Instructions: You have a total of 50 minutes to complete this test.
Answer each of the following questions completely.
Time Start_____ Time finish_____ Pledged_____
You must supply all details that led to your answer.
You must provide correct SI units where required.
Do not discuss any aspect of this test with anyone until I return the test.

[1] An open and a closed organ pipe both have lengths of 15m. If the speed of sound is 343 m/s, find the following:

[1a] Sketch the wave forms (of molecular displacement, Δs) for the lowest 3 modes of oscillations for the open pipe.

[1b] Find the frequencies (f) of the lowest 3 modes of oscillations for the open pipe.

[1c] Sketch the wave forms (of molecular displacement, Δs) for the lowest 3 modes of oscillations for the closed pipe.

[1d] Find the frequencies (f) of the lowest 3 modes of oscillations for the closed pipe.

[2] Suppose a simple pendulum has a length of 10.0 m. You may assume the acceleration due to gravity is $g=9.8\ m/s^2$. Be sure to use correct SI units in your answers.

[2a] What is the period (T) of small oscillations about the equilibrium position?

T=_____

[2b] What mass should be placed on a spring with a spring constant of $k=4\,N/m$ in order to produce the same frequency as the pendulum has?

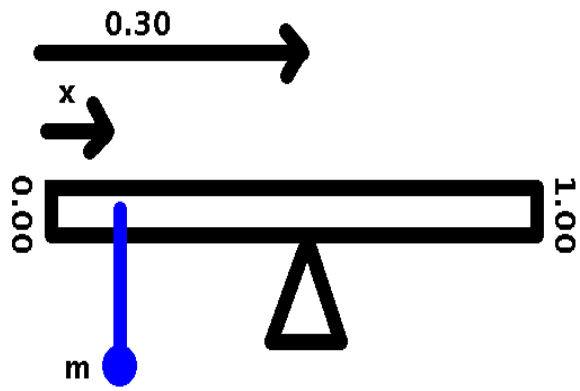
m=_____

[2c] If a spring mass system with $k=4\,N/m$ and m=6 kg is displaced through a maximum displacement of $x_{max}=0.5$ m, what is the total energy of the system?

E=_____

[2d] What is the speed of the mass in problem [2c] when it passes through the equilibrium position?

v=_____



[3] A meter stick of mass m_1=0.5kg and length L=1m is on a pivot at x_1=0.30m. Find the position that a mass m=4 kg would need to be placed so that the system would be in static equilibrium by answering the following questions.

[3a] Sketch in and properly **label all forces** on the diagram above. Indicate the force from the pivot as Fp.

[3b] Apply Newton's law to find the force exerted by the pivot in terms of m,m_1 and g.

F_p =_____

[3c] Now, consider the axis to be located at the end marked 0.00. Write the torque equation required to achieve static equilibrium in terms of m, m_1, g, F_p and distances. Be sure to include proper signs here.

ΣΓ=_____.

[3d] Solve for the position x where the mass m would be placed for static equilibrium to result. Your answer here is numerical with correct SI units.

x=_____

[4] A wire has a length L is under a tension T and has a mass per unit length μ. For each of the sections below, you may assume L=10 m, T=20 N and μ=0.05 kg/m. **Be sure to include correct SI units in your answers.**

[4a] Find the wave speed of a transverse pulse on this string.

v=_____

[4b] How long will it take for a pulse to travel through the wire and return if both ends are fixed. You may assume the wire was plucked on the end.

t=_____

[4c] Suppose both ends of the wire are fixed. Find the lowest frequency (f) of (standing) transverse oscillations on this wire.

f=_____

[4d] Suppose for the same wire, one end is fixed and one end is free. Find the lowest frequency (f) of (standing) transverse oscillations on this wire..

f=_____