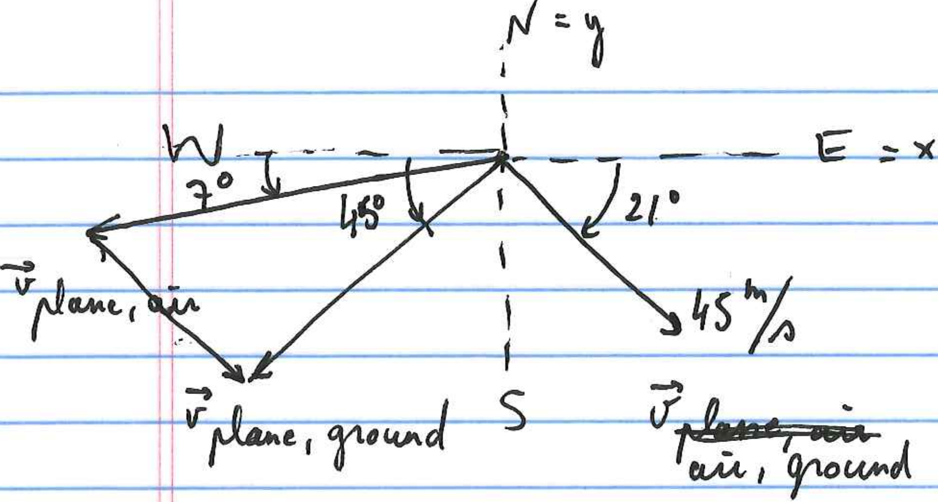


$\cos 60° = \frac{1}{2}$

$\sin 30° = \frac{1}{2}$

$\cos 45° = \sin 45°$

$\Downarrow = \frac{\sqrt{2}}{2}$

$\tan 45° = 1$

$$\vec{v}_{plane,\,ground} = \vec{v}_{plane,\,air} + \underbrace{\vec{v}_{air,\,ground}}$$

$$x: -|\vec{v}_{plane,\,ground}| \cos 45° = -|\vec{v}_{plane,\,air}| \cos 7° + 45\,\text{m/s} \cos \cancel{}\,21°$$

$$y: -|\vec{v}_{plane,\,ground}| \sin 45° = -|\vec{v}_{plane,\,air}| \sin 7° - 45\,\text{m/s} \sin 21°$$

$$x \to |\vec{v}_{plane,\,ground}| = \frac{1}{\cos 45°}\left(|\vec{v}_{plane,\,air}| \cos 7° - 45\,\text{m/s} \cos 21°\right)$$

$$y \to +\underbrace{\frac{\sin 45°}{\cos 45°}}_{1}\left(\underline{|\vec{v}_{plane,\,air}|} \cos 7° - 45\,\text{m/s} \cos 21°\right) = + \underline{|\vec{v}_{plane,\,air}|} \sin 7° + 45\,\text{m/s} \sin 21°$$

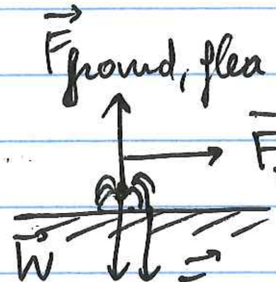
$$|\vec{v}_{plane,\,air}| \left(\cos 7° - \sin 7°\right) = 45\,\text{m/s}\left(\sin 21° + \cos 21°\right)$$

$$|\vec{v}_{plane,\,air}| = 45\,\text{m/s}\; \frac{\sin 21° + \cos 21°}{\cos 7° - \sin 7°} = 66.8\,\text{m/s}$$

$$|\vec{v}_{plane,\,ground}| = \frac{1}{\cos 45°}\left(66.8\,\text{m/s} \cos 7° - 45\,\text{m/s} \cos 21°\right)$$

$$= 34.3\,\text{m/s}$$

$|\vec{v}|$



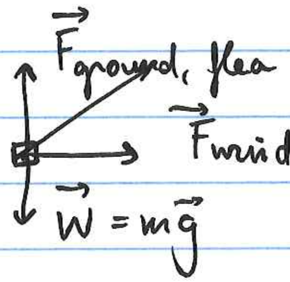
$\vec{F}_{wind} = 1.16 \times 10^{-6} N$

$m_{flea} = 6.0 \times 10^{-7} kg$

$\vec{F}_{flea, ground} = 1.27 \times 10^{-5} N$ down $\quad y: -1.27 \times 10^{-5} N$

3rd law

$\vec{F}_{ground, flea} = 1.27 \times 10^{-5} N$ up $\quad y: +1.27 \times 10^{-5} N$



$\vec{F}_{net} = \vec{F}_{ground, flea} + \vec{F}_{wind} + \vec{W}$

$x: \quad F_x = F_{wind} = 1.16 \times 10^{-6} N$

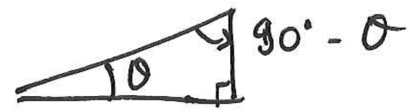
$y: \quad F_y = F_{ground, flea} - mg = 1.27 \times 10^{-5} N - (9.8 \, m/s^2)(6.0 \times 10^{-7} kg)$

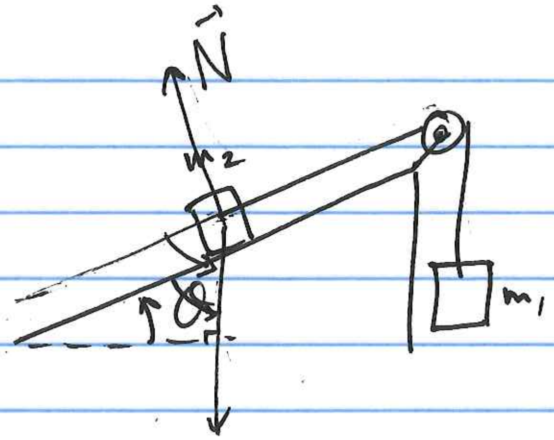
$F_x = 1.16 \times 10^{-6} N$

$F_y = 1.15 \times 10^{-5} N$

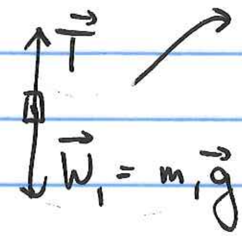
$\rightarrow |\vec{F}| = \sqrt{F_x^2 + F_y^2}$

$|\vec{F}| = |m\vec{a}| \rightarrow |\vec{a}| = \dfrac{|\vec{F}|}{6.0 \times 10^{-7} kg} = 11.5 \, m/s^2$





FBD:

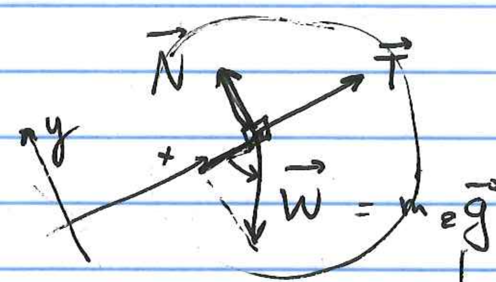


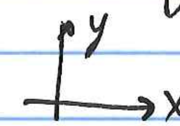
2nd

$T - m_1 g = 0 = a_{m_1}$

$\downarrow$

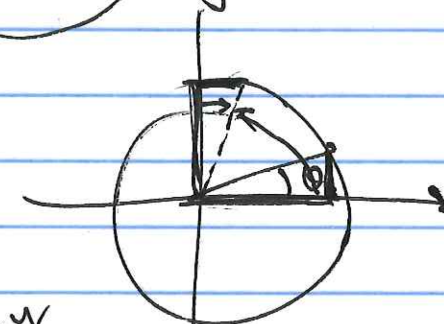
$T = m_1 g$





when is $\vec{a}_2 = 0$?

$\vec{F}_{net} = m\vec{a}_2 = 0$

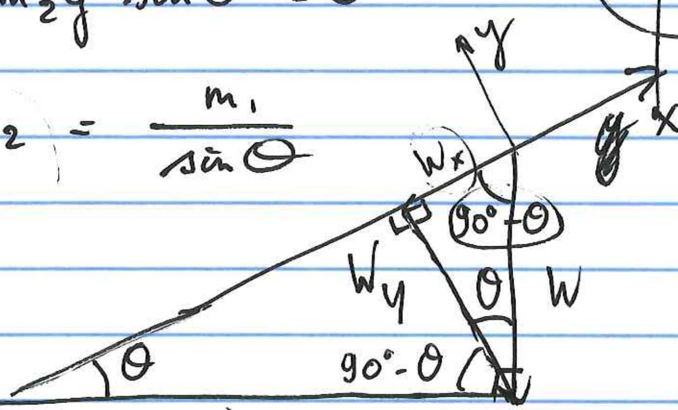


x: $T - m_2 g \cos(90° - \theta) = 0$

$T - m_2 g \sin\theta = 0$

$m_1 g - m_2 g \sin\theta = 0$

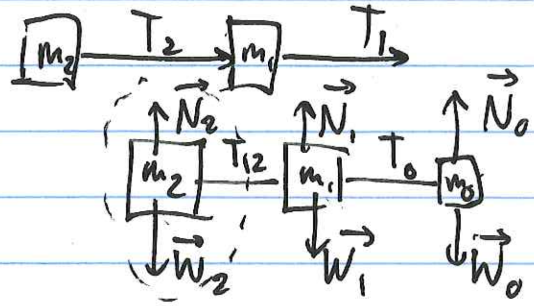
$\hookrightarrow m_2 = \dfrac{m_1}{\sin\theta}$

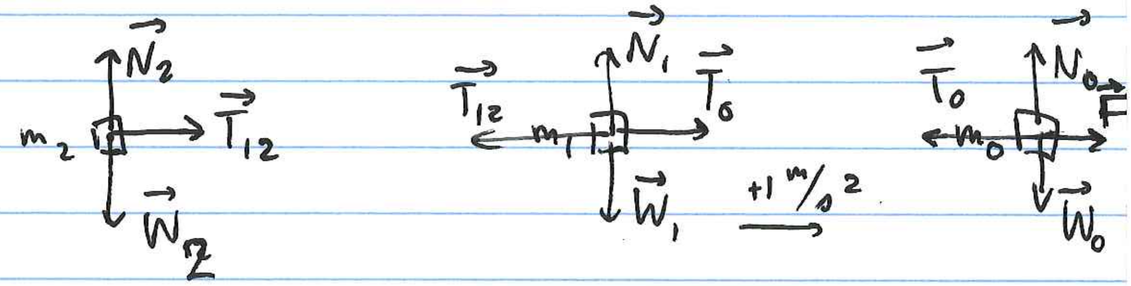


$W_y = -W \sin(90° - \theta) = -W\cos\theta$

y: $N - W \cancel{\sin} \cos\theta = 0$

$\hookrightarrow N = m_1 g \cos\theta$





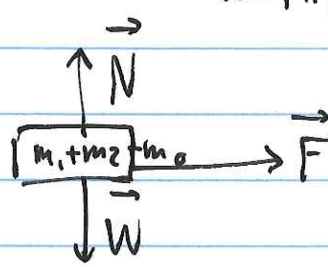
$\xrightarrow{1\,m/s^2}$ $\longrightarrow$ $F_{net,x,2} = m_2(+1\,m/s^2) = \underline{T_{12}}$

$F_{net,x,1} = m_1(+1\,m/s^2) = \underline{T_0} - T_{12}$

$F_{net,x,0} = m_0(+1\,m/s^2) = F - T_0$

$\downarrow$

F



$\underline{(m_1+m_2+m_0)(+1\,m/s^2)} = \vec{F}$

PHYS 107 - Midterm 1

ch2: kinematics
ch3: ballistic motion
ch4: Newton's laws

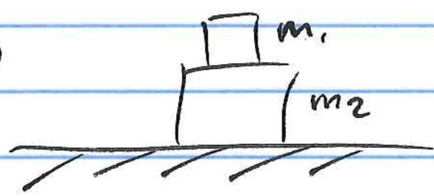
MC questions : * acceleration at highest point of ballistic trajectory
* velocity given vs. time → calculate acceleration and distance

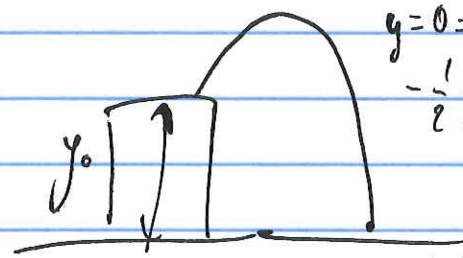
Q : contact forces between stacked masses

16 4 - 20

$18 + 2t - 5t^2 = 0$

$t = \frac{-2 \pm \sqrt{4 + 4\times5\times18}}{-10}$

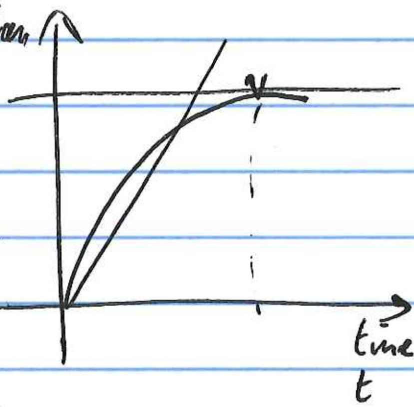




$y = 0 = y_0 + v_{0,y}t - \frac{1}{2}gt^2$

1 + 5×18

position y



$\begin{array}{r} 20 \\ 18 \\ \hline 360 \end{array}$ $\begin{array}{r} 20 \\ 16 \\ \hline 324 \end{array}$

$-\frac{1}{2}(10)t^2 + v_0 t$

$y_0 = \frac{1}{2}gt^2 - v_0 \sin\theta t$

$y_0 = 5t^2 - v_0\frac{t}{2}$

$h = \frac{v_0^2}{2g} = \frac{v_0^2}{20}$ $\boxed{2s}$

$20 - 2 = 18m$

$-\frac{1}{2}gt^2 = h$

100 - 64 = 36

$h = 20$
$t = 20$ $\rightarrow v_0 = 20$

$at^2 + bt = y$

$t = x$

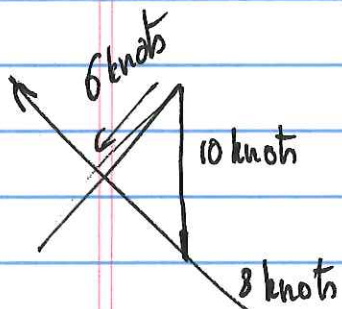
$2at + b = 0$

$b = -2at$

$15 = at^2 + bt = at^2 - 2at^2$
$= -2at^2$

$15 = t$

$a = \frac{15}{2t^2}$



$y_0 = 18m \rightarrow t = 2s$