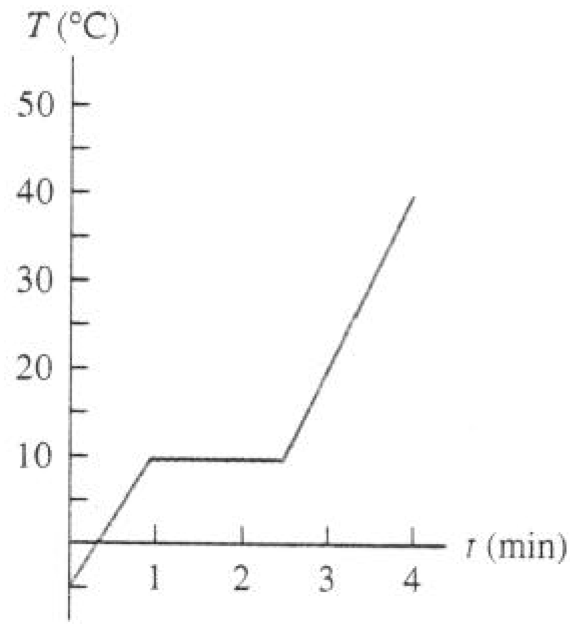
17.44 As a physicist, you put heat into a 500-g solid sample at the rate of 10.0 kJ/min, while recording its temperature as a function of time. You plot your data and obtain the graph shown in Fig. 17.27. a) What is the latent heat of fusion for this solid? b) What are the specific heats of the liquid and solid states of the material?



17.44: (a) $L_F = \frac{Q_{\text{melt}}}{m} = \frac{(10{,}000\ \text{J/min})(1.5\ \text{min})}{0.50\ \text{kg}} = 30{,}000\ \text{J/kg}$

(b) *Liquid:* $Q = mc\Delta T \rightarrow c = \frac{Q}{m\Delta T}$

$$c = \frac{(10{,}000\ \text{J/min})(1.5\ \text{min})}{(0.50\ \text{kg})(30\text{C}^\circ)} = 1{,}000\ \text{J/kg}\cdot\text{C}^\circ$$

Solid: $c = \frac{Q}{m\Delta T} = \frac{(10{,}000\ \text{J/min})(1.0\ \text{min})}{(0.50\ \text{kg})(15\ \text{C}^\circ)} = 1300\ \text{J/kg}\cdot\text{C}^\circ$

17.66 One end of an insulated metal rod is maintained at 100°C, and the other end is maintained at 0°C by an ice-water mixture. The rod is 60.0 cm long and has a cross-sectional area of 1.25 cm². The heat conducted by the rod melts 8.50 g of ice in 10.0 min. Find the thermal conductivity *k* of the metal.

17.66: Using the chain rule, $H = \frac{dQ}{dt} = L_f \frac{dm}{dt}$ and solving Eq. (17.21) for k,

$$\begin{aligned} k &= L_f \frac{dm}{dt} \frac{L}{A\Delta T} \\ &= (334 \times 10^3 \text{ J/kg}) \frac{(8.50 \times 10^{-3} \text{ kg})}{(600 \text{ s})} \frac{(60.0 \times 10^{-2} \text{ m})}{(1.250 \times 10^{-4} \text{ m}^2)(100 \text{ K})} \\ &= 227 \text{ W/m}\cdot\text{K}. \end{aligned}$$

18.14 A diver observes a bubble of air rising from the bottom of a lake (where the absolute pressure is 3.50 atm) to the surface (where the pressure is 1.00 atm). The temperature at the bottom is 4.0°C, and the temperature at the surface is 23.0°C. a) What is the ratio of the volume of the bubble as it reaches the surface to its volume at the bottom? b) Would it be safe for the diver to hold his breath while ascending from the bottom of the lake to the surface? Why or why not?

18.14: a) $\frac{V_2}{V_1} = \frac{p_1}{p_2}\frac{T_2}{T_1} = (3.50)(\frac{296 \text{ K}}{277 \text{ K}}) = 3.74$. b) Lungs cannot withstand such a volume change; breathing is a good idea.