Instructions: You have a total of 55 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](a) An open ended organ pipe has a length of $5.00\text{x}10^{1}$ m. Assuming that the speed of sound is 343 m/s, find the frequency of oscillation of the lowest lying mode in this organ pipe.

[1](b) How long would an organ pipe with one end closed need to be so that the fundamental mode has the same frequency?

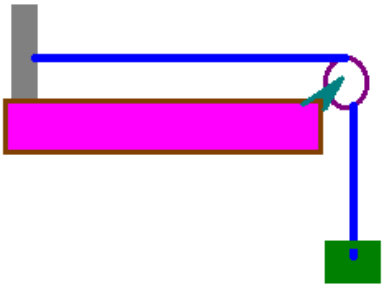
[1](c) What tension would a string of length $5.00\text{x}10^{1}\,\text{m}$ with a mass per unit length $\mu = 1.00\text{x}10^{-3}\,\frac{\text{kg}}{\text{m}}$ need to have so that the same fundamental frequency of oscillation will exist when both ends of the string are fixed?

(2) Suppose a simple pendulum has a length of 10.0 m. You may assume the acceleration due to gravity is $g = 9.80\,\frac{\text{m}}{\text{s}^2}$.

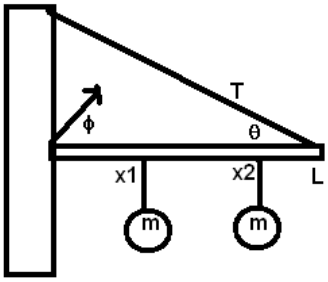
[2](a) What is the period of small oscillations about the equilibrium position?

[2](b) What mass should be placed on a spring with a spring constant of $k = 0.500\,\frac{\text{N}}{\text{m}}$ in order to produce the same frequency as the pendulum has?

[3] A wire has a mass of 0.05 kg and a total length of 2.00 m with 1 m of the wire hanging over a pulley as shown and is attached to a 10 kg mass while the other end of the wire is attached to a grey block. Find the lowest 3 modes of oscillation in this system. You may assume that the end at the pulley is fixed as is the end at the grey block.



[4] A rod of length L and mass m_1 has a mass m attached at x_1 and a mass m attached at x_2. Find the tension in the cable which is attached to the end of the rod. Your answer must be in terms of m, m_1, x_1, x_2, g, L and θ.



[5] A wheel initially at rest of radius R and moment of inertia $I = mR^2$ has a force $F = bt^2$ (b has SI units of N/s^2) applied tangent to the edge of the wheel so that the wheel starts spinning. At time t, the force is removed from the wheel.
(a) After a time t, what is the angular velocity of the wheel?
(b) What is the kinetic energy of the wheel at time t?
(c) What is the angular velocity of the wheel at time t?
(d) What is the angular momentum of the wheel at time t?
(e) Suppose that at time t, the radius of the wheel suddenly expands by a factor of 2 so that $R_{after}=2R$. What is the angular velocity of the wheel after this expansion has occurred?