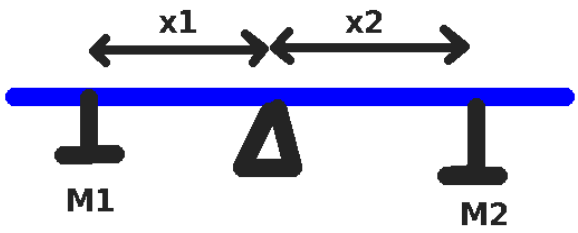
November 5, 2021	Physics 240: UnTest #3: page 1	Name _____

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 **massless** bar is balanced as shown (it is in static equilibrium). Two masses M2 and M2 are placed at distances x1 and x2 from the pivot as shown.

(a) Sketch and label on the diagram below all forces acting on the bar.



(b) Write each term in the sum of the forces acting on the bar.

(c) Assume the pivot and axis are located at the same location (shown in the diagram above).Write each term in the sum of torques about this axis.

(d) Find the force from the pivot in terms of M_1, M_2 and g.

(e) Find the value of x_2 in terms of x_1, M_1, and M_2.

(f) Suppose $M_1=2M_2$ and $x_1=2$ m. Provide a numerical value for x_2 with correct SI units.

[2] A spring-mass system has a spring constant k and a mass m is attached to the spring.

(a) Find the period (T) of small oscillations about equilibrium with correct SI units when k=2 N/m and m=8 kg.

(b) Suppose at t=0 the mass is at an amplitude which is seen to be 0.5m. Find the maximum velocity with correct SI units, again with k=2 N/m and m=8 kg.

(c) How long must a simple pendulum located near the surface of the earth be so that small oscillations about equilibrium have a frequency (f) of 1.0 Hz?

[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 L=4 m, T=8 N and μ=0.02 kg/m. **Be sure to include correct SI units in your answers.**

(a) Calculate the speed of a pulse on the wire.

(b) If the wire is plucked on one end, how long would it take for a pulse to return?

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

(d) Suppose both ends of the wire are fixed. Find the lowest frequency of (standing) transverse oscillations.

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

(a) Sketch the wave forms (of molecular displacement, Δs) for the lowest 3 modes of oscillations for the open pipe.

(b) Find the frequencies (f) of the lowest 3 modes of oscillations for the open pipe.

(c) Sketch the wave forms (of molecular displacement, Δs) for the lowest 3 modes of oscillations for the closed pipe.

(d) Find the frequencies (f) of the lowest 3 modes of oscillations for the closed pipe.