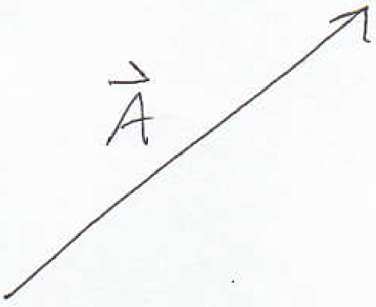
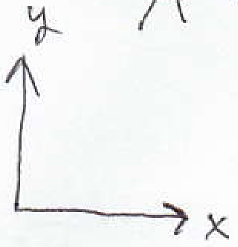
2D vectors: $\vec{A}$ has magnitude

and direction



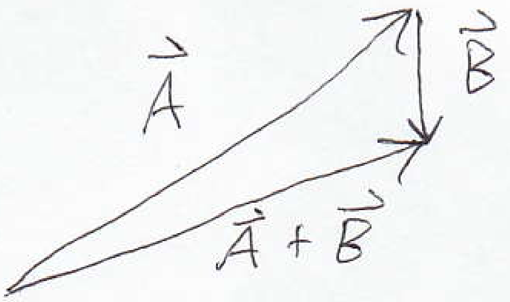


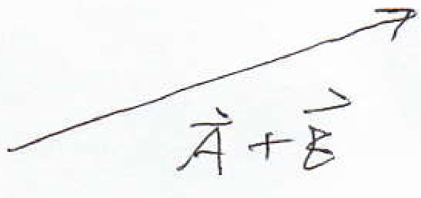
$$\vec{A} = (A_x, A_y)$$

$$\vec{A} = A_x\hat{i} + A_y\hat{j}$$

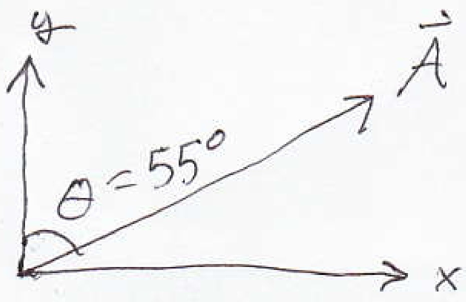
$\hat{i} = (1,0)$ $\hat{j} = (0,1)$

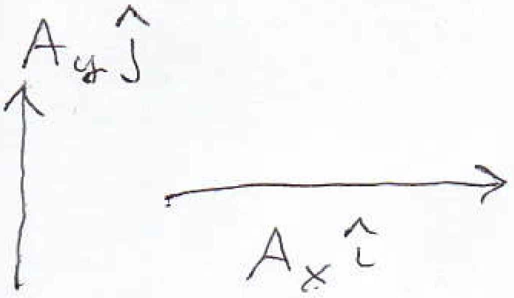
Add vectors "head to tail":

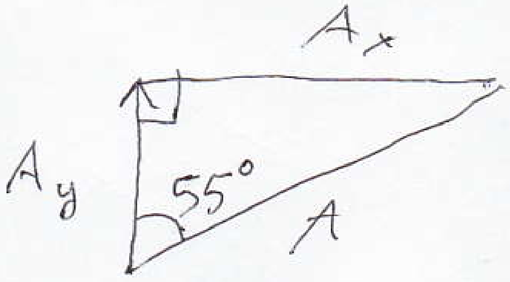




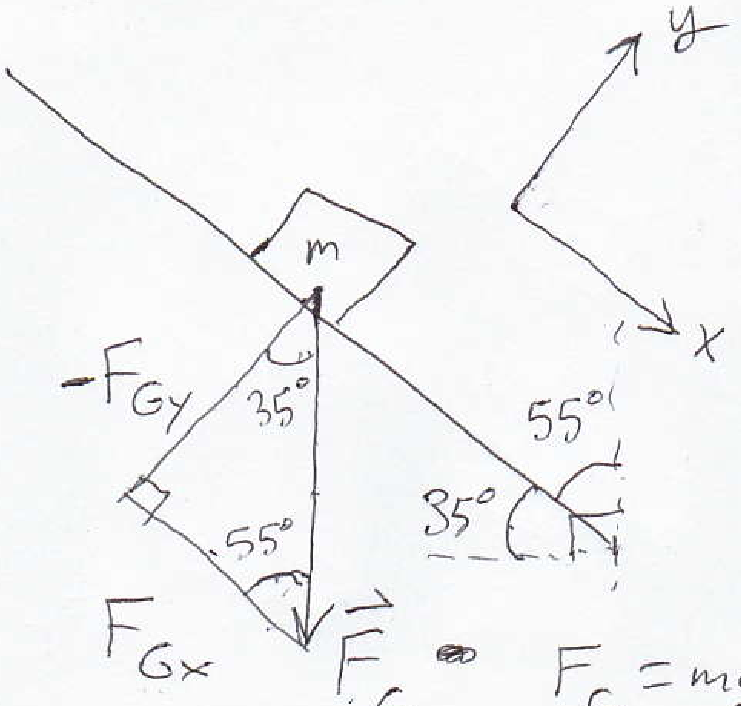
$$\vec{A}+\vec{B} = (A_x + B_x, A_y + B_y)$$







$$A_x = A \sin 55°$$
$$A_y = A \cos 55°$$



$\underbrace{F_G = mg}_{\text{magnitude}}$ $g = 9.80 \, m/s^2$

$$F_{Gx} = F_G \sin 35° = mg \sin 35°$$

no friction $\Rightarrow a = \frac{F_{Gx}}{m} = g \sin 35°$

Constant acceleration kinematics:

$$\begin{cases} x = \frac{1}{2}a_x t^2 + v_{ix} + x_i \\ y = \frac{1}{2}a_y t^2 + v_{iy} + y_i \end{cases}$$

(x_i, y_i) = initial position at $t=0$

$\vec{v}_i = (v_{ix}, v_{iy})$ = initial velocity at $t=0$

Choose coordinate system to get $(x_i, y_i) = (0, 0)$ and maybe $a_x = 0$ or $a_y = 0$

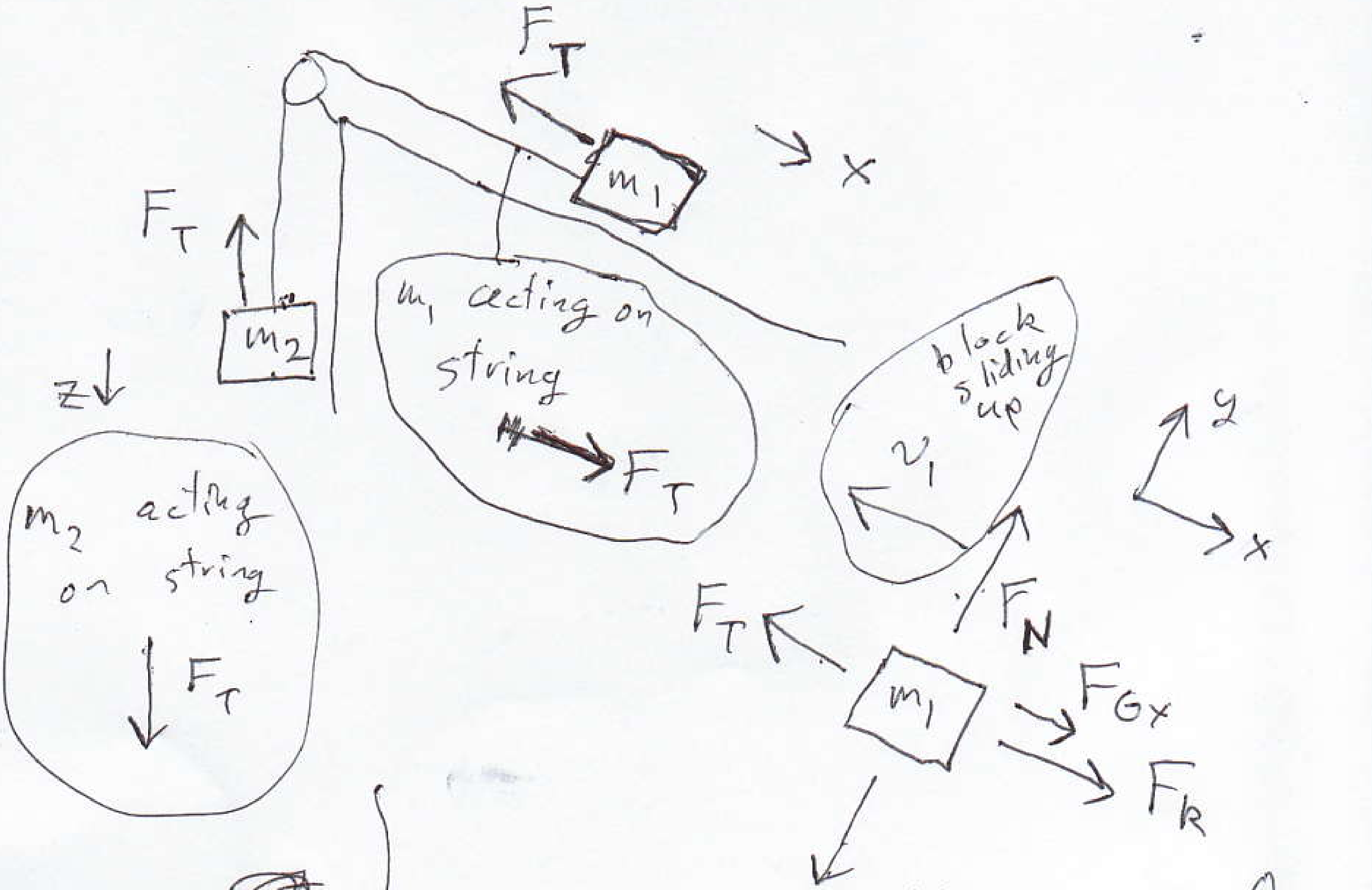
These imply some other useful equations:

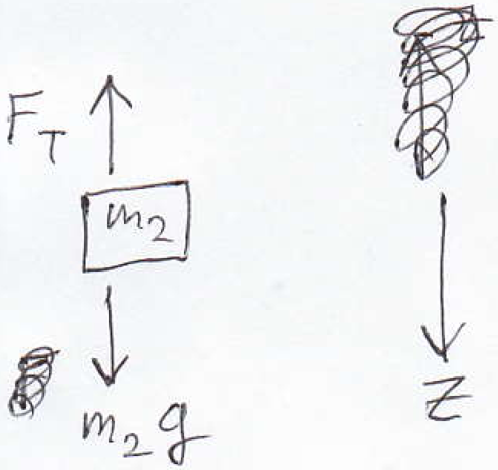
$$v_x = a_x t + v_{ix}$$

$$v_y = a_y t + v_{iy}$$

$$v_x^2 = v_{ix}^2 + 2a_x(x - x_i)$$

$$v_y^2 = v_{iy}^2 + 2a_y(y - y_i)$$





$g = 9.80 m/s^2$

$$\underbrace{m_2 a_{2z}}_{?} = m_2 g - \underbrace{F_T}_{?}$$

$$\underbrace{a_{2z}}_{?} = - \underbrace{a_{1x}}_{?}$$

$$-F_{Gy} = F_N = m_1 g \cos\theta$$

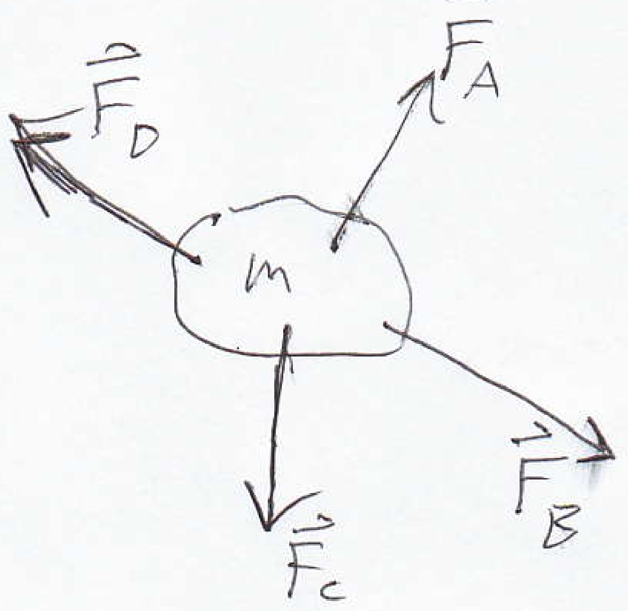
because $a_{1y} = 0$

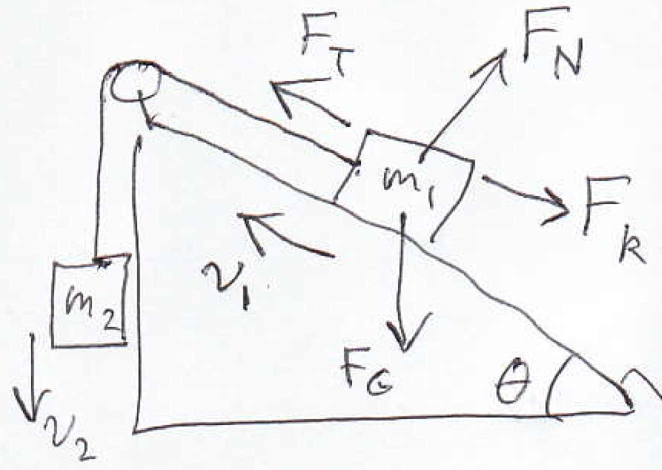
$$F_{Gx} = \boxed{m_1 g \sin\theta}$$

$$(5.1) \quad F_k = \mu_k F_N = \boxed{m_1 g \mu_k \cos\theta}$$

$$\overbrace{m_1 a_{1x}}^{?} = \underbrace{-F_T}_{?} + F_{Gx} + F_k$$

You may need to find acceleration given forces using Newton's Laws. (Or find Find a force given acceleration)





$$m\vec{a} = \underbrace{\sum}_{\text{sum}} \vec{F} = \vec{F}_A + \vec{F}_B + \vec{F}_C + \vec{F}_D$$

↑ Newton's 2nd Law

$\mu_k = 0.15$ $m_1 = 0.500\,\text{kg}$

$\theta = (3.0\times10)^\circ$ $m_2 = 0.300\,\text{kg}$

What is acceleration of $\boxed{m_1}$?

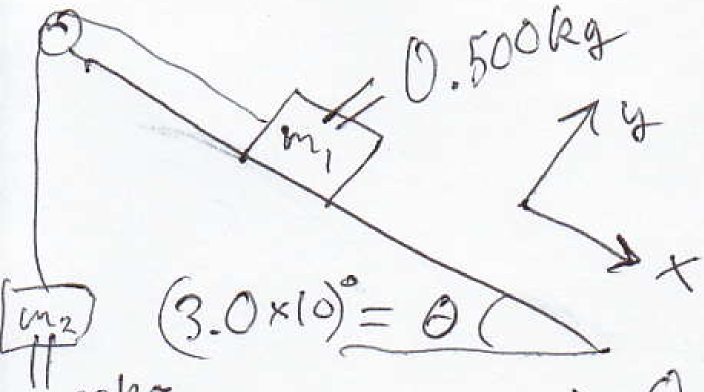
Newton's 3rd: Forces come in pairs:

$$\begin{cases} -m_2 a_{1x} = m_2 g - F_T \\ \boxed{\begin{aligned} m_1 a_{1x} &= -F_T + F_{Gx} + F_k \\ m_2 a_{1x} &= F_T - m_2 g \end{aligned}} \end{cases}$$

add

$$(m_1 + m_2) a_{1x} = F_{Gx} + F_k - m_2 g$$

$$a_{1x} = \frac{F_{Gx} + F_k - m_2 g}{m_1 + m_2}$$



$|a_{1x}| = a_1$

$a_{1y} = 0 \Rightarrow$

$g = 9.80\,m/s^2$

$$a_{1x} = \frac{m_1 g \sin\theta + m_1 g \mu_k \cos\theta - m_2 g}{m_1 + m_2}$$

μ_k = coefficient of kinetic friction = 0.15

$a_{1x} = 1.8\times10^{-1}\,m/s^2 \Rightarrow a_1 = |a_{1x}| = a_{1x}$

$a_1 = 1.8\times10^{-1}\,m/s^2$ down the ramp

If $m_2 = 1.000kg$, $a_{1x} = -4.5\,m/s^2$

$a_1 = 4.5\,m/s^2$ up the ramp

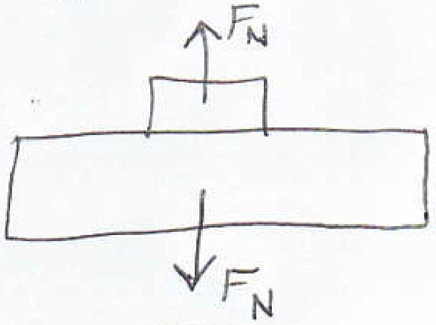
$F_k = \boxed{\mu_k} F_N$ $\quad$ $F_s \le \boxed{\mu_s} F_N$

kinetic friction

static friction

only depend on two touching materials

F_N = normal force



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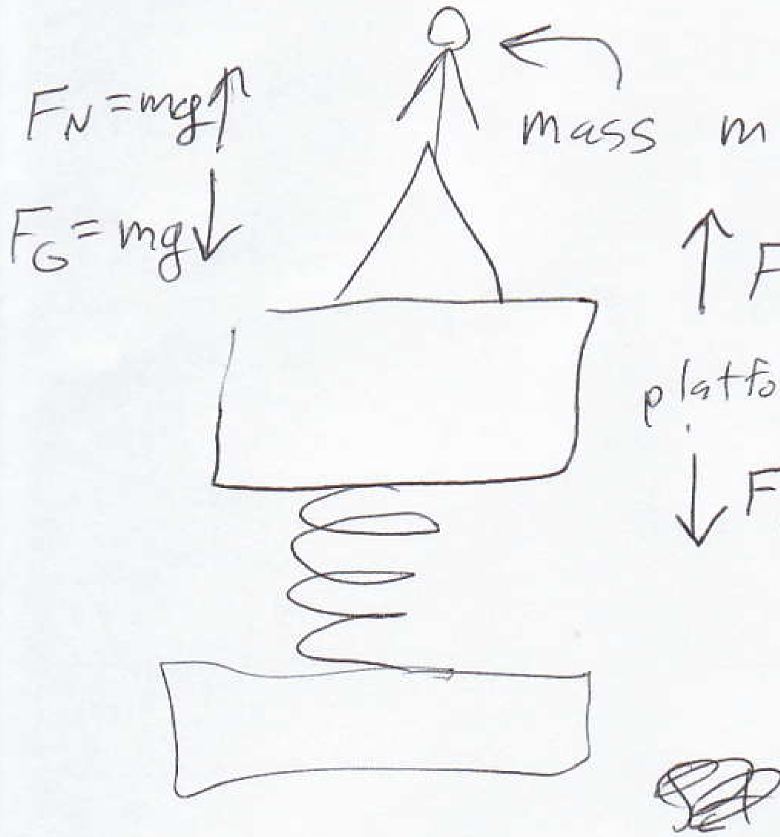

15a) yes

15b) no

$\uparrow F_{sp}$ spring. force = mg

platform at rest

$\downarrow F_N = mg$

because platform not accelerating

Scale measures F_s, which equals weight mg.

weight is a force, not a mass

1 pound = 4.44822N is a force unit