Physics 201 - Lecture 15

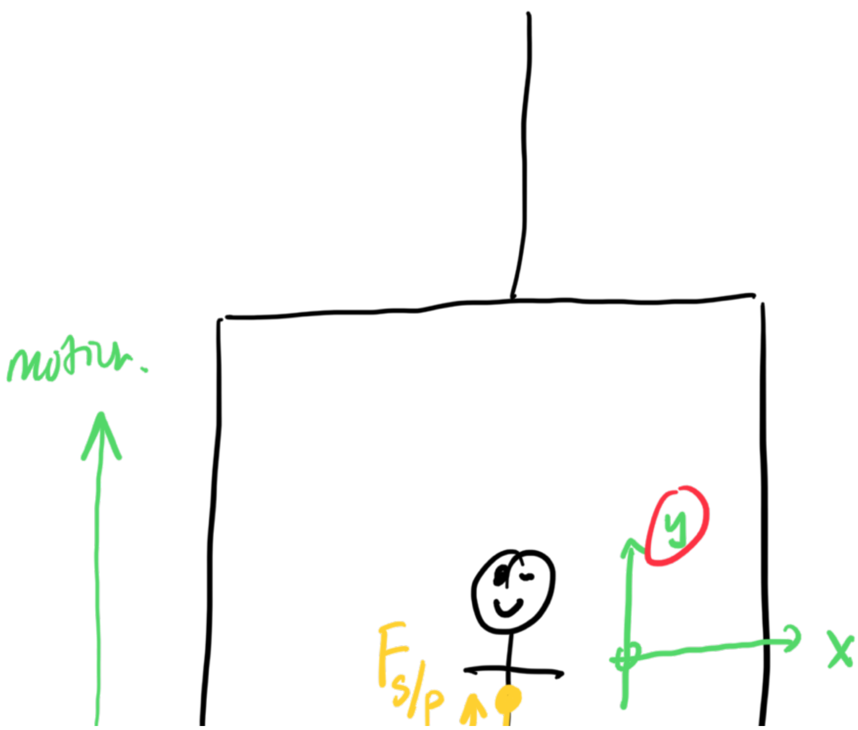
→ finish assignment 4

→ more on friction.

→ start assignment 5

(we will go slowly through each problem!)

9.



→ Free Body Diagram(s) for the objects of interest.

① gravity
② contact forces

|| Person.

$$\Sigma F_y = m a_y$$

Man ∴

$$\boxed{F_{s/p} - mg = m a_y}$$

a) $a_y = 1.25 \ m/s^2$ (+ve because "upwards")

$$F_{s/p} = m a_y + mg$$
$$= (88)(1.25) + (88)(9.8$$

$= 972\ N$

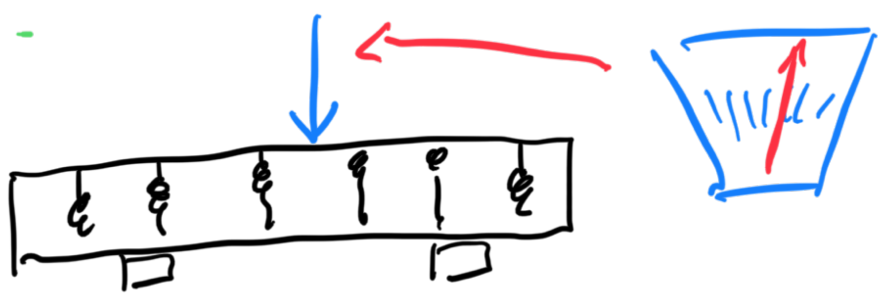
$\vec{F}_{s/p} = 972\ N$ upwards.

$$\boxed{\vec{F}_{p/s} = 972\ N \text{ downwards.}}$$

$\vec{F}_{s/p} = -\vec{F}_{p/s}$ Newton's 3rd Law

Scale

How do scales work?



velocity" $\rightarrow$ $a = 0$

b) constant ...

$$F_{s/p} - mg = ma_y$$

$$F_{s/p} = mg = 862N$$

$$\vec{F}_{s/p} = 862\ N \text{ upwards.}$$

$$\vec{F}_{p/s} = \boxed{826\ N} \text{ downwards.}$$

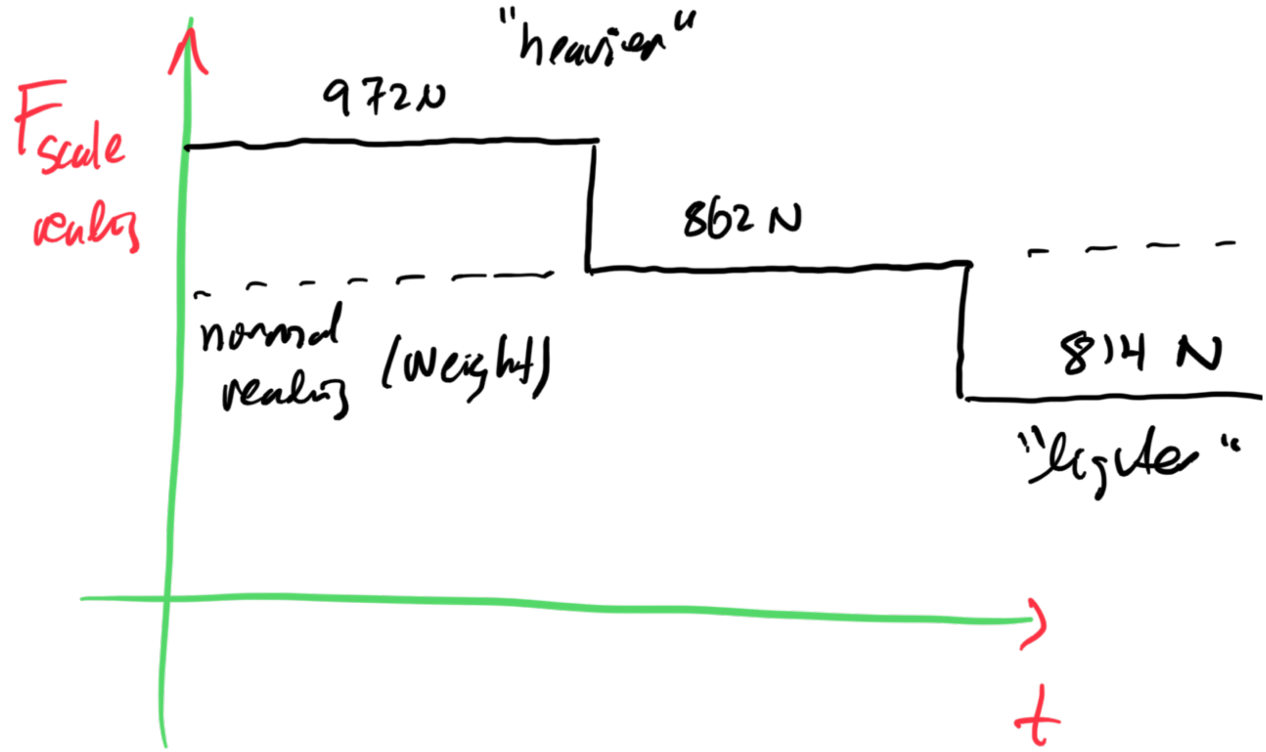
c) $a_y = -0.550\ m/s$

$$F_{s/p} - mg = ma_y$$

$$F_{s/p} = ma_y + mg$$

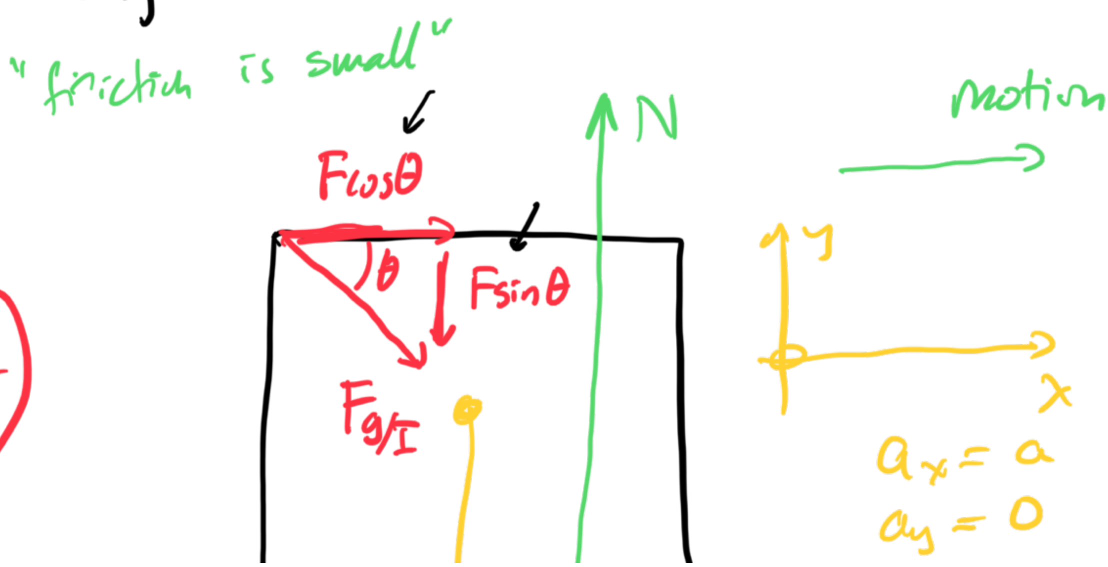
$$= (88)(-0.55) + (88)(9.8$$

$= 814\ N$

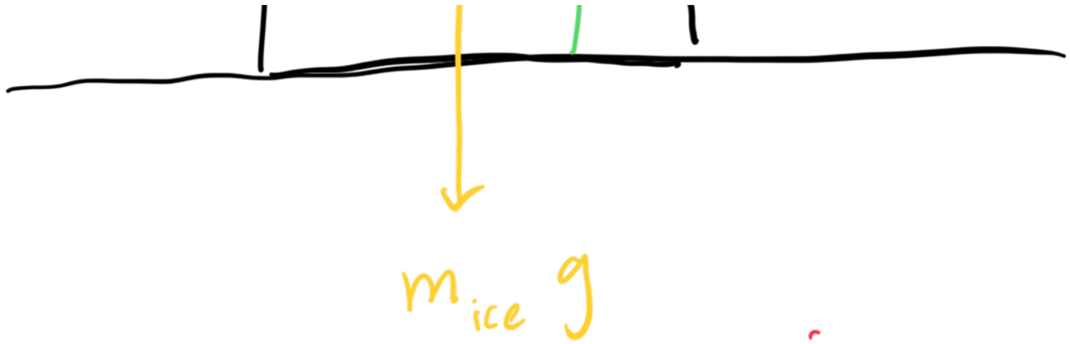


---

10. Object of interest $\boxed{ICE}$



10/10



1. identify all forces
2. coordinate system
3. resolve into components.

X	Y
$a_x = a$	$a_y = 0$
$\Sigma F_x = m a_x$	$\Sigma F_y = m a_y = 0$
$\boxed{F\cos\theta = m a_x}$	$\boxed{N - mg - F\sin\theta = 0}$

$N = mg + F\sin\theta$

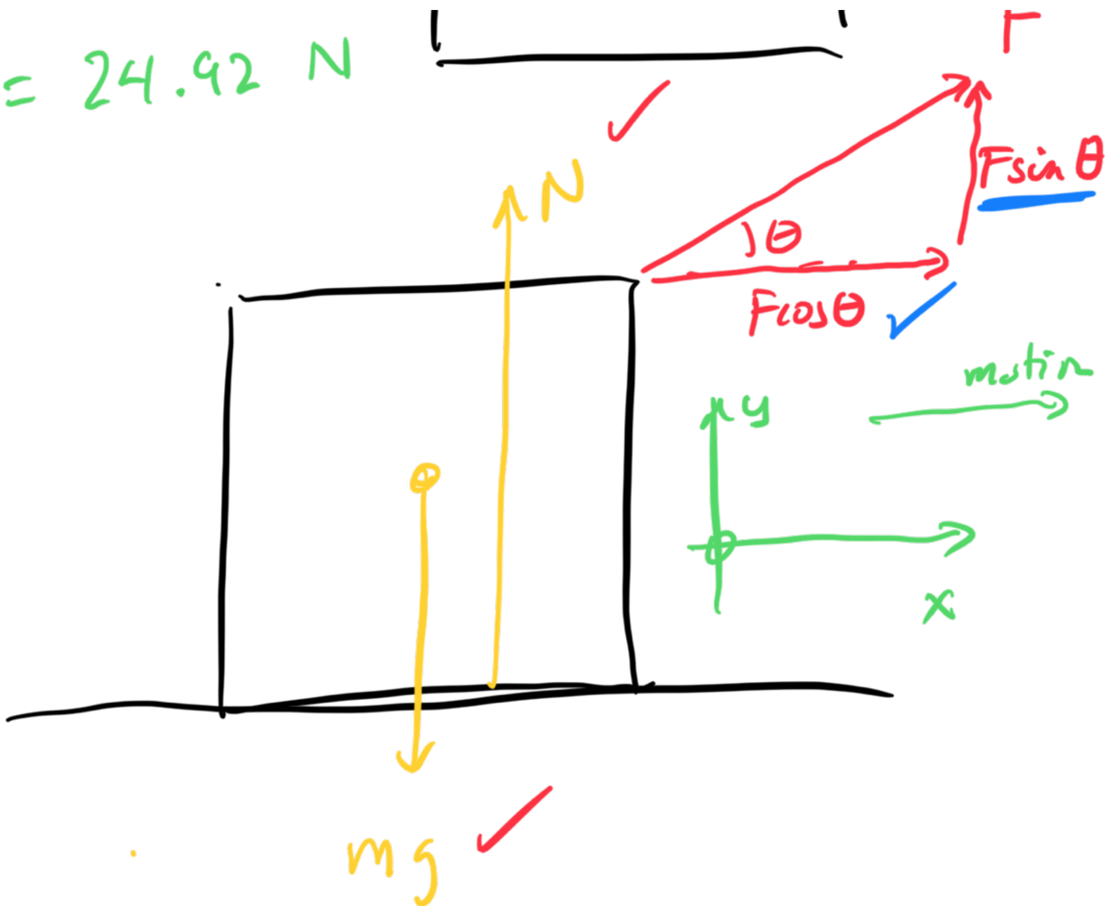
$= (40)(9.8) + (24.92)\sin(28$

$\boxed{N = 404\ N}$

$F = \dfrac{m a_x}{\cos\theta}$

$= \dfrac{(40)(.550)}{\cos(28^\circ)}$

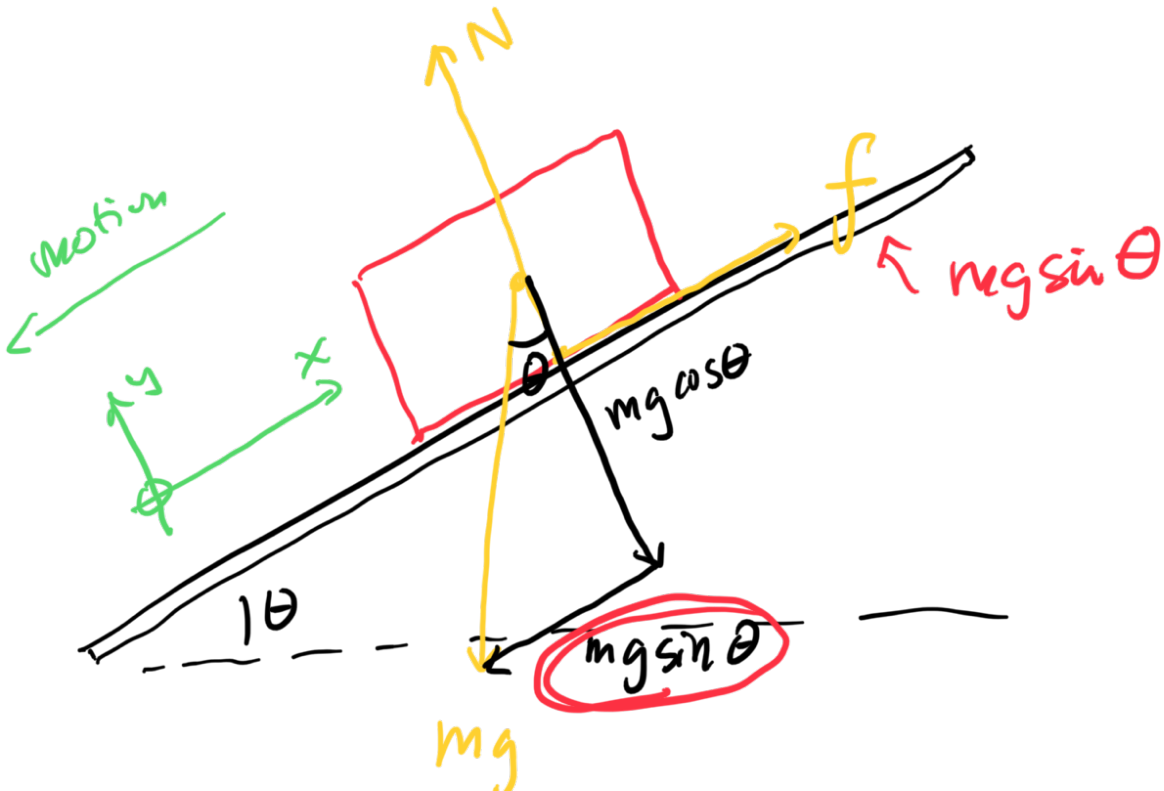
$= 24.92\ N$



X	Y
$F\cos\theta = ma_x$	$N - mg + F\sin\theta = 0$
$F = 24.92N$	$N = mg - F\sin\theta$
	$= (40)(9.8) - (24.92)\sin 28$
	$= 380\ N$

$\boxed{\text{Friction}}$ → energy losses

→ $$$



X	Y
$\Sigma F_x = ma_x$	$\Sigma F_y = ma_y = 0$
$f - mg\sin\theta = ma_x$	$N - mg\cos\theta = 0$
	$\boxed{N = mg\cos\theta}$

coefficient of friction.

Definition of friction :

$$f = \mu N$$

$$f = \mu m g \cos\theta$$

$$\mu \cancel{m} g \cos\theta - \cancel{m} g \sin\theta = \cancel{m} a_x$$

$$a_x = \mu g \cos\theta - g \sin\theta$$

$$\Rightarrow \boxed{a_x = g \left(\mu \cos\theta - \sin\theta \right)}$$

TWO REGIMES:

Static

Kinetic

- object is not moving relative to the surface.

- object is sli[illegible] relative to the surface.

$a_x = 0$ ← not moving

$$0 = g\,(\underbrace{\mu\cos\theta - \sin\theta}_{=0})$$

$$\mu\cos\theta - \sin\theta = 0$$

$$\mu\cos\theta = \sin\theta$$

$$\mu = \frac{\sin\theta}{\cos\theta}$$

$$\boxed{\mu = \tan\theta}$$

$$\mu_s^{max} = \tan(\theta_{critical}$$

[redacted]

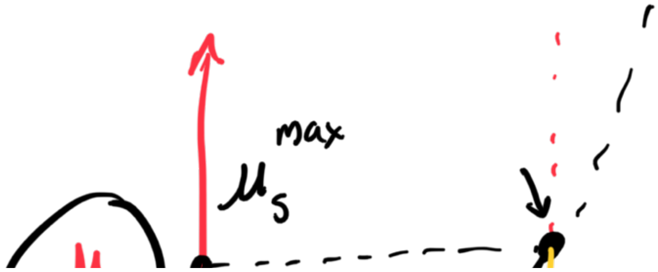
$$\theta_{critical} = \tan^{-1}(\mu_s$$

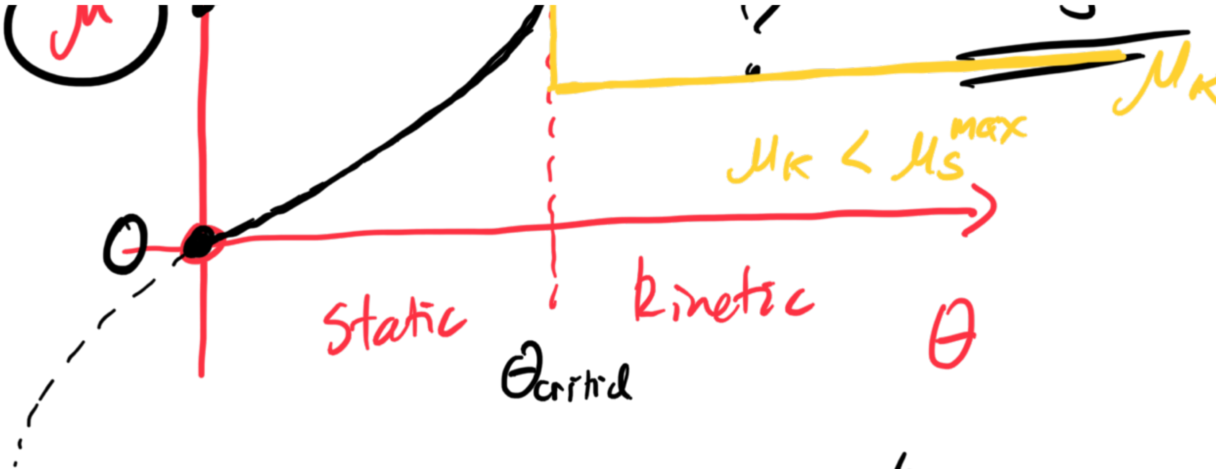
$$f = \mu mg\cos\theta$$

$$= \tan\theta \cdot mg\cos\theta$$

$$= \frac{\sin\theta}{\cancel{\cos\theta}} \cdot mg\,\cancel{\cos\theta}$$

$$= mg\sin\theta$$





measured by experiment.

μ_s^{max} ≡ max. coefficient of static friction.

surface just gets overwhelmed

Textbooks are sloppy!

" the maximum coefficient of static friction is 0.6 "

$$\boxed{0 \leq \mu_s \leq \mu_s^{max}}$$

Kinetic Friction (Sliding)

Coefficient of kinetic friction

$= \underline{\underline{\mu_K}}$ ← constant!

(given)

Given: $\mu_s^{max} = 0.6$, $\mu_K = 0.4$

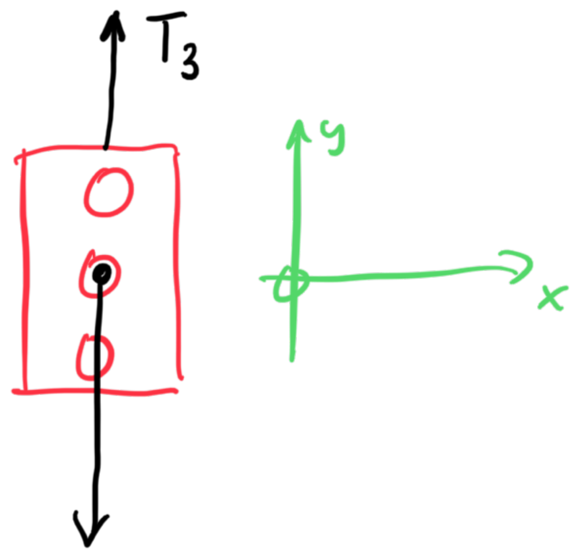
Q1. What kind of problem is this?

"Find the tension . . . . "

Find the ______

Force

→ Force problem → $\boxed{\text{FBD}}$

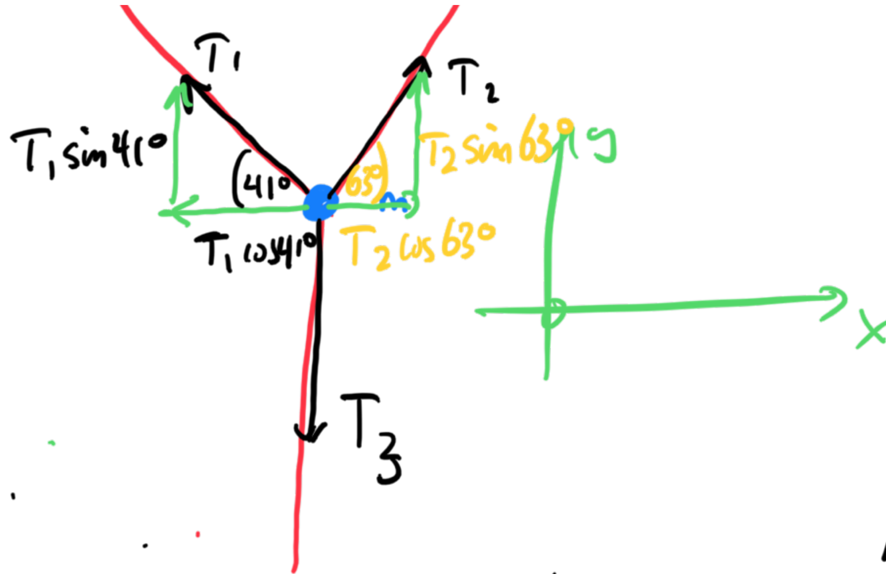


$mg = 587\text{ N}$

$$T_3 - mg = m a_y = 0$$

$$T_3 = mg = 587\text{ N}$$

What is the object of interest?



$$y: \quad T_1 \sin 41° + T_2 \sin 63° - \overset{587}{\cancel{T_3}} =$$

$$x: \quad -T_1 \cos 41° + T_2 \cos 63° = 0$$

algebra

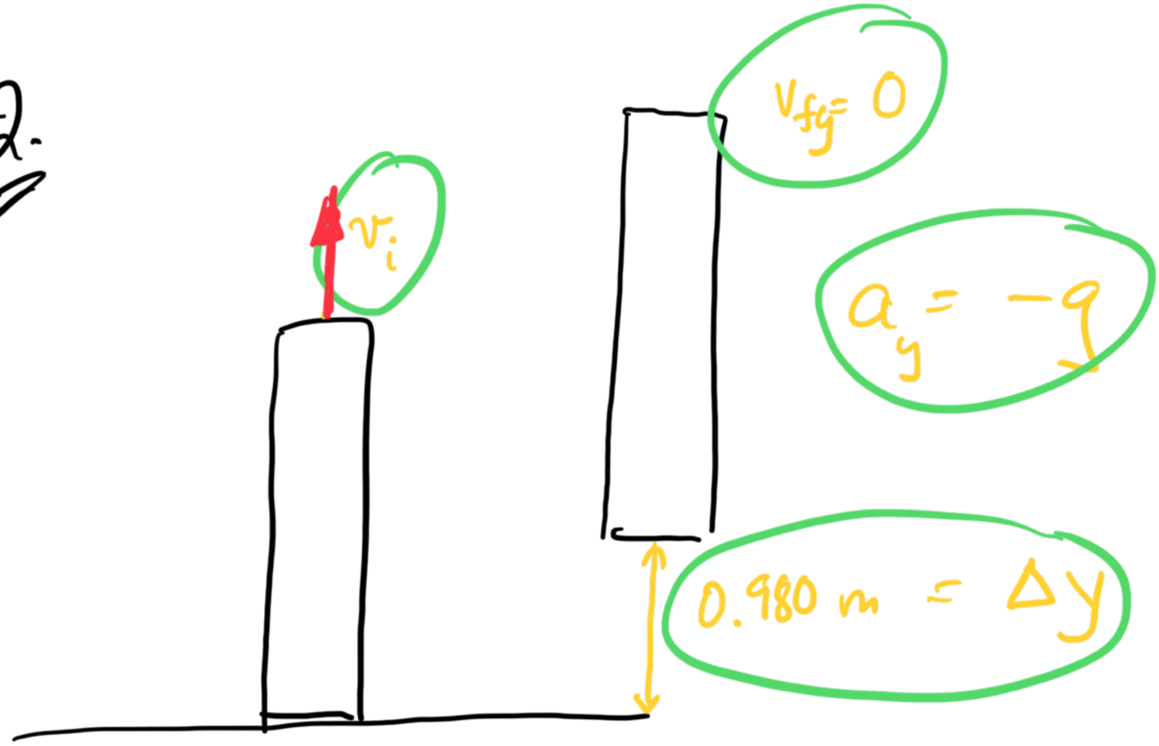
trig.

solution

31% chance that I got it wrong.

$$\boxed{T_1 = 275\ N, \quad T_2 = 457\ N}$$

2.



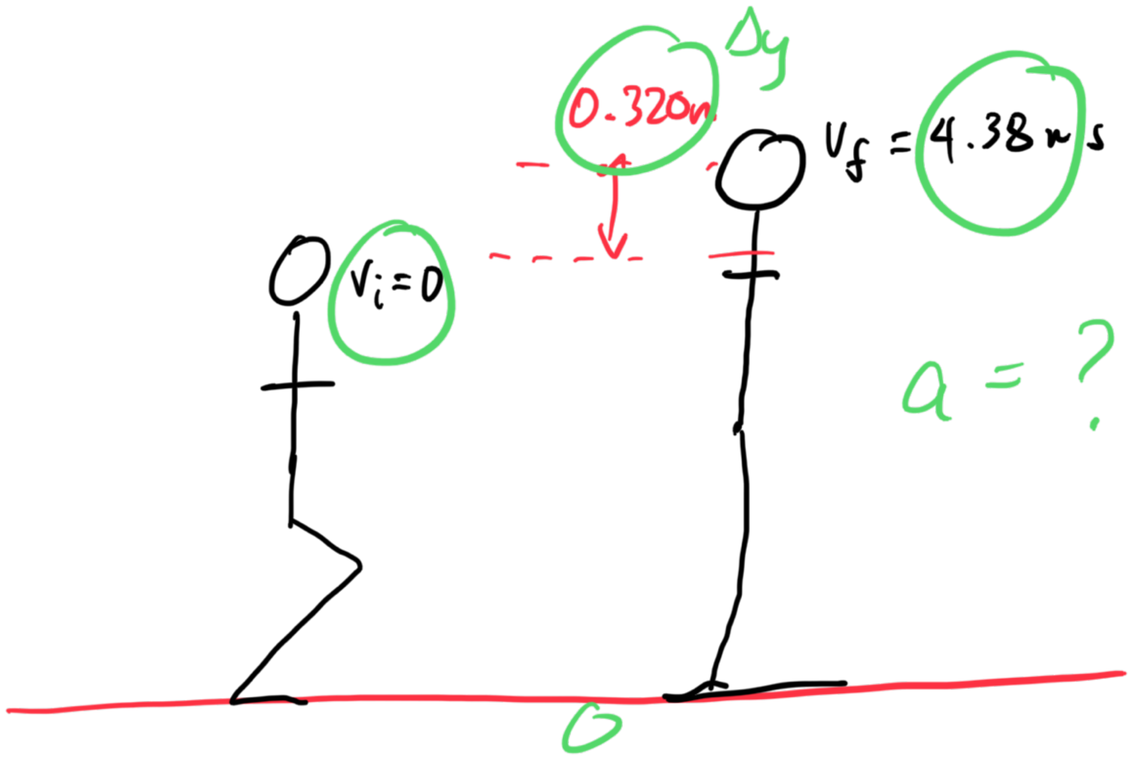
$$v_f^2 = v_i^2 + 2a_y \Delta y$$

$$0 = v_i^2 - 2g\Delta y$$

$$v_i^2 = 2g\Delta y$$

$$v_i = \pm\sqrt{2g\Delta y}$$

$$v_i = 4.38\ m/s$$



$$V_f^2 = \cancel{V_i^2}^{\,0} + 2a\,\Delta y$$

$$(4.38)^2 = 2(a)(.320)$$

$$a = \frac{(4.38)^2}{2(.320)} = 29.98 \ m/s^2$$

$m = 104$ kg

c) ~~"force"~~ → $F = ma$

$= \cancel{(104)(29.98}$

~~= 3117.5 N~~

~~3118~~

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

$$\Downarrow$$

$$F^{y}_{net} = m a_y$$

$$F_{floor/guy} - mg = 3117.5\ N$$

$$\underline{F_{floor/guy}} = 3117.5 + mg$$
$$= 4140 \text{ N} \uparrow$$

$$F_{guy/f} = 4140 \text{ N} \downarrow$$