

CH353 – Physical Chemistry
Spring 2015, Unique 51170

Because the melting temperature of water decreases with increasing pressure, a commonly repeated hypothesis is that an ice skater is able to move across the surface of solid ice by exerting enough force on the ice to temporarily melt the ice to water, thus dramatically reducing the coefficient of friction. Assume that the above hypothesis is true if the skater is able to exert enough force to lower the melting temperature of ice by 0.1 K. Is this a reasonable hypothesis for a person weighing 70 kg who is wearing ice skating blades that are 30 cm long and 3 mm wide? Justify your answer.

Assume that the ice is maintained at 0°C, that the density of ice is approximately 0.92 g cm⁻³, and that the density of liquid water is 1.0 g mL⁻¹. $\Delta H_{fus}(\text{H}_2\text{O}) = 6.01 \text{ kJ mol}^{-1}$ at 273 K. You may approximate the force of gravity as 10 N kg⁻¹.

To achieve the conditions of the above hypothesis, how much would this skater have to weigh (if wearing the same blades described above)?

Provide an alternative hypothesis for how skating across solid ice may be possible.