Newton's Laws

① Law of Inertia

② $\vec{F}_{net} = m\vec{a}$

Also: $F_g = mg$

$F_f = \mu F_N$

DRAW A FBD

PP 168

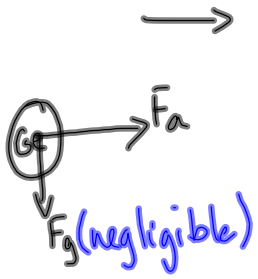
7. $m = 7.2 \times 10^{-25}\,kg$

$\vec{V}_1 = 0$

$\vec{V}_2 = 7.3 \times 10^6 \frac{m}{s}\,[E]$

$\Delta t = 5.5 \times 10^{-6}\,s$

$F_a = ?$



$\vec{a} = \frac{\Delta \vec{V}}{\Delta t}$

$\vec{a} = \frac{\vec{V}_2 - \vec{V}_1}{\Delta t}$

$\vec{a} = \frac{7.3 \times 10^6\,m/s\,[E] - 0}{5.5 \times 10^{-6}\,s}$

$\vec{a} = 1.3 \times 10^{12}\,m/s^2\,[E]$

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

$\vec{F}_a = m\vec{a}$ ← need to find acc.

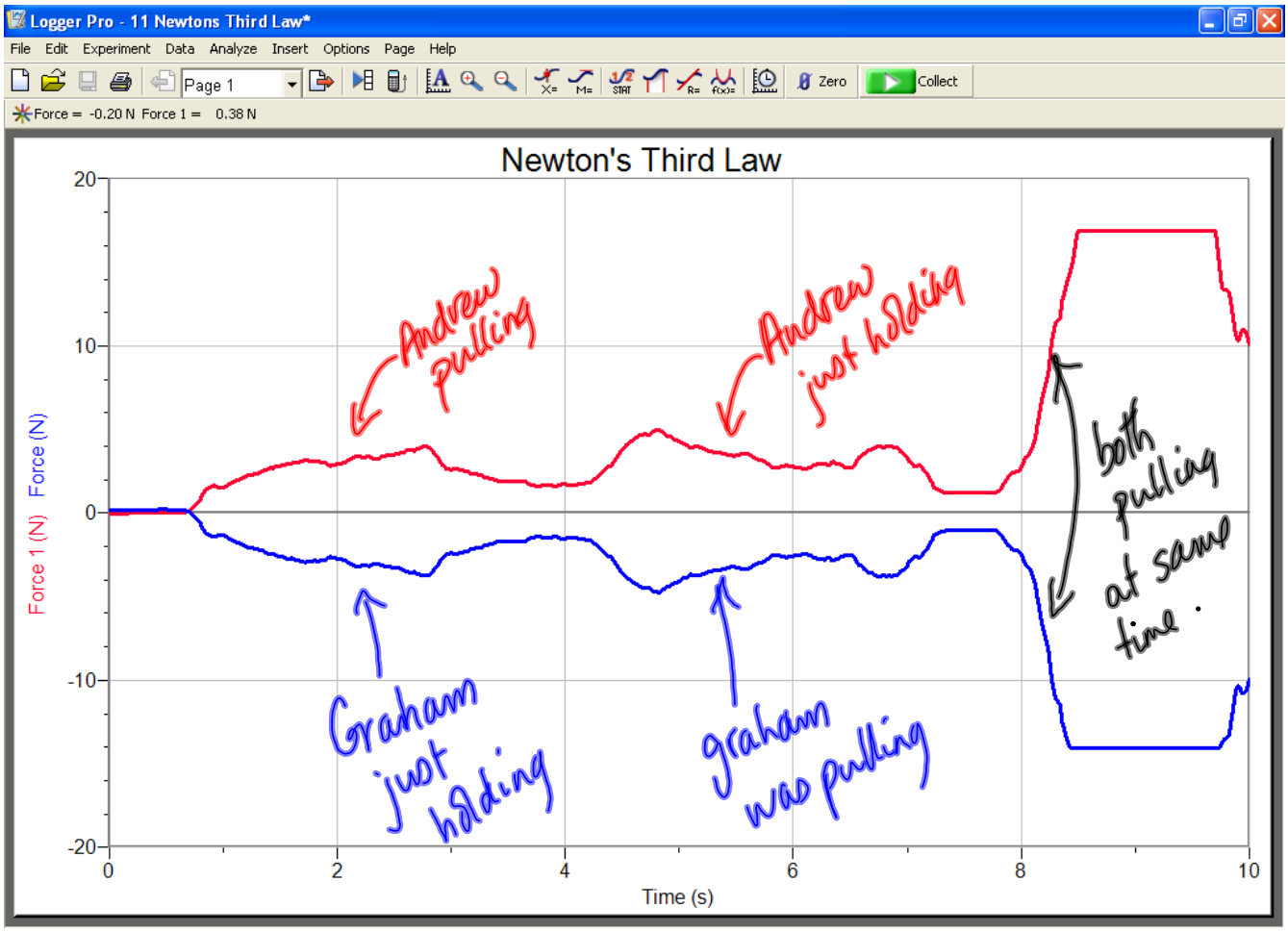
$\vec{F}_a = (7.2 \times 10^{-25}\,kg)(1.3 \times 10^{12}\,m/s^2\,[E])$

$\vec{F}_a = 9.6 \times 10^{-13}\,N\,[E]$

dynamics ← acc → kinematics

$(F_{net} = ma)$ $(V_2, V_1, \Delta t, \Delta d)$

3 NEWTON'S THIRD LAW

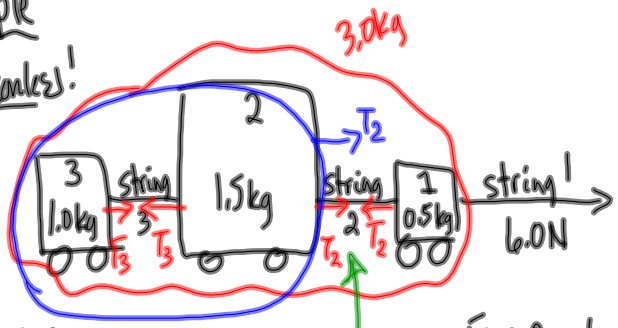


For every force there is an equal but opposing force.

$$F_{A\,on\,B} = -F_{B\,on\,A}$$

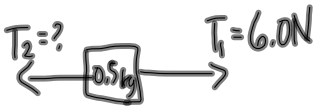
Example

frictionless!



Cart 1

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



action-reaction pair

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

$T_1 - T_2 = ma$

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

$6.0N - T_2 = 1.0N$

$\boxed{T_2 = 5.0N}$

Find Acceleration:

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

$T_1 = ma$

$6.0N = (3.0kg)a$

$\boxed{a = 2.0m/s^2}$

Cart 2

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

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

$T_2 - T_3 = ma$

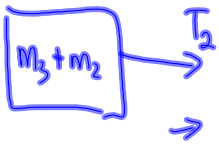
$5.0N - T_3 = (1.5kg)(2.0m/s^2)$

$5.0N - T_3 = 3.0N$

$\boxed{T_3 = 2.0N}$

Alternatively:

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



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

$T_2 = (m_3 + m_2)a$

$T_2 = (1.0kg + 1.5kg)2.0m/s^2$

$T_2 = (2.5kg)(2.0m/s^2)$

$\boxed{T_2 = 5.0N}$

MP/184 (Apparent Weight - "feel" like weight)

During an elevator ride you may feel heavier or lighter than normal. This is due to the acceleration you experience.

$m = 55\,kg$

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

$F_{scale} = ?$ ($\vec{a} = 0.75\,m/s^2$ [up])

Not moving:

$F_{scal} = F_g$

$F_{scale} = mg$

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

$F_{scale} = 539.55\,N$

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

(normal weight)

When $\vec{a} = 0.75\,m/s^2$ [up]:

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

$F_{scale} - F_g = ma$

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

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

$F_{scale} = 580.8\,N$

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

-9.81 m/s²

← what if we cut the cable?

$a = -9.81\,m/s^2$

$-539.55\,N$ → feel weightless, terrified!

ON → feel heavier than normal

(+ acc ⇒ heavier)

↓ going up, speeding up

↓ going down, slowing down

To DO:

① PP/182/18+19

② PP/186

③ Assignment