PP/168

6. $m = 1.2 \times 10^3\ kg$

$\vec{v}_1 = 45\ km/h\ [W]$ ($\times \frac{1000}{3600}$) 12.5 m/s

$\vec{v}_2 = 0\ km/h$

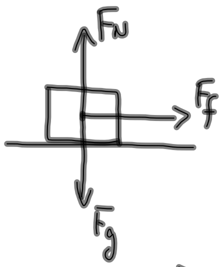
$\Delta d = 35\ m$

$\mu = ??$

$a = ?$

[W] ← +

Draw a FBD.



Find the acceleration of the car while braking:

$$v_2^2 = v_1^2 + 2a\Delta d$$

$$\frac{v_2^2 - v_1^2}{2\Delta d} = \frac{2a\Delta d}{2\Delta d}$$

$$a = \frac{v_2^2 - v_1^2}{2\Delta d}$$

$$a = \frac{0^2 - (12.5\ m/s)^2}{2(35\ m)}$$

$$\boxed{a \doteq -2.2\ m/s^2}$$

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

$$-F_f = ma$$

$$F_f = -(1.2 \times 10^3\ kg)(-2.2\ m/s^2)$$

$$\boxed{F_f \doteq 2.7 \times 10^3\ N}$$

$$F_f = \mu F_N$$

$$\mu = \frac{F_f}{F_N}$$

$$\mu = \frac{F_f}{F_g}$$

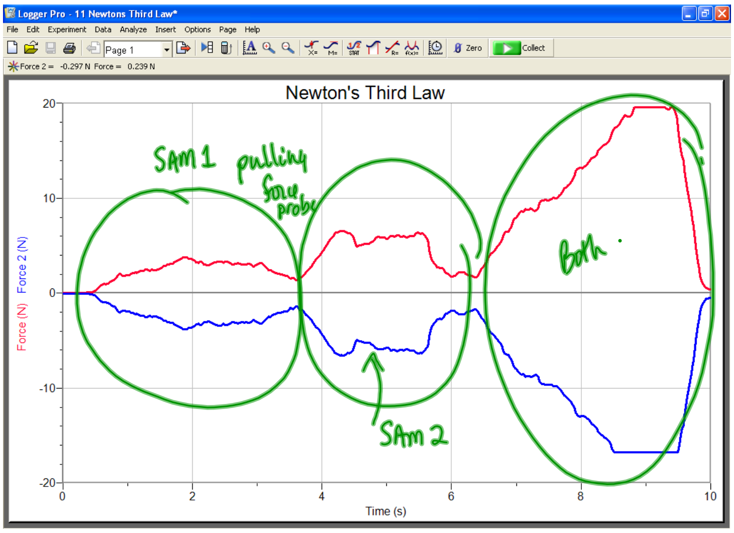
$$\mu = \frac{F_f}{mg}$$

$$\mu = \frac{2.7 \times 10^3\ N}{(1.2 \times 10^3\ kg)(9.81\ m/s^2)}$$

$$\boxed{\mu \doteq 0.23}$$

Newton's Third Law (Action-Reaction)

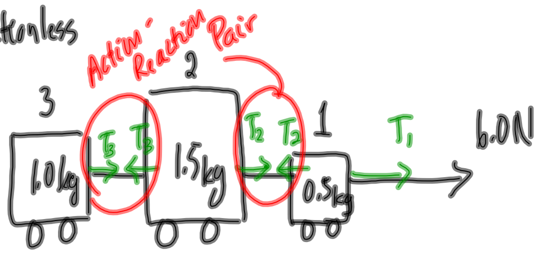
For every action force on object A due to object B, there is a reaction force, equal in magnitude & opposite in direction, due to object A acting on object B.



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

Example: A Child's Pull Toy

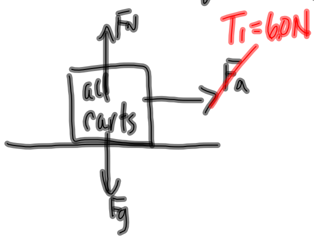
- frictionless



a) acceleration of the toy?

b) What is the force (tension) in each string

a) The Applied force of 6.0N acts on all 3 carts (a total mass of 3.0kg)



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

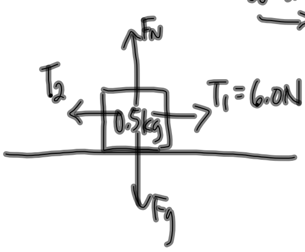
$T_1 = ma$

$(6.0N) = (3.0kg)a$

$a = 2.0 m/s^2$

b) Consider Cart 1:

$a = 2.0 m/s^2$



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

$T_1 - T_2 = ma$

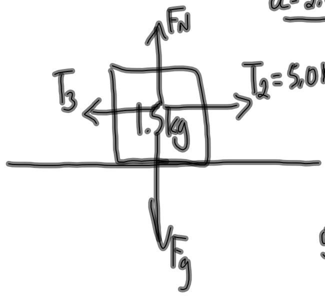
$6.0N - T_2 = (0.5kg)(2.0m/s^2)$

$6.0N - T_2 = 1.0N$

$T_2 = 5.0N$

Consider Cart 2:

$a = 2.0 m/s^2$



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

$T_2 - T_3 = ma$

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

$5.0N - T_3 = 3.0N$

$T_3 = 2.0N$

See also MP/180

Apparent Weight

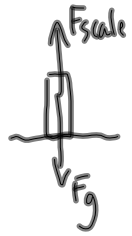
MP|184

$m = 55kg$

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

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

a) not moving.... draw a FBD.



$a = 0$

$F_{scale} = F_g$

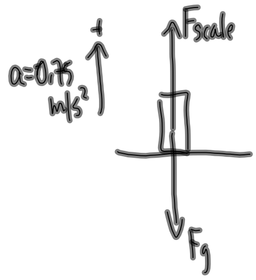
$F_{scale} = mg$

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

$F_{scale} = 539.55N$

feel like normal weight → $F_{scale} \doteq 5.4 \times 10^2 N$

b) $\vec{a} = 0.75 m/s^2$ [up]



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

$F_{scale} - F_g = ma$

$F_{scale} = ma + F_g$ ← normal weight

$F_{scale} = (55kg)(~~0.75 m/s^2~~) + 539.55N$ — $-9.81 m/s^2$ (cut the cable)

feel "heavier" → $F_{scale} = 5.8$ ~~$\times 10^2$~~ N — 0N feel weightless

Positive accelerations make you feel heavier (going up | speeding up + going down | slowing down)

Negative accelerations make you feel lighter (going up | slowing down + going down | speeding up)

TO DO

① PP|182| 18+19 (towing)

② PP|186 (apparent weight)