PHYS102 – Chapter 16 (Instructor: Dr. Al–Shukri)

1. A string under a tension of 15 N, is set into vibration to produce a wave of speed 20 m/s, and a maximum transverse speed of 8 m/s. For this wave, the average power is:

a. 24 W b. 11 W c. 30 W d. 15 W e. 44 W

2. At $t = 0$, a transverse wave pulse in a wire is described by the function: $y(x,0) = 8.0 / (x^2 + 111)$, where x and y are in cm. Calculate y at $x = 3.0$ cm and $t = 1.0$ s if the wave is traveling in the negative x direction with a speed of 4.0 cm/s.

a. 0.5 mm b. 0.4 mm c. 0.3 mm d. 0.2 mm e. 0.1 mm

3. The resultant wave of two interfering waves moving in the same direction is given by:
$y(x. t) = 10.0 \cos(\pi/6) \sin(3.0\, x + 20\pi\, t + \pi/6)$.
One of the two originally interfering waves could be:

a. $y(x.t) = 5.0 \sin(3.0\, x + 20\pi\, t + \pi/3)$.
b. $y(x.t) = 10.0 \sin(3.0\, x + 20\pi\, t + \pi/3)$.
c. $y(x,t) = 5.0 \sin(3.0\, x + 20\pi\, t + \pi/6)$.
d. $y(x.t) = 10.0 \sin(3.0\, x + 20\pi\, t)$.
e. $y(x,t) = 10.0 \sin(3.0\, x - 20\pi\, t)$.

4. A wave on a string is reflected from a fixed end. The reflected wave:

a. is 180° out of phase with the original wave at the fixed end.
a. has a larger speed than the original wave.
b. has a larger amplitude than the original wave.
c. cannot be transverse.
d. is in phase with the original wave at the fixed end.
e. has a larger speed than the original wave.

5. Standing waves are produced in a string at the two consecutive resonant frequencies 155 Hz and 195 Hz. If the mass of the string is 5.00 g and its length is 0.80 m, then the tension applied to the string should be:

a. 25.6 N b. 17.2 N c. 28.5 N d. 19.0 N e. 6.4 N

6. A traveling wave is given by: $y(x,t) = 6.0 \cos[0.63\, x + 25.1\, t)]$, where x and y are in cm and t is in seconds. It interferes with a similar wave propagating in the opposite direction to produce a standing wave. The distance between the node and the consecutive antinode is:

a. 2.5 cm b. 5.0 cm c. 1.0 cm d. 7.9 cm e. 0.5 cm

7. What is the wave speed of a transverse wave on a string described by $y = (2.0\text{ mm}) \sin[10.0\, x - 100\, t]$, where x is in meters and t is seconds.

a. 10 m/s b. 1000 m/s c. 0.010 m/s
d. 20 m/s e. 2000 m/s

8. A string has a mass density of 0.10 kg/m and it is under tension of 10.0 N. What must be the frequency of traveling waves of amplitude 10.0 mm for the average power to be 0.5 W?

a. 16 Hz b. 100 Hz c. 0.01 Hz d. 10 Hz e. 32 Hz

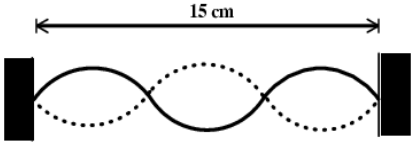
9 The velocity of a traveling wave on a string under fixed tension

a. does not change when the frequency increases
b. increases when the frequency increases
c. decreases when the frequency increases
d. decreases when the wave length increases
e. decreases when the amplitude increases

10. Two identical waves moving in the same direction along a stretched string, interfere with each other. The amplitude of each wave is 10.0 mm and the phase difference between them is 1.60 radians. What is the amplitude of the resultant wave?

a. 14 mm b. 10 mm c. 7.3 mm d. 20 mm e. 8.0 mm

11. A standing wave pattern is established on a string as shown in the **Figure**. The wavelength of the component traveling wave is



a. 10 cm b. 5.0 cm c. 0.2 cm d. 0.4 cm e. 15 cm

12. A string that is stretched between two supports separated by 0.5 m has resonant frequencies of 500 Hz and 450 Hz, with no intermediate resonant frequencies, what is the wave speed in the string?

a. 50 m/s b. 90 m/s c. 75 m/s d. 20 m/s e. 35 m/s

13. The equation of a wave traveling along a string, under a tension of 10 N, is given by:
$y = (6.0\text{ cm}) \sin(0.02\, \pi x + 40.0\, \pi t)$,
where x is in centimeters and t is in seconds. Determine the mass per unit length of the string.

a. 25 g/m b. 60 g/m c. 50 g/m d. 10 g/m e 72 g/m

14. A sinusoidal wave, given by the equation:
$y(x,t) = 0.07 \cos(6.0\, x - 30\, t)$, where x and y are in meters and t is in seconds, is moving in a string of linear density = 1.2 g/m. At what rate is the energy transferred by the wave?

a. 1.32×10^{-2} W. b. 1.05×10^{-2} W.
c. 3.02×10^{-2} W. d. 2.21×10^{-2} W.
e. No enough information is given to solve this question.

15. A sinusoidal wave is given by the equation:
$y(x,t) = 7.0 \cos(-k\, x - \omega\, t + \varphi)$. Which of the following statements is true about this wave:

a. The wave is moving to the negative x-axis.
b. The wave is moving to the positive x-axis.
c. The wave is a standing wave.
d. The wave is moving with speed k/w.
e. The wave is moving with speed kw.

16. A wave in a string, of linear density 0.13 g/m, is given by the equation: $y(x,t) = 0.018 \sin(3.0\, x - 24\, t)$, where x and y are in meters and t is in seconds. The tension in the string is:

a. 8.32×10^{-3} N. b. 2.43×10^{-5} N. c. 3.90×10^{-3} N.
d. 3.12×10^{-2} N. e. 2.34×10^{-4} N.

17. Two identical sinusoidal waves, are out of phase with each other, travel in the same direction. They interfere and produce a resultant wave given by the equation: $y(x,t)= 8.20\times10^{-4} \sin(4.50\ x - 8.60\ t + 1.57)$, where x and y are in meters and t is in seconds. What is the amplitude of the two interfering waves?

a. 0.390 m. b. 1.05 m. c. 2.50 m.
d. 0.250 m. e. 0.270 m.

18. A string has linear density = 5.1 g/m and is under a tension of 120 N. If the vibrating length of the string is 60 cm, What is the lowest resonant frequency?

a. 128 Hz. b. 158 Hz. c. 225 Hz.
d. 312 Hz. e. Not enough information.

19. In an air pipe, closed at one end, the three successive resonance frequencies are 425 Hz, 595 Hz, and 765 Hz. If the speed of sound in air is 340 m/s, the length of the pipe is:

a. 1.0 m b. 2.0 m c. 0.5 m d. 2.5 m e. 1.5 m

20. A water wave is described by the equation: $y(x,t) = 0.40 \cos [0.10(x + 3t)]$, where x and y are in meters and t is in seconds. The maximum transverse speed of the water molecules is

a. 0.12 m/s. b. 1.20 m/s. c. 0.04 m/s.
d. 0.22 m/s. e. 4.11 m/s.

21. Two identical waves, moving in the same direction, have a phase difference of $\pi/2$. The amplitude of each of the two waves is 0.12 m. If they interfere, then the amplitude of the resultant wave is:

a. 0.17 m. b. 0.21 m.
c. 0.24 m. d. 1.12 m.
e. Not enough information is given to solve this question.

22. A wave of speed 20 m/s on a string, fixed at both ends, has an equation for a standing wave given by: $y(x,t) = 0.05 \sin(k\ x) \cos(30\ t)$, where x and y are in meters and t is in seconds. What is the distance between two consecutive nodes?

a. 2.1 m b. 3.2 m c. 0.1 m d. 1.1 m e. 5.0 m

23. A 40 cm string of linear mass density 8.0 g/m is fixed at both ends. The string is driven by a variable frequency audio oscillator ranged from 300 Hz to 800 Hz. It was found that the string is set in oscillation only at the frequencies 440 Hz and 660 Hz. What is the tension in the string?

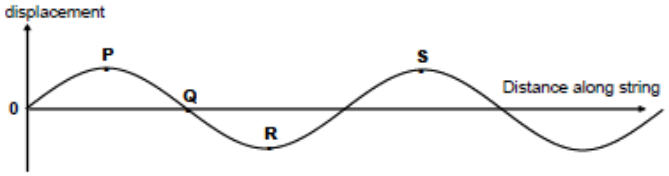
a. 248 N b. 322 N c. 125 N d. 500 N e. 496 N

24. Consider a wave of wavelength λ described by the equation: $y(x,t) = A \cos (k\ x - \omega\ t)$. At t = 0, the displacement is zero at x = :

a. ¼ λ , ¾ λ , . . . b. ½ λ, λ, ... c. ⅓ λ, ⅔ λ, . . .
d. ½ λ, 3/2 λ, . . . e. ⅛ λ, ⅜ λ,. . .

25. The **Figure** shows the snap shot of part of a transverse wave traveling along a string. Which statement about the motion of elements of the string is correct? For the element at

a. S, the magnitude of its acceleration is a maximum.
b. S, the magnitude of its acceleration is zero.
c. P, its speed is a maximum.
d. Q, its speed is zero.
e. Q, its displacement is a maximum.



26. A wave in a string, is given by the equation: $y(x, t) = 0.24 \sin(3.0\ x - 24\ t)$, where x and y are in meters and t is in seconds. Calculate the magnitude of the transverse speed at x = 2.0 m and t = 1.0 s.

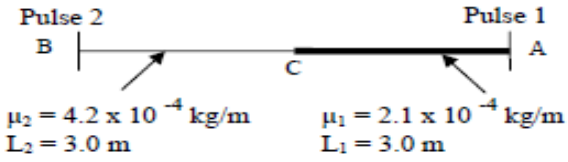
a. 3.8 m/s b. 1.8 m/s c. 5.5 m/s
d. 8.0 m/s e. 2.1 m/s

27. Consider the following sinusoidal wave: $y(x,t) = 10.0\cos(0.200x - 100t)$, where x , y in cm and t in s. At a given instant, let point A be at the origin (x = 0) and point B be the first point along x that is 90º out of phase with point A. What is the coordinate of point B?

a. 7.85 cm b. 31.4 cm c. 15.7 cm d. 3.18 cm e. 12.7 cm

28. In the **Figure**, two equivalent pulses, Pulse 1 and Pulse 2, are sent from points A and B at the same time, respectively. Which pulse reaches point C first?

a. Pulse 1. b. Pulse 2.
c. Both at the same time. d. Not enough information.



29. Two pipes have the same length L. Pipe B open at one end and closed at the other, while pipe A open at both ends. Which harmonic of pipe B matches the second harmonic of pipe A?

a. Never match. b. The fourth.
c. The second. d. The fundamental.
e. One needs to know the length.

30. A uniform wire, having a mass of 0.4 kg and length of 6.5 m, is connected to a pulse generator. The tension is maintained in the wire by suspending a 3.5 kg mass on the other end. Find the time it takes a pulse to travel from a pulse generator to the other end.

a. 0.28 s b. 0.35 s c. 0.40 s
d. 0.15 s e. 2.00 s