Example

Woman skis down a 20m high hill. The frictional forces are not negligible, so her speed at the bottom of the hill is only 10m/s. How much work is done by frictional forces if her mass is 50kg?

$$\frac{1}{2}mv^2 + 0 = 0 + mdg + W_a$$
$$= -7300\ J$$

Chapter (6)
Work, Energy and Power

- ✓ **6.1 Work**
- ✓ **6.2 Kinetic Energy**
- ✓ **6.3 Potential Energy and conservative forces**
- ✓ **6.4 Dissipative forces**
- ✓ **6.6 Solving problems using work and energy**
- **6.9 Power**

Power

$$\overline{\mathcal{P}} \equiv \frac{W}{\Delta t}$$

Instantaneous power $$\mathcal{P} \equiv \lim_{\Delta t \to 0} \frac{W}{\Delta t} = \frac{dW}{dt}$$

The SI unit of power is joules per second (J/s), also called the **watt** (W)

$$1 \text{ W} = 1 \text{ J/s} = 1 \text{ kg}\cdot\text{m}^2/\text{s}^3$$

Power

In general, power is defined for any type of energy transfer. Therefore, the most general expression for power is

$$\mathcal{P} = \frac{dW}{dt} = \mathbf{F}\cdot\frac{d\mathbf{r}}{dt} = \mathbf{F}\cdot\mathbf{v}$$

The electric motor of a model train accelerates the train from rest to 0.620 m/s in 21.0 ms. The total mass of the train is 875 g. Find the average power delivered to the train during the acceleration.

$$\mathscr{P}_{\text{av}} = \frac{W}{\Delta t} = \frac{K_f}{\Delta t} = \frac{mv^2}{2\Delta t} = \frac{0.875\ \text{kg}(0.620\ \text{m/s})^2}{2\left(21\times 10^{-3}\ \text{s}\right)} = \boxed{8.01\ \text{W}}$$

A 700-N Marine in basic training climbs a 10.0-m vertical rope at a constant speed in 8.00 s. What is his power output?

$$\text{Power} = \frac{W}{t} \qquad \mathscr{P} = \frac{mgh}{t} = \frac{(700\ \text{N})(10.0\ \text{m})}{8.00\ \text{s}} = \boxed{875\ \text{W}}$$