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 $\vec{F} = \left[F_0 + bt^2\right]\hat{x}$ 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 $\vec{v}_b = -|v_0|\,\hat{x}$. 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.

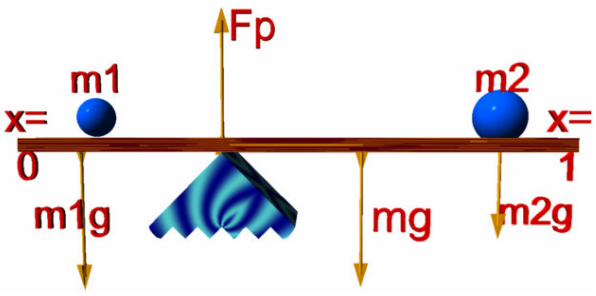
(c) Find the change in velocity of the mass after a time t in terms of F_0, b, m and t.

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.

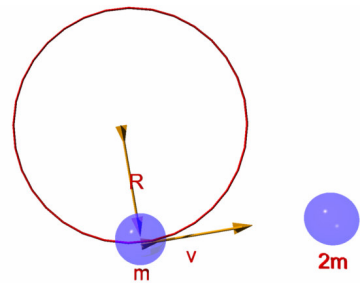
(d) What is the magnitude of the torque which is applied to the system at some time t in terms of R, F_0, b and t?

(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=1m) with a mass of m=2.5 kg has a pivot located at x=0.3m. A mass m_1=19.0kg 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 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?

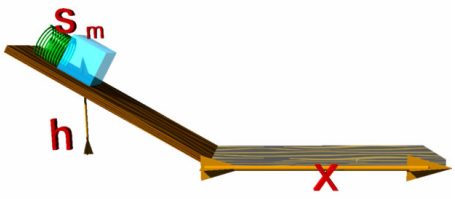
(b) What is the tangential velocity of the mass in terms of F, m and R?

(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=1.5N, m=1.3kg and R=2.6m 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 μ=0.5. Provide numerical answers to (a) and (b) with correct SI units.

(c: a): _____

(c: b):_____