Big Exam #6 - don't use a calculator for this.

1) A $5x10^6$ ton meteor hurls through space and will hit the earth at 72000 km/hr… Pandemonium Ensues.
   a) Convert these units to ones that we can use.
   b) Calculate the kinetic energy of this meteor.
   c) Show how you arrived at the correct units.

a) $v = \frac{72000 \times 1000\ m}{1\ hr\left(\frac{60\ min}{1\ hr}\right)\left(\frac{60\ s}{1\ min}\right)} = \frac{7.2 \times 10^{7}\ m}{3.6 \times 10^{3}\ s} = 2 \times 10^{4}\ m/s$

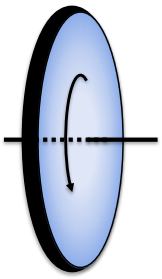
$E_k = \frac{1}{2}mv^2$ $\quad 5 \times 10^6\ ton\left(\frac{10^3\ kg}{ton}\right) = 5 \times 10^9\ kg$

b) $E_k = \frac{1}{2}mv^2 = \frac{1}{2}(5 \times 10^9\ kg)(2 \times 10^4\ m/s)^2$

$= \frac{1}{2}(5 \times 10^9\ kg)(4 \times 10^8\ m^2/s^2) = 10^{18}\ kg\ m^2/s^2 = 10^{18}\ J$

c) done

2) You are holding the axle of a bicycle wheel (one hand on each side) out in front of you, spinning as shown.
   a) What is the direction of the angular momentum vector?
   b) You push away with your right hand (into the paper) and pull in with your left hand. What is the direction of the torque you put on the wheel? What is the direction of the angular impulse that you give to the wheel?
   c) After you push for a moment, how does the orientation of the wheel change?



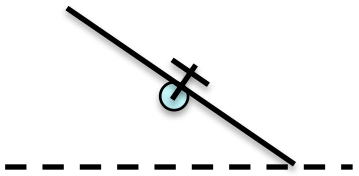
a) $\vec{L}_i$

b) $\vec{\tau}$ $\quad \Delta\vec{L}$

c) $\vec{L}_f = \vec{L}_i + \vec{\tau}\cdot\Delta t$ $\quad \vec{L}_f$ $\quad \Delta\vec{L}$ $\quad \vec{L}_i$

So, when you try to rotate the wheel in the upward rotational direction, it actually rotates in a direction out toward you… what you see as the clockwise direction.

3) At right, you see a glider executing a horizontal circular path. My 50 kg friend is sitting on a scale in the glider.

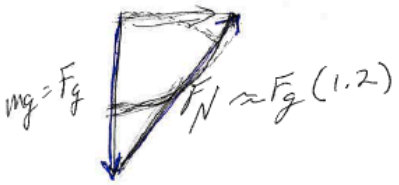


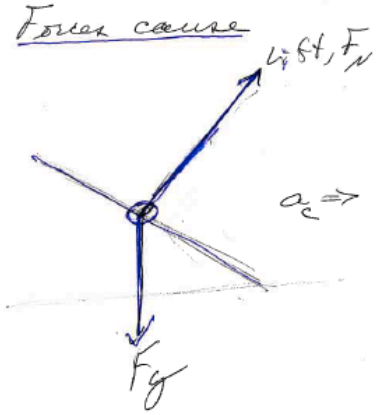
a) What does the scale read underneath my friend?
b) Which way is my friend accelerating? How do you know?
c) Estimate my friend's acceleration.
d) If the circle she is tracing in the glider has a radius of 50 m, estimate the glider's speed.

Please my very basic FBD to the right indicating that I'm baking a turn to the right, accelerating to the right. On the left, please see my vector sum of the forces, where I estimate the relative strengths of the normal force and the vector sum of the forces based on the length of the arrows.

a) Dynamics because there are Forces causing (centripetal) acceleration.

$\Sigma \vec{F} \approx 0.7 F_g$





F_N read on the scale is ~ 20% more than the F_g, ~ 60 kg or 600 N

$\Sigma \vec{F} = m\vec{a}_c$ from the drawing $\Sigma F \approx 0.7 F_g = ma$

$0.7 \times mg = ma$

$7\ m/s^2 \approx a$

$a = \frac{v^2}{r}$ $v = \sqrt{ar}$

$\approx \sqrt{7\ m/s^2 \cdot 50\ m}$

$\approx (350\ m^2/s^2)^{\frac{1}{2}} \approx 19\ m/s$