

This is a practice test for test #2. Although the problems on your test may be similar to these, you are responsible for all the material we have covered.

Instructions: Answer each of the following questions completely, **showing all details** and including sketches as needed, together with correct SI units as required. You have a total of 50 minutes to complete this test.

Time started: _____ Time ended: _____

Do not discuss this test with any person until after Wednesday October 26, 2005

[1] Suppose a force varies in time as $\vec{F} = [F_0 + bt^2]\hat{x}$ where F_0 is a constant and b has SI units of N/s. If this force is applied to a mass m which is initially moving with a velocity $\vec{v}_0 = -|v_0|\hat{x}$. You may assume that the force was initially applied at $t=0$.

(a) Find the impulse, \vec{J} , at some later time in terms of F_0 , b and t .

(b) Find the change in momentum of the mass after a time t in terms of F_0 , b , m and t .

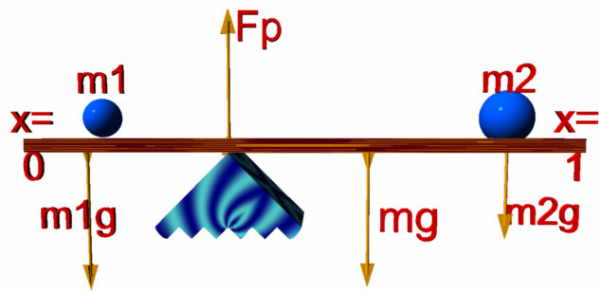
(c) Find the change in velocity of the mass after a time t in terms of F_0 , b , m and t .

Now, suppose this same force is applied at a radius R from the axis of symmetry of a wheel which has a moment of inertia $I = \frac{2}{3}MR^2$ and is applied tangent to the surface (at right angles to R) so that the wheel starts rotating. You may assume that the force was initially applied at $t=0$.

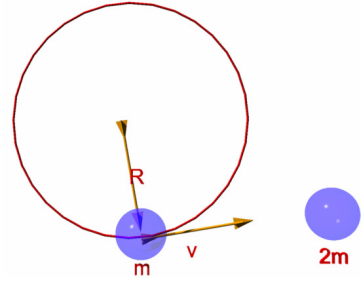
(d) What is the magnitude of the torque which is applied to the system at some time t in terms of R , F_0 , b and t ?

(e) What is the magnitude of the angular acceleration of the wheel at some time t in terms of R , F_0 , b , M and t ?

(f) If the torque is applied for a time t , what is the change in angular velocity at the end of this time interval t in terms of R , F_0 , b , M and t ?



[2] A board ($L=1\text{m}$) with a mass of $m=2.5\text{ kg}$ has a pivot located at $x=0.3\text{m}$. A mass $m_1=19.0\text{kg}$ is placed on the meter stick at a position of 0.20 m . What is the value of a mass m_2 that must be placed at the position $x=0.80\text{ m}$ in order for the system to balance? Hint: work the problem symbolically first and choose your axis carefully! You may assume the board has a uniform mass density.



[3] A mass m is attached to a string of length R and then the mass is forced to undergo uniform circular motion. Suppose the force acting on the mass to cause this motion is F .

(a) What is the angular velocity of the mass m in terms of F , m and R ?

(b) What is the tangential velocity of the mass in terms of F , m and R ?

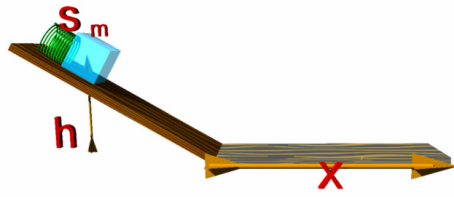
(c) Suppose the string breaks and the mass then strikes and sticks together with a mass $2m$. Find the speed that the masses move off with after the collision in terms of F , R and m .

(d) Provide numerical results for (a, b and c) for the case $F=1.5\text{N}$, $m=1.3\text{kg}$ and $R=2.6\text{m}$ together with correct SI units.

(d: a): _____

(d: b): _____

(d: c): _____



[4] A mass m is placed against a spring of spring constant k as shown below. The spring is compressed through a distance s . At this point, the mass is elevated a distance h above the ground. The spring is then released from rest, thus pushing the mass down the plane. Answer the following:

(a) If the inclined ramp is frictionless, how fast is the mass moving at the bottom of the ramp in terms of k , m , s , g and h ?

(b) Suppose the flat portion of the system has a coefficient of friction μ . How far (along x) will the mass move until it stops. You may ignore the fact that the mass will bounce a bit when it strikes the flat plane and I am asking only for the distance along x here. Your answer should involve μ , k , s , g , m and h .

(c) Suppose $m=1.0$ kg, $h=2.0$ m, $s=0.3$ m, $k=100$ N/m and $\mu=0.5$. Provide numerical answers to (a) and (b) with correct SI units.

(c: a): _____

(c: b): _____