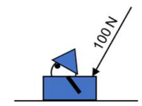
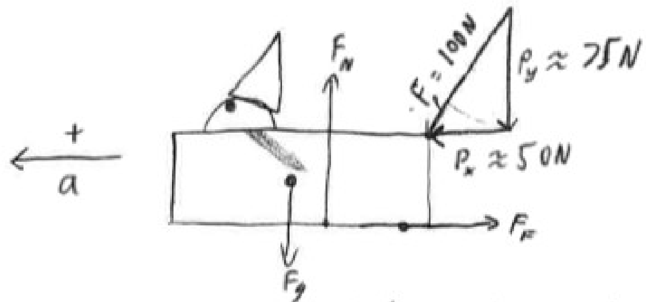
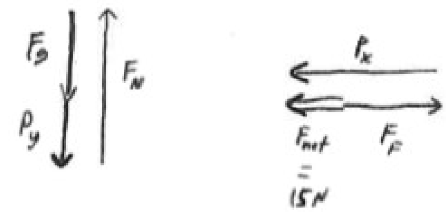
1) Imagine pushing your niece in a sled (combined mass 10 kg) as shown at right with a 100 N force on snow that has a coefficient of friction of 0.2, initially at a speed of 2 m/s to the left. Please find her acceleration, including direction.







Dynamics b/c there is a $\Sigma\vec{F}$ causing acceleration:

$F_g = mg$
$= (10\,Kg)(10\,m/s^2)$
$F_g = 100\,N$

$F_N = F_g + P_y$
$F_N = 100N + 75N$
$F_N = 175\,N$

$F_F = F_N \cdot \mu$
$F_F = 175 \cdot .2$
$F_F \approx 35N$

Force of friction is found based off the coefficient of friction and the normal force, the latter of which is equal to the force of gravity + the y component of the push as they are both in the downward direction, but $a_y = 0\,m/s^2$.

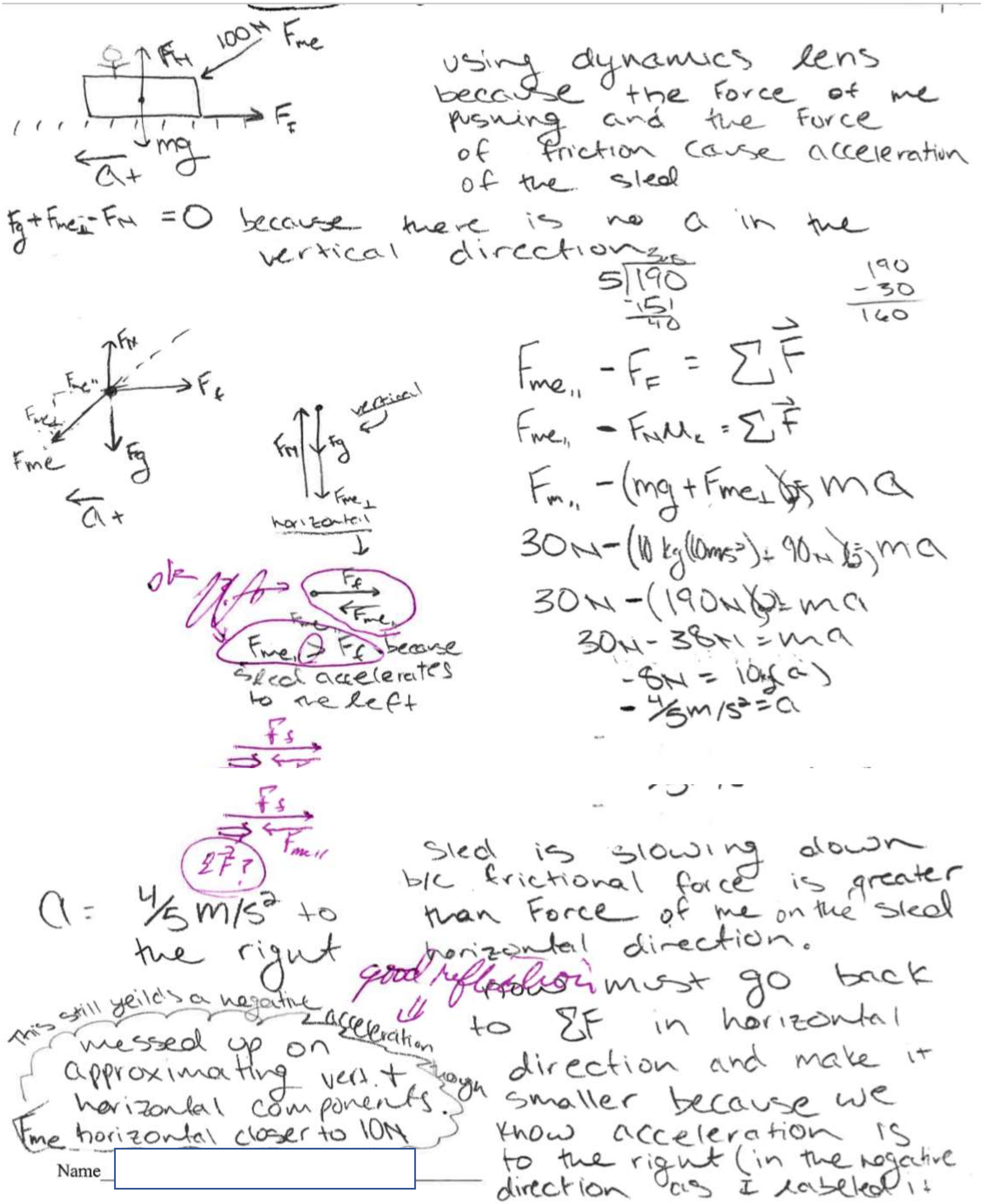
$\Sigma F_x = P_x - F_F$
$\Sigma F_x = 50N - 35N$
$\Sigma F_x = 15N$

$a_x = \frac{\Sigma F_x}{m}$
$a_x = \frac{15\,N}{10\,kg}$

$a_x \approx 1.5\,m/s^2$ to the left

ΣF then show that there is a net force of 15 N to the left, which means the 10 Kg system accelerates at 1.5 m/s^2 to the left

I like this next one's reflection. They estimated the components for a pretty steep angle, so the horizontal force was less than what most people got. The result is that their acceleration was actually to the right!



100 N F_{me}

F_N F_f mg $a+$

using dynamics lens because the force of me pushing and the force of friction cause acceleration of the sled

$F_g + F_{me\perp} - F_N = 0$ because there is no a in the vertical direction

$F_{me\parallel} - F_F = \sum \vec{F}$

$F_{me\parallel} - F_N \mu_k = \sum \vec{F}$

$F_{m\parallel} - (mg + F_{me\perp})(.2) = ma$

$30N - (10\,kg(10\,m/s^2) + 90N)(.2) = ma$

$30N - (190N)(.2) = ma$

$30N - 38N = ma$

$-8N = 10\,kg(a)$

$-4/5\,m/s^2 = a$

vertical: F_N, F_g, $F_{me\perp}$

horizontal: F_f, $F_{me\parallel}$

ok

$F_{me\parallel} > F_f$ because sled accelerates to the left

F_s

$\Sigma \vec{F}$?

$a = 4/5\,m/s^2$ to the right

Sled is slowing down b/c frictional force is greater than force of me on the sled horizontal direction.

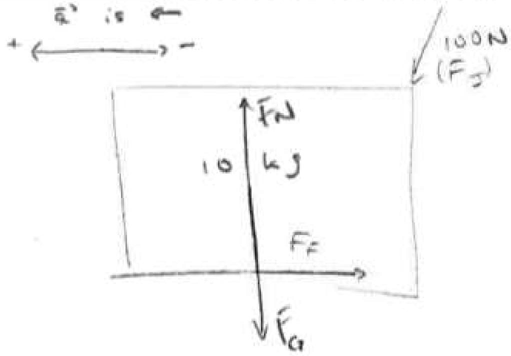
good reflection

must go back to ΣF in horizontal direction and make it smaller because we know acceleration is to the right (in the negative direction as I labeled it)

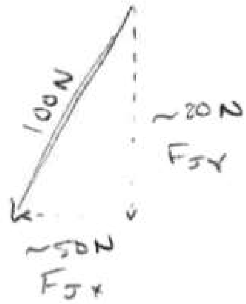
This still yeild's a negative acceleration though

messed up on approximating vert. + horizontal components. F_{me} horizontal closer to 10N

Name



Dynamics lens, because forces cause acceleration. Acceleration is in the positive x direction, so we only need to worry about forces parallel to the x-axis.



$\sum \vec{F}_x = m\vec{a}_x$

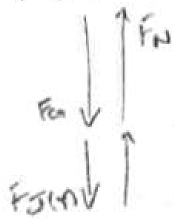
$F_{Jx} - F_F = m\vec{a}_x$

$50N - F_F = 10kg(\vec{a}_x)$

↳ I push in the x direction with about 50N of force, but friction with the snow holds me back

nice!

$F_{NET}(y) = 0$



The sled is in equilibrium in the y direction, so when I add to the force of gravity the normal force must also increase so that $F_{NET} = 0$. This increases friction.

$F_F = \mu \cdot F_N$

↳ $F_N = F_G + F_{JY}$

$F_N = 10kg(10 m/s^2) + 80N$

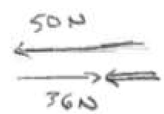
$F_N = 180N$

$F_F = .2\,(180N)$

$F_F = 36N$

↳ The force of friction is 36N in the direction opposite to the one I'm pushing in.

$F_{NET}(x) = m\vec{a}_x$



There is a net force to the left, so that means that acceleration must be towards the left

$\sum F_x = m\vec{a}_x$

$50N - 36N = 10kg(\vec{a}_x)$

$\frac{14N}{10kg} = \vec{a}_x$

$1.4 m/s^2 = \vec{a}_x$