

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](a) An closed organ (1 end closed) pipe has a length of 2.50 m. Assuming that the speed of sound is 343 m/s, find the frequency of oscillation of the **next to lowest lying mode** in this organ pipe.

[1](b) How long would an organ pipe (with both ends open) need to be so that the lowest lying mode has a frequency of 50 Hz?

[1](c) What tension would a string of length 5.00 m with a mass per unit length $\mu = 1.00 \times 10^{-3} \text{ kg/m}$ need to have so it would have a lowest frequency of oscillation of 35 Hz when both ends of the string are fixed?

[1](d) if a string is 10 m long with a mass per unit length of $\mu = 0.1 \text{ kg/m}$ were under a tension of 100N, how long would it take a transverse pulse to travel the length of the string?

[2] Suppose a simple pendulum has a length of 15.0 m. You may assume the acceleration due to gravity is $g=9.8\text{m/s}^2$.

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

T= _____

[2](b) What mass should be placed on a spring with a spring constant of $k=3.0\text{N/m}$ in order to produce a period of 3 seconds?

m= _____

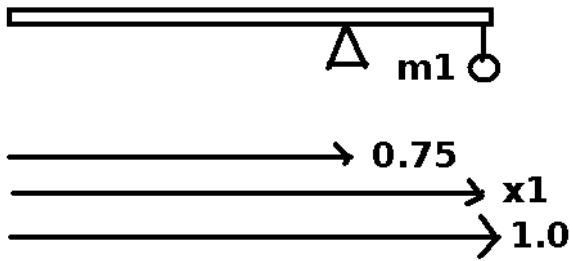
[2](c) If the spring mass system in problem 2(b) is displaced through a maximum displacement of $x_{\text{max}}=0.5$ m, what is the total energy of the system?

E= _____

[2](d) What is the kinetic energy of the mass spring system in (2c) when the mass passes through the equilibrium position corresponding to zero displacement?

K= _____

[3] A meterstick of mass $m=1.0\text{kg}$ and length $L=1\text{m}$ is on a pivot at $x=0.75\text{m}$. Find the position that a mass $m_1=5\text{ kg}$ 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. Do not neglect the weight of the meterstick, noting that it acts at the center of mass of the meterstick. Indicate the force from the pivot as F_p .

[b] Apply Newton's law to find the force exerted by the pivot. Your answer here is numeric with correct SI units.

$$F_p = \underline{\hspace{2cm}}$$

[c] Now, consider the axis to be located at the pivot ($x=0.75$). Write the torque equation (using correct signs) required to achieve static equilibrium. Note that mass m_1 is at ($x_1 - .75$) from the pivot. Your answer involves the symbols m , m_1 , g and x_1 . All other distances you may replace by their actual values.

$$\Sigma\Gamma=0 = \underline{\hspace{2cm}}$$

[d] 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.

$$x_1 = \underline{\hspace{2cm}}$$

[4] A wheel of radius R and mass m has a moment of inertia given by $I = \frac{1}{2}mR^2$ about its axis. In this problem, you may assume $m=3$ kg and $R=0.1$ m and be sure to use correct SI units in your answers.

(a) if the wheel is spinning with a frequency $f=10$ Hz, what is the angular velocity of the wheel?

$$\omega = \underline{\hspace{2cm}}$$

(b) What is the angular momentum of the wheel if it is just spinning with a frequency of 10 Hz but not translating?

$$L = \underline{\hspace{2cm}}$$

(c) if the wheel is spinning with a frequency $f=10$ Hz, what is the kinetic energy of the wheel?

$$K = \underline{\hspace{2cm}}$$

(d) If the wheel rolls without slipping on a flat surface, how far will the center of mass of the wheel translate in 1 second?

$$x = \underline{\hspace{2cm}}$$