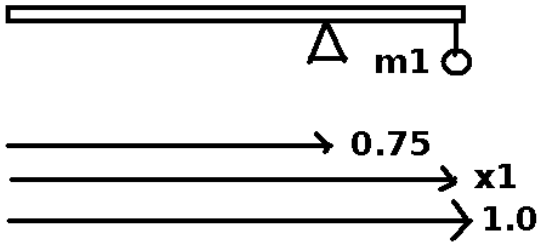
November 1, 2024	Physics 240: UnTest #3: page 1	Name _____

Time Start_____ Time finish_____ Pledged_____

Instructions: You have a total of 50 minutes to complete this test. Answer each of the following questions completely. Supply all details that led to your answer and correct SI units where required. Do not discuss any aspect of this test with anyone until I return the test. Constants: g=9.8 m/s²

[1] A stick of mass m=0.7 kg and length L=1m is on a pivot at x=0.75m. A mass m_1=1 kg is placed at a distance x_1 from the left end of the meter stick as shown.



[1a] Sketch in and properly **label all forces** on the diagram above. Do not neglect the weight of the meter stick and be sure to indicate (correctly) where it is located on the meter stick. Indicate the force from the pivot as Fp.

[1b] Apply Newton's law to find the force exerted by the pivot. Be sure to include correct SI units.

F=_____

[1c] Now, consider the axis to be located at the pivot (x=0.75 m). Write the resulting torque equation about this axis. Your equation is symbolic and involves g, m, m_1 and x_1.

$\sum \Gamma$= _____ .

[1d] Solve for the position x_1 where the mass m_1 would be placed for static equilibrium to result. Your answer here is numerical with correct SI units. Be sure to provide x_1 and not just the distance from the pivot here.

x_1=_____

[2] A spring-mass system has a spring constant k (k=3 N/m) and a mass m (m=7 kg) is attached to the spring. Answer the following showing complete details with correct SI units.

[2a] Suppose at t=0, the mass is at an equilibrium position and moving with a speed of 1.5 m/s. Find the amplitude of the oscillation.
[2b] Find the frequency of oscillations about the equilibrium position.
[2c] A simple pendulum is seen to have a period of 2 s when undergoing small oscillations near the surface of the earth. How long is the pendulum?
[2d] A system is described by an equation of motion of the form (z is a displacement variable, b and c are positive constants): $b\frac{d^2z}{dt^2}+cz=0$. What is the angular frequency ω of small oscillations about equilibrium for this system?

[3] A wire has a length L and is under a tension T and has a mass per unit length μ. For each of the sections below, you may assume T=5 N and μ=0.03 kg/m. **Be sure to include correct SI units in your answers.**

[3a] Suppose a pulse on the string was timed and the time to travel to the end and back was found to be 1.3 s. How long is the string?

For the rest of the problem, Assume the string has a length L=5.0 m.

[3b] Suppose both ends of the wire are fixed. Find the lowest frequency of (standing) transverse oscillations.

[3c] Suppose for the same wire, one end is fixed and one end is free. Find the lowest frequency of (standing) transverse oscillations.

[4] An open and a closed organ pipe both have lengths of 5m. If the speed of sound is 343 m/s, find the following:

[4a] Sketch the wave forms (of molecular displacement, Δs) for the lowest 3 modes of oscillations for the closed pipe.

[4b] Find the frequencies (f) of the lowest 3 modes of oscillations for the closed pipe.

[4c] Sketch the wave forms (of molecular displacement, Δs) for the lowest 3 modes of oscillations for the open pipe.

[4d] Find the frequencies (f) of the lowest 3 modes of oscillations for the open pipe.