PHYS 21800 PRACTICE EXAM 3

Part I – Multiple Choice Questions [2 pts each]

Directions: Circle the one alternative that best completes the statement or answers the question. Unless otherwise stated, assume ideal conditions (no air resistance, uniform gravity, etc.)

1) Which of the following is not a unit for pressure?
(A) psi

(B) pascal

(C) newton

(D) atmosphere

2) The output piston of a hydraulic press has an area three times the area of the input piston. An input force of 10 N will produce an output force of
(A) 3.3 N.

(B) 10 N.

(C) 30 N.

(D) 45 N.

3) A cement block sinks in fresh water. The density of the block must be
(A) zero.

(B) equal to the density of water.

(C) less than the density of water.

(D) greater than the density of water.

4) Whose Principal states that "the buoyant force acting on any object immersed in a fluid equals the weight of the fluid that it displaces"?
(A) Archimedes

(B) Bernoulli

(C) Doppler

(D) Pascal

5) Which of the following is the SI unit for stress?
(A) newton

(B) pascal

(C) newton per meter

(D) it has no unit

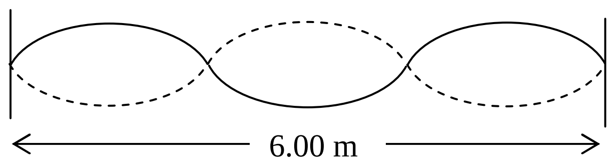
6) Which of the following is not a characteristic of a system in simple harmonic motion?
(A) Total mechanical energy is conserved.

(B) The restoring force is proportional to the displacement.

(C) The motion is periodic.

(D) There are always large displacements from equilibrium.

In the diagram below, a light string of length 6.00 m vibrates as a standing wave between two fixed points:



<u>Questions 7 and 8 both refer to this diagram.</u>

7) The wavelength of the standing wave equals
(A) 2.00 m

(B) 3.00 m

(C) 4.00 m

(D) 6.00 m

8) If the wave speed along the string equals 1.20 m/s, then its frequency must be
(A) 0.300 Hz

(B) 0.600 Hz

(C) 3.33 Hz

(D) 4.80 Hz

9) Sounds of frequencies below 20 Hz are within which range?
(A) audible

(B) ultrasound

(C) threshold of pain

(D) infrasound

10) The loudness of a sound wave is measured by its
(A) intensity.

(B) wavelength.

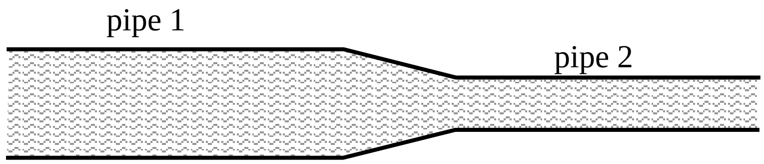
(C) frequency.

(D) speed.

Part II – Word Problems [20 pts each]

Directions: Show your work to receive full credit. Box your final answer and record its appropriate unit.

Problem 1



A liquid of density 375 kg/m^3 flows from horizontal pipe 1 of radius 4.24 cm into horizontal pipe 2 of radius 3.00 cm. The two pipes are at the same height. In pipe 1, the pressure is 700 Pa and the speed of the fluid is 0.800 m/s.

(A) Calculate the volume flow rate in m^3/s. (Note that it is the same for each pipe.)

(B) Calculate the speed of the fluid in pipe 2.

(C) The pressure of the fluid in pipe 2.

Problem 2

A 0.050-kg block connected to a spring with a constant of 35.0 N/m oscillates with an amplitude of 0.040 m on a frictionless horizontal surface.

(A) Calculate the period of oscillation in seconds.

(B) Calculate the total mechanical energy of the system.

(C) Calculate the speed of the block when it is 0.030 m from its equilibrium position.

Problem 3

A sinusoidal wave on a string is described by the function $y = 0.12 \sin(0.80x - 50t)$, where x and y are in meters and t is in seconds. The linear mass density of the string is 0.068 kg/m.

(A) Calculate the wavelength.

(B) Calculate the frequency.

(C) Calculate the tension in the string.

Problem 4

The power output of a certain public-address speaker is 6.00 watts. Suppose that it broadcasts sound waves equally in all directions.

(A) Calculate the distance from the speaker where the sound would be painful to the ear.

(B) Calculate the distance from the speaker where the sound would be barely audible.

Formulas and Constants

$F_{net} = ma$ $\quad w = mg$ $\quad f = \mu n$ $\quad F_{grav} = \frac{Gm_1 m_2}{r^2}$

$s_{av} = \frac{d}{t}$ $\quad v_{av} = \frac{\Delta x}{t}$ $\quad a_{av} = \frac{\Delta v}{t}$ $\quad G = 6.67\times10^{-11}\ \text{N}\cdot\text{m}^2/\text{kg}^2$

$\Delta x = v_i t + \frac{1}{2}at^2$ $\quad v_f = v_i + at$ $\quad \Delta x = \frac{1}{2}(v_i + v_f)t$ $\quad g = 9.8\ \text{m/s}^2$

$v_{fy} = v_{iy} - gt$ $\quad \Delta y = v_{iy}t - \frac{1}{2}gt^2$ $\quad v_{fy}^2 = v_{iy}^2 - 2g\Delta y$ $\quad \Delta x = v_{ix}t$

$d = r\Delta\theta$ $\quad v = r\omega$ $\quad \omega = \frac{2\pi}{T}$ $\quad a_c = \frac{v^2}{r} = \omega^2 r$ $\quad F_c = ma_c$

$1\ \text{rev} = 2\pi\ \text{rad} = 360°$ $\quad v = \sqrt{\frac{GM}{r}}$ $\quad v = \frac{2\pi r}{T}$ $\quad a_T = r\alpha$

$\omega_f = \omega_i + \alpha t$ $\quad \Delta\theta = \frac{1}{2}(\omega_f + \omega_i)t$ $\quad \omega_f^2 = \omega_i^2 + 2\alpha\Delta\theta$ $\quad \Delta\theta = \omega_i t + \frac{1}{2}\alpha t^2$

$W = F\Delta x\cos\theta$ $\quad W_f = -\mu_k n\Delta x$ $\quad P = \frac{\Delta E}{t}$ $\quad K = \frac{1}{2}mv^2$ $\quad U_{grav} = mgy$

$U_{elastic} = \frac{1}{2}kx^2$ $\quad E = K + U$ $\quad E_1 + W_f = E_2$ $\quad p = mv$ $\quad \Delta p = m\Delta v$

$\Delta p = F_{net}t$ $\quad \tau = rF\sin\theta$ $\quad \tau_{net} = I\alpha$ $\quad K_{rot} = \frac{1}{2}I\omega^2$ $\quad L = I\omega$

$P = \frac{F}{A}$ $\quad P = P_{atm} + P_{gauge}$ $\quad \frac{F_1}{A_1} = \frac{F_2}{A_2}$ $\quad \rho = \frac{m}{V}$ $\quad P = P_{atm} + \rho gd$ $\quad \frac{\Delta V}{t} = Av$

$P_{atm} = 1\ \text{atm} = 1.013\times10^5\ \text{Pa}$ $\quad \rho_{water} = 1\ \text{g/cm}^3 = 1000\ \text{kg/m}^3$ $\quad A_1 v_1 = A_2 v_2$

$P + \frac{1}{2}\rho v^2 + \rho gy = \text{const}$ $\quad \frac{F}{A} = Y\cdot\frac{\Delta L}{L}$ $\quad F_{spring} = -kx$ $\quad \omega_{spring} = \sqrt{\frac{k}{m}}$ $\quad \omega_{pend} = \sqrt{\frac{g}{L}}$

$v_{\max} = \omega A$ $\quad a_{\max} = \omega^2 A$ $\quad f = \frac{1}{T}$ $\quad \omega = 2\pi f$ $\quad \omega = \frac{2\pi}{T}$ $\quad \kappa = \frac{2\pi}{\lambda}$

$y = A\sin(\kappa x \pm \omega t)$ $\quad v = \frac{d}{t}$ $\quad v = f\lambda$ $\quad v_{string} = \sqrt{\frac{F_T}{\mu}}$ $\quad \mu = \frac{m}{L}$ $\quad f_n = nf_1$

$f_1 = \frac{v}{2L}$ $\quad I = \frac{P}{4\pi r^2}$ $\quad I_1 r_1^2 = I_2 r_2^2$ $\quad \beta = 10\log\left(\frac{I}{I_0}\right)$ $\quad I = 10^{\frac{\beta}{10}-12}$ $\quad I_0 = 10^{-12}\ \text{W/m}^2$

$I_{pain} = 1\ \text{W/m}^2$ $\quad f_o = \left(\frac{v - v_o}{v - v_s}\right)\cdot f_s$