Lab Test Labs 7-12 PLAB 193 Spring 2016 D Norwood

Read the whole test and answer questions you find easier first. You can use your calculator and the lab writeups you gave me – NOTHING ELSE! Ask if something isn’t clear. Ask if there are constants you think you need; I may tell you to estimate it, but I may also tell you. I WON’T tell you whether you need it or not – that’s your job. I will tell you certain incidental equations (e.g., area of a sphere) that you probably should know, but that are not the focus of this class. Relax. Say your mantra. The cat whiskers come from within.

1. (15 points) A one meter long ramp is tilted at an angle of 17°. A wooden block with a mass of 0.15 kg is placed at the top of the ramp. When released, it slides to the bottom in 0.25 seconds. What is the coefficient of static friction for this block on this ramp? (If it's not possible to tell me, explain why it's not possible. If it's only possible to give a range of values, give me that.)
2. **(20 points)** At the front of the room is a scale set up to measure specific gravity. As is, it does NOT measure the buoyant force.

   A) *Explain* (DON'T just tell) why the result shown on the scale is NOT the buoyant force.

   B) Explain what you would have to do to measure the buoyant force (don't do it, just explain how). Include how your method solves the problem you discuss in part A).
3. **(20 points)** In the mass on a spring lab, you determined the stiffness in two ways: from the expression \( F = -kx \) and from \( T = 2\pi \sqrt{\frac{m}{k}} \).

A) Determine the units of stiffness from the expression \( F = -kx \).

B) Determine the units of stiffness from the expression \( T = 2\pi \sqrt{\frac{m}{k}} \).

C) Show that the units in each case above are the same.
4. **(15 points)** At the front of the room are two pendula (one on either side).

   A) Pick one (and tell me which you picked) and measure the period.

   B) Use the model we developed \( T = 2\pi \sqrt{\frac{L}{g}} \) with the known value of \( g \) \( 9.8 \, \text{N/kg} \) to find the length.
5. **(10 points)** Heat trapping by greenhouse gasses continues to heat the oceans to record levels, this year by about 0.82º C since 1880. The thermal expansion coefficient of water is 
\[ \alpha \approx 71 \cdot 10^{-6}/°C \] and the depth of the mixing layer (the height of water that is heated by global warming) is about 1500 m. Estimate how much the sea level has risen due only to thermal expansion.
6. **(20 points)** Suppose that a tin can and a sphere are released from the top of a ramp. Recall that our model for rolling down a ramp was:

\[
a \approx g \frac{I}{mr^2} \sin \theta - \frac{\mu g}{1 + \frac{I}{mr^2}}
\]

Suppose the friction coefficient for both objects of 0.1. Is it possible to predict which object reaches the bottom first? If so, do it. If not, explain why you can't.