PART I: Multiple choice questions

Only one of the choices given is the correct answer. No explanation for your choice is required. Each multiple choice problem is worth 5 points.

1. While swimming near the bottom of a pool, you let out a small bubble of air. As the bubble rises toward the surface, what happens to its diameter?

(a) bubble diameter decreases

(b) bubble diameter stays the same

(c) bubble diameter increases

(d) it depends on the shape of the swimming pool

2. Two glasses of water are sitting on a table. Both have a constant diameter, but one of them is wider than the other. Both glasses contain the same volume of water. Which of the following is true about the force and pressure exerted by the water on the bottom of each glass?

(a) the pressure on the wider glass is greater, but the force is less

(b) the force on the wider glass is greater, but the pressure is less

(c) the pressure on both is the same, but the force on the wider glass is greater

(d) the force on both is the same, but the pressure on the thinner glass is greater

3. Two pennies are placed on opposite sides of a balancing scale. One of them is made of copper, while the other is zinc coated in copper. Both pennies are the same size and shape. The density of copper is greater than zinc. If the scale is submerged in water, will the angle of tilt between the two sides change and if so in which direction?

(a) The scale will tip down further towards the side of the copper penny.

(b) The scale will tip up back towards the side of the zinc penny.

(c) The angle between the two sides will remain unchanged.

4. Which of the following will increase the period of a simple pendulum?

(a) Decreasing the mass hanging from the pendulum.

(b) Increasing the mass hanging from the pendulum.

(c) Decreasing the length of the pendulum.

(d) Moving the pendulum from sea level to the top of a mountain where the Earth's gravitational pull is slightly less.

5. A mass on a spring in simple harmonic motion has amplitude A and period T. What is the total distance traveled by the mass after a time T?

(a) 0

(b) A/2

(c) A

(d) 2A

(e) 4A

6. A mass oscillates in simple harmonic motion with amplitude A. If the mass is doubled but the amplitude is not changed, what will happen to the total energy of the system?

(a) total energy will increase

(b) total energy will not change

(c) total energy will decrease

PART II: Short problems

To earn full credit on the following problems, you must exhibit the steps that lead to your final result (and will depend on the clarity of your method of solution as well as on your final answer). Problems 7 and 8 are worth 20 points each, and problem 9 is worth 30 points.

7. What gauge pressure in the water mains is necessary if a firehose is to spray water (directly upward) to a height of 18 m?

8. Tarzan stands on a branch as a leopard threatens. Fortunately, Jane is on a nearby branch of the same height, holding a 25 m long vine attached directly above the point midway between her and Tarzan. She grasps the vine and steps off with negligible velocity. How soon does she reach Tarzan?

9. Suppose the top of a water tower has a gauge pressure P_1, and that it is connected through pipes to a faucet surrounded by air at atmospheric pressure P_0.

(a) Derive a formula for the speed, v, at which the water flows out of the faucet, if the difference in height between the top of the water tower and the faucet is y. You may assume there is no other pumping mechanism involved besides gravity, and that the rate at which the water level in the tower is dropping is approximately zero.

(b) If $P_1 = 0.85$ atm, P_0 is standard atmospheric pressure, and $y = 2.4$ m, determine v.