SPSP 312 Name _____
30 Sept 02 Circle your section day **Tues** **Wed**

Test 1

Remember:

Show all your work for full credit. Minimum of **4** steps:
- **Draw a diagram !!**
- What equation are you plugging into?
- What numbers are you substituting?
- What is your final answer?

Ask if anything seems unclear.

Vectors have **magnitude** and **direction !** or **two** components **!**

Formulae and Constants: Note: **bold** means vector!

g = 9.80 m/s^2 = 980 cm/s^2 G = 6.67 x 10 $^{-11}$ N•m^2/kg^2

Text Eqn	
2-11	$v_x = v_{x0} + a_x (t - t_0)$
2-15	$x = x_0 + v_{x0}(t - t_0) + \frac{1}{2} a_x (t - t_0)^2$
2-16	$v_x^2 = v_{x0}^2 + 2 a_x (x - x_0)$
2-17	$x = x_0 + \frac{1}{2}(v_{x0} + v_x)(t - t_0)$
2-18	$x = x_0 + v_x (t - t_0) - \frac{1}{2} a_x (t - t_0)^2$

$f_k = \mu_k F_N$ $f_s \le \mu_s F_N$ $a_c = a_{radial} = v^2 / r$ $F = GM_1m_2 / r^2$

$W = \int \vec{F} \, d\vec{r} = -U$ $F_x = -\, dU/dx$ $K = {}^1/_2\, mv^2$ $U_{spr} = {}^1/_2\, kx^2$

$\vec{p} = m\vec{v}$ $\mathbf{F} = d\mathbf{p}/dt$ Impulse $= \int \vec{F}\, dt = \Delta \vec{p}$ $\vec{\tau} = \vec{r} \times \vec{F} = r F \sin\theta$

$\tau = r \quad F = r F$

$\vec{l} = \vec{r} \times \vec{p}$ $I = \Sigma m r^2 = \int r^2 dm$ $I = I_{cm} + M h^2$

Page

1. _____/25
2. _____/15
3. _____/25
4. _____/35

/100

1. (a) Fill in the table below by saying in words the name of the angular variable that corresponds to the given linear variable, then write the symbol for the angular variable, and give its units. I have filled in the first row as an example.

Linear variable	Name of angular variable	Symbol for angular variable	Units of angular variable
x	angular position	θ	radians
mass			
Force			
p = momentum			

(b) For each of the linear equations given to the left below, write the analogous rotational equation in the column to the right below.

linear equation **rotational equation**

$v_x^2 = v_{0x}^2 + 2a_x(x - x_0)$

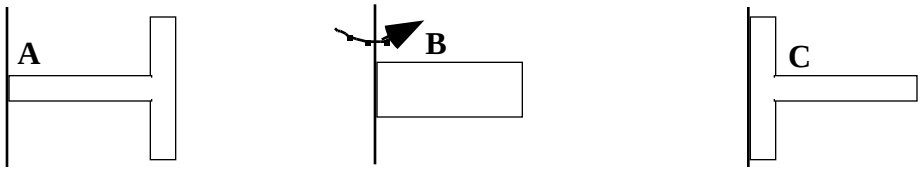
$K = {}^1/_2\, mv^2$

$\Sigma\vec{F} = \frac{d\vec{p}}{dt}$

$\Sigma\vec{F} = m\,\vec{a}$

(c) Under what general circumstances is angular momentum conserved?

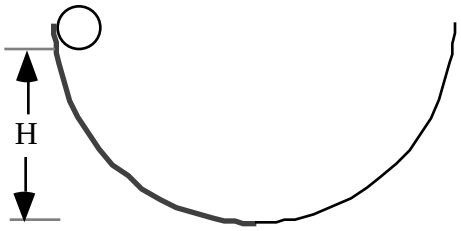
2. The three objects shown below are all constructed from 2 identical rectangular rods and have the same mass and the same maximum horizontal dimension. The axes of rotation are shown by the the black dots. Put them in order from the object with the largest moment of inertia to smallest:



Largest _____ _____ _____ Smallest

continues over

3. Ahemispherical (radius R) bowl has a rough surface with friction on its left half and a smooth frictionless surface on the right half. Anickel released from rest at height H rolls without slipping down the left half of the bowl.



(a) Write an equation which you could solve for the speed of the nickel at the lowest position. You may include the mass m and radius r of the nickel, the initial height of the nickel H and any known constants in your equation. Note: $I_{cm} = (^1/_2)mr^2$ for the nickel. Answer may include **only: m, r, H, R, known consts, v** (the unknown!)

(b) Does the nickel continue to rotate at it moves up the frictionless right-hand side of the bowl?

yes **no** (Circle one.)

Explain.

3.1. For each of the following sets of units, rewrite the units given in terms of kilograms, meters, and seconds and reduce the result to its simplest form.

(a) newton • sec^2

(b) newton • $meter^2$ / [m / sec^2]

(c) Does either of these have the units of a standard physical variable (acceleration, force, etc)?

(a) **(b)** **neither** (Circle one.)

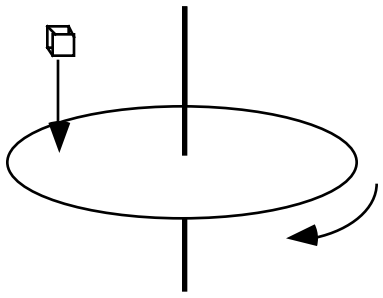
If so, what variable?

continues over

4. Adisk rotates about its central axis, and it accelerates with constant angular acceleration. At one time it is rotating at 37 rev/s. Then 83 revolutions later, its angular speed is 17 rev/s.
(a) Calculate the angular acceleration.

(b) Calculate the time required to complete the 83 revolutions mentioned.

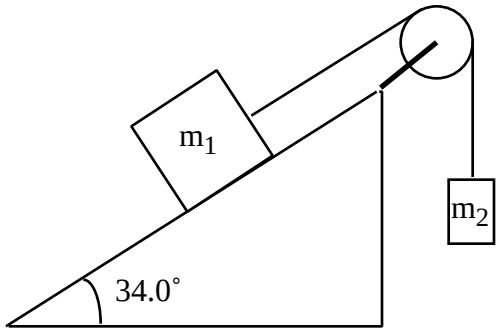
5. Athin stainless steel disk (with moment of inertia 0.0400 kg•m^2) is rotating (without friction) in a horizontal plane about its center with an angular speed of 12.0 rad/sec. Alead block of mass 0.250 kg is dropped from a height of 50.0 cm onto the rotating disk and sticks in place (a negligible amount of instant super glue?) a distance of 15.0 cm from the axis of rotation.
(a) Is mechanical energy conserved in this process? **yes** **no** (Circle one.)
Why or why not?



(b) Calculate the new angular speed of the disk-cube combination.

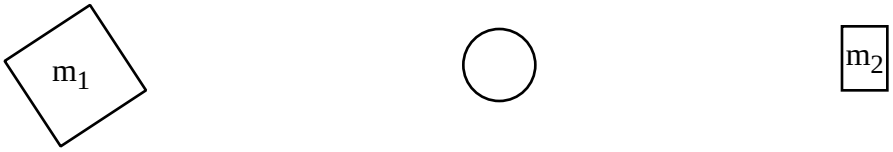
not on this test -- maybe test 2!

6. Amodified Atwood's machine consists of the following: two masses, connected as shown in the diagram, are released from rest; M_1 is on a frictionless surface, and the cord does not slip on the pulley. The m_2 (= 240 grams) falls with an acceleraton of 0.444 m/s^2. M_1 = 350 gr and the radius of the pulley is 2.54 cm.



(a) What is the magnitude of the acceleration of mass 1? Explain.

(b) Draw the force diagrams (include the acceleration as a double arrow); write the appropriate Newton's 2nd law equations for each object; calculate the value of the moment of inertia of the pulley. **Bonus**: What is the approximate direction of the force supporting the pulley?



(c) Why isn't the tension in the cord between the pulley and mass 2 equal to the tension in the cord between the pulley and mass 1?

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