Chapter 14 - simple harmonic motion

14–1 and 14–2 simple harmonic motion
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Chapter 15: wave motion

15–1 and 15–2 Characteristics of Waves
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CHAPTER 16 - SOUND

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CHAPTER 14 - SIMPLE HARMONIC MOTION

14–1 and 14–2 Simple Harmonic Motion

2. An elastic cord is 65 cm long when a weight of 75 N hangs from it but is 85 cm long when a weight of 180 N hangs from it. What is the “spring” constant $k$ of this elastic cord?

6. (a) The spring constant is found from the ratio of applied force to displacement.

$$k = \frac{F_{\text{ext}}}{x} = \frac{mg}{x} = \frac{(2.4\,\text{kg}) \left(9.80\,\text{m/s}^2\right)}{0.036\,\text{m}} = 653\,\text{N/m} \approx 650\,\text{N/m}$$

(b) The amplitude is the distance pulled down from equilibrium, so $A = 2.5\,\text{cm}$

The frequency of oscillation is found from the oscillating mass and the spring constant.

$$f = \frac{1}{2\pi} \sqrt{\frac{k}{m}} = \frac{1}{2\pi} \sqrt{\frac{653\,\text{N/m}}{2.4\,\text{kg}}} = 2.625\,\text{Hz} \approx 2.6\,\text{Hz}$$

CHAPTER 15: WAVE MOTION

15–1 and 15–2 Characteristics of Waves

1. A fisherman notices that wave crests pass the bow of his anchored boat every 3.0 s. He measures the distance between two crests to be 8.0 m. How fast are the waves traveling?

2. A sound wave in air has a frequency of 262 Hz and travels with a speed of 343 m/s. How far apart are the wave crests (compressions)?
15–4 Mathematical Representation of Traveling Wave

22. (I) A transverse wave on a wire is given by \( D(x, t) = 0.015 \sin(25x - 1200t) \) where \( D \) and \( x \) are in meters and \( t \) is in seconds. (a) Write an expression for a wave with the same amplitude, wavelength, and frequency but traveling in the opposite direction. (b) What is the speed of either wave?

24. (II) A transverse traveling wave on a cord is represented by \( D = 0.22 \sin(5.6x + 34t) \) where \( D \) and \( x \) are in meters and \( t \) is in seconds. For this wave determine (a) the wavelength, (b) frequency, (c) velocity (magnitude and direction), (d) amplitude, and (e) maximum and minimum speeds of particles of the cord.

15–8 Interference

41. (I) The two pulses shown in Fig. 15–36 are moving toward each other. (a) Sketch the shape of the string at the moment they directly overlap. (b) Sketch the shape of the string a few moments later. (c) In Fig. 15–22a, at the moment the pulses pass each other, the string is straight. What has happened to the energy at this moment?

15–9 Standing Waves; Resonance

43. (I) A violin string vibrates at 441 Hz when unfingered. At what frequency will it vibrate if it is fingered one-third of the way down from the end? (That is, only two-thirds of the string vibrates as a standing wave.)

44. (I) If a violin string vibrates at 294 Hz as its fundamental frequency, what are the frequencies of the first four harmonics?

45. (I) In an earthquake, it is noted that a footbridge oscillated up and down in a one-loop (fundamental standing wave) pattern once every 1.5 s. What other possible resonant periods of motion are there for this bridge? What frequencies do they correspond to?
CHAPTER 16 - SOUND

16–3 Intensity of Sound; Decibels

14. (I) What is the intensity of a sound at the pain level of 120 dB? Compare it to that of a whisper at 20 dB.

15. (I) What is the sound level of a sound whose intensity is $2.03 \times 10^6 \text{ W/m}^2$?

16–7 Doppler Effect

61. (I) The predominant frequency of a certain fire truck’s siren is 1350 Hz when at rest. What frequency do you detect if you move with a speed of 30.0 m/s (a) toward the fire truck, and (b) away from it?

62. (I) A bat at rest sends out ultrasonic sound waves at 50.0 kHz and receives them returned from an object moving directly away from it at 30.0 m/s. What is the received sound frequency?