Name: _____ Date: _____

1. A 40-cm long string, with one end clamped and the other free to move transversely, is vibrating in its fundamental standing wave mode. If the wave speed is 320 cm/s the frequency is:

A) 32 Hz
B) 16 Hz
C) 8 Hz
D) 4 Hz
E) 2 Hz

2. A long string is constructed by joining the ends of two shorter strings. The tension in the strings is the same but string I has 4 times the linear density of string II. When a sinusoidal wave passes from string I to string II:

A) the frequency decreases by a factor of 4
B) the frequency decreases by a factor of 2
C) the wave speed decreases by a factor of 4
D) the wave speed decreases by a factor of 2
E) the wave speed increases by a factor of 2

3. Sinusoidal waves travel on five different strings, all with the same tension. Four of the strings have the same linear mass density, but the fifth has a different linear mass density. Use the mathematical forms of the waves, given below, to identify the string with the different linear mass density. In the expressions x and y are in centimeters and t is in seconds.

A) $y(x, t) = (2\text{ cm}) \sin (2x - 4t)$
B) $y(x, t) = (2\text{ cm}) \sin (4x - 10t)$
C) $y(x, t) = (2\text{ cm}) \sin (6x - 12t)$
D) $y(x,t) = (2\text{ cm}) \sin (8x-16t)$
E) $y(x,t) = (2\text{ cm}) \sin (10x-20t)$

4. The time required for a small pulse to travel from A to B on a stretched cord shown is NOT altered by changing:

A) the linear density of the cord
B) the length between A and B
C) the shape of the pulse
D) the tension in the cord
E) none of the above (changes in all alter the time)

5. The speed of a sinusoidal wave on a string depends on:

A) the frequency of the wave
B) the wavelength of the wave
C) the length of the string
D) the tension in the string
E) the amplitude of the wave

6. A string of length L is clamped at each end and vibrates in a standing wave pattern. The wavelengths of the constituent traveling waves CANNOT be:

A) L
B) $2L$
C) $L/2$
D) $2L/3$
E) $4L$

7. For a transverse wave on a string the string displacement is described by $y(x,t) = f(x - at)$, where f is a given function and a is a positive constant. Which of the following does NOT necessarily follow from this statement?

A) The shape of the string at time $t = 0$ is given by $f(x)$.
B) The shape of the waveform does not change as it moves along the string.
C) The waveform moves in the positive x direction.
D) The speed of the waveform is a.
E) The speed of the waveform is x/t.

8. A string, clamped at its ends, vibrates in three segments. The string is 100 cm long. The wavelength is:

A) 33.3 cm
B) 66.7 cm
C) 150 cm
D) 300 cm
E) need to know the frequency

9. The displacement of a string is given by

$$y(x, t) = Y \sin (kx + \omega t) .$$

speed of the wave is:

A) $2\pi k/\omega$
B) ω/k
C) ωk
D) $2\pi/k$
E) $k/2\pi$

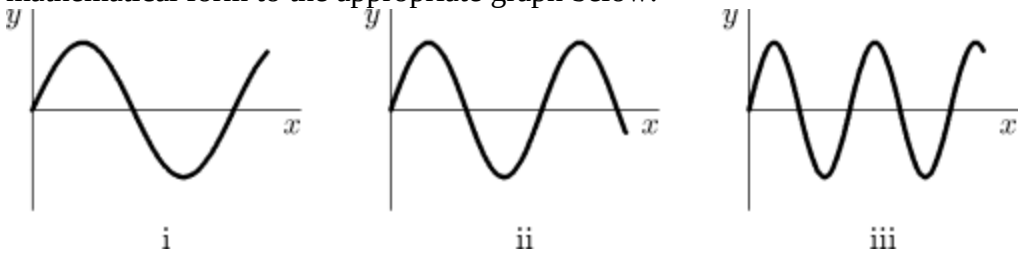
10. Two sinusoidal waves have the same angular frequency, the same amplitude Y, and travel in the same direction in the same medium. If they differ in phase by 50º, the amplitude of the resultant wave is given by:

A) $0.64Y$
B) $1.3Y$
C) $0.91Y$
D) $1.8Y$
E) $0.35Y$

11. Suppose the maximum speed of a string carrying a sinusoidal wave is V^{string}. When the displacement of a point on the string is half its maximum, the speed of the point is:

A) $V^{\text{string}}/2$
B) $2V^{\text{string}}$
C) $V^{\text{string}}/4$
D) $3V^{\text{string}}/4$
E) $\sqrt{3}V^{\text{string}}/2$

12. Three traveling sinusoidal waves are on identical strings, with the same tension. The mathematical forms of the waves are $y_1(x, t) = Y \sin(3x - 6t)$, $y_2(x, t) = Y \sin(4x - 8t)$, and $y_3(x, t) = Y \sin(6x - 12t)$, where x is in meters and t is in seconds. Match each mathematical form to the appropriate graph below.



i ii iii

A) y_1: i, y_2: ii, y_3: iii
B) y_1: iii, y_2: ii, y_3: i
C) y_1: i, y_2: iii, y_3: ii
D) y_1: ii, y_2: i, y_3: iii
E) y_1: iii, y_2: i, y_3: ii

13. The sinusoidal wave

$$y(x, t) = Y \sin(kx - \omega t)$$

incident on the fixed end of a string at $x = L$. The reflected wave is given by:

A) $Y \sin(kx + \omega t)$
B) $-Y \sin(kx + \omega t)$
C) $Y \sin(kx + \omega t - kL)$
D) $Y \sin(kx + \omega t - 2kL)$
E) $-Y \sin(kx + \omega t + 2kL)$

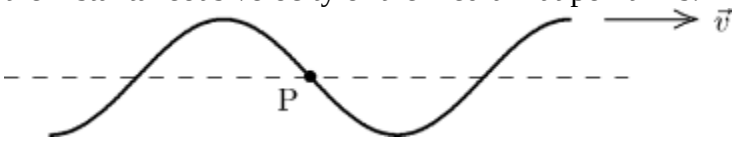
14. A standing wave:

A) can be constructed from two similar waves traveling in opposite directions
B) must be transverse
C) must be longitudinal
D) has motionless points that are closer than half a wavelength
E) has a wave velocity that differs by a factor of two from what it would be for a traveling wave

15. When a string is vibrating in a standing wave pattern the power transmitted across an antinode, compared to the power transmitted across a node, is:

A) more
B) less
C) the same (zero)
D) the same (non–zero)
E) sometimes more, sometimes less, and sometimes the same

16. The transverse wave shown is traveling from left to right in a medium. The direction of the instantaneous velocity of the medium at point P is:



A) ↑
B) ↓
C) →
D) ↗
E) no direction since $v = 0$

17. Let f be the frequency, v^{wave} the speed, and T the period of a sinusoidal traveling wave. The angular frequency is given by:

A) $1/T$
B) $2\pi/T$
C) $v^{\text{wave}}T$
D) f/T
E) T/f

18. When a certain string is clamped at both ends, the lowest four resonant frequencies are measured to be 100, 150, 200, and 250 Hz. One of the resonant frequencies (below 200 Hz) is missing. What is it?

A) 25 Hz
B) 50 Hz
C) 75 Hz
D) 125 Hz
E) 225 Hz

19. A wave on a stretched string is reflected from a fixed end P of the string. The phase difference, at P, between the incident and reflected waves is:

A) zero
B) π rad
C) $\pi/2$ rad
D) depends on the velocity of the wave
E) depends on the frequency of the wave

20. The displacement of a string is given by

$$y(x, t) = Y \sin (kx + \omega t) .$$

wavelength of the wave is:

A) $2\pi k/\omega$
B) k/ω
C) ωk
D) $2\pi/k$
E) $k/2\pi$

21. Sinusoidal water waves are generated in a large ripple tank. The waves travel at 20 cm/s and their adjacent crests are 5.0 cm apart. The time required for each new whole cycle to be generated is:

A) 100 s
B) 4.0 s
C) 2.0 s
D) 0.5 s
E) 0.25 s

22. A wave is described by $y(x, t) = 0.1 \sin (3x + 10t)$, where x is in meters, y is in centimeters, and t is in seconds. The angular wave number is:

A) 0.10 rad/m
B) 3π rad/m
C) 10) rad/m
D) 10π) rad/m
E) 3.0 rad/cm

23. The displacement of a string carrying a traveling sinusoidal wave is given by

$$y(x, t) = Y \sin (kx - \omega t - \phi_0) .$$

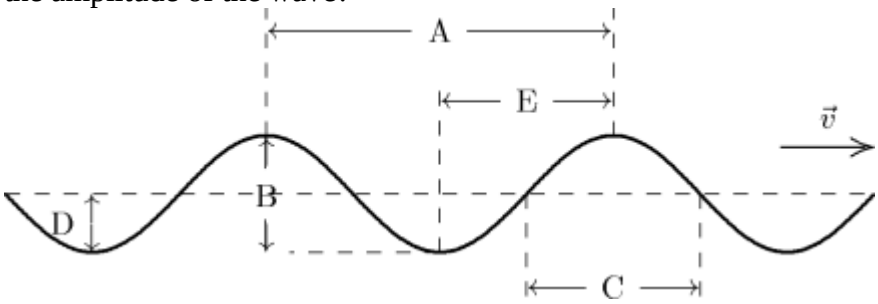
time $t = 0$ the point at $x = 0$ has a velocity of 0 and a positive displacement. The phase constant ϕ_0 is:

A) 45º
B) 90º
C) 135º
D) 180º
E) 270º

24. A transverse traveling sinusoidal wave on a string has a frequency of 100 Hz, a wavelength of 0.040 m, and an amplitude of 2.0 mm. The maximum velocity in m/s of any point on the string is:

A) 0.2
B) 1.3
C) 4
D) 15
E) 25

25. A sinusoidal wave is traveling toward the right as shown. Which letter correctly labels the amplitude of the wave?



A) A
B) B
C) C
D) D
E) E

Answer Key

1. E
2. E
3. B
4. C
5. D
6. E
7. E
8. B
9. B
10. D
11. E
12. A
13. D
14. A
15. C
16. A
17. B
18. B
19. B
20. D
21. E
22. E
23. E
24. B
25. D