boundary lines occurs at the *triple point* – at this temperature and pressure, all three phases co-exist in equilibrium. Phase diagrams are constructed from experimental data by measuring the temperature at which various phase changes occur at a series of different pressures and/or by measuring the pressure at which phases changes occur at a series of different temperatures. Simple phase diagrams have the following general features. There are usually three regions each representing a particular phase. (Note that many solids can exist in more than one phase, which will give rise to additional regions. See for example, the phase diagram for sulfur.) The *normal melting* and *normal boiling points* are defined as the temperatures at which a substance undergoes S/L and L/V transitions at 1.00 atm pressure and can be read directly from the phase diagram by following a horizontal line at $P = 1.00$ atm to where it intersects the solid/liquid boundary and the liquid/vapour boundary, respectively. The *critical point* is specified on many phase diagrams and is defined as the point beyond which there is no clear phase transition between the vapour and the liquid. Strictly speaking, beyond the critical point, neither the vapour or the liquid exist. A substance beyond the critical point has characteristics of both the vapour and liquid phases and is often described as a '*supercritical fluid*'.

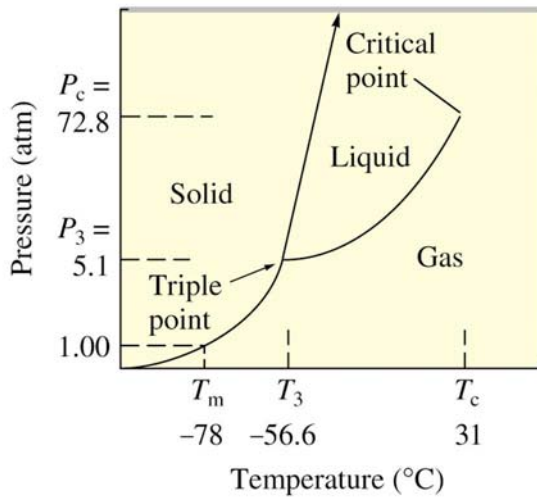
Given a phase diagram, one can immediately predict the phase of a substance under a given set of conditions. Additionally, one can easily predict phase changes that will occur with changes in either the pressure or the temperature. For example, if a vapour at a specified temperature is compressed (constant T, P increases: called *isothermal compression*), then the pressure at which condensation occurs can be obtained by following a vertical path and reading the pressure at the point this isotherm crosses the liquid-vapour boundary. A similar exercise can be applied to temperature increases occurring at constant pressure (constant P, T increasing: called *isobaric heating*). Note that at a temperature higher than the critical temperature (T_c) no amount of compression will result in a phase transition. A similar conclusion can be drawn for liquid-vapour changes at pressures greater than the critical pressure. The phase diagrams for **H₂O** and **CO₂** are shown below.

Phase Diagram for H₂O



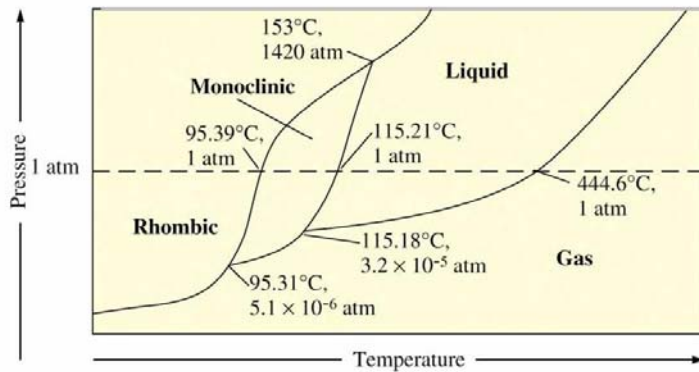
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Phase Diagram for CO₂



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Phase Diagram for Sulfur



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