PS 160 — Physics II for Engineers — Practice Test #1

Name _____ Score: ____/100 Total points: ____/____

Approximate grade ____

Relax. Look over all questions before you begin, and attempt the easier ones first. Place your answers in the boxes provided. To receive full credit you must SHOW your work and EXPLAIN your method. You may work on the back of each sheet. All problems are worth 10 points unless otherwise noted.

Some possibly useful formulas

$$\omega = \sqrt{\frac{g}{\ell}} \quad \omega = \sqrt{\frac{k}{m}} \quad \omega = \sqrt{\frac{mgd}{I}}$$

$$\rho A v = \mathcal{C} \quad p + \rho g y + \rho v^2/2 = \mathcal{C} \quad \rho = m/V \quad \frac{dp}{dy} = -\rho g$$

$$v = \sqrt{\frac{T}{\mu}} \quad v = \sqrt{\frac{B}{\rho}} \quad v = \sqrt{gh} \quad p_{max} = BkA \quad I = \frac{p_{max}^2}{2\sqrt{\rho B}} \quad f_n = \frac{nv}{2L} \quad \frac{I_1}{I_2} = \frac{r_2^2}{r_1^2}$$

$$f_L = f_S\left(\frac{v + v_L}{v + v_S}\right) \quad v_{\text{sound}} = 344 \text{ m/s} \quad \beta = (10 \text{ dB}) \log_{10}\left(\frac{I}{I_0}\right) \quad I_0 = 10^{-12} \text{ W/m}^2$$

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1. You are watching an object that is moving in SHM. When the object is displaced 0.600 m to the right of its equilibrium position, it has a velocity of 2.20 m/s to the right and an acceleration of 8.40 m/s^2 to the left. How much farther from this point will the object move before it stops momentarily and then starts to move back to the left?

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2. A simple pendulum has a period (on the surface of Earth) of $T = 10$ s. (a) What is the length of the pendulum's string? (b) What is its period on the surface of Mars (where $g_{\text{mars}} = 3.7$ m s^{-2})?

(a)

(b)

3. A slab of ice (92% of the density of water) floats on a freshwater lake. What minimum volume must the slab have for a 45.0-kg woman to be able to stand on it without getting her feet wet?

4. A *large* sealed tank containing seawater (3% more dense than fresh water) to a height of 11.0 m also contains air above the water at a *gauge* pressure of 3.00 atm. Water flows out from the bottom through a *small* hole. How fast is this water moving?

5. A wave is described by the function

$$y(x,t) = (10\text{ m})\sin\left[(40\text{ m}^{-1})x - (60\text{ s}^{-1})t\right].$$

(a) Calculate the wave speed v. (b) Calculate the wavenumber k. (c) Is it traveling to the right or to the left?

(a)

(b)

(c)

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6. Light is a wave, and its intensity behaves exactly like sound. The sun emits light power at the rate of 3.8×10^{26} W, What is the light intensity I at the Earth, which is 1.5×10^{11} m away?

7. Two guitarists attempt to play the same note of wavelength 6.50 cm at the same time, but one of the instruments is slightly out of tune and plays a note of wavelength 6.52 cm instead. What is the frequency of the beat these musicians hear when they play together?

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8. The fundamental frequency of a pipe that is open at both ends is 594 Hz. If one end is now closed, what is the frequency of the new fundamental?

SHORT ANSWER — answer *only* two questions

9. Does the sound intensity level β obey the inverse-square law? Why or why not?

10. Group the following waves according to whether they are longitudinal or transverse: sound, electromagnetic, string waves, surface water waves, earthquake waves.

11. A person and an iron anchor are in a boat that is floating in a swimming pool. He throws the anchor from the boat into the water where it sinks to the bottom. What happens to the water level in the pool? Does it rise up, lower, or remain the same? Explain your answer

12. A simple pendulum oscillates in simple harmonic motion. Is there any instant at which the (instantaneous) velocity vector of the bob is perpendicular to the (instantaneous) acceleration vector of the bob? Explain. (A diagram will help your explanation.)