33. (a) The heat generated is the power output of the drill multiplied by the time: $Q = Pt$. We use $1\,\text{hp} = 2545\,\text{Btu/h}$ to convert the given value of the power to Btu/h and $1\,\text{min} = (1/60)\,\text{h}$ to convert the given value of the time to hours. Then,

$$Q = \frac{(0.400\,\text{hp})(2545\,\text{Btu/h})(2.00\,\text{min})}{60\,\text{min/h}} = 33.9\ \text{Btu}\ .$$

(b) We use $0.75Q = cm\,\Delta T$ to compute the rise in temperature. Here c is the specific heat of copper and m is the mass of the copper block. Table 19-3 gives $c = 386\,\text{J/kg}\cdot\text{K}$. We use $1\,\text{J} = 9.481\times10^{-4}\,\text{Btu}$ and $1\,\text{kg} = 6.852\times10^{-2}\,\text{slug}$ (see Appendix D) to show that

$$c = \frac{(386\,\text{J/kg}\cdot\text{K})(9.481\times10^{-4}\,\text{Btu/J})}{6.852\times10^{-2}\,\text{slug/kg}} = 5.341\ \text{Btu/slug}\cdot\text{K}\ .$$

The mass of the block is its weight W divided by the gravitational acceleration (which is 32 ft/s^2 in customary units, which uses "slugs" for mass):

$$m = \frac{W}{g} = \frac{1.60\,\text{lb}}{32\,\text{ft/s}^2} = 0.0500\ \text{slug}\ .$$

Thus,

$$\Delta T = \frac{0.750Q}{cm} = \frac{(0.750)(33.9\,\text{Btu})}{(5.341\,\text{Btu/slug}\cdot\text{K})(0.0500\,\text{slug})} = 95.3\,\text{K} = 95.3\,\text{C}^\circ\ .$$

This is equivalent to $(9/5)(95.3) = 172\,\text{F}^\circ$.