

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 5.00×10^1 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?

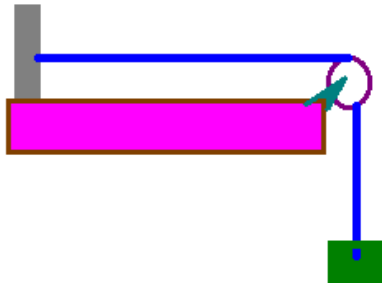
[1](c) What tension would a string of length 5.00×10^1 m with a mass per unit length $\mu = 1.00 \times 10^{-3} \frac{\text{kg}}{\text{m}}$ need to have so that the same fundamental frequency of oscillation will exist when both ends of the string are fixed?

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

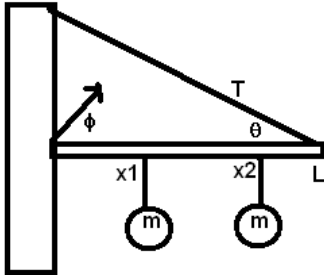
[2](a) What is the period of small oscillations about the equilibrium position?

[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 applied tangent to the edge of the wheel so that the wheel starts spinning. At time t , the force is removed from the wheel. Your answers must be in terms of the variables indicated in parenthesis.

- (a) After a time t , what is the angular velocity of the wheel (F , t , m , R)?
- (b) What is the kinetic energy of the wheel at time t (F , t , m)?
- (c) What is the angular momentum of the wheel at time t (F , R , t)?
- (d) Suppose that at time t , the radius of the wheel suddenly expands by a factor of 2 so that $R_{\text{after}} = 2R$. What is the angular velocity of the wheel after this expansion has occurred (F , R , t)?