PHYSICS IN MOTION
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Unit 4G
Spring Potential Energy
Practice Problems TEACHER

Work each of the following problems. SHOW ALL WORK.

1. **A 20 N force is necessary to stretch a spring 0.5 m. What is the spring constant of this spring?**

$$F_s = kx$$
$$20\,N = k(0.5\,m)$$
$$k = 40\,{}^{N}\!/\!_{m}$$

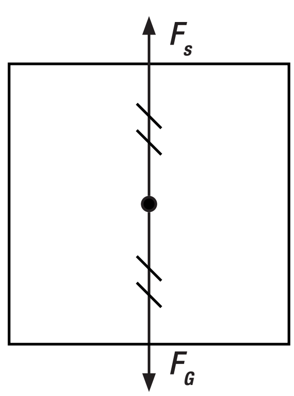
2. **A spring has a spring constant of 25 N/m. What force is necessary to stretch the spring 0.2 m?**

$$F_s = kx$$
$$F_s = (25\,{}^{N}\!/\!_{m})(0.2\,m)$$
$$F_s = 5\,N$$

3. **A 40 N force is applied to a spring with a spring constant of 100 N/m. How far can this spring be compressed by this force?**

$$F_s = kx$$
$$40\,N = (100\,{}^{N}\!/\!_{m})x$$
$$x = 0.4\,m$$

4. **A spring with an unknown spring constant is hung vertically, and a 200 g mass is attached to the bottom. If the spring stretches 0.25 m from its resting position to the position at which the hanging mass is in equilibrium, what is the spring constant of this spring? Draw a free-body diagram for the hanging mass.**



$$F_{net} = 0$$
$$F_s - F_G = 0$$
$$F_s = F_G$$
$$kx = mg$$
$$k(0.25\,m) = (0.2\,kg)(9.8\,{}^{m}\!/\!_{s^2})$$
$$k(0.25\,m) = 1.96\,N$$
$$k = 7.84\,N/m$$

questions continued on next page

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5. A spring with a spring constant of 20 N/m is compressed 0.5 m. How much energy is stored in this spring?

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

$$PE_s = \frac{1}{2}(20\ {}^{N}\!/\!_{m})(0.5\ m)^2$$

$$PE_s = 2.5\ J$$

6. A spring with a spring constant of 100 N/m is stretched 0.2 m. How much energy is stored in this spring?

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

$$PE_s = \frac{1}{2}(100\ {}^{N}\!/\!_{m})(0.2\ m)^2$$

$$PE_s = 2\ J$$

7. A spring is placed horizontally on a frictionless table. The spring constant of the spring is 50 N/m, and it is compressed 0.1 m by a 2 kg block.

   a. How much energy is stored in the spring?

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

$$PE_s = \frac{1}{2}(50\ {}^{N}\!/\!_{m})(0.1\ m)^2$$

$$PE_s = 0.25\ J$$

   b. When the spring expands back to its resting position, it pushes the block away. What is the kinetic energy of the block as a result of this force?

All of the spring potential energy is converted to kinetic energy, so the block has .25 J of kinetic energy.

   c. What is the velocity of the block as it is pushed away by the spring?

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

$$.25\ J = \frac{1}{2}(2\ kg)v^2$$

$$\sqrt{.25\ {}^{m^2}\!/\!_{s^2}} = \sqrt{v^2}$$

$$v = 0.5\ {}^{m}\!/\!_{s}$$

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Work each of the following problems. SHOW ALL WORK.

8. A 1.5 kg block moves at 4 m/s moves along a frictionless horizontal surface. The block slides into a spring with a spring constant of 240 N/m. How far is the spring compressed after the block comes to rest?

The block is moving, so it has kinetic energy before it slides into the spring:

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

$$KE = \frac{1}{2}(1.5\,kg)(4\,{}^{m}\!/\!{}_{s})^2$$

$$KE = 12\,J$$

The block slides into the spring, which it compresses as it stops. All of the kinetic energy is converted into spring potential energy:

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

$$12\,J = \frac{1}{2}(240\,{}^{N}\!/\!{}_{m})x^2$$

$$\sqrt{0.1\,m^2} = \sqrt{x^2}$$

$$x = 0.32\,m$$