Physics 53 Exam #4 December 7, 2012 Dr. Alward

1. A metal cubic block has a density of 3000 kg/m^3. The length of each side of the cube is 0.20 m. Block is placed at the bottom of a pool of water. What is the contact force (in newtons) exerted upward on the block by the bottom of the pool?

(a) 45.98
(b) 78.44
(c) 156.80
(d) 212.34
(e) None of these

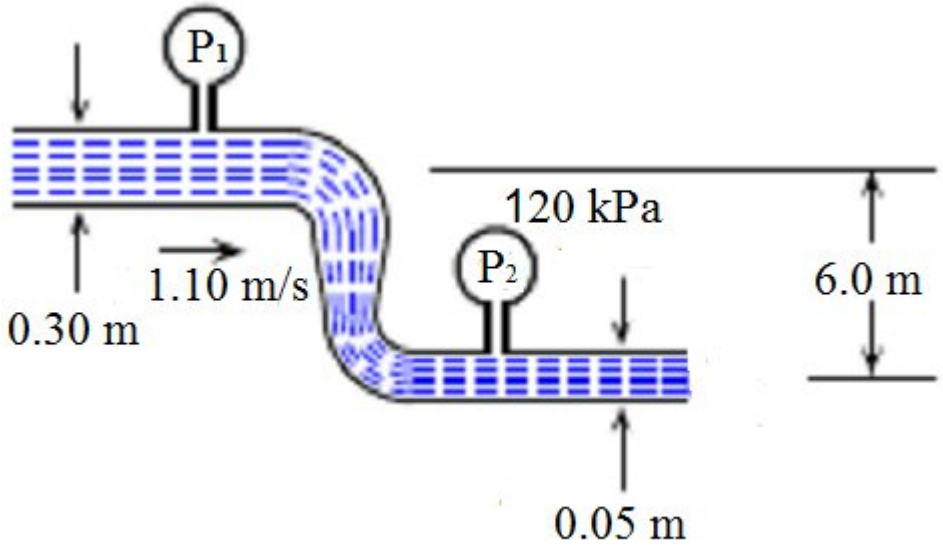
2. A soccer ball weighing 4.0 N and having a radius of 11.3 cm (0.113 m) is held motionless completely under water by a hand pushing downward on the top of the ball. What force (in newtons) is exerted by the hand?

(a) 516
(b) 412
(c) 316
(d) 189
(e) None of these

3. A block of mass m = 0.250 kg is oscillating at the end of a spring whose spring constant is 100 N/m. The position of the block is given by the equation, $x = A\cos(\omega t+\phi)$. At time t = 0 the spring is stretched by 0.20 m, and the block is moving to the right at a speed of 6.0 m/s. What is the phase constant, ϕ (in radians)?

(a) -0.98
(b) 0.45
(c) 1.23
(d) -1.50
(e) None of these

4. What is the pressure P_1 in the water in the shown in the figure below? The pressure in the water in the lower portion of the pipe is 120,000 Pa (120 kPa). State your answer in kilo-pascals (kPa).



(a) 844.675
(b) 714.454
(c) 432.333
(d) 235.665
(e) None of these

5. A wire is clamped at one end and oscillated at the other end at small amplitude, at a frequency of 10 Hz. A standing wave is created. The distance between consecutive nodes is 0.40 meter. What is the speed (in m/s) of the waves on this wire?

(a) 5.6
(b) 6.4
(c) 8.0
(d) 11.2
(e) None of these

6. The speed of waves on a clamped string of length 2.40 m is 6.0 m/s. At what frequency (in Hz) must the unclamped end of the string be oscillated in order that a standing wave with five antinodes be created?

(a) 6.90
(b) 6.25
(c) 5.62
(d) 4.44
(e) None of these

7. What is the length (in meters) of a pendulum that has a period of 10 seconds?

(a) 24.82
(b) 12.45
(c) 16.78
(d) 12.45
(e) None of these

8. A highway patrol car traveling north at 50 m/s is chasing a car that is also moving north. The highway patrol car's siren is broadcasting sound at 2400 Hz. The frequency heard by the chased car is 2317 Hz. What is the chased car's approximate speed (in m/s)?

(a) 60
(b) 62
(c) 54
(d) 65
(e) None of these

9. Sound is being broadcast from a spherically-symmetric sound source. A listener is 20 meters from the source. At the listener's ear the decibel level is 70 dB. If the listener moves to a location that is 160 meters from the source, what will be the new approximate decibel level (in dB) at the listener's ear? (Use the approximate "rule of three" for halvings.)

(a) 50
(b) 60
(c) 48
(d) 52
(e) None of these

10. A mass undergoes simple harmonic motion with amplitude 0.60 m. If the total energy of the spring-mass system is 4000 J, how much energy (in joules) will be stored in the spring when x = 0.18 m?

(a) 414
(b) 360
(c) 404
(d) 512
(e) None of these

11. When a mass of 1.0 kg is suspended from a "massless" spring, it stretches the spring by 0.20 m. (This information can be used to find the spring constant, k.) If the spring and mass are now placed on a frictionless table, with the free end of the spring clamped, and the mass at the other end is then displaced and released, what will be the frequency, f, (in hertz) of the motion, in hertz?

(a) 2.34
(b) 1.89
(c) 1.11
(d) 2.20
(e) None of these

12. A mass is attached to a spring and displaced and then released from rest. The equation of motion is $x = A \cos(\omega t+\phi)$, where $\phi = 0$. Determine the time (as a multiple of the period, T) when the kinetic energy of the mass is three times the potential energy of the spring.

(a) T/2
(b) T/3
(c) T/4
(d) T/6
(e) None of these

13. The object in a spring-mass system undergoing simple harmonic motion has a maximum velocity of 20 m/s and a maximum acceleration of 100 m/s^2. What is the amplitude (in meters) of this motion?

(a) 2
(b) 3
(c) 4
(d) 8
(e) None of these

14. A gas-filled balloon is lifting an object of mass M. What must be the volume V of the balloon in order that the balloon and mass rise at constant speed? Let the density of the surrounding air be ρ_0, and the density of the gas in the balloon be ρ.

(a) (1/3) (ρ_0M)
(b) M/(ρ_0-ρ)
(c) 4M/[3(ρ_0-ρ)]
(d) M/(ρ-ρ_0)
(e) None of these

15. The equation for a wave traveling in the positive-x direction is $y = A \sin(kx-\omega t+\phi)$. A traveling wave travels in the positive-x direction with amplitude 4.0 mm, frequency

f = 2.5/π Hz, and wavelength λ = π/5 m. The displacement y of the wave at t = 0 and x = 0 is -4.0 mm. What is the expression for the displacement y, in mm?

(a) y = 4.0 sin (10x –5t -π/2)
(b) y = 4.0 sin (10πx –5t +π/2)
(c) y = 4.0 sin (20x –2t -π/2)
(d) y = 4.0 sin (10x –5t +π/2)
(e) None of these

16. Copper wire has a radius of 1.0 mm (1.0 x 10^{-3} m). The density of copper is 8920 kg/m^3. With what velocity (in m/s) will traveling waves travel copper wire when it is subjected to a tension of 40 N? (Length is not given.)

(a) 37.8
(b) 41.2
(c) 24.6
(d) 19.4
(e) None of these

17. What must be the length (in meters) of an open-closed tube in which the lowest-possible resonant frequency is 34 Hz?

(a) 4.0
(b) 3.2
(c) 2.5
(d) 5.0
(e) None of these

18. At a distance of 10 m from a spherically-symmetric sound source the sound level is 90 dB. How far (in meters) from the sound source will the sound level be 30 dB?

(a) 10,000
(b) 1,000
(c) 2,000
(d) 3,600
(e) None of these

19. Two sound sources separated by 25 m are broadcasting sound at a frequency 170 Hz, in phase. A listener is positioned midway between the two sources. How far (in m) toward one of the sources should the listener move in order to hear minimum sound?

(a) 1.4
(b) 2.2
(c) 0.7
(d) 0.5
(e) None of these

20. What frequency (in hertz) of sound will resonate with three nodes in an open-open tube of length 2.40 m?

(a) 167.2
(b) 312.4
(c) 178.5
(d) 212.5
(e) None of these