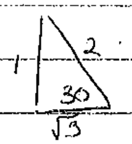
① $h=3$ $\quad \vec{r}(t)=120\cos\theta\, t\,\vec{i}+\left[3+120\sin\theta\, t-16t^2\right]\vec{j}$

$v_0=120$

$\theta=30^\circ$ $\quad \vec{r}(t)=60\sqrt{3}\,t\,\vec{i}+\left[3+60t-16t^2\right]\vec{j}$



$x=60\sqrt{3}\,t$ $\qquad y=3+60t-16t^2$

$385=60\sqrt{3}\,t$ $\qquad y=3+60\left(\frac{77}{12\sqrt{3}}\right)-16\left(\frac{77}{12\sqrt{3}}\right)^2$

$\frac{77}{12\sqrt{3}}=t$ $\qquad y=3+\frac{385}{\sqrt{3}}-\frac{94864}{432}$

$\frac{77\sqrt{3}}{36}=t$

$y=5.687$ ft

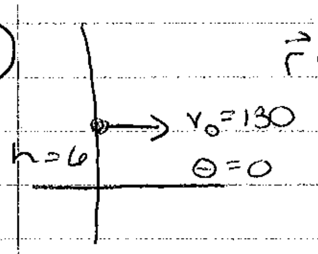
will not clear 6 ft wall

② $x=120\cos(31)\,t$ $\qquad y=3+120\sin 31\, t-16(t)^2$

$385=120\cos(31)\,t$ $\qquad y=10.177$ ft

$3.742948816=t$ $\qquad \therefore$ will clear 6 ft wall

③ $\vec{r}(t)=130\cos\theta\, t\,\vec{i}+\left[6+130\sin 0-16t^2\right]\vec{j}$



$\vec{r}(t)=130t\,\vec{i}+\left[6-16t^2\right]\vec{j}$

$x=130t$ $\qquad y=6-16t^2$

$60=130t$ $\qquad y=6-16\left(\frac{6}{13}\right)^2$

$\frac{6}{13}=t$ $\qquad y=2.592$ ft

$\cancel{y}=8-16\left(\frac{1}{2}\right)^2$ $\qquad 60=120t$

$\cancel{y}=8-4$ $\qquad \frac{1}{2}=t$

$y=4$ in air

④ $\vec{r}(t)=120t\,\vec{i}+\left[8-16t^2\right]\vec{j}$

$x=120t$ $\qquad y=8-16t^2$ $\qquad\Big|\qquad 0=8-16t^2$ $\qquad x=120t$

$39=120t$ $\qquad y=8-16\left(\frac{39}{120}\right)^2$ $\qquad\Big|\qquad 16t^2=8$ $\qquad x=120\sqrt{\frac{1}{2}}$

$\frac{39}{120}=t$ $\qquad\Big|\qquad t^2=\frac{1}{2}$

$y=6.31$ ft $\qquad\Big|\qquad t=\sqrt{\frac{1}{2}}$ $\qquad x=84.85$

$\therefore$ clears net $\qquad \therefore$ serve is out

5) $\vec{r}(t) = 80t\,\vec{i} + [8 - 16t^2]\,\vec{j}$

a) $x = 80t$ $\quad y = 8 - 16t^2$

$39 = 80t$ $\quad y = 8 - 16\left(\frac{39}{80}\right)^2$

$\frac{39}{80} = t$

$y = 4.1975$

$\therefore$ clears net

$60 = 80t$ $\quad 0 = 8 - 16t^2$

$3/4 = t$ $\quad t = \sqrt{1/2}$

$y = 8 - 16\left(\frac{3}{4}\right)^2$ $\quad x = 80\sqrt{1/2}$

$y = -1$ $\quad x = 56.569$

$\therefore$ serve is in

b) $x = 65t$ $\quad y = 8 - 16\left(\frac{39}{65}\right)^2$

$39 = 65t$

$\frac{39}{65} = t$ $\quad y = 2.24$

doesn't clear net

6) $\vec{r}(t) = 900\cos 45\, t\,\vec{i} + [3 + 900\sin 45 t - 16t^2]\,\vec{j}$

$h = 3$ $\quad \vec{r}(t) = 450\sqrt{2}\,t\,\vec{i} + [3 + 450\sqrt{2}t - 16t^2]\,\vec{j}$

$v_0 = 900$

$\theta = 45$ $\quad$ max : $\frac{dy}{dx} = 0$ $\quad \frac{450\sqrt{2} - 32t}{450\sqrt{2}} = 0$

$\frac{450\sqrt{2}}{32} = t$

max height at

$y = 3 + 450\sqrt{2}\left(\frac{450\sqrt{2}}{32}\right) - 16\left(\frac{450\sqrt{2}}{32}\right)^2$

max height : $y = \cancel{3\ldots}\ 6331.125$ ft

lands : $0 = 3 + 450\sqrt{2}t - 16t^2$

$t = 39.77947$

$x = 450\sqrt{2}(39.77947)$

$x = 25315.49969$ ft

horizontal range

(7) $h = 3$ $\quad \vec{r}(t) = v_0 \cos\theta\, t\, \vec{i} + \left[h + v_0 \sin\theta\, t - 16t^2\right]\vec{j}$

$\theta = 45^\circ$

$x = 300$ $\quad \vec{r}(t) = \frac{v_0\sqrt{2}}{2} t\, \vec{i} + \left[3 + \frac{v_0\sqrt{2}}{2} t - 16t^2\right]\vec{j}$

$v_0 = ?$

$y = ?$

$$\boxed{\frac{v_0\sqrt{2}}{2} t} = 300 \qquad 3 + \boxed{\frac{v_0\sqrt{2}}{2} t} - 16t^2 = 3$$

$$v_0 \frac{\sqrt{2}}{2} \cdot \frac{5\sqrt{3}}{2} = 300 \qquad 3 + 300 - 16t^2 = 3$$

$$300 = 16t^2$$

$$v_0 5\sqrt{6} = 1200 \qquad \frac{5}{2}\sqrt{3} = \frac{10}{4}\sqrt{3} = \sqrt{\frac{300}{16}} = t$$

$$v_0 = \frac{1200}{5\sqrt{6}} = \frac{240}{\sqrt{6}} = \frac{240\sqrt{6}}{6} = 40\sqrt{6}$$

$$v_0 = 97.979 \text{ ft/sec}$$

max height occurs at $\quad 0 = \frac{\cancel{1}200}{5\sqrt{6}} \cdot \frac{\sqrt{2}}{\cancel{2}} - 32t$

$$0 = \frac{\cancel{8}\,120}{\sqrt{3}} - 32t$$

$$t = \frac{120}{32\sqrt{3}} = \frac{\cancel{30}\;15}{4\sqrt{3}}$$

$$y = 3 + 40\cancel{\sqrt{6}} \cdot \frac{\sqrt{2}}{\cancel{2}} \cdot \frac{120}{32\cancel{\sqrt{3}}} - 16\left(\frac{15}{4\sqrt{3}}\right)^2$$

$3 + 150 - 75$

? $y = \cancel{7}78$ ft

max height

$\therefore$ rose $\cancel{7}78$ ft in air

$72 \sim 78$

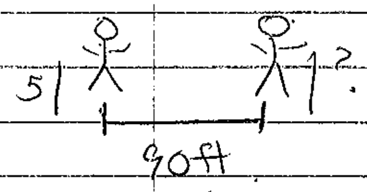
$h=5$

(8) $v_0=50$ $\quad \vec{r}(t) = 73\tfrac{1}{3}\cos 15\, t\, \vec{i} + \left[5 + 73\tfrac{1}{3}\sin 15 t - 16t^2\right]$

$\theta = 15 \quad\quad 90 = \frac{220}{3}\cos 15\, t$

$y = 5 + \frac{220}{3}\sin 15(1.271) - 16(1.27$

$1.271 = t$



$y = 3.2766$ ft
height when caught

$\frac{50\,m}{h} \cdot \frac{1h}{60m} \cdot \frac{1m}{60sec} \cdot \frac{5280ft}{1m} = 73\tfrac{1}{3}\ \text{ft/sec}$

(9) $x = v_0 \cos t \quad\quad y = h + v_0 \sin\theta\, t - 16t^2$

$\frac{x}{v_0\cos\theta} = t \quad\quad y = h + \frac{\cancel{v_0}\sin\theta\, x}{\cancel{v_0}\cos\theta} - 16\left(\frac{x}{v_0\cos\theta}\right)^2$

$$y = \frac{-16\sec^2\theta}{v_0^2}x^2 + (\tan\theta)x + h$$

10) $\tan\theta = 1 \quad\quad \frac{-16\sec^2\theta}{v_0^2} = -.005$

$\theta = \frac{\pi}{4}$

$\frac{\sqrt{2}}{2} \quad\quad \frac{-16(2)}{v_0^2} = -.005$

$\sec\frac{\pi}{4} = \frac{2}{\sqrt{2}} = \sqrt{2} \quad\quad \frac{+32}{.005} = v_0^2 = 6400$

$v_0 = 80$ ft/sec

$x = 80\cos\frac{\pi}{4}t$

$x = \frac{80\sqrt{2}}{2}t = 40\sqrt{2}t$

$\vec{v} = \langle 80\cos\frac{\pi}{4},\ 80\sin\frac{\pi}{4} - 32t\rangle$

$\frac{60}{40\sqrt{2}} = 40\sqrt{2}t \quad\quad \vec{v} = \langle 40\sqrt{2},\ 40\sqrt{2} - 32t\rangle$

$\vec{v}\left(\frac{3\sqrt{2}}{4}\right) = \langle 40\sqrt{2},\ 40\sqrt{2} - 24\sqrt{2}\rangle$

$\frac{3\sqrt{2}}{4} = \frac{3}{2\sqrt{2}} = t \quad\quad = \langle 40\sqrt{2},\ 16\sqrt{2}\rangle$

$|\vec{v}| = \sqrt{3200+512} \approx 60.926$