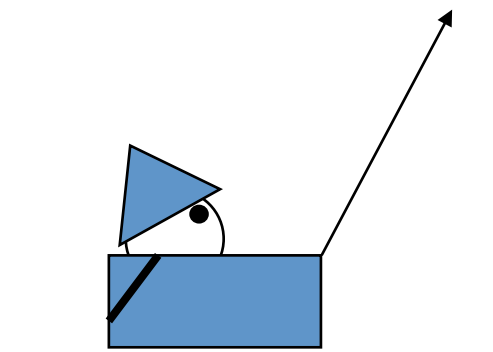


Problem Set #3 due beginning of class, Monday, Jan 26. Remember to start with the lens discussion.

#1. I pulled my daughter in a sled (total mass = 25 kg) on some frictionless ice as shown at right. I'm pulling with 100 N on the rope that makes a 60° angle with the horizon.



- If we start from rest, what is her speed after I've pulled her 4 m? Start your answer by first explaining why using the work-energy theorem is the best way to solve this, and then find her speed.
- What is her acceleration when I am pulling her? *Which lens do you use for this?*
- Using your answer from a) above find the length of time I was pulling her. *Which lens do you use for this?*
- Repeat part a) above for the scenario that she is already moving at 6 m/s when I start to pull her.
- What is the force that her little sled exerts on the ice?
- Momentum*: did her momentum change? If so, how did this not violate the conservation of momentum?
- If we start from rest, what is her speed after I've pulled her 4 seconds? *Which lens do you use for this?*
- Now find out how far I pulled her in this 4 seconds. *Which lens do you use for this?*
- Repeat part g) above for the scenario that she is already moving at 6 m/s when I start to pull her

#2. Ballistics Pendulum this problem has been moved to PS #4. I apologize for the inconvenience.

#3. The fuzzy dice (total mass: 200 g) hanging from my rear view mirror normally hang vertically. However, when I take off at a light, I see them tilted backwards at a constant angle of 20 degrees *below the horizontal*! Find the acceleration of my car and the tension in the string.

- With meticulous attention to the protocol outlined in the dynamics video, please solve this problem. The process is what I'm looking for, so please follow the protocol.
- Could *your* car do this? Please make an argument as to why you know this isn't reasonable, or why this totally makes sense. – You can calculate the power output for the first two seconds if you like for a 1-metric-ton car, or by some other method.

#4. My friend and I drive off the road and can't get the car back on the road. However, luckily there is a big tree on the other side of the road 20 m from the car and my friend has his slack line in the car! We run the slack line between the tree and the car and tighten it as much as we can, but the car doesn't budge (This exact problem is dealt with in chapter 4 of your text). My friend has a mass of about 50 kg and steps into the middle of the slack line making it sag only 10 cm.

- What is the force that is on the slack line now with my friend on it? Start with an indication of what kind of problem this is. If it's a dynamic problem, you are graded on the protocol.
- This doesn't make the car move, so my friend jumps up and down on the slack line as if it's a trampoline. With a thorough discussion of at least one of the concepts, please describe why this will or will not assist us. I encourage you to think about dynamics, but state why you know this.

#5. You're driving along due East at 20 m/s minding your own business in your 2000 kg truck when you are struck by a 1000 kg car. The two vehicles stick together with subsequent velocity of 10 m/s **due North**. Find the velocity of the other car before it hit you. Include speed and direction. Start with a discussion about what's happening with momentum, energy, and forces. Explain why this is a momentum problem and make sure you have a very good "before" drawing and an "after" drawing.

#6. Suppose you lower an object with decreasing speed (*follow the protocol for each question*):

- a. Compare the force you exert on the object to the gravitational force on the object.
- b. Compare the force you exert on the object to the force it exerts on you.

#7. Answer the two questions below with a yes and no answer *and a reason or example*.

- a. Is it possible to have $v = 0$ and $a \neq 0$? If not, why not? If so, give an example.
- b. Is it possible to have $a = 0$ and $v \neq 0$? If not, why not? If so, give an example.