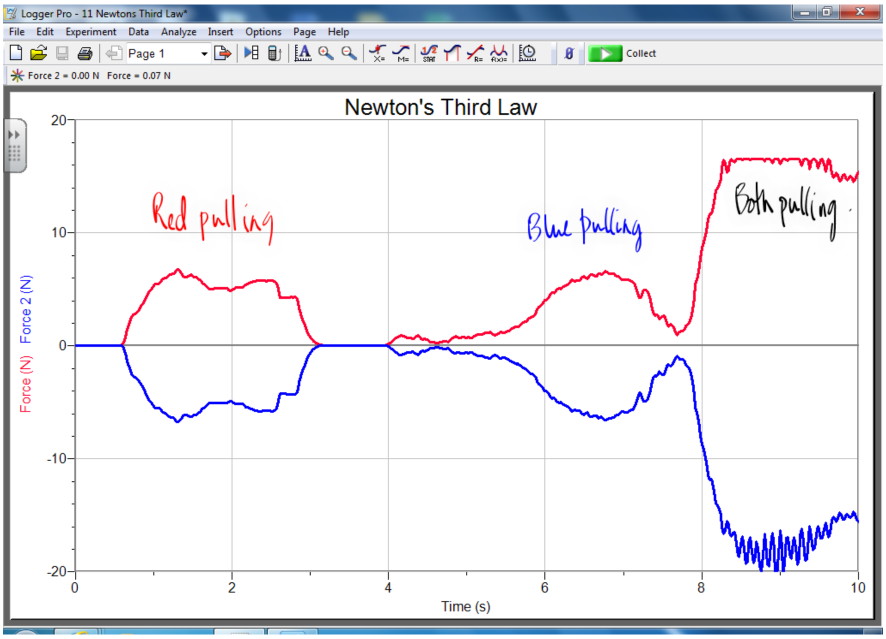
§5-3 Newton's Third Law

Recall Thought Experiment from p153, #1:

You said: 0 - A, 2 - B, 17 - C, 12 - D ✓

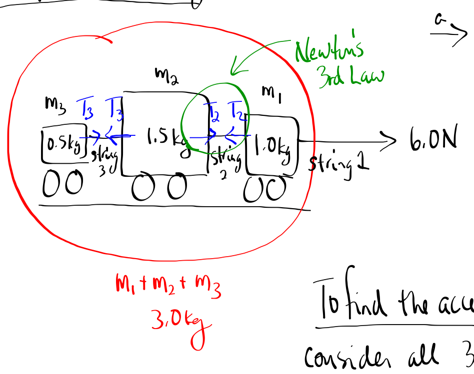


Newtons Third Law (see p178)

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.

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

Example - A pull toy



- frictionless
- find the tension in each string.

To find the acceleration:

Consider all 3 masses combined

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

$$F_a = ma$$

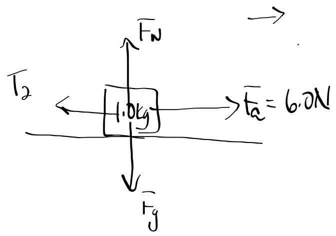
$$a = \frac{F_a}{M}$$

$$a = \frac{6.0N}{3.0kg}$$

$$a = 2.0 m/s^2$$

The tension in the first string (attached to the first cart) is 6.0N (the applied force)

Consider only Cart 1



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

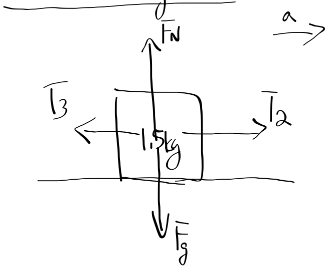
$$F_a - T_2 = ma$$

$$6.0N - T_2 = (1.0kg)(2.0 m/s^2)$$

$$6.0N - T_2 = 2.0N$$

$$T_2 = 4.0N$$

Consider Only Cart 2:



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

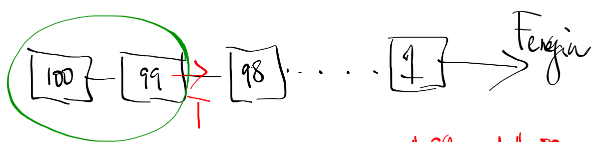
$$T_2 - T_3 = ma$$

$$4.0N - T_3 = (1.5kg)(2.0 m/s^2)$$

$$4.0N - T_3 = 3.0N$$

$$T_3 = 1.0N$$

What if you had a train with 100 cars and you wanted to find the Tension in the connection between #98 and #99?



This T acts on #99 and #100 combined together.

MP|184

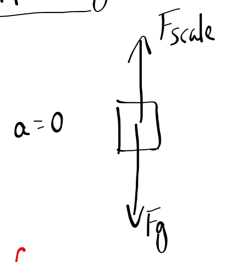
$m = 55 kg$

$\vec{a} = 0.55 m/s^2$ [up]

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

$F_{scale} = ?$ (moving)

Not Moving:



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

$F_{scale} - F_g = \cancel{ma}$ 0

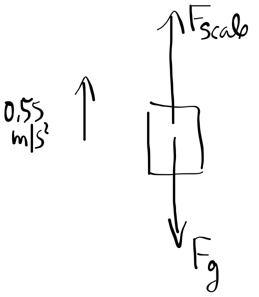
$F_{scale} = F_g$

$F_{scale} = (55 kg)(9.81 m/s^2)$

$\boxed{F_{scale} = 5.6 \times 10^2 N}$

You feel like your normal weight when the elevator is not moving OR the elevator is moving at a constant velocity

b) moving up with acc:



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

$F_{scale} - F_g = ma$ $\quad -9.81 m/s^2$

$F_{scale} - 539.55 N = (55 kg)(0.55 m/s^2)$

$F_{scale} - 539.55 N = \cancel{30.25 N}$ $\quad -539.55 N$

$F_{scale} = 56\cancel{9.80} N$ $\quad$ ON

$\boxed{F_{scale} = 5.7 \times 10^2 N}$

You will feel heavier when there is + acceleration

⇒ going up/speeding up

⇒ going down/slowing down.

This means you feel heavier!

You will feel lighter where there is neg. acceleration

⇒ going up/slowing down

⇒ going down/speeding up

What happens if someone cuts the cable???

Then you feel weightless.

TO DO

1. PP|182 (not #20) ~ towing questions
2. PP|186 ~ elevator problem