MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) A 1.6–kg block on a horizontal frictionless surface is attached to a spring whose force constant is 190 N/m. The block is pulled from its equilibrium position at $x = 0$ m to a displacement $x = +0.080$ m and is released from rest. The block then executes simple harmonic motion along the x–axis (horizontal). The velocity of the block at time $t = 0.40$ s is closest to: 1) ________

A) 0.8 m/s B) –0.8 m/s C) 0.3 m/s D) –0.3 m/s E) zero

Situation 1

The angle with the vertical of a swinging simple pendulum obeys the equation $\Theta(t) = (0.150 \text{ rad}) \cos[(2.85 \text{ rad/s})t + 1.66]$.

2) In Situation 1, the mass of the swinging bob at the end of the pendulum is closest to: 2) ________

A) 2.85 kg
B) 1.66 kg
C) 0.454 kg
D) 0.150 kg
E) It cannot be determined from the information given.

3) What happens when a periodic driving force is applied to a vibrating system? 3) ________

A) The system will stop vibrating and finally come to a stop.
B) The system will exhibit chaotic motion.
C) The system will vibrate at the frequency of the driving force.
D) The system will vibrate at its natural frequency.
E) It will vibrate at some multiple of the driving frequency (called a harmonic or "overtone").

Situation 2

A 5.0–kg block is attached to a spring whose force constant is 125 N/m. The block is pulled from its equilibrium position at $x = 0$ m to a position at $x = +0.687$ m and is released from rest. The block then executes damped oscillation along the x–axis. The damping force is proportional to the velocity. When the block first returns to $x = 0$ m, its x–component of velocity is –2.0 m/s and its x–component of acceleration is $+5.6 \text{ m/s}^2$.

4) In Situation 2, the damping coefficient b is closest to: 4) ________

A) 14 kg/s^2 B) 16 kg/s^2 C) 18 kg/s^2 D) 20 kg/s^2 E) 22 kg/s^2

5) A transverse wave is propagated in a string stretched along the x–axis. The equation of the wave, in SI units, is given by: $y = 0.005 \cos \pi(38t - 14x)$. The wave speed, including the sense of direction along the x–axis, in SI units, is closest to: 5) ________

A) 2.7 B) –2.7 C) 0.37 D) –0.37 E) zero

6) A string, 80 cm long and having a mass of 61 g, is attached to a 660–Hz vibrator at one end. The other end of the string is fixed and the string is kept under tension. The vibrator produces a transverse wave in the string, whose amplitude is 5.0 mm, and that propagates with a velocity of 32 m/s. The energy of the wave is absorbed at the fixed end. In this situation, the tension in the string, in SI units, is closest to: 6) ________

A) 78 B) 75 C) 81 D) 84 E) 87

7) A string, 50 cm long and having a mass of 57 g, is attached to a 910–Hz vibrator at one end. The other end of the string is fixed and the string is kept under tension. The vibrator produces a transverse wave in the string, whose amplitude is 6.0 mm, and that propagates with a velocity of 25 m/s. The energy of the wave is absorbed at the fixed end. In this situation, the average power transmitted by the wave, in SI units, is closest to: 7) ________

A) 1700 B) 2500 C) 3400 D) 4200 E) 5100

8) Which of the following is a FALSE statement? 8) ________

A) In a transverse wave the particle motion is perpendicular to the velocity vector of the wave.
B) Not all waves are mechanical in nature.
C) The speed of a wave and the speed of the vibrating particles that constitute the wave are different entities.
D) Waves transport energy and matter from one region to another.
E) A wave in which particles move back and forth in the same direction as the wave is moving is called a longitudinal wave.

9) A string, 0.23 m long, vibrating in the $n = 2$ harmonic, excites an open pipe, 0.82 m long, into its $n = 3$ harmonic. The speed of sound in air is 345 m/s. The number of antinodes in the standing wave pattern of the pipe is: 9) ________

A) 4 B) 2 C) 3 D) 5 E) 6

10) At one instant of time two transverse waves are traveling in the same direction along a stretched string. They are described in SI units by 10) ________

$y_1 = 0.05 \cos 5x$ and $y_2 = 0.05 \sin 5x$

How far from the origin is the nearest crest of the composite wave?

A) 0.16 m B) 0.31 m C) 0.63 m D) 0.10 m E) 0.20 m

11) Two violinists are trying to tune their instruments in an orchestra. One is producing the desired frequency, 440 Hz. The other is producing a frequency of 448.4 Hz. By what percentage should the out–of–tune musician change the tension in his string to bring his instrument into tune at 440 Hz? 11) ________

A) 2.0% B) 1.0% C) 0.5% D) 4.0% E) 0.6%

12) Which of the following increases when a sound becomes louder? 12) ________

A) Phase
B) Wavelength
C) Amplitude
D) Period
E) Velocity