

Review for the Waves and Sound Test

- 10 waves pass every second. The frequency of this wave is 10 unit = Hz
- 10 waves pass every second. The period of this wave is 1/10 or 0.1 unit = sec
- If the speed of sound is 345 m/s, what is the wavelength of the wave above?

$$v = f\lambda \quad 345 = 10\lambda \quad \lambda = 34.5 \text{ m}$$

4. **DOPPLER EFFECT:**

- As a sound moves toward you, the apparent frequency of it ↑.
- As a sound moves away from you, the apparent frequency of it ↓.

- At car honking its horn is **moving away** from a stationary observer at 14 m/s. If the frequency of the horn is 250 Hz, what frequency would the observer hear if it is 12° C outside? **(240 Hz)**

$$v_s = 14 \text{ m/s}$$

$$f = 250$$

$$v = 330 + (.6 \cdot 12) = 337.2$$

$$f' = 250 \left(\frac{337.2}{337.2 + 14} \right) = \boxed{240 \text{ Hz}}$$

add - away

- What frequency would the observer hear if the car was **moving towards** her? **(261 Hz)**

$$f' = 250 \left(\frac{337.2}{337.2 - 14} \right) = \boxed{260.8 \text{ Hz}}$$

take away - toward

- If the temperature of the air decreases by 15° C, how much does the speed of sound decrease by?

$$v = 330 + (.6 \cdot 15) = 9 \text{ m/s}$$

or pick 2 temps, solve v, & subtract

- A sound wave of frequency 420 Hz is heard 1 mile away 4.2 seconds after the sound is made. What is the wavelength of the sound wave? **(0.91 m)**

$$\textcircled{1} v = \frac{\Delta x}{\Delta t} = \frac{1609}{4.2} = 383.1 \text{ m/s}$$

$$\textcircled{2} v = f\lambda \quad 383.1 = 420 \cdot \lambda \quad \lambda = 0.91 \text{ m}$$

- Convert 346 Hz into kHz. 0.346 kHz 45.9 MHz = 45.9 x 10⁶ Hz Hz *or*

- Radio waves travel at what speed? light - 3 x 10⁸ m/s 45,900,000 Hz
- Calculate the wavelength of 105.1 FM in meters. **(2.85 m)**

$$v = 3 \times 10^8 \text{ m/s}$$

$$f = 105.1 \times 10^6 \text{ Hz}$$

$$3 \times 10^8 = (105.1 \times 10^6) \lambda \quad \lambda = 2.85 \text{ m}$$

- Calculate the wavelength of AM 1130 in meters. **(265.5 m)**

$$v = 3 \times 10^8 \text{ m/s}$$

$$f = 1130 \times 10^3 = 1,130,000$$

$$3 \times 10^8 = 1,130,000 \lambda \quad \lambda = 265.5 \text{ m}$$

- If the speed of sound outside this morning was 313 m/s, what is the temperature in °F? **(-19 F)**

$$\textcircled{1} v = 330 + (.6 \cdot ^\circ\text{C})$$

$$313 = 330 + (.6 \cdot ^\circ\text{C})$$

$$-17 = .6 \cdot ^\circ\text{C}$$

$$^\circ\text{C} = -28.3$$

$$\textcircled{2} ^\circ\text{C} = \frac{^\circ\text{F} - 32}{1.8}$$

$$-28.3 = \frac{^\circ\text{F} - 32}{1.8}$$

$$\boxed{^\circ\text{F} = -19^\circ\text{F}}$$

$$v = 330 + (.6 \cdot 25) = 345 \text{ m/s}$$

13. A child drops a rock off a cliff that is 45 m high. If the temperature is 25 °C, how soon after dropping the rock will she hear the sound of the rock hitting the ground? **Be careful...think this one through!** The rock has to fall (1-D motion) and the sound has to travel back up. (3.16 sec)

- ① $\Delta y = v_i \Delta t + \frac{1}{2} a \Delta t^2$ (rock fall down)
 ② $v = \frac{\Delta x}{\Delta t}$ (sound back up)
 ③ add together

14. If you hear a firecracker 0.25 sec after seeing it and it is 85 °F outside, how far away from the fireworks are you? (86.9 m)

- ① 85°F → C (29.44°C)
 ② $v = 330 + (.6 \cdot 29.44)$
 ③ $v = \frac{\Delta x}{\Delta t}$

15. How are frequency and wavelength related? inverse indirect

16. A longer BW has a longer / shorter wavelength, which leads to a higher / lower frequency causing the pitch to be higher / lower.

17. What are the first 2 harmonics of an organ pipe that is 40 cm long and is closed at one end if the speed of sound is 350 m/s? (ans. 219 Hz, 657 Hz)

$L = 0.4 \text{ m}$
 $v = 350 \text{ m/s}$

$f = n \left(\frac{v}{4L} \right)$ only ODDS!
 $n = 1, 3, 5$

18. If a pipe has a fundamental frequency of 250 Hz, find the next two harmonics if the pipe is

OPEN: 1, 2, 3...

CLOSED: 1, 3, 5... only ODDS!

250, 500, 750 Hz

250, 750, 1250 Hz

19. You spin a flexible plastic pipe that is open at both ends around your head that has a length of 0.9 meters. If it is 70 °F in the room, find the first three harmonics. (ans. 190 Hz, 380 Hz, 570 Hz)

① 70°F = 21.1°C

③ $f = n \left(\frac{v}{2L} \right)$

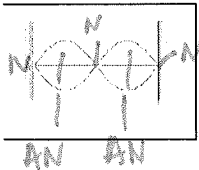
② $v = 330 + (.6 \cdot 21.1)$
 342.7

20. Why does sound travel faster in solids than gases? molecules closer together

21. Why does sound travel faster in warmer weather? molecules move faster

22. Describe an example of resonance. shiny glass breaking wine glass, Tacoma bridge

23. Label where the nodes and antinodes are on the standing wave off to the side.



24. A string instrument (guitar) uses all harmonics / only ODD harmonics.

25. A string instrument (guitar) needs to end in a(n) node / antinode

26. A Boomwhacker that is capped on 1 end uses all harmonics / only ODD harmonics.

27. A Boomwhacker that is capped on 1 end needs to end in a(n) node / antinode

28. Which travels faster, light or sound? light

29. The average speed of sound in MN would be the largest during what season? Summer - hottest!

30. How are FM and AM radio waves different?

Shape of wave (freq vs. amplitude change)
 AM - kHz
 FM - MHz

31. WHY do you hear a higher pitch when an object moving toward you is honking its horn? (what is happening to the frequency of the sound waves?)

