Chapter Title: Kinetic Energy and Work

Sections: Kinetic Energy, Work, Work Done by the Gravitational Force, Work Done by the Spring Force, Work Done by a General Variable Force, Power

---

Kinetic Energy

Kinetic energy K is energy associated with the state of motion of an object. The faster the object moves, the greater is its kinetic energy. When the object is stationary, its kinetic energy is zero.

Work

Work, W is energy transferred to or from an object by means of a force acting on the object.

Work-Kinetic Energy Theorem:

$$W = \Delta K$$

That is,

change in the kinetic energy of a particle = net work done on the particle

Work Done by the Gravitational Force

For gravitational force, $F = mg$

$$W = mgs\cos\theta$$

If an object is rising, the angle $\theta = 180°$,

$$W = mgs\cos 180° = mgs\,(-1) = -mgs$$

If the object is falling, the angle $\theta = 0°$,

$$W = mgs$$

Work Done by the Spring Force

For spring force, $F = -kx$

$$W = \int_{x_i}^{x_f} F dx = \frac{1}{2}kx_i^2 - \frac{1}{2}kx_f^2$$

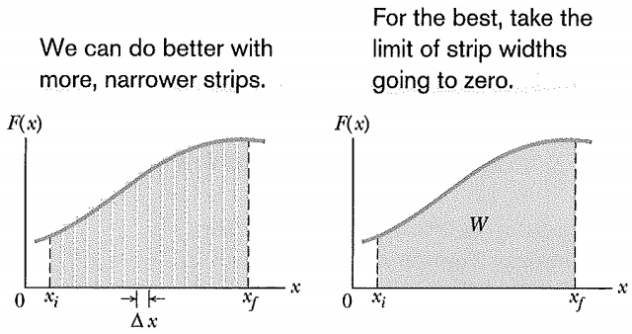
If $x_i = 0$, then work done by a spring force, $W = -\frac{1}{2}kx^2$

Work Done by a General Variable Force

$$W = \sum \Delta W_j = \sum F_j \Delta x$$

$$W = \lim_{\Delta x \to 0} \sum F_j \Delta x$$

$$W = \int_{x_i}^{x_f} F(x)dx$$



Power

The time rate at which work is done by a force is said to be the power due to the force.

$$P_{avg} = \frac{\Delta W}{\Delta t}$$