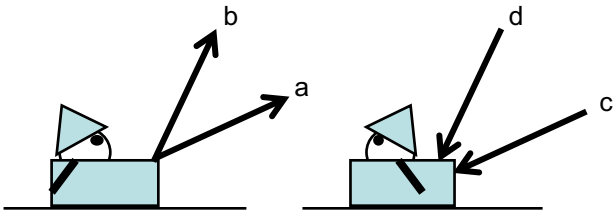
PS#7 Due in Class Monday, May 22. Please pay good attention to describe the lens you are using and explain your method.

1. MT #2. Please repeat the work of your midterm adding the small extra questions I put in.

2. My daughter is sledding (total mass = 20 kg), and I am applying a force of 120 N to her sled. I have 4 different options (pushing and pulling at two different angles) and I try all of them.



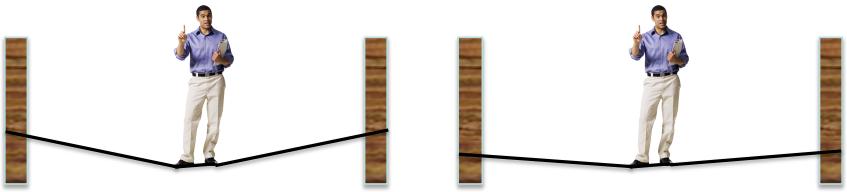
   In choosing an axis, make sure you ask yourself ***the question***. The direction of acceleration is what informs our choice of axis.
   a) For each scenario, estimate both the acceleration of the sled and the normal force between the sled and the frictionless snow.
   b) Now, please rank the different force scenarios in order of least acceleration to greatest acceleration. If some accelerations are the same, please indicate that.
   c) Now, let's say that the coefficient of friction of the snow is *actually* 0.2. How does this change things? Please rank again the different force scenarios in order of least acceleration to greatest acceleration.
   d) Have you ever pushed a lawn mower (or watched someone do it)… you are using force scenario d, pushing along the handle. When you run into some thick grass the "coefficient of friction" might be high enough to stop you cold. What scenario can you change to, and why does this work?

3. Consider pushing the sled above in scenario "c" on the 0.2 frictional snow for a total of four meters, please find the amount of work I do, the amount of heat produced and the final speed of the sled. Carefully lay out your lens discussion.

4. Consider throwing a rock from the edge of a 60 m high cliff at a speed of 30 m/s in the direction indicated by force vector "b" above. ***the answer to the question helps inform our choice of axis.
   a) Please make a drawing showing the rock at each second until it hits the ground. You may not use a calculator, as we are making simple approximations here. For each second elapsed, estimate where the rock is and its velocity. Draw the velocity vector at that point.
   b) Use an energy lens to judge if your final speed is reasonably close to what you would expect.

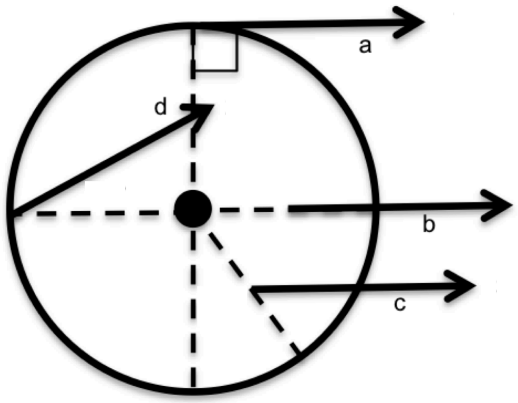
5. On a surface of frictionless ice, a 1000 kg car driving 20 m/s eastward collides and sticks to a 5000 kg truck driving 15 m/s northward. The vehicles stick together and slide off:
   a) Please draw and indicate the final velocity of the vehicles.
   b) Please calculate the amount of energy turned to heat in the collision.

6. Slacklining is pretty fun, but you have to run some webbing between two trees first. At right, you see two pictures of me at 70 kg, slack lining.

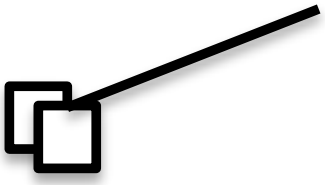


   a) In which drawing is the line tighter? Please prove how you know this with a good force drawing and discussion. Lens?
   b) Using your force drawing, please estimate the tension on the slack line at left.

7. My bicycle wheel has a radius of 50 cm and seems to be locked up around the hub. I want to get it to turn. Please find the torque when I put a force of 200 N on it in the different ways shown at right. Please rank the torques from highest torque to lowest torque and estimate the torque of each.



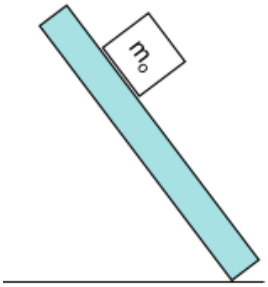
8. You are watching the fuzzy dice from the rear view mirror. As you take off on level ground, it makes an angle as shown at right.



   a) Ask yourself **** and state how this will inform your choice of axis.
   b) Estimate the acceleration of the car.
   c) What must be the coefficient of friction of your tires for this to happen?
   d) Is this realistic?
   e) If the mass of the dice is 100 g, what is the tension in the string?

9. Consider the fuzzy dice above. Now the car is stationary and you are sitting it in. You grab the dice and pull them to once side exactly as in the diagram above. Then you let go of them.
   a) Ask yourself that question again****. Is the direction of acceleration the same as above? State how this direction will inform your choice of axis.
   b) Again find the acceleration of the dice with direction.
   c) Again, if the mass of the dice is 100 g, please find the tension in the string. Is it the same as the string above? Why might this make sense?

10. Consider the mass on the inclined plane shown at right.
   a) Ask ****, and then state how will this inform you to set up the axis.
   b) Estimate the acceleration if the surface is frictionless.
   c) What coefficient of friction is necessary for the block to slide at a constant speed?



**** We see how important the direction of acceleration is in these situatios