

- A bucket of water is pushed from right to left with increasing speed across a horizontal surface. Consider the pressure at two points at the same level in the water.

 - It is the same
 - It is higher at the point on the left
 - It is higher at the point on the right
 - At first it is higher at the point on the left but as the bucket speeds up it is lower there
 - At first it is higher at the point on the right but as the bucket speeds up it is lower there

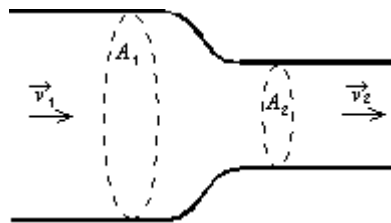
- An object hangs from a spring balance. The balance indicates 30 N in air, 20 N when the object is submerged in water. What does the balance indicate when the object is submerged in liquid with a density that is 600 kg/m^3 ?

 - 20 N
 - 24 N
 - 30 N
 - 26 N
 - None of these

- A boat floating in fresh water displaces 16,000 N of water. How many newtons of salt-water would it displace if it floats in salt-water whose density is 1.2 times the density of fresh water?

 - 14,500
 - 17,600
 - 16,000
 - 19,200
 - 13,333

- An incompressible liquid flows along the pipe as shown. The ratio of the speeds v_2/v_1 is:

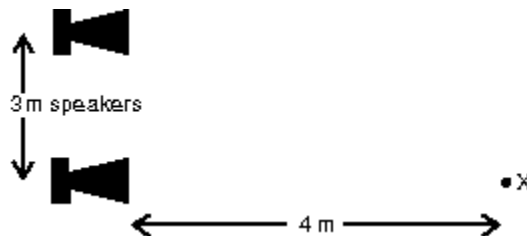


- A_1/A_2
- A_2/A_1
- $\sqrt{A_1/A_2}$
- $\sqrt{A_2/A_1}$
- v_1/v_2

5. A water line enters a house at ground level. A smaller diameter pipe carries water to a faucet 5.0 m above ground, on the second floor. Water flows at 2.0 m/s in the main line and at 7.0 m/s on the second floor. Take the density of water to be 1000 kg/m^3 . The pressure in the pipe on the second floor is lower by :
- A) $4.56 \times 10^4 \text{ Pa}$
 - B) $5.43 \times 10^4 \text{ Pa}$
 - C) $7.15 \times 10^4 \text{ Pa}$
 - D) $8.60 \times 10^5 \text{ Pa}$
 - E) None of these
6. The displacement of a mass oscillating on a spring is given by $x(t) = A\cos(\omega t + \phi)$. If the initial displacement is positive, but less than A, and the initial velocity is in the positive x direction, then the phase constant ϕ is an angle in which quadrant? Note: Quadrant 1: 0-90, Quadrant 2: 90-180, Quadrant 3: 180-270, Quadrant 4: 270-360.
- A) 1
 - B) 2
 - C) 3
 - D) 4
 - E) Not enough information to determine
7. A 0.20-kg object mass attached to a spring whose spring constant is 500 N/m executes simple harmonic motion. If its maximum speed is 5.0 m/s, the amplitude of its oscillation is:
- A) 0.0020 m
 - B) 0.10 m
 - C) 0.20 m
 - D) 25 m
 - E) 250 m
8. A horizontal spring mass system consists of a 0.40 kg mass at the end of a spring whose spring constant is 1000 N/m. At time $t = 0$ seconds, the mass is displaced to the right of its equilibrium position by 0.30 m, and is moving to the right at a speed of 0.20 m/s. Find the phase constant of the motion, in radians, assuming that the equation of motion of the mass is $x(t) = A \sin(\omega t + \Phi)$.
- A) 0.457
 - B) -0.013
 - C) 1.214
 - D) 1.56
 - E) None of these

9. A wave is described by $y(x,t) = 0.1 \sin(\pi x/2 - 10t)$, where x is in meters, y is in centimeters and t is in seconds. The wavelength (in meters) is:
- A) 10
 - B) $\pi/2$
 - C) 4
 - D) 2
 - E) None of these
10. When a 100-Hz oscillator is used to generate a sinusoidal wave on a certain string the wavelength is 10 cm. When the tension in the string is tripled the wavelength (in cm) is approximately:
- A) 20
 - B) 10
 - C) 14
 - D) 5
 - E) 17
11. A string, clamped at its ends, vibrates in three segments. The string is 100 cm long. The wavelength of the waves traveling back and forth along the string is:
- A) 33.3 cm
 - B) 66.7 cm
 - C) 150 cm
 - D) 300 cm
 - E) need to know the frequency
12. A 40-cm long string, with one end clamped and the other end is vibrated by an oscillator, creating a standing wave with two anti-nodes. If the wave speed is 320 cm/s, what must be the frequency of the oscillator?
- A) 32 Hz
 - B) 16 Hz
 - C) 8 Hz
 - D) 4 Hz
 - E) 2 Hz

13. A column of a certain gas is open at both ends. The shortest length of such a column that will resonate with a 200 Hz tuning fork is 42.5 cm. The speed of sound in the gas must be:
- A) 85.0 m/s
 - B) 170 m/s
 - C) 340 m/s
 - D) 470 m/s
 - E) 940 m/s
14. The speed of sound in air is 340 m/s. What is the third-lowest frequency of sound (in Hz) that will resonate in a 120 cm tube that is closed at one end, open at the other?
- A) 121
 - B) 234
 - C) 354
 - D) 413
 - E) None of these
15. Two speakers 14 m apart are emitting tones at a frequency of 1020 Hz. What is the closest distance (in m) from one speaker, along the line connecting the speakers, at which the sound intensity will be zero?
- A) 2.4
 - B) 1.5
 - C) 1.2
 - D) 0.5
 - E) none of these
16. Two small identical speakers are connected (in phase) to the same source. The speakers are 3 m apart and at ear level. An observer stands at X, 4 m in front of one speaker as shown. The sound she hears will be most intense if the wavelength is:



- A) 5 m
- B) 4 m
- C) 3 m
- D) 2 m
- E) 1 m

17. What is the intensity of sound (in W/m^2) at a point where the decibel level is 93 dB?
- A) 2.045
 - B) 0.002
 - C) 0.087
 - D) 1.432
 - E) 11.660
18. A listener is at the center of a circular array of 40 identical machines, each emitting sound uniformly in all directions. Only three of the machines are operating, creating in total a decibel level of 40 dB at the listener's ear. What is the total number of machines that would need to be turned on to create a dB level at the listener's ear of approximately 49 dB?
- A) 3
 - B) 6
 - C) 12
 - D) 18
 - E) 24
19. A uniform, solid wooden raft is 0.30 meter tall, 4.0 meter long, and 3.0 meter wide, and is floating in water. Its density is 800 kg/m^3 . How many centimeters of the raft are below water?
- A) 6
 - B) 8
 - C) 12
 - D) 24
 - E) 28
20. An ambulance siren emits sound at a frequency of 2000 Hz. How fast would it have to be moving toward a stationary listener for the listener to hear siren sound at a frequency of 2080 Hz? (The speed of sound is 340 m/s.)
- A) 13.07
 - B) 19.45
 - C) 26.80
 - D) 33.09
 - E) None of these

Answer Key

1. C
2. B
3. C
4. A
5. C
6. D
7. B
8. D
9. C
10. E
11. B
12. C
13. B
14. C
15. D
16. E
17. B
18. *(No Answer Provided)*
19. D
20. A