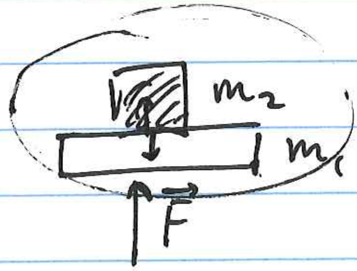
TopHat

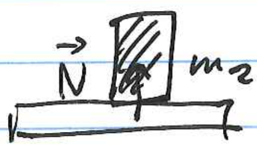


$$\vec{F}_{net} = \vec{F} + \vec{W}$$

$$F_{net,y} = F - (m_1 + m_2)g$$

$$30N - (2.5kg)\,10\,m/s^2 = 30N - 25N = 5N$$

$$\longrightarrow a = \frac{F_{net}}{m} = \frac{5N}{2.5\,kg} = +2\,m/s^2$$



$2.0\ m/s^2$

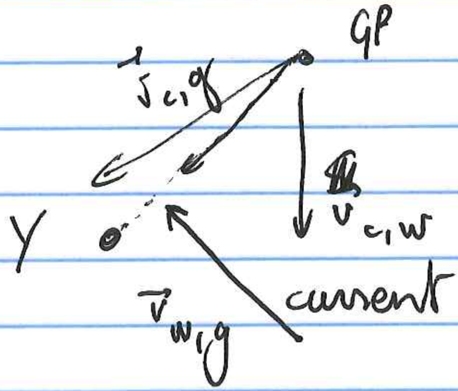
$$\vec{N} = F_{tray,\ bottle\ \&\ glasses}$$

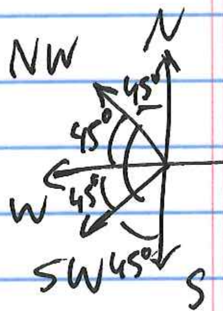
$$\vec{W}_2 = \underbrace{m_2 g}_{(2kg)(10\,m/s^2)} = -20N$$

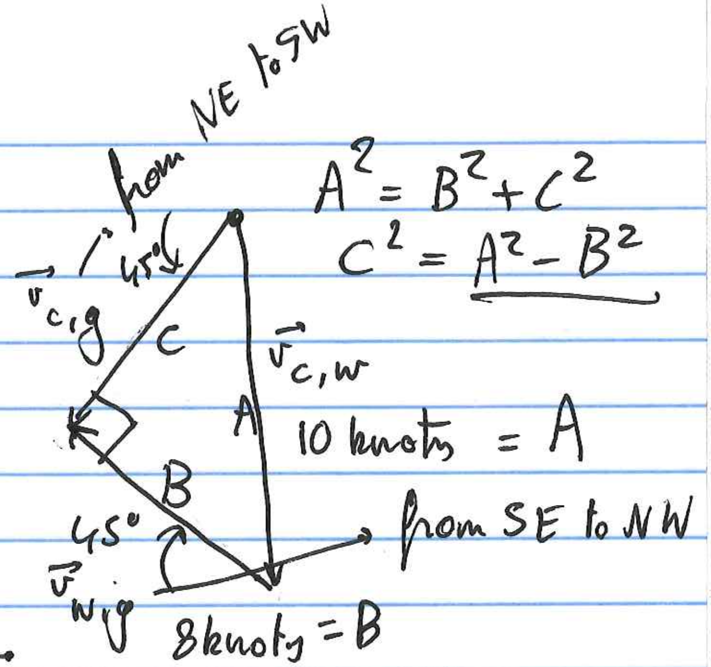
$$\underbrace{m_2 a}_{2kg \cdot 2\,m/s^2 \;=\; 4N} = F_{tray,bottle} - 20N$$

$$4N \longrightarrow \underline{F_{tray,\ bottle}} = 4N + 20N = 24N$$

$$\vec{F}_{bottle,\ tray} = -\vec{F}_{tray,\ bottle} = -24N$$





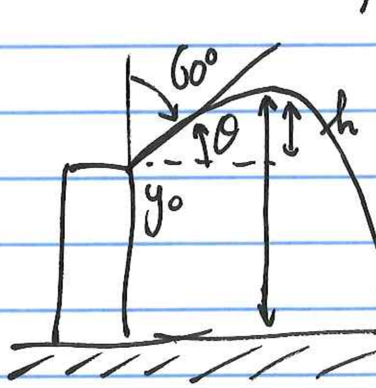


$A^2 = B^2 + C^2$

$C^2 = \underline{A^2 - B^2}$

$$|\vec{v}_{c,g}| = \sqrt{10^2 - 8^2} \text{ knots} = \sqrt{100-64} \text{ knots}$$
$$\sqrt{36} \text{ knots}$$
$$6 \text{ knots}$$

$6 \text{ knots} = 6 \text{ nm/hour} \rightarrow 2 \text{ nm} \rightarrow \underline{\tfrac{1}{3} \text{ hour}}$



$$= \frac{\overset{4 \text{ m/s}}{v_0^2} \sin^2\theta}{2g} = 0.2 \text{ m} = \frac{(4 \text{ m/s})^2 \left(\frac{1}{2}\right)^2}{2(10 \text{ m/s}^2)}$$
$$+16.0 \text{ m}$$
$$y_0$$
$$\hookrightarrow y_{max} = 16.2 \text{ m}$$

$$v_{0,y} = v_0 \sin\theta = 4 \text{ m/s} \cdot \sin 30° = 2 \text{ m/s}$$

$$y = 0 = y_0 + \underbrace{v_{0,y}}_{2 \text{ m/s}} t - \frac{1}{2} g t^2 \quad \text{only } y\text{-components}$$

$$\hookrightarrow 0 = 16 + 2t - 5t^2 \rightarrow t = \frac{-2 \pm \sqrt{4 + 320}}{2(-5)}$$

$$= \begin{cases} \cancel{-1.6 \text{ s}} \\ \underline{+2.0 \text{ s}} \end{cases}$$

$$v_y = v_{0,y} - gt = 2 \text{ m/s} - 20 \text{ m/s}$$
$$= -18 \text{ m/s}$$

$$h = \frac{v_0^2 \sin 60°}{2g} = \frac{(4\,m/s)^2 \left(\frac{\sqrt{3}}{2}\right)^2}{2g} = 0.6\,m$$

$$\hookrightarrow y_{max} = 16.0\,m + 0.6\,m = \underline{16.6\,m}$$

$$v_{0,y} = 4\,m/s \sin 60° = 4 \cdot \frac{\sqrt{3}}{2}\,m/s$$

$$\underline{2\sqrt{3}\,m/s}$$

$$y = 0 = 16.0\,m + 2\sqrt{3}\,m/s\,t - 5\,m/s^2\,t^2$$

$$\hookrightarrow t = \frac{-2\sqrt{3}\,m/s \pm \sqrt{}}{2(-5\,m/s^2)}$$

$$\cancel{v_y = v_{0,y} - gt}$$

$$v_y^2 = v_{0,y}^2 - 2g(y - y_0)$$

$$v_y^2 = (2\sqrt{3})^2 - (20)(16\,m) \rightarrow \sqrt{}$$

* Gravitational force in circular motion

$$\underline{a_c} = r\omega^2 \rightarrow F_c = F_G = G\frac{M_1 M_2}{r^2} = ma_c$$

$$F_G = G\frac{M_{Earth}\, m_W}{r_E^2} \rightarrow a_c = \frac{F_G}{m_W}$$

$r_E = 6380\,km$

$M_E = 5.98 \times 10^{24}\,kg$

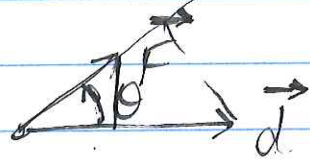
$G = 6.673 \times 10^{-11}\,\frac{Nm^2}{kg^2}$

$$a_c = G\frac{M_{Earth}}{r_E^2} = \underline{\underline{9.80\ m/s^2}}$$

$$\vec{W} = m\vec{g}$$

Work & Energy

Work = force times distance of motion parallel to the direction of the force



$$\boxed{W = |\vec{F}| \cdot |\vec{d}| \cdot \cos\theta}$$

$$d_F = |\vec{d}| \cos\theta$$

$$\rightarrow W = |\vec{F}|\, d_F = F d \cos\theta$$

$$W = d\, F_d = F d \cos\theta$$

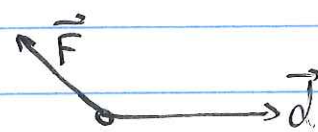
$$F_d = F\cos\theta$$

$0 < \theta < 90° \rightarrow \cos\theta > 0 \rightarrow W > 0$

add energy

$\theta = 90° \rightarrow \cos\theta = 0 \rightarrow W = 0$

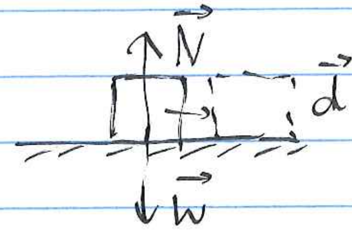
$\theta > 90°$



$\rightarrow W < 0$

lose energy

$\vec{F} \perp \vec{d}$:



$\vec{N} \perp \vec{d}$

$\rightarrow W_N = 0$