Problem 8.29

Power is defined as the amount of work done per unit time. That means:

$$P = \frac{W}{\Delta t} = \frac{\vec{F} \bullet \vec{d}}{\Delta t} = \vec{F} \bullet \left(\frac{\vec{d}}{\Delta t} \right) = \vec{F} \bullet \vec{v}$$

In other words, the power provided by a constant force on an object that is moving with constant velocity is the dot product between the force and the velocity. For this problem, the work gravity does is equal and opposite the work the guy does (the velocity change is zero), so doing the power calculation on gravity, we get:

$$\begin{aligned} P &= \vec{F} \bullet \vec{v} \\ &= (mg)\left(\frac{h}{t}\right)\cos 0^\circ \\ &= (820.\ \text{N})\left(\frac{(12.0\ \text{m})}{(8.00\ \text{s})}\right) \\ &= 1.23\text{x}10^3\ \text{N•m/s} \quad (\text{or } 1.23\text{x}10^3 \text{ watts or W, or } 1.23 \text{ kilowatts, or kW}) \end{aligned}$$

Note that we could also have done this using:

$$\begin{aligned} P &= \frac{W}{\Delta t} \\ &= \frac{(mg)h}{\Delta t} \\ &= \frac{(820.\ \text{N})(12.0\ \text{m})}{(8.00\ \text{s})} \\ &= 1.23\ \text{kW} \end{aligned}$$