

3. We have had a cold December, and it is time for ice skating. The Clausius-Clapeyron equation describes the slope, $\frac{dP}{dT}$, of the 1st-order phase transition line in the pressure-temperature (P,T) phase diagram.
- a) Derive the Clausius-Clapeyron Equation for $\frac{dP}{dT}$ in terms of the specific heat and the density difference between the two phases.
- b) For the phase change of ice to water, the latent heat of fusion L is about $+3 \times 10^5$ J/kg, and the volume change ΔV is about -10^{-4} m³/kg. Estimate the pressure needed to depress the freezing point of ice by 5 C.
- c) Comment quantitatively on the urban legend that skates glide with low friction over ice because the ice melts under the pressure of the skate blade pressing down on it. Assume the skater is of mass 70 kg, the skate blade is 30 cm long and 5 mm wide, and the temperature is -5 C.