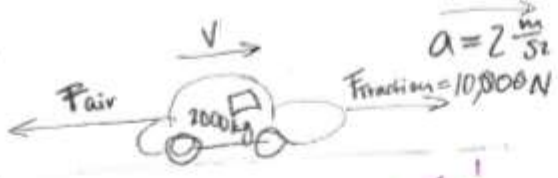
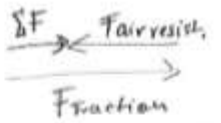
Assessment #3 121 Schwartz

1) You drive a powerful 2000 kg race car! In the shop, we measure that the car puts out maximum power at about 100 m/s with the wheels putting out a force of 10,000 N! So, you take it out on the track up to 100 m/s and then slam on the accelerator. You find that the car accelerates at only 2 m/s^2. You complain to the race track authorities, who inform you that air resistance is a big deal at high speeds. Please find the force provided by the air resistance.

I myself would not put velocity in a Free Body Diagram… it just confuses the focus… you decide. Remember it's forces that cause acceleration. Velocity is something different.

Picture:





nice!

Lens: Dynamics (F → a)

Motivation: Forces cause acceleration so we see the force of Traction going in the opposite direction of Air resistance at different amounts causing acceleration

Equation: $\sum \vec{F} = m\vec{a}$ and $F_{air} = F_{Trac.} - \sum F$

Solution: $\sum \vec{F} = m\vec{a} = 2000\,kg \cdot 2\,\frac{m}{s^2} = 4000N$

$F_{air\ resist.} = F_{Trac.} - \sum F = 10{,}000N - 4000N = 6{,}000N$

$F_{air\ resistance} = 6{,}000N$

Check: This makes sense because in order for acceleration to be forward/positive (→) $F_{Traction}$ has to be larger than F_{air}.

A+

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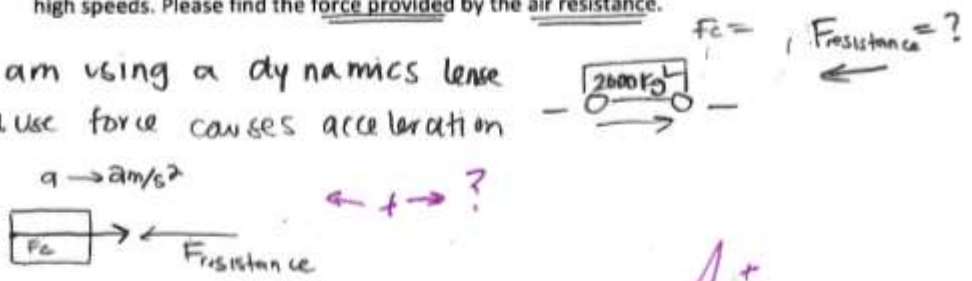
I am using a dynamics lense because force causes acceleration



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the shop: $F = ma$

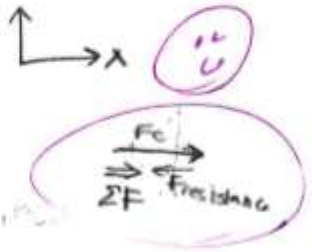
$a = F/m$ $\quad a = \frac{10{,}000\ kg \cdot m/s^2}{2{,}000\ kg}$ $\quad a = 5\ m/s^2$

track: $F_{Total} = F_{car} - F_{resistance}$

$\sum F = m\vec{a}$ $\quad \sum F = F_{car} - F_{resistance}$

$F = (2{,}000\ kg)(a\ m/s^2)$ $\quad \sum F = m\vec{a} - F_{resistance}$

$F = 4{,}000\ N$ $\quad F_{resistance} = F_{car} - \sum F$



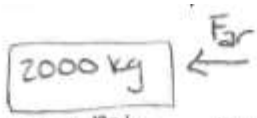
$F_{resistance} = 10{,}000\ N - 4{,}000\ N$

$F_{resistance} = 6{,}000\ N$

~~$F_{resistance} = -3\ m/s^2\ (2{,}000\ kg)$~~

$F_{resistance} = 6{,}000\ N$

Force provided by air resistance is 6,000N in negative X direction

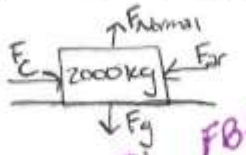


← drawing

$v = 100\ m/s$ then $a = 2\ m/s^2$

I am using a dynamics lens because forces are causing acceleration. → which forces?

$\Sigma \vec{F} = m\vec{a}$



FBD.

$\Sigma \vec{F} = m\vec{a}$

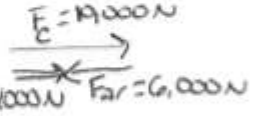
$\Sigma \vec{F} = 2000\ kg * 2\ m/s^2$

$\Sigma \vec{F} = 4000\ kg\ m/s^2$ (or N)

$\Sigma F = F_c + F_{ar}$ equation

$4000\ N = 10{,}000\ N + F_{ar}$

$-6000\ N = F_{ar}$ (negative because F_{ar} is in the negative direction) please identify direction on FBD!



$\Sigma \vec{F}$ diagram!

The force of air resistance is 6000N in the negative direction (against the car's forward movement).

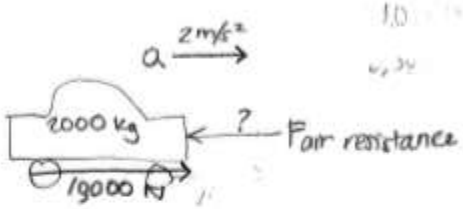
A+

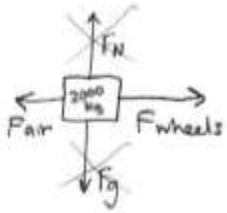
high speeds. Please find the force provided by the air resistance.

which?

0.) Lens: Dynamics because there is forces acting on the car, causing acceleration

$\Sigma \vec{F} = m\vec{a}$





$\vec{F} = m\vec{a}$ $10{,}000\ N = 2000\ kg\ a$

(without air resistance) $a = 5\ m/s^2 \rightarrow$

$\Sigma \vec{F} = m\vec{a}$

F_{wheels} ⊕ →

ΣF F_{air} ⊖ ←

$F_{wheels} - F_{air} = ma$

$10{,}000\ N - F_{air} = (2000\ kg)(2\ m/s^2)$

$-F_{air} = 4000\ N$

$-10{,}000\ N$

$-F_{air} = -6{,}000\ N$

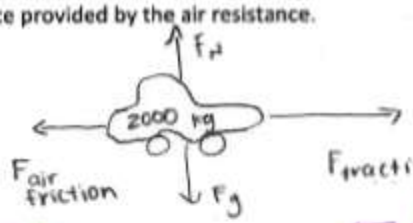
$F_{air\ resistance} = 6{,}000\ N \leftarrow$

high speeds. Please find the force provided by the air resistance.

$m = 2000$ kg

$F = 10,000$ N

$a = 2$ m/s^2



$F_{traction} = 10,000$ N

← + → ?

↔ ? label deviation.

$F_{net} = ma$

$F_{net} = 2000$ kg · 2 m/s^2

$F_{net} = 4000$ N

$F_{traction} = 10,000$ N

$\Sigma F \equiv F_{net} = F_{traction} + F_{air\ friction}$

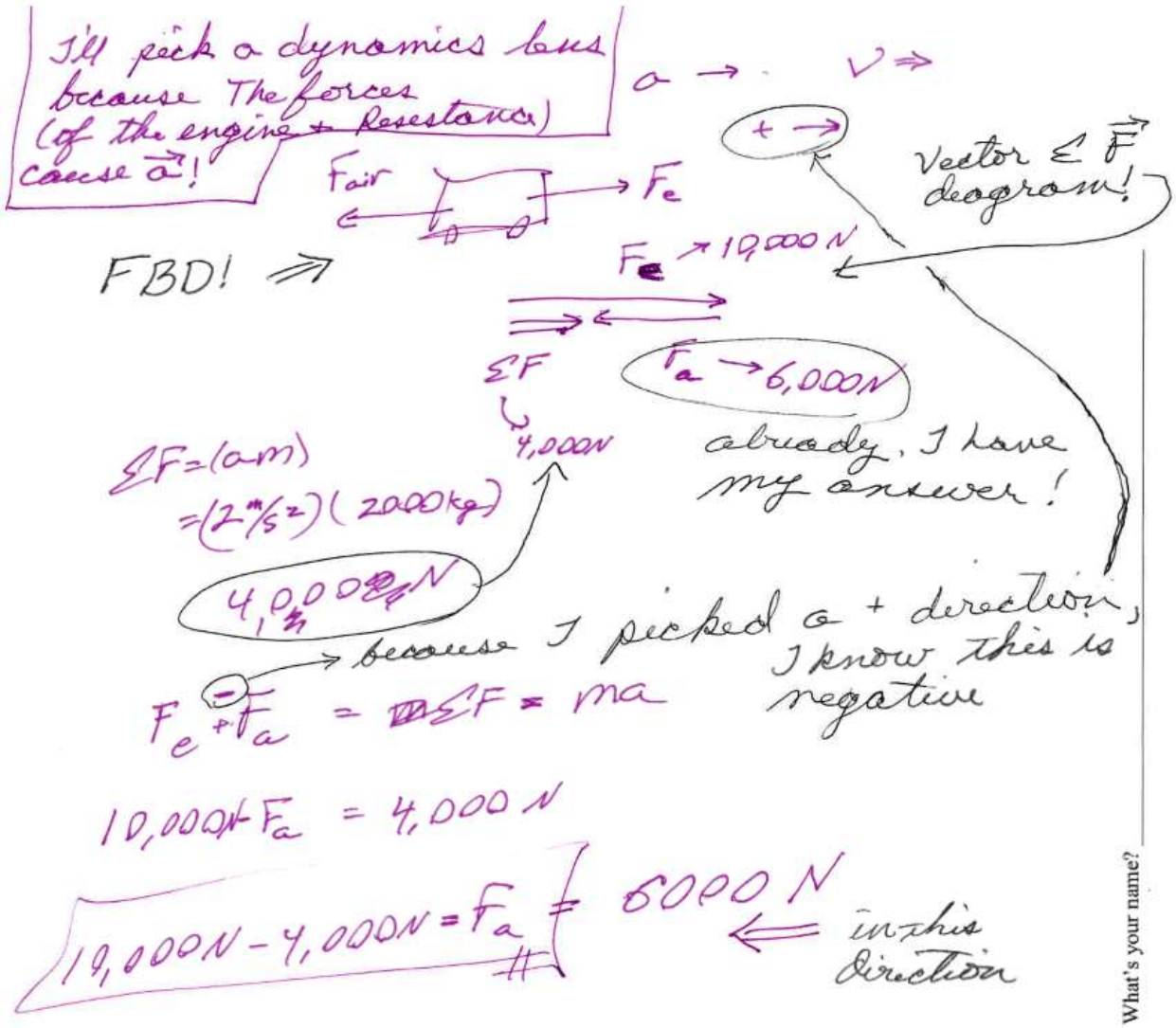
$4000\ N = 10,000\ N + F_{air\ friction}$

$\therefore F_{air\ friction} = -6,000$ N

I chose the dynamics lens because a net force made up of two opposing forces is causing a positive, forward acceleration of the car. I know that $F_{net} = ma$ and that F_{net} is comprised of $F_{traction}$ and $F_{air\ friction}$.

A+

Below is my poor attempt. Many students did a much better job that I did. Congrats!



What’s your name?____