

Practice Problems

14.1 Periodic Motion

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1. How much force is necessary to stretch a spring 0.25 m when the spring constant is 95 N/m?

$$\begin{aligned} F &= kx \\ &= (95 \text{ N/m})(0.25 \text{ m}) \\ &= 24 \text{ N} \end{aligned}$$

2. A spring has a spring constant of 56 N/m. How far will it stretch when a block weighing 18 N is hung from its end?

$$\begin{aligned} F &= kx \\ x &= \frac{F}{k} = \frac{18 \text{ N}}{56 \text{ N/m}} = 0.32 \text{ m} \end{aligned}$$

3. What is the spring constant of a spring that stretches 12 cm when an object weighing 24 N is hung from it?

$$\begin{aligned} F &= kx \\ k &= \frac{F}{x} \\ &= \frac{24 \text{ N}}{0.12 \text{ m}} \\ &= 2.0 \times 10^2 \text{ N/m} \end{aligned}$$

4. A spring with a spring constant of 144 N/m is compressed by a distance of 16.5 cm. How much elastic potential energy is stored in the spring?

$$\begin{aligned} PE_{\text{sp}} &= \frac{1}{2} kx^2 \\ &= \frac{1}{2} (144 \text{ N/m})(0.165 \text{ m})^2 = 1.96 \text{ J} \end{aligned}$$

5. A spring has a spring constant of 256 N/m. How far must it be stretched to give it an elastic potential energy of 48 J?

$$PE_{\text{sp}} = \frac{1}{2} kx^2$$

$$x = \sqrt{\frac{2PE_{\text{sp}}}{k}} = \sqrt{\frac{(2)(48 \text{ J})}{256 \text{ N/m}}} = 0.61 \text{ m}$$

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6. What is the period on Earth of a pendulum with a length of 1.0 m?

$$T = 2\pi \sqrt{\frac{l}{g}} = 2\pi \sqrt{\frac{1.0 \text{ m}}{9.80 \text{ m/s}^2}} = 2.0 \text{ s}$$

7. How long must a pendulum be on the Moon, where $g = 1.6 \text{ m/s}^2$, to have a period of 2.0 s?

$$\begin{aligned} T &= 2\pi \sqrt{\frac{l}{g}} \\ l &= g \left(\frac{T}{2\pi} \right)^2 = (1.6 \text{ m/s}^2) \left(\frac{2.0 \text{ s}}{2\pi} \right)^2 = 0.16 \text{ m} \end{aligned}$$

8. On a planet with an unknown value of g , the period of a 0.75-m-long pendulum is 1.8 s. What is g for this planet?

$$\begin{aligned} T &= 2\pi \sqrt{\frac{l}{g}} \\ g &= l \left(\frac{2\pi}{T} \right)^2 = (0.75 \text{ m}) \left(\frac{2\pi}{1.8 \text{ s}} \right)^2 = 9.1 \text{ m/s}^2 \end{aligned}$$

Section Review

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9. **Hooke's Law** Two springs look alike but have different spring constants. How could you determine which one has the greater spring constant?

Hang the same object from both springs. The one that stretches less has the greater spring constant.

10. **Hooke's Law** Objects of various weights are hung from a rubber band that is suspended from a hook. The weights of the objects are plotted on a graph against the

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