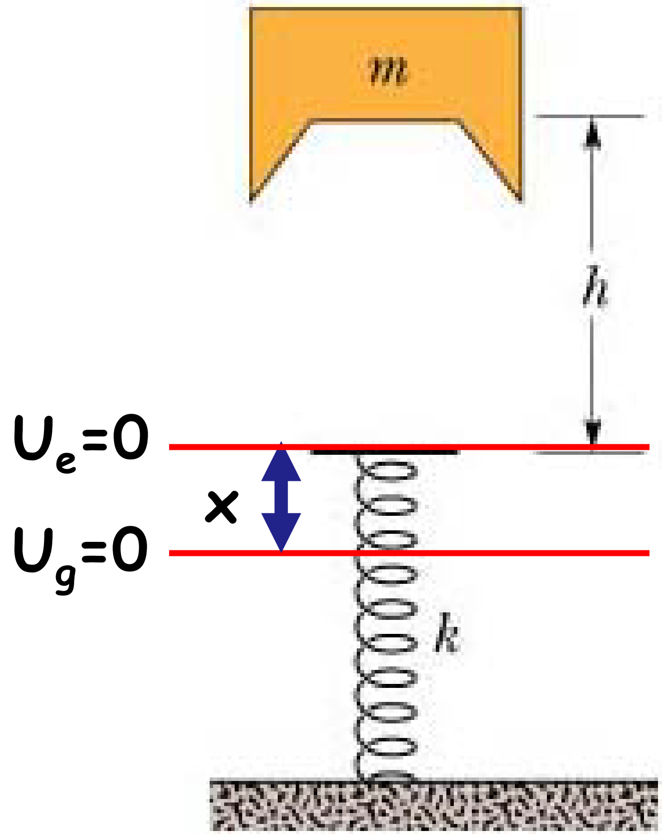
# <u>Solving problems:</u>

# Chapter 3: Work and Mechanical Energy

Homework: 22, 56, 79

24. A block of mass m = 2.0 kg is dropped from height h = 50 cm onto a spring of spring constant k = 1960 N/m. Find the maximum distance the spring is compressed.




Gravitational potential energy:

$$U_g = mgh$$

Elastic potential energy:

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

Kinetic energy:

$$K = \frac{1}{2}mv^2$$

Conservation of mechanical energy:

$$K_i + U_i = K_f + U_f$$

$$mg(h+x) = \frac{1}{2}kx^2 \Rightarrow x = \frac{mg \pm \sqrt{(mg)^2 + 2mghk}}{k}$$

We select x > 0, so:

$$x = 0.11(\text{m})$$

56. You push a 2.0 kg block against a horizontal spring, compressing the spring by 12 cm. Then you release the block, and the spring sends it sliding across a tabletop. It stops 75 cm from where you released it. The spring constant is 170 N/m. What is the block-table coefficient of kinetic friction?

At the beginning:

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

When the block stops, elastic potential energy is completely transferred to thermal energy (work done by friction):

$$U_e = \frac{1}{2}kx^2 = \Delta E_{\text{thermal}} = f_k . d$$

$f_k$ is the kinetic frictional force: $f_k = \mu_k mg$

$$\Rightarrow \mu_k = \frac{kx^2}{2mgd} = \frac{170 \times 0.12^2}{2 \times 2.0 \times 9.8 \times 0.75} = 0.083$$

79. 1500 kg car begins sliding down a 5.0 inclined road with a speed of 30 km/h. The engine is turned off, and the only forces acting on the car are a net frictional force from the road and the gravitational force. After the car has traveled 50 m along the road, its speed is 40 km/h. (a) How much is the mechanical energy of the car reduced because of the net frictional force? (b) What is the magnitude of that net frictional force?

a) $\Delta E_{mec} = \Delta K + \Delta U = K_f - K_i + U_f - U_i$

$= mg \times 50 \times \sin 5^0 + \frac{1}{2} m (v_f{}^2 - v_i{}^2)$

b) $W = \Delta \mathrm{E}_{\mathrm{mec}} + \Delta \mathrm{E}_{\mathrm{thermal}}$

No external force: W=0

$W = 0 \Leftrightarrow \Delta \mathrm{E}_{\mathrm{thermal}} = -\Delta \mathrm{E}_{\mathrm{mec}}$

$\mathrm{f}_{\mathrm{k}} \mathrm{d} = - \Delta \mathrm{E}_{\mathrm{mec}} \Longrightarrow \mathrm{f}_{\mathrm{k}} = - \Delta \mathrm{E}_{\mathrm{mec}} / d$