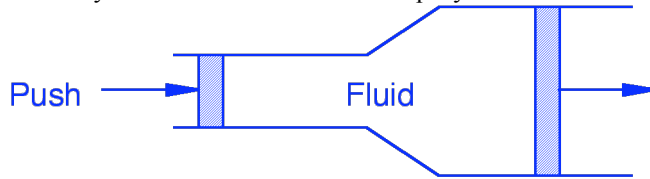


## Quizzes Section 1

### Pressure

1. The hydraulic device shown can amplify



- (a) force.
- (b) power.
- (c) both force and power.

2. Two columns are filled with water to the same height. One column has a larger diameter than the other. The pressure at the bottom of the columns will be

- (a) less in the larger column.
- (b) the same in each.
- (c) greater in the larger column.

### Archimedes' Principle

3. A piece of iron and a piece of lead have equal volumes. When they are submerged under water, the lead has

- (a) less buoyant force.
- (b) the same buoyant force.
- (c) greater buoyant force.

4. A glass is filled with water to the brim. A large ice cube floats in the water and protrudes well above the top of the glass. As the ice melts, the water level

- (a) goes down.
- (b) remains unchanged.
- (c) goes up and therefore spills out of the glass.

5. A block of wood floats in a bowl of water. On top of the block there is a lead weight attached. The block turns over so that the lead weight is under water still attached to the floating block. When this happens, the water level in the bowl

- (a) goes down.
- (b) remains unchanged.
- (c) goes up.

6. A drinking glass with no water inside is floating in a sink full of dishwater. The glass tips so that water from the sink runs inside and it sinks to the bottom. When this happens, the level of the water in the sink

- (a) goes down.
- (b) stays the same.
- (c) goes up.

### Bernoulli Effect

7. Fluid flows faster as it passes through a narrowed section of pipe. The pressure in this section of pipe is

- (a) higher.
- (b) lower.
- (c) the same.

8. A tornado moves over a house and causes the windows to explode. They will explode

- (a) outward.
- (b) inward.

9. A farmer wants to sprinkle water on top of a hill and considers buying a pump that can sustain 100psi. The height of the hill is 200ft, which the farmer knows corresponds to the available 100psi. You should tell the farmer

- (a) to buy the pump.
- (b) not to buy the pump.

### Waves on a String

10. A sinusoidal wave propagates on a string. The tension in a string remains fixed, but the frequency is doubled. What happens to the wavelength?

- (a) The wavelength is halved.
- (b) The wavelength remains unchanged.
- (c) The wavelength is doubled.

11. A sinusoidal wave is generated by continuously wiggling one end of a long cord. Energy is transported from the wiggled end to the far end where it is absorbed completely. The amplitude of oscillations is doubled at the same frequency and tension.

- (a) The transmitted power remains unchanged.
- (b) The transmitted power doubles.
- (c) The transmitted power quadruples.

### Sound Waves

12. The distance from a sound source is tripled. The *amplitude* of the pressure wave ( $\Delta P_{\max}$ ) will

- (a) decrease by 9.
- (b) decrease by 3.
- (c) remain unchanged.

13. A sound increases from 50dB to 90dB. How much does the intensity increase?

- (a) 40 times.
- (b) 400 times.
- (c) 10,000 times.
- (d) 40,000 times.
- (e) other.

### Doppler Effect

14. A stationary observer hears a pitch from a source that moves *towards* him at a large fraction of the speed of sound. If instead the source is stationary and the observer moves at the same speed *towards* the source, the observed frequency will be

- (a) lower than before
- (b) the same as before
- (c) higher than before

15. A strong steady wind begins to blow during an outdoor concert (assume no change in air pressure). If the orchestra was tuned before the wind started, then according to the audience,

- (a) the string section will be out of tune with the woodwinds.
- (b) the orchestra will still be in tune but at a new pitch.
- (c) there will be no change in pitch and everyone will be in tune.

16. Can you hear a bullet coming toward you that is traveling faster than the speed of sound?

- (a) Yes.
- (b) No.

17. If there is a small microphone on the bullet, will it be able to record your continuous yelling before reaching you?

- (a) Yes.
- (b) No.

### Wave Interference

18. Two speakers emit sound waves with identical frequency. The power emitted from each speaker is the same. The sound waves interfere in a region of space. Some locations experience destructive interference resulting in no sound. Other regions experience constructive interference.

- (a) Energy is not conserved because of the missing energy in the destructive regions.
- (b) The constructive regions have approximately double the intensity from one speaker.
- (c) The constructive regions have approximately four times the intensity from one speaker alone.

19. Two frequencies, 500Hz and 501Hz, interfere. We hear wa-wa-wa-. How often do we hear wa?

- (a) Once per second.
- (b) Twice per second.

### Standing Waves

20. A musician plays a song on a guitar. He then steps into a room filled with helium and plays the same song. The frequency of the notes will

- (a) be lower.
- (b) remain the same.
- (c) be higher.

21. A musician plays a note on a flute. She then draws a breath of helium and attempts to play the note. The frequency of the note will

- (a) be lower.
- (b) remain the same.
- (c) be higher.

22. A sound wave with frequency  $f = 500\text{Hz}$  travels in air with a velocity of  $v_{\text{air}} = 343\text{m/s}$ . Part of the wave enters some water for which sound has a speed of  $v_{\text{water}} = 1500\text{m/s}$ . The frequency of the wave in the water will be

- (a) greater than 500Hz .
- (b) equal to 500Hz .
- (c) less than 500Hz .

### Answers

1. (a) The force on the large piston is greater, but it moves slower than the small piston such that power is conserved.
2. (b) The pressure depends only on the depth of the fluid.
3. (b) The lead and the iron displace the same amount of fluid and therefore have the same buoyant force.
4. (b) The ice displaces water equal to its own weight. The melted ice neatly fits into the previously displaced volume.
5. (b) In either case the combined weight of the wood and the lead is supported by displaced water. Since the weight doesn't change, the displaced water is the same.
6. (a) When the glass floats, all of its weight is supported by displaced water. After sinking, part of its weight is supported by the bottom of the sink so it displaces less water.
7. (b) There must be a greater pressure in the wide slow-moving region in order to accelerate the fluid as it enters the narrow fast moving region.
8. (a) The fast moving air outside of the house will have a reduced pressure relative to the air at rest inside the house. Outside the house, P must be less to compensate for the larger v according

$$\text{to } P + \frac{1}{2}\rho v^2 + \rho gy = \text{const} .$$

9. (b) There will be no pressure left at the top to allow the nozzles of the sprinklers to perform. Pressure is converted to velocity in the nozzles.
10. (a) The velocity  $v$  does not change if the tension is fixed. Since  $v = \lambda f$ , the frequency  $f$  goes up by the amount the wavelength  $\lambda$  goes down.
11. (c) As the amplitude is doubled, each piece of the cord must double its average transverse velocity. Therefore, each wave crest contains four times the kinetic energy so the delivered power is four times.
12. (b) As the sound moves outward, the same power is distributed over a larger area nine times bigger. The intensity (power per area) drops by a factor of nine, but the pressure amplitude drops by a factor of three since  $I \propto \Delta P_{\max}^2$ .
13. (c)
- $$10dB \log_{10} \frac{I_{90}}{I_0} - 10dB \log_{10} \frac{I_{50}}{I_0} = 40dB$$
- $$\Rightarrow \log_{10} \frac{I_{90}}{I_0} - \log_{10} \frac{I_{50}}{I_0} = 4 \Rightarrow \log_{10} \frac{I_{90}}{I_{50}} = 4$$
- $$\Rightarrow 10^4 = \frac{I_{90}}{I_{50}}$$
14. (a) As the source approaches the speed of sound, the waves are bunched up and the wavelength becomes arbitrarily short, corresponding to very high frequencies. As the observer approaches the speed of sound, the period of crossing wave crests is halved and the frequency only doubles.
15. (c) The air speed is the same for everyone involved, sources and observers. The frequency shift that occurs for sounds leaving instruments will be canceled upon observation. Note: in the rest frame of the air, the frequency is different.
16. (b) Sound waves are unable to move faster than the bullet.
17. (a) The microphone will receive your sound (albeit at a high pitch) because the bullet will encounter the sound waves in route.
18. (c) The constructive interference has amplitude equal to the sum of the amplitudes from each speaker. The intensity is the square of the doubled amplitude. The energy missing from destructive regions appears in the constructive regions.
19. (a)  $f_{\text{wa}} = |f_1 - f_2|$
20. (b) The frequency is determined solely by the tension and length of each string. (The wavelengths for given frequencies in helium are longer than in air, disrupting resonant feedback from the acoustical chamber of the guitar. This may make lower notes quieter.)
21. (c) Since the speed of sound is faster in helium than in air, the wavelength, which is fixed by the length of the flute, corresponds to a higher frequency
22. (b) Sound waves leaving air vibrate the water surface at 500Hz. Waves entering the water must leave the surface at 500Hz, or wave fronts would pile up. Therefore, frequency cannot change.