Review of Forces

Weight: $\vec{F}_g = m\vec{g}$

Friction: $F_f = \mu F_N$ (static + kinetic)

* Draw a FBD *

Newton's Laws:

1. Law of Inertia
2. $\vec{F}_{net} = m\vec{a}$ (* FBD *)
3. ???

kinematics problems ($a, v_1, v_2, \Delta d, \Delta t$)

Newton's Third Law

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.

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

Thought Experiments (p153)

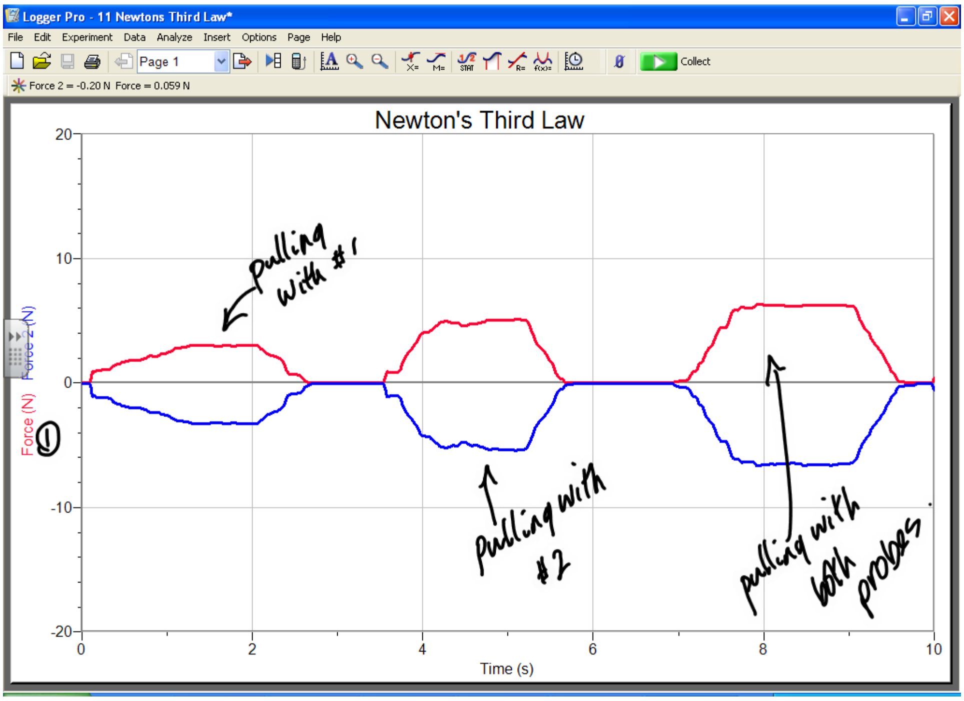
	A	B	C	D
1		3	11	12
2		1	3	14
3	~~4~~	~~4~~	~~8~~	7

Come back to this → (row 1)

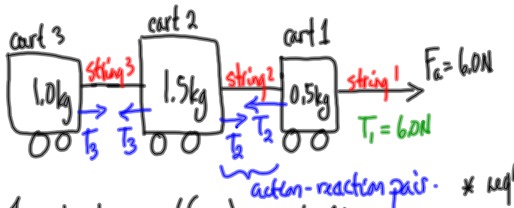
Newton's 3rd law → (column D)

← $F_g + F_{air}$ (row 2)

inertia. + F_g (row 3)



Example of Applying Newton's Third Law

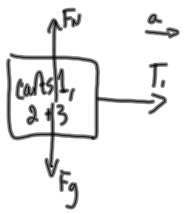


* neglect friction.

Find the tension (force) in each String:

The tension in string 1: $T_1 = 6.0N$

Find the acceleration: $\vec{F}_{net} = m\vec{a}$ (consider all 3 carts as one object)

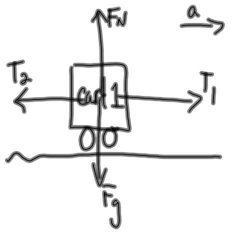


$T_1 = ma$

$6.0N = (3.0kg)a$

$a = 2.0 m/s^2$ ← each cart will have the same acceleration

Consider only Cart 1:



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

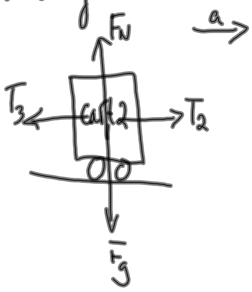
$T_1 - T_2 = ma$

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

$6.0N - T_2 = 1.0N$

$T_2 = 5.0N$

Consider only Cart 2:



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

$T_2 - T_3 = ma$

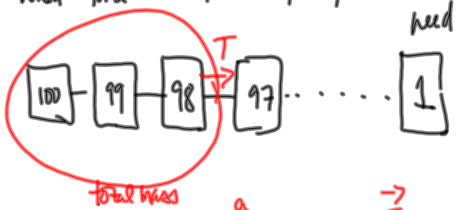
$5.0N - T_3 = (1.5kg)(2.0m/s^2)$

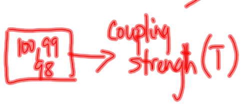
$5.0N - T_3 = 3.0N$

$T_3 = 2.0N$

What if you had a very long train (100 cars)?

What force does the coupling b/w car 97 and 98 need withstand?





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

$T = m_{100,99,98}\, a$

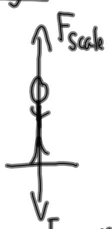
Apparent Weight (Feel-Like Weight) (MP|184)

$m = 55 kg$

$F_{scale} = ?$, not moving

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

Not moving: ($a = 0 m/s^2$)



$\vec{F}_{net} = 0$

$F_{scale} = F_g$

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

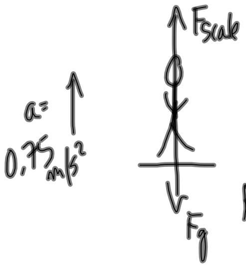
$F_g = mg$

$F_g = (55 kg)(9.81 m/s^2)$

$F_g = 539.55 N$

$F_g \doteq 5.4 \times 10^2 N$

Moving up: ($a = + 0.75 m/s^2$) ← up



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

$F_{scale} - F_g = ma$

$F_{scale} = ma + F_g$

$F_{scale} = (55 kg)(~~+0.75 m/s^2~~) + 539.55 N$ (−9.81 m/s²)

$F_{scale} = 41.25 N + 539.55 N$ (−539.55 N)

($41.25 N$ = F_{net})

$F_{scale} = 58~~0.8~~ N$ ON

$F_{scale} \doteq 5.8 \times 10^2 N$ ← feel heavier

Normal (a=0)
- not moving
- constant velocity

Heavier (+ acc)
- speeding up/going up
- slowing down/going down

Lighter (- acc)
- slowing down/going up
- speeding up/going down

What if the cable is cut?
Your scale reading would be
0 Newtons!!

TO DO:
1. PP|182|18-19 (Towing Problems)
2. PP|186|21-23
3. Hw Prob (Two) from PP|163 or PP|168