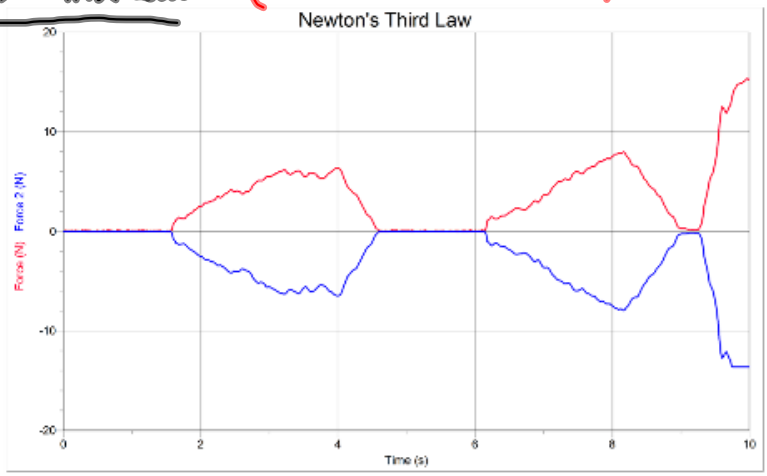
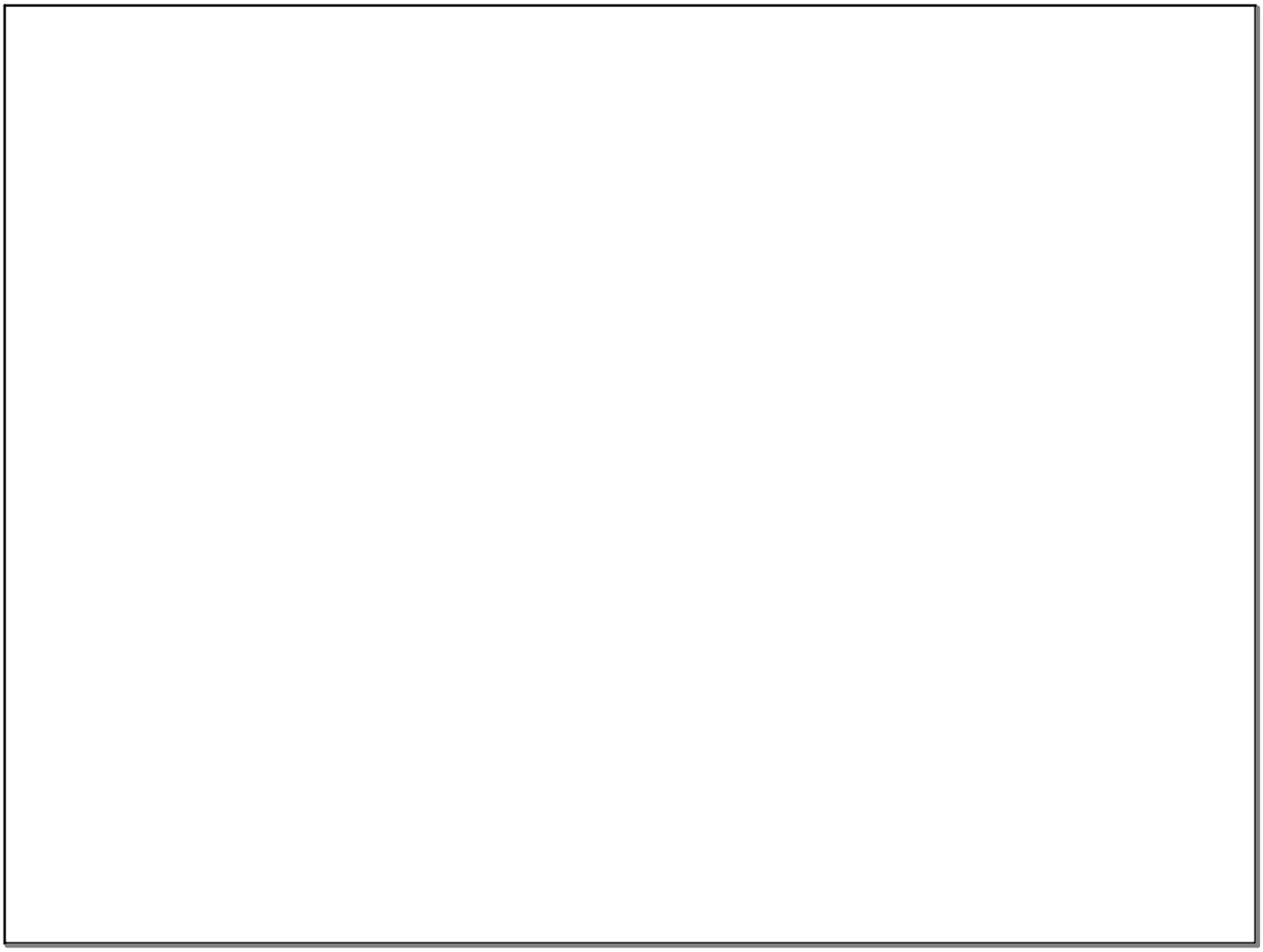
Newton's Third Law (Action-Reaction)



For every action force on object B due to object A, there is a reaction force, equal in magnitude but opposite in direction, due to object B acting back on object A.

$$\vec{F}_{A\text{ on }B} = -\vec{F}_{B\text{ on }A}$$



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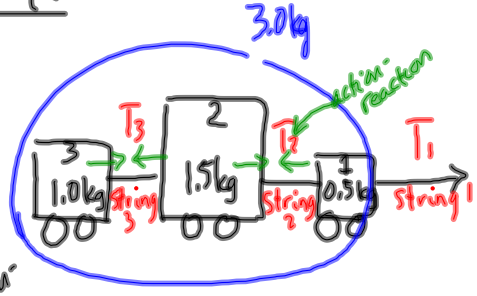
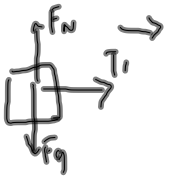
Example



Find the force in each string (T_1, T_2, T_3)

frictionless

Consider all 3 carts together:



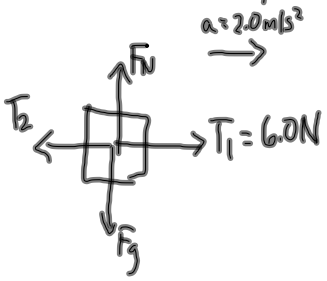
$\vec{F}_{net} = m\vec{a}$

$T_1 = ma$

$6.0N = (3.0kg)a$

$a = 2.0 m/s^2$

Consider Cart 1 by itself:



$\vec{F}_{net} = m\vec{a}$

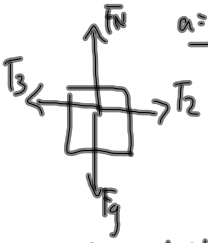
$T_1 - T_2 = ma$

$6.0N - T_2 = (0.5kg)(2.0 m/s^2)$

$6.0N - T_2 = 1.0N$

$T_2 = 5.0N$

Consider Cart 2:



$\vec{F}_{net} = m\vec{a}$

$T_2 - T_3 = ma$

$5.0N - T_3 = (1.5kg)(2.0 m/s^2)$

$5.0N - T_3 = 3.0N$

$T_3 = 2.0N$

The tensions in each string are:

$T_1 = 6.0N$

$T_2 = 5.0N$

$T_3 = 2.0N$

MP|184

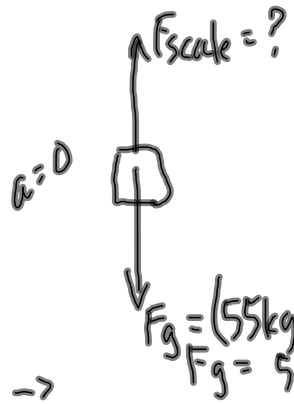
m = 55kg

a) F_{scale} = ? (not moving)

b) F_{scale} = ? ($\vec{a}$ = 0.75m/s² [up])

↑ the "feel like" weight or "apparent weight"

a)



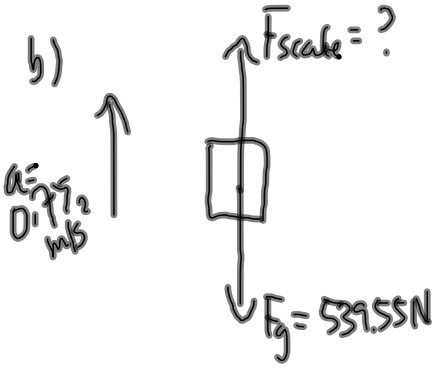
$\vec{F}_{net} = m\vec{a}$

$F_{scale} - F_g = ma$ (a = 0)

"true weight" → $F_{scale} = F_g$

$F_{scale} = 5.4 \times 10^2$ N

b)



$\vec{F}_{net} = m\vec{a}$

$F_{scale} - F_g = ma$ (−9.8m/s²)

$F_{scale} - 539.55N = (55kg)(0.75\ m/s^2)$

$F_{scale} - 539.55N = 41.25N$

$F_{scale} = 580.8N$

$F_{scale} = 5.8 \times 10^2$ N

feel heavier than normal → +acc | speeding up | going up | slowing down | going down

PP|182 (18 + 19) (towing)

PP|186 (elevator)