CHAPTER 13

VIBRATIONS AND WAVES

1. (b).

2. (d).

3. (b), because \( f = \frac{1}{T} \).

4. (a), because \( U = \frac{1}{2} kx^2 \).

5. (a) \( E = \frac{1}{2} kA^2 \), so \( \text{four times as large} \) \hspace{1cm} (b) \( \nu_{\max} = \sqrt{\frac{k}{m}} A \), so \( \text{twice as large} \).

6. At the equilibrium position the elastic potential energy is zero, and so all the energy is kinetic. Therefore the speed \( \text{increases} \) as it approaches the equilibrium position.

7. In one period \( T \), the mass goes through a distance equal to \( 4A \). So the time is \( \frac{T}{4} \) for distance \( A \) and \( \frac{T}{2} \) for \( 2A \).

8. \( \text{No} \), this is not a simple harmonic motion because the \( \text{restoring force does not obey Hooke's law} \). Once the ball is in the air, the gravitational force is always constant and downward.

9. In each \( T \), it travels \( A - A + A + A = 4A \).

10. \( f = \frac{1}{T} = \frac{1}{0.50 \text{ s}} = 2.0 \text{ Hz} \)

11. \( T = \frac{1}{f} = \frac{1}{40 \text{ Hz}} = 0.025 \text{ s} \).

12. \( T = \frac{1}{f} \hspace{1cm} \Delta \nu = \frac{1}{f_1} - \frac{1}{f_2} = \frac{1}{0.50 \text{ s}} - \frac{1}{0.25 \text{ s}} = -2.0 \text{ s} = \text{decrease of 2.0 s} \)

13. \( k = \frac{F}{x} = \frac{mg}{x} = (0.25 \text{ kg})(9.80 \text{ m/s}^2) \frac{0.060 \text{ m}}{0.060 \text{ m}} = 41 \text{ N/m} \).

14. \( \nu_{\max} = \sqrt{\frac{k}{m}} A = \sqrt{\frac{10 \text{ N/m}}{0.50 \text{ kg}}} (0.050 \text{ m}) = 0.22 \text{ m/s} \).