Solutions

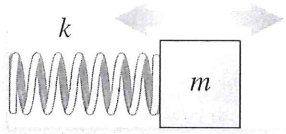
socrative by MasteryConnect

AP Physics 1 - Test 10 - Oscillations and Waves Score:

1. A mass oscillates on a horizontal spring with period T = 2.0 s. What is the frequency?

(A) 0.50 Hz
(B) 1.0 Hz
(C) 2.0 Hz
(D) 3.0 Hz
(E) 4.0 Hz

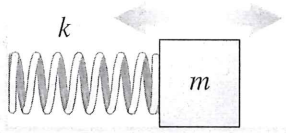
$f = \frac{1}{T} = \frac{1}{2} = 0.5\ Hz$



2. A mass oscillates on a horizontal spring with period T = 2.0 s. If the mass is pulled to the right and then released, how long will it take for the mass to reach the leftmost point of its motion?

(A) 1.0 s
(B) 1.4 s
(C) 2.0 s
(D) 2.8 s
(E) 4.0 s

One Period is the amount of time to return to initial position. So the amount of time to go from one end to the other is half.



3. A typical earthquake produces vertical oscillations of the earth. Suppose a particular quake oscillates the ground at a frequency of 0.15 Hz. As the earth moves up and down, what time elapses between the highest point of the motion and the lowest point?

(A) 1 s
(B) 3.3 s
(C) 6.7 s
(D) 13 s

half the period.

$T = \frac{1}{f} = \frac{1}{0.15} = 6.67\ s$

half of the period = 3.33 s

4. A mass oscillates on a horizontal spring with period T = 2.0 s. If the amplitude of the oscillation is doubled, the new period will be

(A) 1.0 s
(B) 1.4 s
(C) 2.0 s
(D) 2.8 s
(E) 4.0 s

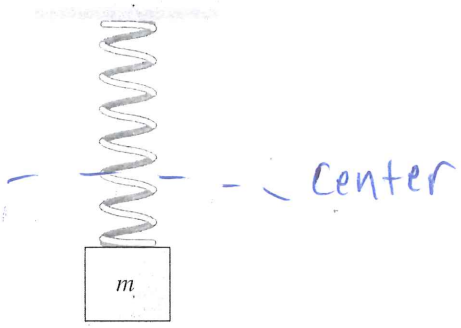
$T_{spring} = 2\pi\sqrt{\frac{m}{k}}$

displacement does not affect period.

9. A block oscillates on a vertical spring. When the block is at the lowest point of the oscillation, it's acceleration a_y is

(A) Negative
(B) Zero
(C) Positive

thus acceleration
Force always points toward the center of oscillation

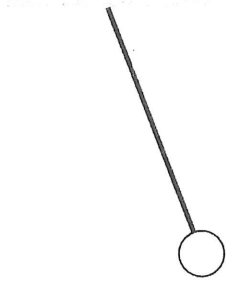


10. A ball on a massless, rigid rod oscillates as a simple pendulum with a period of 2.0 s. If the ball is replaced with another ball having twice the mass, the period will be

(A) 1.0 s
(B) 1.4 s
(C) 2.0 s
(D) 2.8 s
(E) 4.0 s

$T_{pendulum} = 2\pi\sqrt{\frac{l}{g}}$

m does not affect T

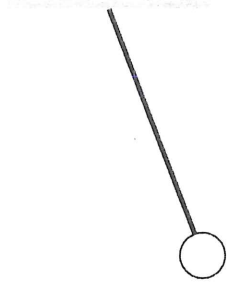


11. On Planet X, a ball on a massless, rigid rod oscillates as a simple pendulum with a period of 2.0 s. If the pendulum is taken to the moon of Planet X, where the free-fall acceleration g is half as big, the period will be

(A) 1.0 s
(B) 1.4 s
(C) 2.0 s
(D) 2.8 s
(E) 4.0 s

$T_{pendulum} \propto \sqrt{\frac{l}{g}}$ ← x½

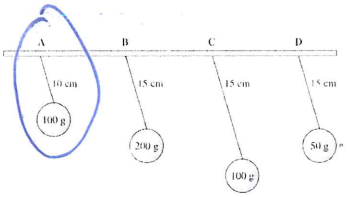
↑
x√2



12. A series of pendulums with different length strings and different masses is shown below. Each pendulum is pulled to the side by the same (small) angle, the pendulums are released, and they begin to swing from side to side. Which of the pendulums oscillates with the highest frequency?

(A) A
(B) B
(C) C
(D) D

Shorter pendulums oscillate faster than long ones



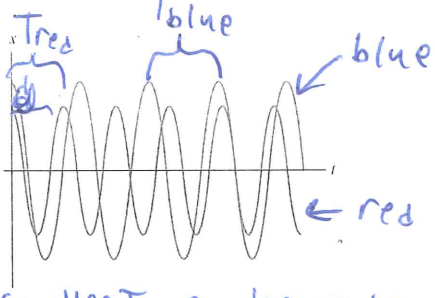
$T_{red} < T_{blue}$

5. Two identical blocks oscillate on different horizontal springs. Which spring has the larger spring constant?

(A) The red spring
(B) The blue spring
(C) They are both the same
(D) There's not enough information to tell

$T_s = 2\pi\sqrt{\frac{m}{k}}$

larger k means smaller T. red has the smaller T, so larger k



6. A block of mass m oscillates on a horizontal spring with period T = 2.0 s. If a second identical block is glued to the top of the first block, the new period will be

(A) 1.0 s
(B) 1.4 s
(C) 2.0 s
(D) 2.8 s
(E) 4.0 s

$T_s = 2\pi\sqrt{\frac{m}{k}}$

$T_s \propto \sqrt{m}$ ~ x2

x$\sqrt{2}$

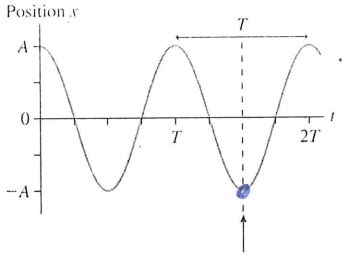
$T_{new} = T_{old}\sqrt{2}$
$= 2\sqrt{2}$

7. A mass oscillates on a horizontal spring. It's velocity is v_x and the spring exerts force F_x. At the time indicated by the arrow

(A) v_x is + and F_x is +
(B) v_x is + and F_x is -
(C) v_x is - and F_x is 0
(D) v_x is 0 and F_x is +
(E) v_x is 0 and F_x is -

Slope is horizontal, so $V = 0$

Concavity is U, so $a = +$, so $F = +$

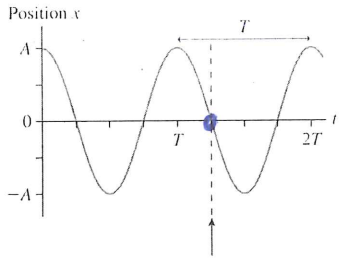


8. A mass oscillates on a horizontal spring. It's velocity is v_x and the spring exerts force F_x. At the time indicated by the arrow

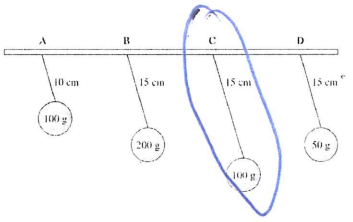
(A) v_x is + and F_x is +
(B) v_x is + and F_x is -
(C) v_x is - and F_x is 0
(D) v_x is 0 and F_x is +
(E) v_x is 0 and F_x is -

Slope is negative so $v = -$

Concavity is neither U nor $\cap$, so $a = 0$, $F = 0$



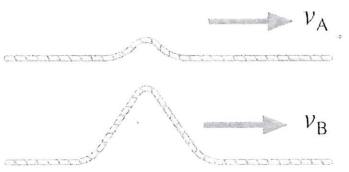
13. A series of pendulums with different length strings and different masses is shown below. Each pendulum is pulled to the side by the same (small) angle, the pendulums are released, and they begin to swing from side to side. Which of the pendulums oscillates with the lowest frequency? **Go off the DRAWN LENGTHS, rather than the written lengths.**



(A) A
(B) B
(C) C
(D) D

14. These two wave pulses travel along the same stretched string, one after the other. Which is true?

Only the medium can affect the velocity of a wave.



(A) $v_A > v_B$
(B) $v_A < v_B$
(C) $v_A = v_B$
(D) Not enough information to tell

15. For a wave pulse on a string to travel twice as fast, the string tension must be

$$v_{string} = \sqrt{\frac{F_T}{\mu}} \quad \times 4$$

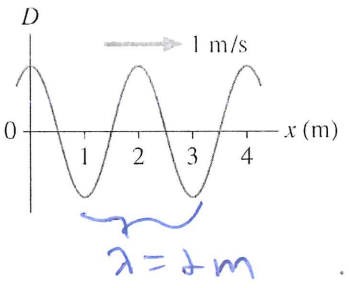
$\times 2$

(A) Increased by a factor of 4.
(B) Increased by a factor of 2.
(C) Decreased to one half its initial value.
(D) Decreased to one fourth its initial value.
(E) Not possible. The pulse speed is always the same.

16. The period of this wave is

$$v = \frac{\lambda}{T} = \lambda f$$

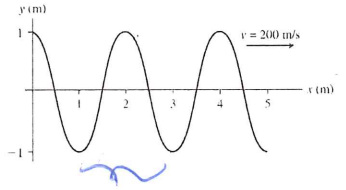
$$T = \frac{\lambda}{v} = \frac{2}{1} = 2$$



$\lambda = 2\,m$

(A) 1 s
(B) 2 s
(C) 4 s
(D) Not enough information to tell

17. For this sinusoidal wave, what is the wavelength?

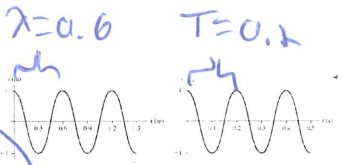


$\lambda = 2\,m$

(A) 0.5 m
(B) 1.0 m
(C) 2.0 m
(D) 4.0 m

18. What is the speed of the wave?

(A) 1.5 m/s
(B) 3.0 m/s
(C) 5.0 m/s
(D) 15 m/s



$v = \frac{\lambda}{T} = \frac{0.6}{0.2} = 3\ m/s$

19. Which has a longer wavelength?

(A) A 400 Hz sound wave in air
(B) A 400 Hz sound wave in water

Velocity of sound is faster in water than in air. So $v = \lambda f \rightarrow \lambda = \frac{v}{f}$ → bigger v means bigger λ

20. A wave bounces back and forth on a guitar string; this is responsible for making the sound of the guitar. As the temperature of the string rises, the tension decreases. This _____ the speed of the wave on the string.

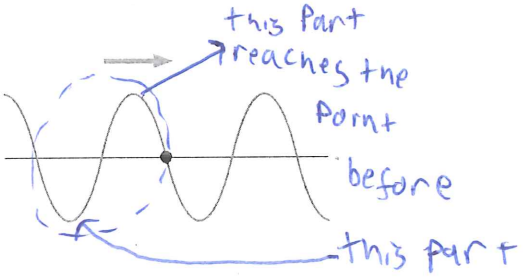
(A) Increases
(B) Does not change
(C) Decreases

$v_{string} = \sqrt{\frac{F_T}{\mu}}$

F_T decreases → v decreases

21. A wave on a string is traveling to the right. At this instant, the motion of the piece of string marked with a dot is

(A) Up
(B) Down
(C) Right
(D) Left
(E) Zero



22. 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

$v_{string} = \sqrt{\frac{F_T}{\mu}}$ → tension, → linear density

23. For a given medium, the frequency of a wave is

(A) independent of wavelength
(B) proportional to wavelength
(C) inversely proportional to wavelength
(D) proportional to the amplitude
(E) inversely proportional to the amplitude

$v = \lambda f$

$f = \frac{v}{\lambda}$

$f \propto \frac{1}{\lambda}$

24. The tension in a string with a linear mass density of 0.0010 kg/m is 0.40 N. A sinusoidal wave with a wavelength of 0.20 m on this string has a frequency of:

(A) 0.0125 Hz
(B) 0.25 Hz
(C) 100 Hz
(D) 630 Hz
(E) 2000 Hz

$v_{string} = \sqrt{\frac{F_T}{\mu}} = \lambda f$

$f = \frac{\sqrt{F_T/\mu}}{\lambda} = \frac{\sqrt{0.4/0.001}}{0.2} = 100\ Hz$

25. 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 mass density of string II. When a sinusoidal wave passes from string I to string II

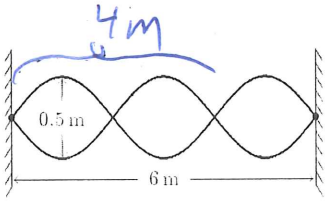
(A) the frequency decreases by a factor of 4
(B) the frequency decreases by a factor of 2
(C) the wavelength decreases by a factor of 4
(D) the wavelength decreases by a factor of 2
(E) the wavelength increases by a factor of 2

The frequency of a wave cannot be changed after the wave has already been created.

$V = \lambda f$

$\times \frac{1}{2} \rightarrow V = \sqrt{\frac{F_T}{\mu}} \leftarrow \times 4$ $\quad \times \frac{1}{2}$ $\quad \times \frac{1}{2}$

26. A standing wave pattern is established in a string as shown. The wavelength of one of the component traveling waves is:



(A) 0.25 m
(B) 0.5 m
(C) 1 m
(D) 2 m
(E) 4 m

27. Which of the following properties of a sound wave determine its "pitch"?

(A) Amplitude
(B) Distance from source to detector
(C) Frequency
(D) Phase
(E) Speed

28. If the speed of sound is 340m/s, the length of the *shortest* open-closed pipe that resonates at 218 Hz is:

(A) 0.23 m
(B) 0.17 m
(C) 0.39 m
(D) 0.78 m
(E) 1.17 m

$V = \lambda f \rightarrow \lambda = \frac{V}{f}$

$\lambda = 1.56\ m$

antinode at open ends
nodes at closed ends

$L = \frac{1}{4}\lambda$

$L = \frac{1}{4}\lambda = \frac{1}{4}(1.56)$

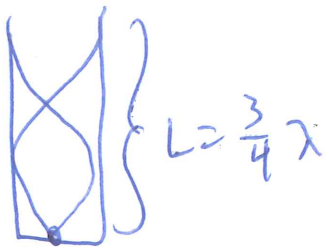
$L = 0.39\ m$

29. If the speed of sound is 340m/s, the length of the *second shortest* open-closed pipe that resonates at 218 Hz is:

(A) 0.23 m
(B) 0.17 m
(C) 0.39 m
(D) 0.78 m
(E) 1.17 m

$L = \frac{3}{4}\lambda = \frac{3}{4}(1.56)$

$L = 1.17\ m$



30. The diagram shows four situations in which a source of sound S with variable frequency and a detector D are either moving or stationary. The arrows indicate the directions of motion. The speeds are all the same. Detector 3 is stationary. Rank the situations according to the frequency of the source, lowest to highest.

(A) 1, 2, 3, 4
(B) 4, 3, 2, 1
(C) 1, 3, 4, 2
(D) 2, 1, 4, 3
(E) None of the above

Pitch is low when moving away and high when moving toward.

31. A source emits sound with a frequency of 1000 Hz. It and an observer are moving in the same direction with the same speed, 100m/s. If the speed of sound is 340m/s, the observer hears sound with a frequency of:

(A) 294 Hz
(B) 545 Hz
(C) 1000 Hz
(D) 1830 Hz
(E) 3400 Hz

no doppler effect

32. A source emits sound with a frequency of 1000 Hz. It and an observer are moving toward each other, each with a speed of 100m/s. If the speed of sound is 340m/s, the observer hears sound with a frequency of:

(A) 294 Hz
(B) 545 Hz
(C) 1000 Hz
(D) 1830 Hz
(E) 3400 Hz

$f' = f_o\left(\frac{v_{sound} \pm v_{obs}}{v_{sound} \mp v_{source}}\right)$

$= (1000)\left(\frac{340 + 100}{340 - 100}\right)$

$= 1833\ Hz$

$v_{obs} = +$

$v_{source} = -$

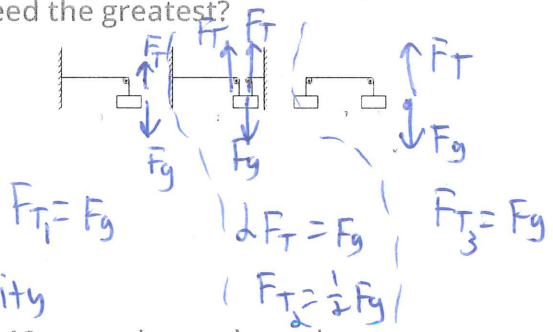
33. The diagrams show three identical strings that have been put under tension by suspending blocks of 5 kg each. For which is the wave speed the greatest?

(A) 1
(B) 2
(C) 3
(D) 1 & 3 tie
(E) 2 & 3 tie

$F_{T_1} = F_{T_3}$

F_{T_2} is smallest.

Larger tension ⇒ larger velocity



34. You see a bolt of lightning and begin counting. After 10 seconds, you hear the loud crack. How far away is the thunder? You can assume the velocity of sound is 343 m/s

(A) 3.4 km
(B) 6.8 km
(C) 0.34 km
(D) 0.68 km

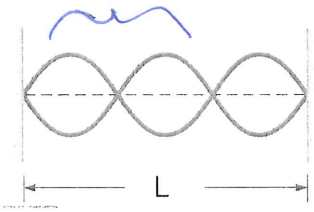
$\Delta X = V \cdot t = (343)(10) = 3430\ m$

35. Suppose you have the 1.2 m standing wave (L=1.2) as shown. A frequency of 500 Hz generates this third harmonic. What is the velocity of the wave on the string?

HINT: Find wavelength first!

(A) 200 m/s
(B) 343 m/s
(C) 150 m/s
(D) 500m/s
(E) 400 m/s

$\lambda = 0.8$



$V = \lambda f$

$= (0.8)(500)$

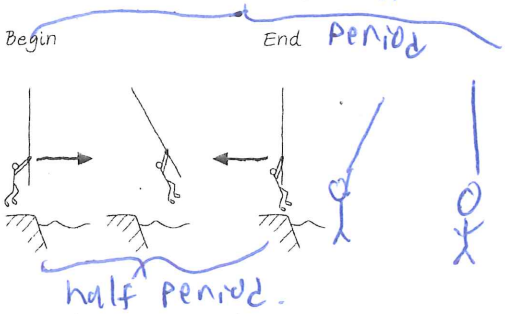
$= 400\ m/s$

36. Suppose Tarzan swung on a rope over a lake, but decided to not let go until he returned to his original position as shown in the picture. How many oscillations have occured?

(A) 1/4
(B) 1/2
(C) 3/4
(D) 1
(E) 5/4

half of full period.

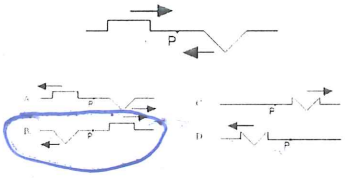
one full period



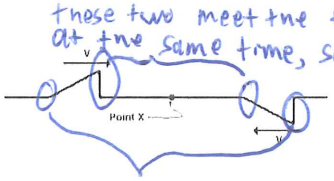
37. Two wave pulses approach each other as seen in the figure. The wave pulses overlap at point P. Which diagram represents the appearance of the wave pulses AFTER they leave point P?

(A) A
(B) B
(C) C
(D) D

they will continue to move in their original directions



38. The diagram shows two transverse pulses moving along a string. One pulse is moving to the right and the second is moving to the left. Both pulses reach point x at the same instant. What would be the resulting motion of point x as the two pulses pass each other?



these two meet the point at the same time, so it moves up

these two meet the point afterward, so it then moves down

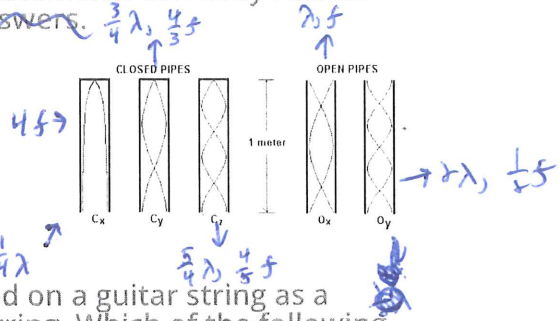
(A) down, up, down

(B) up then down

(C) up, down, up

(D) no motion since the pulses cancel one another.

39. The diagrams above represent 5 different standing sound waves set up inside of a set of organ pipes 1 m long Which of the following statements correctly relates the frequencies of the organ pipes shown? Select two answers.



(A) C_y is twice the frequency of Cx

(B) C_z is five times the frequency of C_x

(C) O_y is twice the frequency of O_x

(D) O_x is twice the frequency of C_x

40. **Multiple Correct**: A standing wave pattern is created on a guitar string as a person tunes the guitar by changing the tension in the string. Which of the following properties of the waves on the string will change as a result of adjusting only the tension in the string? Select two answers.

(A) the speed of the traveling wave that creates the pattern

(B) the wavelength of the standing wave

(C) the frequency of the standing wave

(D) the amplitude of the standing wave