Big Exam #3

Imagine that you are traveling downward in an elevator at a rate of about 10 m/s, but you are slowing down at a rate of 2 m/s every second. The mass of the elevator is 1000 kg (with you in it). I want to find the tension in the cable holding the elevator.

a) I bet you already made a drawing and are considering everything involved.
b) Please consider the 4 lenses. Choose one and provide the motivation…. If you chose dynamics, why would you do this? I mean, what is your motivation?
c) What is the complete *mathematical* relationship between forces and acceleration that define dynamics?
d) If you haven't done it, identify these forces with a free body diagram!
e) Why is it very (very very) important to identify the direction of acceleration in a FBD?

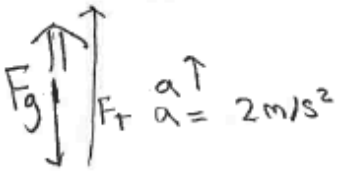
   Because we know $\vec{a} = \frac{\Sigma \vec{F}}{m}$ the acceleration must be in the same direction as the vector sum of the forces… so we must define this direction!
f) Between the tension and the force of gravity, which force is larger or are they the same? Why can you be sure?
g) With a forces diagram, show how you add the forces on the elevator to find the resultant force.
h) Find the tension of the cable from which the elevator is suspended at this moment.

a.)

b.) Dynamics lens because the combined forces of gravity and tension on the cable is causing a ~~deceleration~~ acceleration ↑

c.) $\Sigma \vec{F} = m\vec{a}$ OR $\vec{a} = \frac{\Sigma \vec{F}}{m}$

d.)



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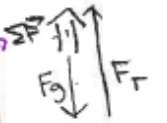
e.) Acceleration is a vector, and therefore if you switch up the direction of acceleration you could end up with the wrong answer. (Negative instead of positive, vice versa).

f.) The force of tension is larger. The elevator is moving downward, but is slowing down. Therefore there has to be a force that is counteracting gravity (which would accelerate the elevator downward.)

g.)



$\Sigma \vec{F} = F_g + F_T$

$2000N = -10000N + F_T$

$12{,}000\ N = F_T$

h.) $\Sigma \vec{F} = m\vec{a}$

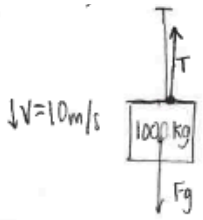
$= 1000kg \cdot 2m/s^2$

$\Sigma \vec{F} = 2000\ N$

$F_g = mg = 1000kg \cdot -10\ m/s^2 = -10{,}000\ N$

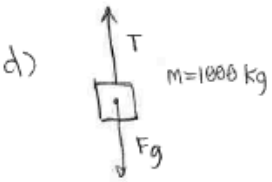
$F_T = \Sigma \vec{F} - F_g$

$F_T =$



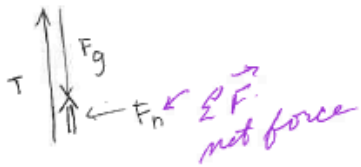
b) Dynamics: There are tension forces being applied on the elevator causing acceleration

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



e) it is important to define the direction of acceleration because if you don't, it is easy to confuse yourself why?

f) since acceleration is a change in velocity and the acceleration is causing velocity to decrease, the force of tension is greater than gravity



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

$\Sigma \vec{F} = 1000\,kg(-2\,m/s^2)$

$\Sigma \vec{F} = -2000\,N$

$\Sigma \vec{F} = Fg - T$

$-2000N = mg - T$

$-2000N = 1000(10) - T$

$-12000N = -T$

$T = 12000\,N$

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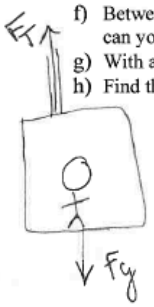


f) Between the tension and the force of gravity, which force is larger or are they the same? Why can you be sure?

g) With a forces diagram, show how you add the forces on the elevator to find the resultant force.

h) Find the tension of the cable from which the elevator is suspended at this moment.

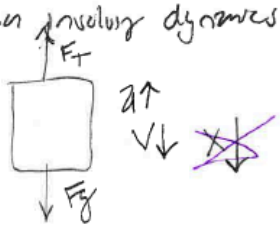
$V\downarrow = 10\,m/s$

$a\uparrow = 2\,m/s^2$ (2)

$m = 1000\,kg$

c) $\vec{a} = \frac{m}{\Sigma \vec{F}}$

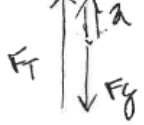
b) Dynamics. Forces are interacting with the elevator causing an acceleration so we have a situation involving dynamics



e) Important to provide acceleration direction b/c it shows which force direction is winning in the net force

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

f)



Tension is the larger because we see a negative acceleration in relation to the +x direction, where gravity is acting

h) $\vec{a} = \frac{m}{\Sigma \vec{F}}$ $-2\,m/s^2 = \frac{1000\,kg}{\Sigma F}$ $\Sigma \vec{F} = -2000N$

$\Sigma F = F_T - F_g$

$Fg = 10\,m/s^2(1000\,kg)$

$Fg = 10{,}000N$

$2000N = F_T - 10{,}000N$

$F_T = 12{,}000N$

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