

Arts & Science 2D06

Quiz #5 2014 Jan 30

Name:

NB: Mark values are given in brackets [] beside each problem. Write all your answers on the quiz paper. No books or notes allowed. Time to write quiz: 50 minutes.

Solution for quadratic equation: $x = (-b \pm \sqrt{b^2 - 4ac})/2a$

Surface area of sphere: $A = 4\pi r^2$ Volume of sphere: $V = \frac{4}{3}\pi r^3$

Bernoulli's equation: $P + \rho gy + \frac{1}{2}\rho v^2 = \text{const}$

Period of simple pendulum: $T = 2\pi\sqrt{\frac{L}{g}}$ Wave speed: $v = f\lambda$

SHM equation of motion: $x = A \cos(\omega t + \varphi)$ where $\omega = \sqrt{k/m} = 2\pi/T$

Air pressure at sea level $P_0 = 1.013 \times 10^5 \text{ N/m}^2$

Density of air at sea level $\rho_{air} = 1.29 \text{ kg/m}^3$

Density of water $\rho_{H_2O} = 1000 \text{ kg/m}^3$

1. [3] In simple harmonic motion of a mass+spring system, the mass's acceleration is proportional to its:

- (a) velocity.
- (b) frequency.
- (c) amplitude.
- (d) displacement.
- (e) all of the above.

Explain/derive your choice in the space below.

2. [4] At position A within a tube containing a compressible fluid that is moving with steady laminar flow, the speed of the fluid is 12.0 m/s and the tube has a diameter 12.00 cm. At position B, the speed of the fluid is 18.0 m/s and the tube has a diameter 6.00 cm. What is the ratio of the density of the fluid at position A to the density of the fluid at position B?

3. [3] You are originally 1.0 m beneath the surface of a pool. If you dive from there to 2.0 m beneath the surface, what happens to the absolute pressure that you will feel?

- (a) It increases by a factor of 4.
- (b) It increases by a factor of 2.
- (c) It increases, but by a factor smaller than 2.
- (d) It decreases by a factor of 2.
- (e) It does not change.

Explain/derive your choice in the space below.

4. [5] A piece of aluminum with a mass of 1.0 kg and density of 2700 kg/m^3 is suspended from a string and then completely immersed in a container of water.

(a) Determine the volume of the piece of aluminum.

(b) Determine the tension in the string after the metal is immersed in the container of water.

5. [5] A mass of 1.53 kg is attached to a spring and the system is undergoing simple harmonic oscillations with a frequency of 1.95 Hz and an amplitude of 7.50 cm. What is the total mechanical energy of the system?

[20] total marks