General Physics I (PHYS 2010)
Spring 2014
Prof Richard Ignace

HOMEWORK #7

Notes:

- This homework is due by the beginning of class on Apr 10. It covers material from chapters 8 and 9.
- You will need a calculator and lots of scrap paper.
- Answers are to be recorded on a scantron that you will turn in. You may keep the questions (i.e., these sheets).
- You may (should) use your book. You may even work with other students. However, you should not copy the answers of other students. The homeworks are exam prep, and so you need to be able to work these problems yourself. If you do not apply yourself and do your own work, you are not likely to perform well on the exams.

1. Consider a teeter totter with fulcrum located underneath at the midway of a 12 m length board. A mass is located at the end of the right side with $m_1 = 15$ kg. A second is at the end of the left side with $m_2 = 20$ kg. Where must a third mass of $m_3 = 40$ kg be placed to balance the teeter totter.

   a. A distance of 0.75 m left of the fulcrum
   b. A distance of 0.75 m right of the fulcrum
   c. A distance of 5.25 m right of the fulcrum
   d. A distance of 5.25 m left of the fulcrum

2. Suppose a ball of radius R with its mass M concentrated toward the center has a moment of inertia of $0.2MR^2$. If this ball is rolling without slipping along a level surface with a linear speed v, what is the ratio of its rotational kinetic energy to its *total* kinetic energy?

   a. 0.82
   b. 0.20
   c. 0.18
   d. 0.90

3. A figure skater with arms initially at her side goes into a spin on ice at 3 rad/s. She then extends her arms directly away from her body. Which of the following results?

   a. a smaller rotational rate
   b. a greater rotational rate
   c. a greater angular momentum
   d. a smaller angular momentum

4. Gerard O'Neill is famous for suggesting human space travel in a long, cylindrical space ship. Rotating the cylinder simulates articial gravity on the inside of the rounded portion. Imagine a spaceship with circular diameter of 4 miles. If it rotates fast enough to simulate 1 g of gravitational acceleration, how long does it take for the ship to rotate once? (Hint: Find the angular velocity ω first. Then find the time to rotate through 2π radians.)

   a. 1.9 mins
   b. 2.9 mins
   c. 3.9 mins
   d. 4.9 mins

5. The quantity pressure expressed in terms of the fundamental quantities (mass, length, time) is equivalent to:

   a. MLT^{-1}.
   b. $\mathrm{ML}^{-1}\mathrm{T}^{-2}$.
   c. $\mathrm{M}^2\mathrm{L}^{-1}\mathrm{T}^{-3}$.
   d. a dimensionless quantity.

6. Consider a dam that is $H = 60$ m high. The side facing the water has a flat area of $A = 6000$ m^2. Determine the force of the water pressure against the dam side. Note that the dry side of the dam is subject to air pressure, so you want ΔP acting against the dam wall. Also, you can use the average pressure difference acting against the dam. ($\bar{\Delta P} = (\Delta P_{top} + \Delta P_{bottom})/2$)

   a. 1.8×10^6
   b. 1.8×10^7
   c. 1.8×10^8
   d. 1.8×10^9

7. A piece of aluminum has density 2.70 grams/cm^3 and mass 390 grams. The aluminum is submerged in a container of fluid with unknown density. A spring balance is attached with string to the piece of aluminum that registers a "weight" of 270 grams. Determine the density of the fluid in the container.

   a. 0.83 grams/cm^3
   b. 1.3 grams/cm^3
   c. 2.2 grams/cm^3
   d. 6.1 grams/cm^3

8. As ice floats in water, about 5% of the ice floats above the surface of the water. If we float some ice in a glass of water, what will happen to the water level as the ice melts?

   a. The water level will rise 5% of the volume of the ice that melts.
   b. The water level will rise, but not as much as the 5% indicated in answer a.
   c. The water level will remain unchanged.
   d. The water level will become lower by 5%.

9. Think of the continuity equation as it pertains to an ideal fluid flowing through a horizontal pipe. Imagine that you take measurements along the pipe in the direction of fluid flow. What happens to the speed of flow as the pipe narrows?

   a. It remains constant as the pipe narrows.
   b. It increases as the pipe narrows.
   c. It decreases as the pipe narrows.
   d. No choices above are valid.

10. An ideal fluid, of density 0.90×10^3 kg/m^3, flows at 6.0 m/s through a level pipe with radius of 0.50 cm. The pressure in the fluid is 1.3×10^5 N/m^2. The pipe slopes up where it becomes level again. If the pressure P drops by 10%, find the change in height of the pipe, Δy. (Hint: the speed of flow remains constant.)

    a. 6.2 m
    b. 31 m
    c. 0.5 m
    d. 1.5 m

11. A hole is poked through the metal side of a drum holding water. The hole is 26 cm below the water surface. What is the initial speed of outflow?

    a. 0.9 m/s
    b. 1.6 m/s
    c. 2.3 m/s
    d. 3.9 m/s