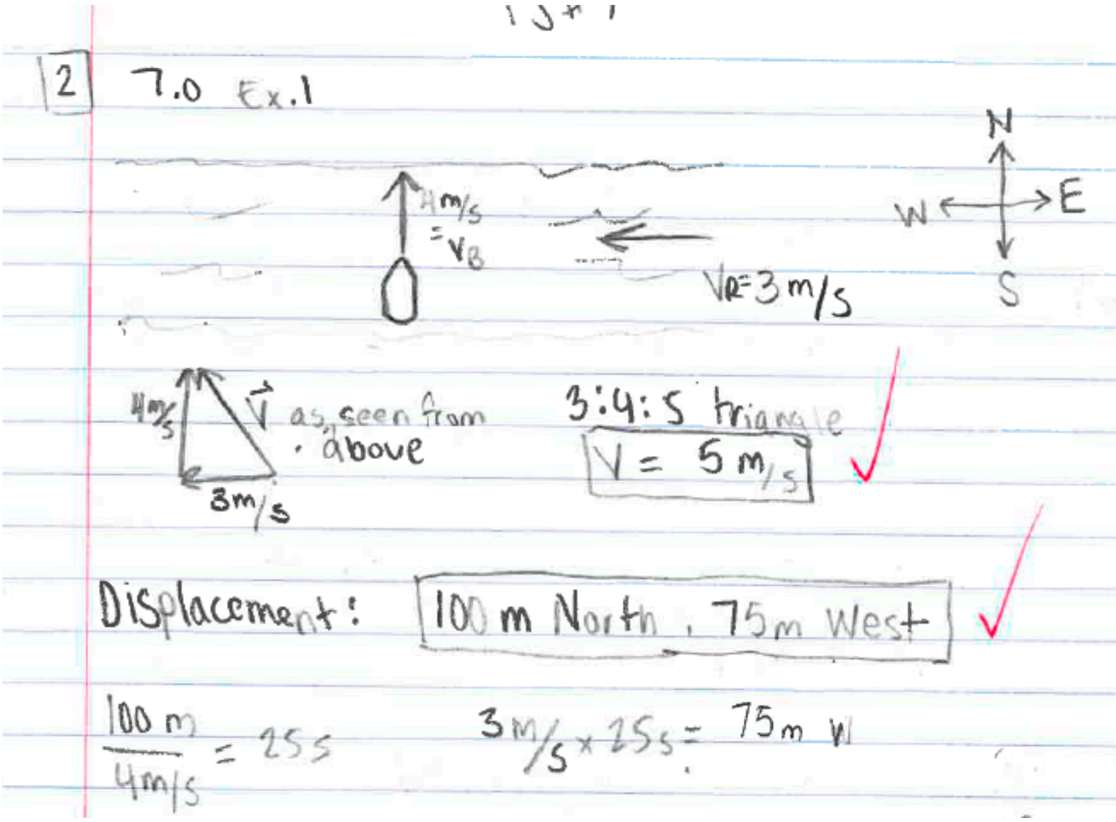
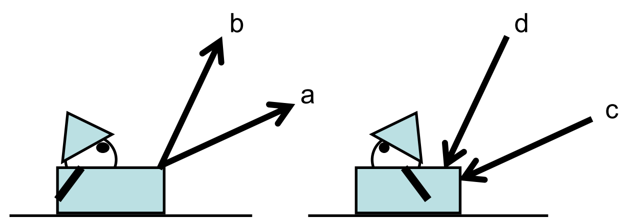
PS#7 Due in Class Monday, Feb. 26. Please pay good attention to describe the lens you are using and explain your method.

1. MT #2. See solutions for MT#2

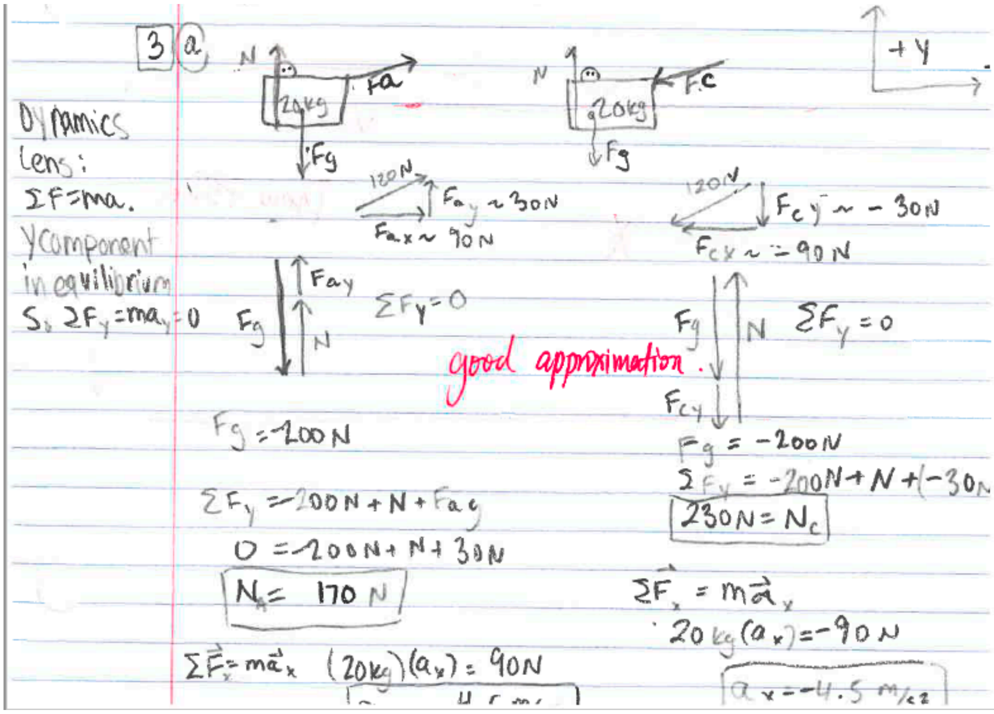
2. 7.0 Exercise 1



3. 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.
Make sure to pick a lens and do a good FBD indicating directions.

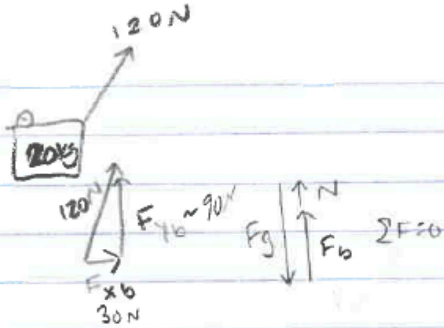


   a) For each scenario, estimate both the acceleration of the sled and the normal force between the sled and the frictionless snow.
   b) Now, please rank the different force scenarios in order of least acceleration to greatest acceleration. If some accelerations are the same, please indicate that.
   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?

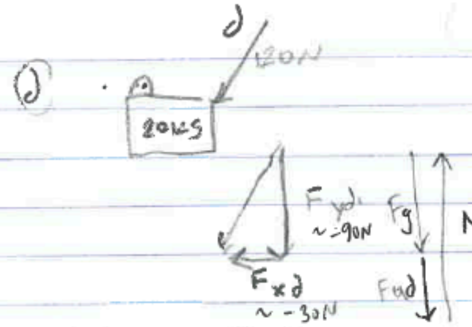


Both a) and c) scenarios yield accelerations of 4.5 m/s[2] for the approximations made by this student.

b.



(d)



!

$\Sigma F_y = 0 = N + G + F_{yB}$

$200 + (-90N) = N$

$\boxed{N_B = \sim 110N}$

$\Sigma F_y = 0 = N + F_g + F_{yD}$

$200 + 90N = N$

$\boxed{N_D = \sim 290N}$

$\Sigma F_x = ma_x = F_{xb}$

$a_x = 30N / 20kg$

$\boxed{a_x = 1.5 m/s^2}$

$F_x = ma_x = F_{xd}$

$a_x = -30N / 20kg$

$\boxed{a_x = 1.5 m/s^2}$

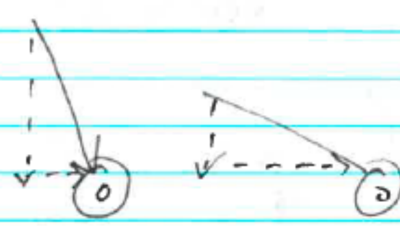
(b) $\boxed{(\vec{a}_A = \vec{a}_C) > (\vec{a}_B = \vec{a}_D)}$ ✓

(c) This changes things since a greater upward component of force will decrease normal force ∴ decrease frictional force in the x direction. ✓

$\boxed{\vec{a}_B > \vec{a}_A > \vec{a}_C > \vec{a}_D}$ ✗ Draw FBDs.

(d) Flip the lawn mower around and pull like scenario A and B. This pull has an upward y-component, decreasing N and decreasing $F_{friction}$ since $F_f = \mu N$. ✓

When pushing a lawn mower, it can be beneficial to lower the handle on the rougher patches.



The amount of downward force decreases, which lowers the normal force acting on the mower and allows you to push it easier!