*Question:*
Problem 12-26 - why can't i find L by using L = mrv and use r= (3^2+(-4)^2)^1/2 and v=(30^2+60^2)^1/2 . If i do it this way, my answer comes out to 670. IN your solutions, you used the cross product, but then added the i and J terms (180+120). Why were u allowed to add these two different components, and why didn't my original solution work?

*Response:* The angular momentum of an object of mass m and momentum p moving past me is given as L = r X p; this is a vector product. The rules of handling vector products, when the vectors are given in vector notation, were discussed in an early chapter and are summarized at the end of appendix E. (They can be easily proven using vector notation.) These are what I used to find the angular momentum for the solution. I did what is described in the appendix, the x-comp of one time y-comp of other minus the complement.

The other way to handle it would be to use the alternative (and equivalent) relation L=r p sin(theta). This is presumably what you are trying to do, except you assumed that theta=90 degrees --- which is incorrect. You can see easily that the angle is not 90 degrees by taking the scalar product and see that it is not zero (what it would need to be if they were at right angles).

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*Question:*
On page 265 part 3 of the solution it says that angular momentum is conserved because there is no external torque to change L. However the ball has a change in angular momentum and isn't torque the change in angular momentum?

*Response:* The key here is to understand what is being taken to be the "system". The system here is the turnstile + the ball. For such a system, indeed there are torques when the ball hits the turnstile, but these are INTERNAL torques, and when looking at the system as a whole and using action-reaction, the total torque on the SYSTEM is zero. So, though the turnstile gains angular momentum and the ball loses angular momentum, the angular momentum of the SYSTEM does not change.

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*Question:*
On page 249, fig. 12-6 a wheel rolls horizontally to the right with friction also directed to the right. Why does the explanation to the right, say that is the wheel rotated slower, both acom and f would point to the left? Wouldn't friction still point to the right even if it were rotating slower?

*Response:* The picture is consistent ... If acom is to the right, the friction force on the wheel would also be to the right. If acom were to the left, the friction force on the wheel would be to the left. If acom were zero, the friction force on the wheel would be zero. Note that in each case the friction force on the ground (from the wheel) is equal and opposite by action-reaction.

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*Question:*
Does every rotating body have a tangential and a radial acceleration? I'm unclear about when to use each one.

*Response:* A point on a body rotating with angular velocity omega, has a centripetal acceleration pointing to the axis of rotation in the amount ac = r(omega)**2. The fact only requires the body to be rotating ... it could, for example, be rotating with constant omega -- or omega could be changing.

The same point also has a tangential acceleration (at right angles to the centripetal acceleration), if the angular velocity is changing (ie, has an angular acceleration: alpha). This tangential acceleration is equal to r (alpha). The total acceleration of the point is the vector sum of the two.

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*Question:*
I was wondering if we were allowed to bring a one-sided formula sheet?

*Response:* Yes, the same rules prevail as for the last exam. These are given in detail at the web site.

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*Question:*
I'm a bit confused on the practice exam for the solutions, part 2, question 3. in solving for the Kf, u showed 1/2 m1v1^2 + 1/2 m2v2^2 which reduces to 1/2 (M/2) (2v^2) where V=Vo/cos *theta* how does that become Mv0^2 / 2 cos^2*theta*?
in trying to solve this, i reduce that second equation to MV0/cos^2 *theta* rather than one half of that. can you explain how you solved for Kf a in more detail?

*Response:*

**Givens:**

$$m_1 = m_2 = \frac{m}{2}$$

$$v_1 = v_2 = v = \frac{v_0}{\cos\theta}$$

**So:**

$$\begin{aligned} K_f &= \tfrac{1}{2}[m_1 v_1^2 + m_2 v_2^2] \\ &= \tfrac{1}{2}\tfrac{m}{2} 2v^2 \\ &= \tfrac{1}{2} m v^2 \\ &= \tfrac{1}{2} m \left[\frac{v_0}{\cos\theta}\right]^2 \end{aligned}$$

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*Question:*
1)I have a question about Problem II, #3 on the practice exam. "energy generated by the explosion" confused me - doesn't it include heat, light and sound as well as kinetic energy? I know at one point we said that the change in energy equals the change in kinetic energy, but that was before we learned about thermal energy and internal energy. Also, on Problem I, # 3, I wasn't sure if "how far she travels" meant from point A or point B.
2)Problem I, #2, I said that the frictional force was negative 55.1N, because it's going in the opposite direction of the velocity. Is that OK?

*Response:*
When ALL kinds of energy are included, energy is conserved in any physical process. In this case, mechanical energy (kinetic) is added to the system when the explosion occurs -- because the explosion liberates a large amount of chemical energy. This energy "generated by the explosion" is of course equal to the difference in kinetic energies - after minus before.

In the first problem, it is asking about distance travelled along the horizontal surface from B to C. If you want to add in the distance from A to B (given), I am sure it would be counted as correct so long as you made clear what you are quoting.

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*Question:*
In chapter 12 of the textbook the first 'Checkpoint' asks about the linear speed and angular speed of two different wheels on a clown's bike. I think the answers to this Checkpoint in the back of the book are wrong. It seems like it should be that the point at the top of the larger rear wheel has greater linear velocity than the point at the top of the front wheel. Also, for part b, the answer should be that the two wheels have the same angular velocity since they both complete one revolution in the same amount of time. Is the back of the book wrong?

*Response:*
Thoughtful question. But the book is correct.

"... is the linear speed at the very top of the rear wheel greater than, less ... as that of that of the front wheel?"

Keep in mind that for both wheels rolling, the center of mass of EACH wheel must move with the translational velocity of the bicycle. Hence, the velocity of the center of each wheel is the same. It follows (from, for example, figure 12-3) that the velocities of the tops of the wheels (twice the velocities of the centers of the wheels) are the same.

For each wheel ROLLING, the angular velocity is equal to v/R -- where v is the velocity of the bicycle (equal to the velocity of the center of each wheel). Hence the rear wheel with larger radius moves with smaller angular velocity. It is NOT true that each wheel completes one revolution in the same time. If they did, one wheel would have to slip.

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*Question:*
I'm a little confused about the signs concerning rockets. Is it true that "v rel" is always stated as a positive number, even though it seems to go in the negative direction from the rocket's velocity?

Also, since you say that "R" and "v rel" are fixed, does that mean that Thrust is always the same at any moment, i.e., the instant of thrust does not matter? I'm wondering if I need to state "At t=250s the thrust is...." - or do I just not mention the time?

It seems like the time should matter, because after time all the fuel will burn up and there should be no more thrust.

*Response:*
You do not allude to a problem or a specific part of the lecture, but I will try to answer anyway. As I mentioned earlier, it is most important to understand what is physically happening and make sure the sign conventions are consistent.

vrel is taken in what I did as a positive number. Clearly the velocity vector of the exhaust gas is oppositely directed to the Thrust on the rocket. vrel depends only on the temperature of the "furnace" in which the fuel is burning. The rate at which mass is lost (R) also depends on temperature, geometry and size of the furnace and the rate at which fuel is supplied to it for burning. As long as all these are kept fixed, the values of R and vel are fixed, so the thrust is fixed. If any of them change, then the Thrust will change. Very clearly, this will happen when there is no more fuel to burn. I was assuming that we were observing when they were all fixed (which is rather typical until burnout).

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