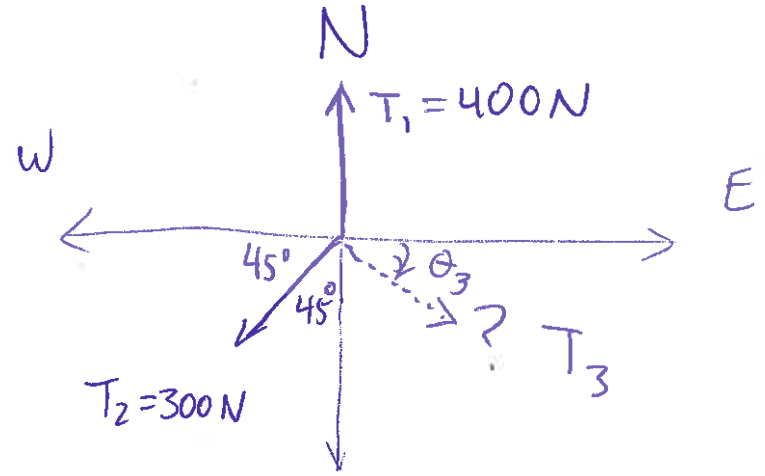
① Spiderman's Web:



$$\sum F = 0 = \vec{T}_1 + \vec{T}_2 + \vec{T}_3$$

$T_{1,y} = 400N$

$T_{2,y} = -212N = (300N)\sin 45°$

$T_{3,y} = ?$

$T_{1,x} = 0$

$T_{2,x} = (300N)\cos 45°$

$T_{3,x} = ?$

$400N - 212N + T_{3,y} = 0$

$T_{3,y} = -188N$

$T_{3,x} - 212N = 0$

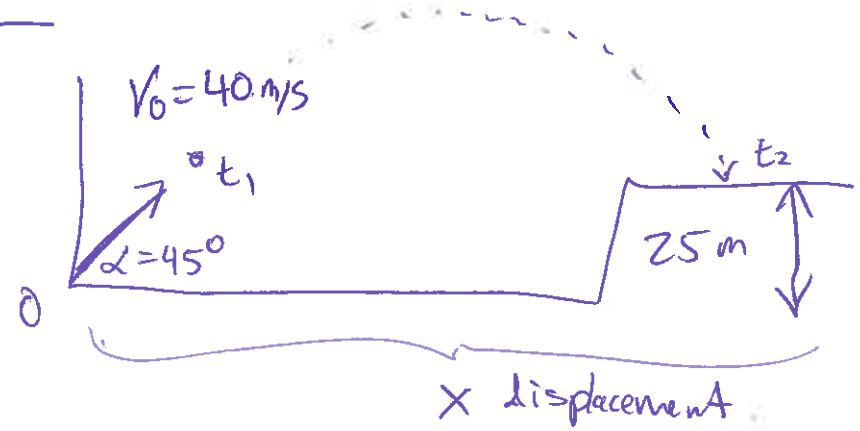
$T_{3,x} = 212N$

$|T_3| = \sqrt{(212)^2 + (188)^2} = \boxed{283N}$

$\tan\theta_3 = \frac{T_{3y}}{T_{3x}} = \frac{-188}{212}$

$\boxed{\theta_3 = -41.6°}$

(2) Hulk



$g = -10\ m/s^2$

$\sin\alpha = \cos\alpha \approx 0.70$

a) $y = y_0 + (V_0 \sin\alpha)t + \frac{1}{2}gt^2$

final: $25 = 0 + 28t - 5t^2$ in mks units.

$-5t^2 + 28t - 25 = 0$

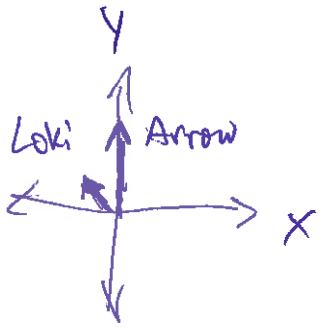
$a = -5 \quad b = 28 \quad c = -25$ for quadratic Eq.

$t_1 = 1.1$ sec. $\boxed{t_2 = 4.5 \text{ sec}}$

b) $x = x_0 + V_0 \cos\alpha\, t = \boxed{126\ m}$

$x_0 = 0$; $V_0 \cos\alpha = 28\ m/s$; $t = 4.5\ s$

③ Hawkeye & Loki:



$V_{A/E} = 100$ m/s North

$V_{L/E} = 40$ m/s NW

$V_{A/L}$? $\quad \vec{V}_{A/E} = \vec{V}_{A/L} + \vec{V}_{L/E}$

$$\vec{V}_{A/L} = \vec{V}_{A/E} - \vec{V}_{L/E}$$

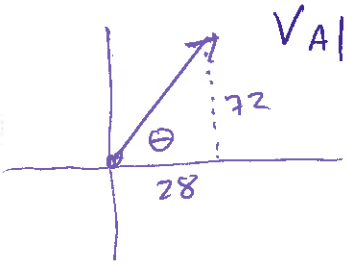
x: $|V_{L/E}|_x = (0.707)40$ m/s $= 28$ m/s in $-x$ dir.

y: $|V_{A/E}|_y = 100$ m/s

$|V_{L/E}|_y = 28$ m/s

x: $|V_{A/L}|_x =$ ~~100 m/s~~ $0 + 28$ m/s, x

$|V_{A/L}|_y = 100$ m/s $- 28$ m/s $= 72$ m/s, y

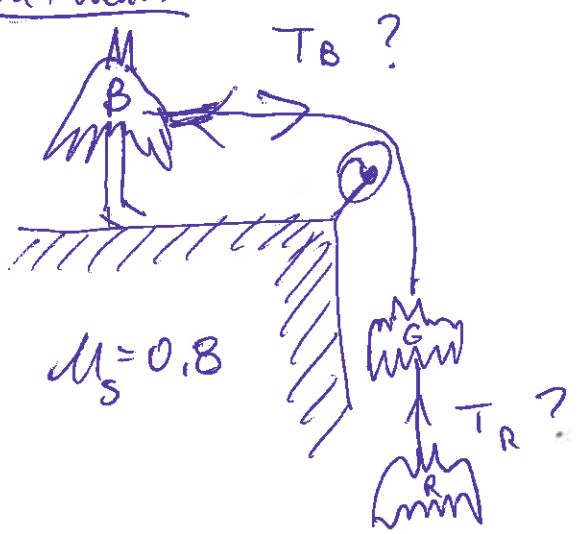


$R = \sqrt{72^2 + 28^2} = \boxed{77 \text{ m/s}}$

$\tan\theta = \frac{72}{28}$

$\boxed{\theta = 69^\circ}$

(4) Batman



$m_{BM} = 150\ kg$

$m_{BG} = m_R = 50\ kg$

A) $T_{BM} = (w_G + w_R) = (100\ kg)(10\ m/s^2) = 1000N$

$\boxed{T_{BM} = 1000N}$

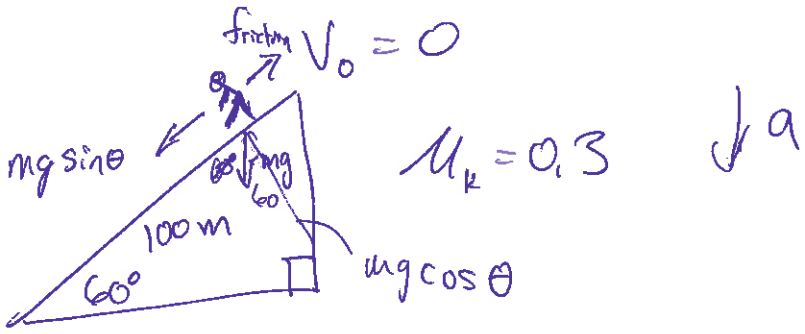
Static friction same and opposite as T_B.

Not $\mu_s N_{Bm}$!

B) $T_R = w_R = (50\ kg)(10\ m/s^2) = \boxed{500N}$

(5) **Black Widow:**

$m_{BW} = 50\ kg$



A) $\Sigma F_{||} = ma$

$\Sigma F_{||} = mg\sin\theta - (mg\cos\theta)\mu_k = ma$

$\sin\theta = 0.87 \approx 10$; $\cos\theta = 0.5 \approx 10$; $\mu_k = 0.3$

$8.7 - (5.0)(0.3) = a \quad [m/s^2]$

$8.7 - 1.5 = a$

Constant.

$\boxed{a = 7.2\ m/s^2}$

$a = 7$ is ok!

B) V_{Bottom}?

$\frac{dx}{dt} = V_0 + at$

$x = x_0 + V_0 t + \frac{1}{2} a_x t^2$

x : 100 m ; x_0 : 0 ; V_0 : 0 ; a_x : 7

$100\ m = 3.5\ t^2$

$t^2 = 29\ sec. \Rightarrow t = 5.4\ sec.$

$V = at = (7)(5.4) =$

$\boxed{V = 38\ m/s}$

(6) Flash

1. $t = 0$ to $t = 10$ sec $\quad V = 400$ m/s

2. $t = 10$ to 20 sec $\quad a = 10t^2$ m/s^4

A) V_f? B) Total distance?

$$V_f = V_0 + \int_0^{10\,\text{sec.}} a(t)\,dt = 400\,\text{m/s} + \left(\frac{10}{3}\right)\left(\frac{1}{3}t^3\right)_{t=10\,\text{sec}}^{3}$$

($V_0 = 400$ m/s, $a(t) = 10t^2$)

$$= 400 + 3333 \text{ m/s}$$

$$= \boxed{3733 \text{ m/s}}$$

B) Total distance

$x = d = vt$ for constant $v \Rightarrow$ $\boxed{d_1 = 4000 \text{ m}}$

d_2: $$d_2 = \int_0^{10\,\text{sec.}} V(t)\,dt$$

$$d_2 = V_0 t + \int_0^{10} \frac{10}{3} t^3\,dt$$

($V_0 = 400$ m/s, $t = 10$ sec.)

$$d_2 = 4000 \text{ m} + \frac{10}{12} t^4 \Big|_{10_s}$$

$$d_2 = 4000 \text{ m} + 8333 \text{ m}$$

$$\boxed{d_2 = 12\,333 \text{ m}}$$

Total $d = d_1 + d_2 = \boxed{16\,333 \text{ m}}$