Waves, Sound, & Light
Practice Test

Name: Key Block:_____

For the questions below, please chose the single best answer:

1. If the particles of the medium are vibrating to and fro in the same direction of energy transport, then the wave is a _____ wave.
   a. longitudinal
   b. sound
   c. standing
   d. transverse

   Longitudinal Wave → v ↔ particles

2. When the particles of a medium are vibrating at right angles to the direction of energy transport, then the wave is a _____ wave.
   a. longitudinal
   b. sound
   c. standing
   d. transverse

   Transverse → v ↕ particles

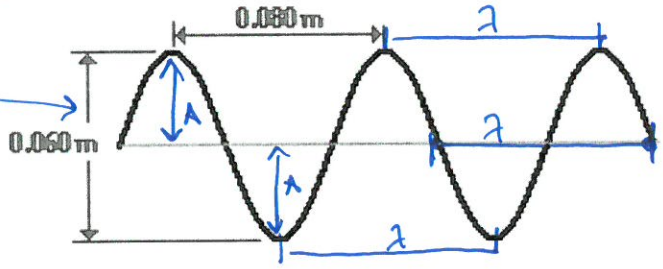
3. A wave is moving through a coiled Slinky™. The time for a single coil to complete one full back and forth vibration is known as the _____.
   a. speed
   b. period
   c. amplitude
   d. frequency

   T

4. What is the amplitude of the wave in the diagram below?

   A

   a. 0.03 m
   b. 0.04 m
   c. 0.05 m
   d. 0.08 m



5. The wavelength of the wave in the diagram above (Question 4) is _____ m.
   a. 0.030
   b. 0.040
   c. 0.060
   d. 0.080

   λ

6. Consider **Diagram A** and **Diagram B** below:

Diagram A

Diagram B

Compared to the wave in **Diagram B**, the wave in **Diagram A** has _____.
a. the same amplitude by a larger wavelength
b. a larger amplitude and a smaller wavelength
c. a smaller amplitude and the same wavelength
d. the same amplitude and a smaller wavelength

7. A wave is traveling through a medium. For a point on the medium the number of vibration cycles per unit of time is defined as the wave's ____.
   a. wavelength
   b. period
   c. amplitude
   d. frequency

$f = \frac{\text{cycles}}{\text{time}}$ (how often)

8. A periodic and repeating disturbance in a lake creates waves that emanate outward from its source to produce circular wave patterns. If the frequency of the source is 2.00 Hz and the wave speed is 5.00 m/s then the distance between adjacent wave crests is ___ meter.
   a. 0.200
   b. 0.400
   c. 1.25
   d. 2.50
   e. 10.0

f v λ

$v = f\lambda$

$5\ m/s = 2\ Hz\ \lambda$

$5/2 = \lambda = 2.5$

9. A wave has a speed of 0.80 m/s and a wavelength of 0.60 meters. What is its frequency?
   a. 0.48 Hz
   b. 0.67 Hz
   c. 0.75 Hz
   d. 1.3 Hz

v λ f

$v = f\lambda$

$.8 = .6(\lambda)$ $\quad .8/.6 = \lambda = 1.3\overline{3}$

10. A pendulum makes exactly 40 vibrations in 20.0 s. Its period is ____. (Be cautious of the units.)
    a. 0.500 Hz.
    b. 0.500 s.
    c. 2.00 Hz.
    d. 2.00 s.
    e. 8.00×10^2 Hz.

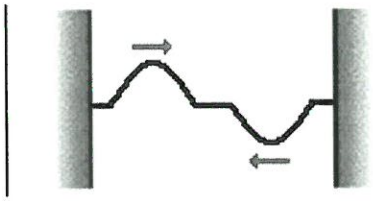
$T = \frac{\text{time}}{\text{cycle}} = \frac{20.0\ s}{40\ \text{vibrations}} = 0.5\ s$

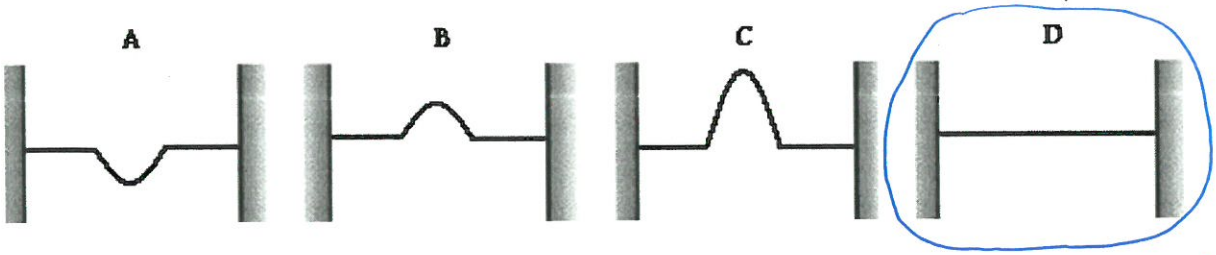
11. A wave with a period of 0.0050 seconds would have a frequency of ____ Hz.
    a. 20
    b. 50
    c. 200
    d. 500
    e. 2000

T f

$f = \frac{1}{T}$ $\quad f = \frac{1}{.005\ s} = 200\ Hz$

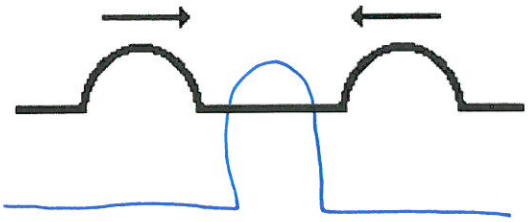
12. Two pulses are traveling in opposite directions along the same medium as shown in the diagram at the right. Which diagram below best depicts the appearance of the medium when each pulse meets in the middle?





crest meets trough & destructive interference!

13. The two pulses shown at the right are moving in opposite directions along the same medium. When they meet, _____ interference will occur.



a. Doppler
b. resonant
c. destructive
d. constructive

crest meets crest
so constructive –

14. Which one of the following characteristics of a sound wave determines the pitch that observers hear?

f

a. The speed of the sound wave
b. The frequency of the sound wave
c. The amplitude of the sound wave
d. The distance of the sound wave from the source

15. Which characteristic of a wave contributes to the loudness of a sound?

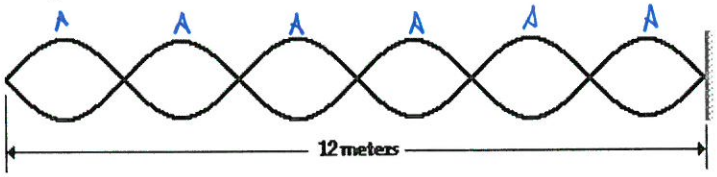
A

a. The speed.
b. The frequency.
c. The wavelength.
d. The amplitude.

16. As two or more waves pass simultaneously through the same region, ____ can occur.
a. refraction
b. diffraction
c. interference
d. reflection

see # 13 & #12

17. Consider the standing wave pattern shown below.



A wave generated at the left end of the medium undergoes reflection at the fixed end on the right side of the medium. The number of antinodes in the diagram is
a. 3.0
b. 5.0
c. 6.0
d. 7.0
e. 12

↳ highest amplitude
A
Six of them

(nodes N are low amplitude)

18. The standing wave pattern in the diagram above is representative of the ____ harmonic.
a. third
b. fifth
c. sixth
d. seventh
e. twelfth

6th = to # of antinodes

f when n = 1

19. A stretched string vibrates with a fundamental frequency of 100 Hz. The frequency of the 2nd harmonic is ____.
a. 50.0 Hz
b. 100. Hz
c. 200. Hz
d. 400. Hz

n = 2

$f = \frac{nv}{2L}$ $n = 1, 2, 3 \ldots$

not changing v or L only changing harmonic # n.
so 100Hz, 200Hz, 300Hz etc.

20. A 30.5-cm long cylindrical pipe is filled with argon gas and closed off at one end. A 262-Hz tuning fork causes it to resonate in its first harmonic. The speed of sound waves through argon gas is _____.

a. 79.9 m/s
b. 160. m/s
c. 320. m/s
d. 523 m/s
e. 1050 m/s

$f = \frac{nv}{4L}$ $n = 1$ $30.5\text{cm} = .305\text{m}$ $262 = \frac{1(v)}{4(.305\text{m})}$ $v = 319.64$

21. A person will hear *beats* when listening to the sounds from two sources as long as those two sources produce sound waves that _____.

a. have the same amplitude
b. travel at the same speed
c. have identical frequencies
d. have similar but slightly different frequencies
e. have frequencies that are simple whole number ratios of each other

$f_{Beat} = |f_1 - f_2|$

22. A 440-Hz tuning fork and a vibrating guitar string are observed to produce exactly 20 beats in 10.0 seconds—a beat frequency of 2 Hz. The guitar string must be vibrating with a frequency of either _____ Hz.

a. 420 or 460
b. 430 or 450
c. 436 or 444
d. 438 or 442

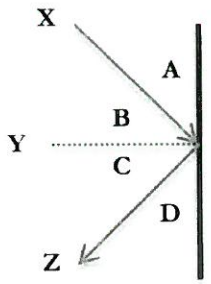
$f_{Beat} = |f_1 - f_2|$ $2\text{Hz} = |440 - f_2|$ $f_2 = 438$ or 442

23. Electromagnetic Waves make up light. Which order of the EM Spectrum correctly depicts EM waves increasing in frequency (and energy for that matter)?

a. Radio waves, infrared, visible, microwaves, ultraviolet, x-ray, gamma ray
b. Radio waves, microwaves, visible, infrared, ultraviolet, x-ray, gamma ray
c. Radio waves, microwaves, infrared, visible, ultraviolet, x-ray, gamma ray
d. Radio waves, infrared, microwaves, visible, ultraviolet, x-ray, gamma ray

Must know the order of these type of waves

Questions 24-26: The diagram at the right shows light reflecting off a surface. Three lines (X, Y and Z) and four angles (A, B, C and D) are labeled. Use the diagram in answering the next several questions.



24. The incident ray is denoted by _____.

a. line X
b. line Y
c. line Z

the ray that "comes in" is incident to mirror

25. The reflected ray is denoted by _____.

a. line X
b. line Y
c. line Z

the ray that "goes out" is reflected from mirror

26. The normal line is denoted by _____.

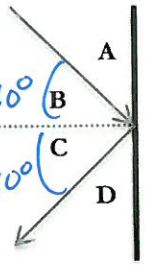
a. line X
b. line Y
c. line Z

means perpendicular

27. Consider the diagram at the right showing a light ray reflecting off a plane mirror. If angle B were 40°, then the angle of reflection would be _____°.

a. 40
b. 50
c. Impossible to tell with just this information.

Both incident & reflected angles are measured from the normal line!



28. What is the cause of refraction?

a. The speeding up of a light wave.
b. The slowing down of a light wave.
c. The change in speed of a light wave. → best answer b/c wave could speed up or slow down

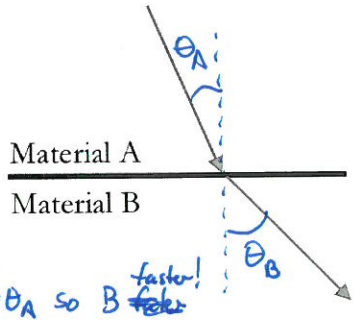
29. When a light ray passes from one material into a more optically dense material where it travels slower, the light ray will bend _____.

memorize this relationship

a. toward the normal line
b. away from the normal line
c. in whichever direction it feels like

30. Consider the diagram at the right for the refraction of light at the boundary between material A and material B. The light is traveling fastest in _____.

a. material A
b. material B
c. Impossible to tell with this information.



Toward normal is slower
Away from normal is faster
$\theta_B > \theta_A$ so B faster!

31. A student is conducting an experiment to measure the speed of sound in the laboratory air. If it's a particularly warm day, which might they correctly suspect would be true?

a. The speed of sound will be slower than typical
b. The speed of sound will be faster than typical
c. The speed of sound doesn't depend on the temperature

Higher temps mean molecules already moving fast & so it takes less time to bump into next molecule

32. A basketball referee uses their whistle to stop play. Does any of the air that the referee blows through the whistle travel and enter the ears of the basketball players as they hear the whistle?

a. Yes, that's why they can hear the whistle.
b. No, the sound wave only transfers vibrations and energy, not matter. (otherwise so gross!)
c. Yes, and it's gross.
d. No, the wave causes the floor to vibrate and this is how the players hear the sound.

33. Given the known speed of light, imagine a 4.25×10^{14} Hz light wave heading from the Sun to Earth. Calculate this wave's tiny wavelength.

a. 7.06×10^{-7} m
b. 8.07×10^{-13} m
c. 1.275×10^{23} m
d. 1.42×10^{6} m

λ $v = 3.00 \times 10^8$ m/s f

$v = f\lambda$

$3.00 \times 10^8 = (4.25 \times 10^{14})\lambda$

$\lambda = \frac{3E8}{4.25E14} = 7.0588 \times 10^{-7}$ m

34. A guitar string is supposed to vibrate at 384 Hz, but is too tight (therefore too high pitched) and is producing a beat frequency of 3.00 Hz when plucked with a 384 Hz tuning fork. With what frequency is the string vibrating?

a. 381 Hz
b. 387 Hz
c. 128 Hz
d. not enough information to determine

f_B f_1

$f_{Beat} = |f_1 - f_2|$

$3.00\text{Hz} = |384 - f_2|$

$f_2 = 381$ or 387 Hz

35. In an attempt to make a musical instrument with a pipe closed at one end, you need to calculate the length of a such a pipe so that you get a fundamental frequency of 512 Hz. How long should you make the pipe?

a. 1.34 m
b. 0.670 m
c. 0.335 m
d. 0.167 m

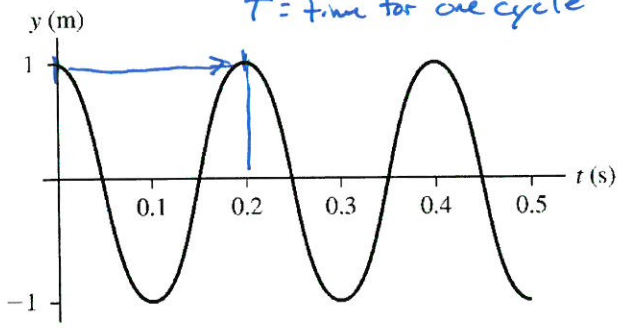
$n = 1$ $f = 512\text{Hz}$ L $f = \frac{nv}{4L}$ $v_{sound} = 343$ m/s

$512 = \frac{1(343)}{4(L)}$

$L = \frac{1(343)}{4(512)} = .16748$

36. Determine the period of the wave depicted in the graph.

T = time for one cycle



one cycle =
1) crest to next crest
2) trough to next trough
3) one complete crest & one complete trough

a. 0.10 s
b. 0.20 s
c. 0.25 s
d. 0.30 s

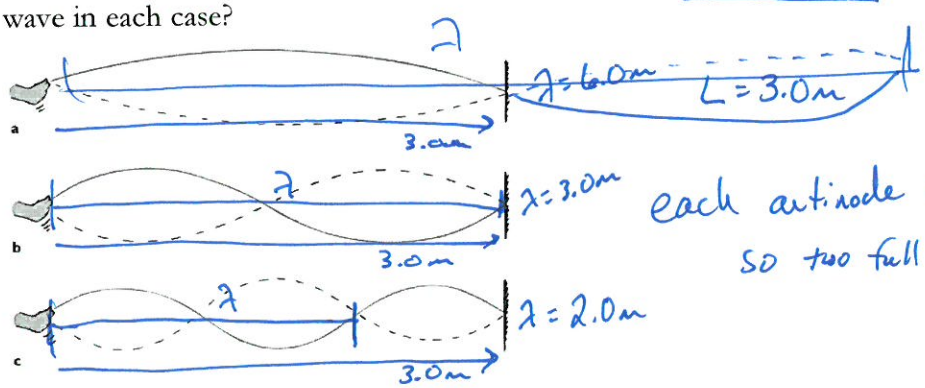
37. Determine the frequency of the wave depicted in number 36.

a. 10 Hz
b. 5.0 Hz
c. 4.0 Hz
d. 20 Hz

$f = \frac{\text{cycles}}{\text{time}} =$

$f = 1/T = 1/.2 = 5\text{Hz}$

38. The length of the string in each of the following 3 cases is 3.0 meters. What is the wavelength of the standing wave in each case?



each antinode is ½ wavelength, so two full antinodes is a complete wavelength

a. The same wavelength in **a, b**, and **c**, namely 3.0 m
b. The only one with a wavelength is **b**, namely 3.0 m
c. The wavelength in **a** is 3.0 m, in **b** is 1.5 m and in **c** is 1.0 m
d. The wavelength in **a** is 6.0 m, in **b** is 3.0 m and in **c** is 2.0 m

39. The speed of a sound wave in water is about 1500 m/s. If the wavelength of a particular sound is 0.250 m, what is the period of the sound wave?

v λ T

a. 1.67×10^{-4} s
b. 6000 s
c. 1.67×10^{-4} Hz
d. 6000 Hz

$v = \frac{\lambda}{T}$ $1500\text{m/s} = \frac{.250\text{m}}{T}$

$T(1500) = .250$

$T = \frac{.250}{1500} = 1.\overline{6} \times 10^{-4}$ s

(or you can find f then find T.)