PHYSICS IN MOTION
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Unit 6A
The Nature of Waves
Practice Problems TEACHER

Work each of the following problems. SHOW ALL WORK.

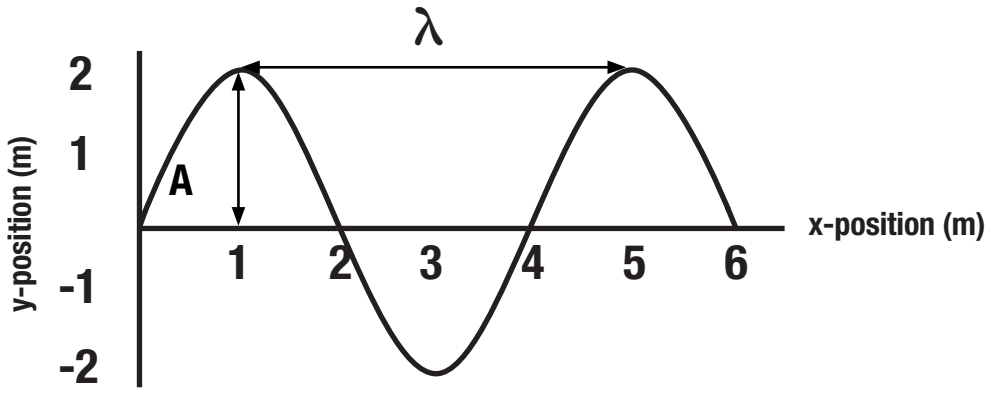
1. **A child sitting at the end of a dock notices that 8 wavelengths pass by in 4 seconds. What is the frequency of the waves passing the dock?**

$$frequency = \frac{\#\ wavelengths}{total\ time} = \frac{8\,\lambda}{4\,s} = \frac{2\,\lambda}{1\,s} = 2\,Hz$$

2. **What is the period of the waves from the previous question?**

$$T = \frac{1}{f} = \frac{1}{2\,Hz} = 0.5\,s$$

3. **Using the diagram below, determine the wavelength and amplitude of the wave:**



The wavelength is 4 m, and the amplitude is 2 m.

4. **A pendulum oscillates 12 times in 4 seconds.**

   a. **What is the frequency of the oscillations?**

$$frequency = \frac{\#\ oscillations}{total\ time} = \frac{12\,osc}{4\,s} = \frac{3\,osc}{1\,s} = 3\,Hz$$

   b. **What is the period of the oscillations?**

$$T = \frac{1}{f} = \frac{1}{3\,Hz} = 0.33\,s$$

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c. What is the length of the pendulum?

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$0.33\,s = 2\pi\sqrt{\frac{l}{9.8\,{}^{m}/_{s^2}}}$$

$$0.0525\,s = \sqrt{\frac{l}{9.8\,{}^{m}/_{s^2}}}$$

$$0.00276\,s^2 = \frac{l}{9.8\,{}^{m}/_{s^2}}$$

$$l = 0.027\,m$$

5. A pendulum is 0.25 m long. What is the frequency of its oscillations?

$$T = 2\pi\sqrt{\frac{l}{g}}$$

$$T = 2\pi\sqrt{\frac{0.25\,m}{9.8\,{}^{m}/_{s^2}}}$$

$$T = 2\pi\sqrt{0.0255\,s^2}$$

$$T = 2\pi(0.16\,s)$$

$$T = 1.00\,s$$

$$f = \frac{1}{T} = \frac{1}{1s} = 1Hz$$

6. A water wave has a frequency of 2 Hz, and there are 3 m between each crest on the wave. How fast is the wave moving?

$$f = 2\,Hz$$
$$\lambda = 3\,m$$

$$v = \lambda f$$
$$v = (3\,m)(2\,Hz)$$
$$v = 6\,{}^{m}/_{s}$$

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7. Sound waves travel at roughly 340 m/s at room temperature. The minimum hearing range of a human is 20 Hz. What is the wavelength of a sound wave?

$$v = 340\ {}^{m}\!/_{s}$$
$$f = 20\ Hz$$

$$v = \lambda f$$
$$340\ {}^{m}\!/_{s} = \lambda\,(20\ Hz)$$

$$\lambda = 17\ m$$

8. If a spring requires 20 N to be compressed a distance of 10 cm, what is its spring constant (N/m)?

$$F = 20\ N$$
$$x = 10\ cm = 0.10\ m$$

$$F = kx$$
$$20\ N = k\,(0.10\ m)$$
$$k = 200\ {}^{N}\!/_{m}$$

9. How much potential energy is stored in the spring from the previous question?

$$k = 200\ {}^{N}\!/_{m}$$
$$x = 0.10\ m$$

$$PE_s = \frac{1}{2}kx^2$$
$$PE_s = \frac{1}{2}(200\ {}^{N}\!/_{m})\,(0.10\ m)^2$$
$$PE_s = 1J$$