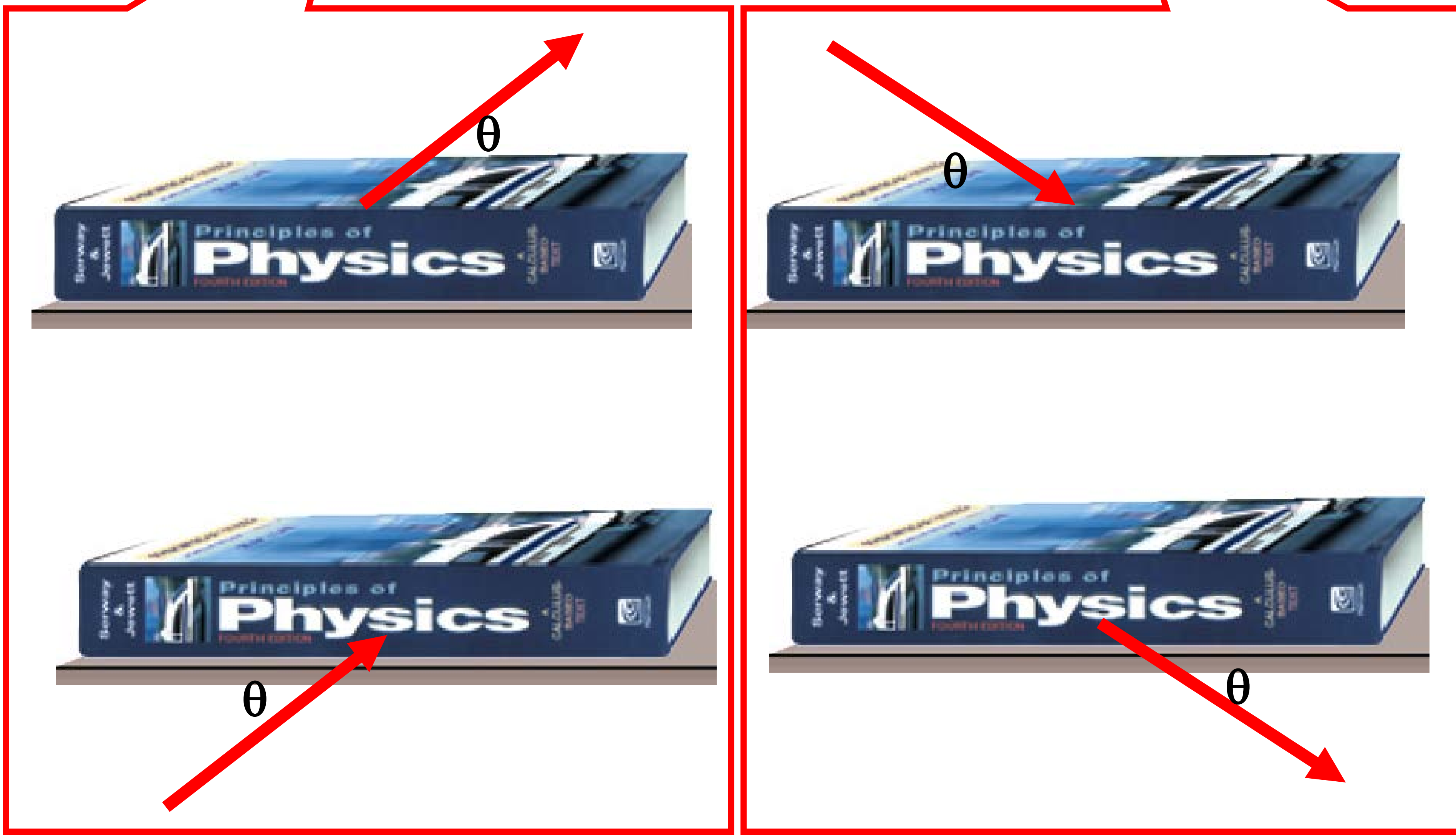
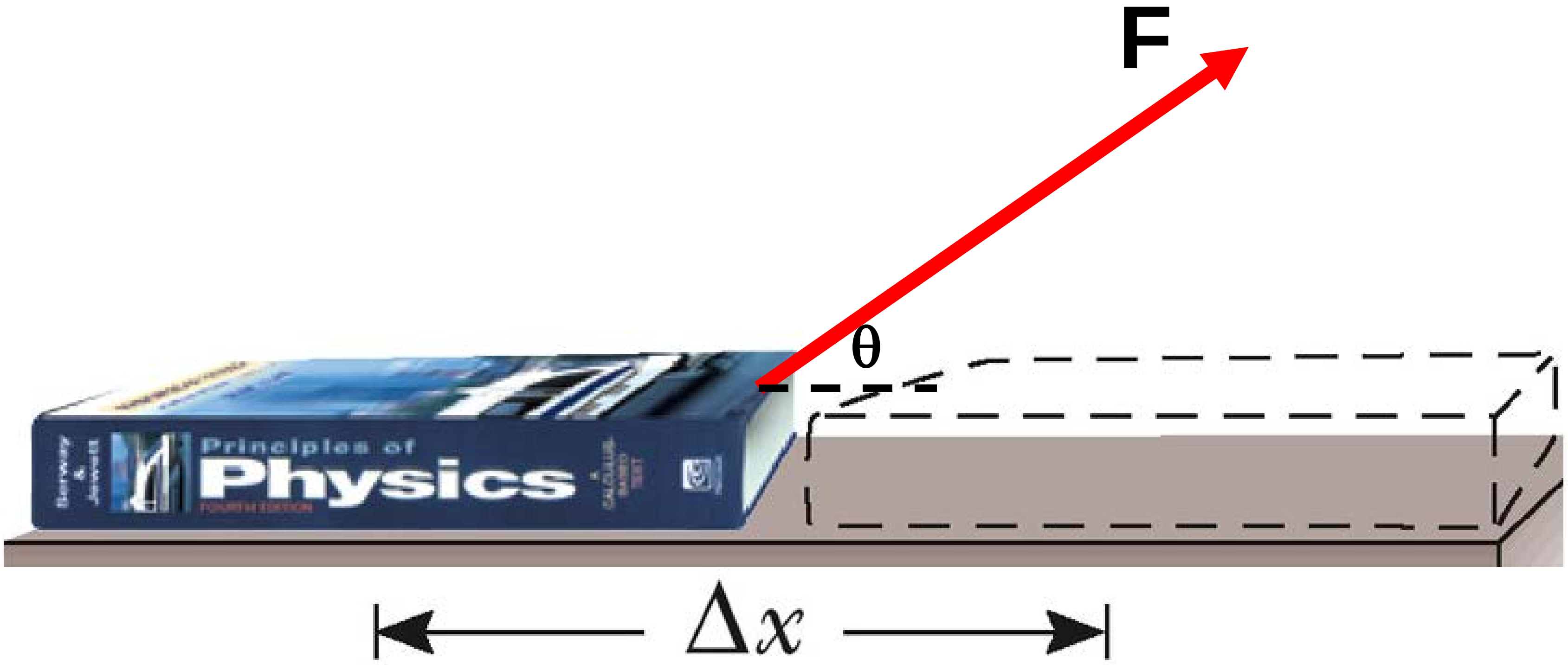
Above or Below the Horizontal?



Work done by a constant force

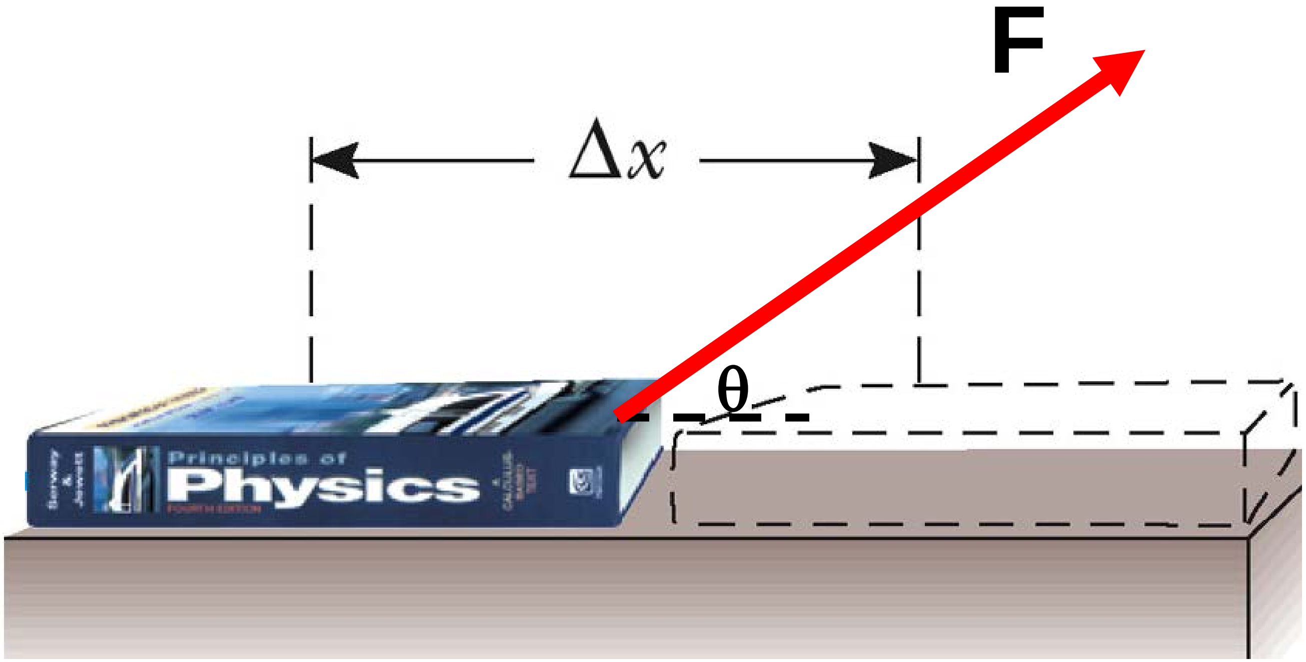
$$W_F = F\Delta s\cos\theta$$



Work

$$W = F\Delta x\cos\theta$$

Constant force

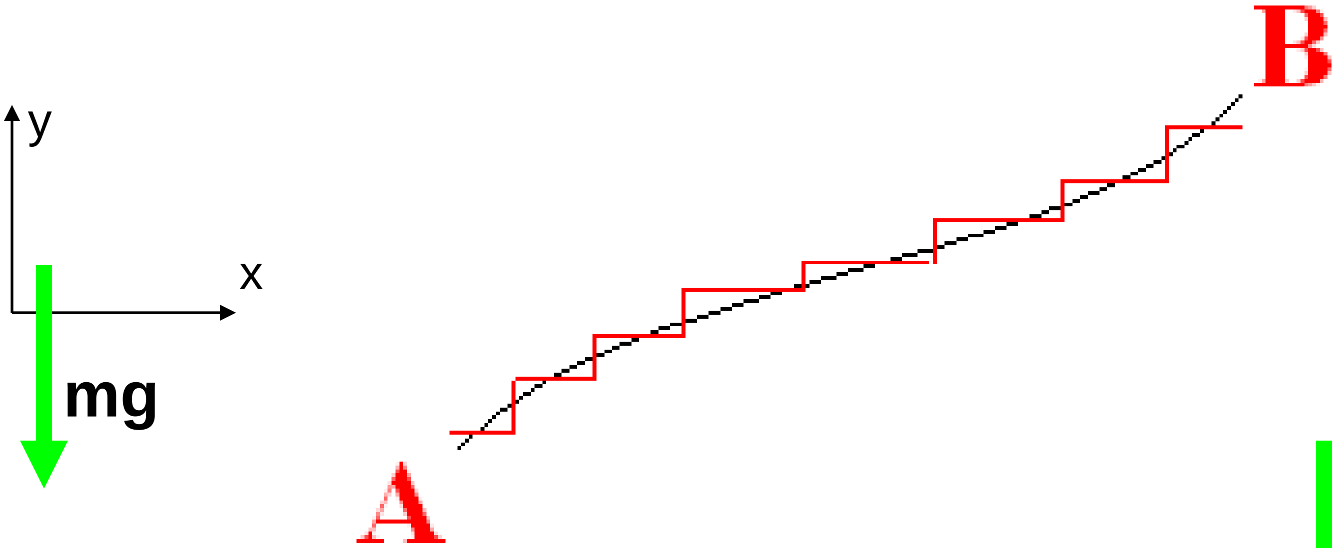


Work

$$W = \int_1^2 F dx\cos\theta$$

Variable force

Work done by gravity



$$W_g = -mg\Delta y$$

Work-Energy Theorem

$$F_{net} = ma$$

$$F_{net}\Delta x = ma\Delta x$$

$$v^2 = v_o^2 + 2a\Delta x$$

$$W_{net} = \frac{1}{2}m\left(v^2 - v_o^2\right)$$

Conservation of Energy

$$W_{NET} = \frac{1}{2}mv^2 - \frac{1}{2}mv_o^2$$

If only work done by gravity

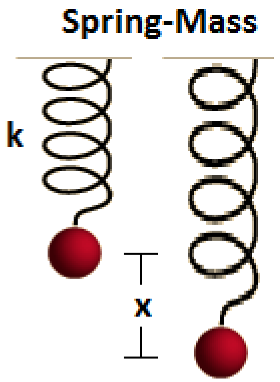
$$W_g = -mg\Delta y = -mg(y - y_o)$$

$$\frac{1}{2}mv_o^2 + mgy_o = \frac{1}{2}mv^2 + mgy$$

Elastic Potential Energy (GPE)

Restoring Force

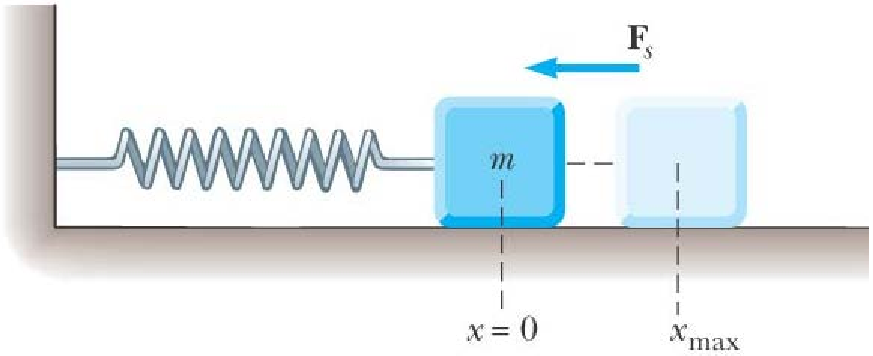
$$F_s = -kx$$



Elastic Potential Energy

$$EPE = \frac{1}{2}kx^2$$

Springs:
Elastic Potential Energy



$$F_s = -kx$$

Hooke's Law

$$W_s = \int_{x_o}^{x} F_s dx = -\int_{x_o}^{x} kx dx = -\frac{1}{2}k(x^2 - x_o^2)$$

Types of Energies

Kinetic Energy	$KE = \frac{1}{2}mv^2$
Gravitational Potential Energy	$GPE = mgy$
Elastic Potential Energy	$EPE = \frac{1}{2}kx^2$

Conservation of Energy

Plus work done by a spring

$$\frac{1}{2}mv_o^2 + mgy_o + \frac{1}{2}kx_o^2 = \frac{1}{2}mv^2 + mgy + \frac{1}{2}kx^2$$

Plus work done by a **force of friction**

$$\frac{1}{2}mv_o^2 + mgy_o + \frac{1}{2}kx_o^2 - f_k\Delta s = \frac{1}{2}mv^2 + mgy + \frac{1}{2}kx^2$$

$f_k\Delta s \rightarrow \Delta E_{\text{int}}$

Conservation of Energy

$$\frac{1}{2}mv_o^2 + mgy_o + \frac{1}{2}kx_o^2 - f_k\Delta s = \frac{1}{2}mv^2 + mgy + \frac{1}{2}kx^2$$

$f_k\Delta s \rightarrow \Delta E_{\text{int}}$

KE_o + GPE_o + EPE_o - Losses = KE + GPE + EPE

SUMMARY

$$W_F = F\Delta s\cos\theta \quad \text{or} \quad W_F = \int_1^2 F\,dx\cos\theta$$

$$W_{NET} = \frac{1}{2}mv^2 - \frac{1}{2}mv_o^2$$

$$\frac{1}{2}mv_o^2 + mgy_o + \frac{1}{2}kx_o^2 - f_k\Delta s = \frac{1}{2}mv^2 + mgy + \frac{1}{2}kx^2$$