1. (a) $a = kt^2 = \frac{dv}{dt}$,

$dv = a\,dt = kt^2\,dt$

hence $\int dv = \int kt^2\,dt$

$v = \frac{1}{3}kt^2 + C$

because $v = -8\ ft/s \quad t = 0$

and $v = +8\ ft/s \quad t = 2s$

$k = 6 \quad C = -8 = v_0$

(b) $v(t) = v_0 + at$

$= v_0 + \frac{k}{3}t^3$

$= -8 + 2t^3$

$= \frac{dx}{dt}$

$dx = (-8 + 2t^3)\,dt$

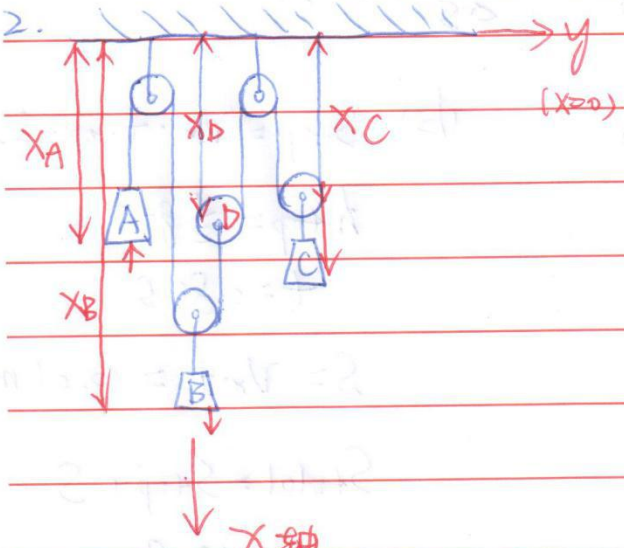
$x = -8t + \frac{1}{2}t^4 + C'$

because $x = 0 \quad t = 2s$

So $C' = 8$

$x = \frac{1}{2}t^4 - 8t + 8 \ (ft)$

2.



(a) $\begin{cases} x_A + x_B + (x_B - x_D) = \text{constant} \\ 2x_D + 2x_C = \text{constant} \end{cases}$

So $\begin{cases} v_A + 2v_B - v_D = 0 \\ 2v_D + 2v_C = 0 \end{cases}$

$\begin{cases} a_A + 2a_B - a_D = 0 \\ 2a_D + 2a_C = 0 \end{cases}$

because $a_A = 6\ in/s$

$v_B = -3\ in/s$

when $v_C = 0$

$V_D = 0$

$V_A = 6\ in/s$

$t = \frac{V_A}{a_A} = 1\ s$

(b) $\frac{\Delta x}{\Delta t} = v$

$$\Rightarrow \begin{cases} \Delta X_A + 2\Delta X_B - \Delta X_D = 0 \\ 2\Delta X_C + 2\Delta X_B = 0 \end{cases}$$

use $V_A^2 = 2a_A \cdot \Delta X_A$

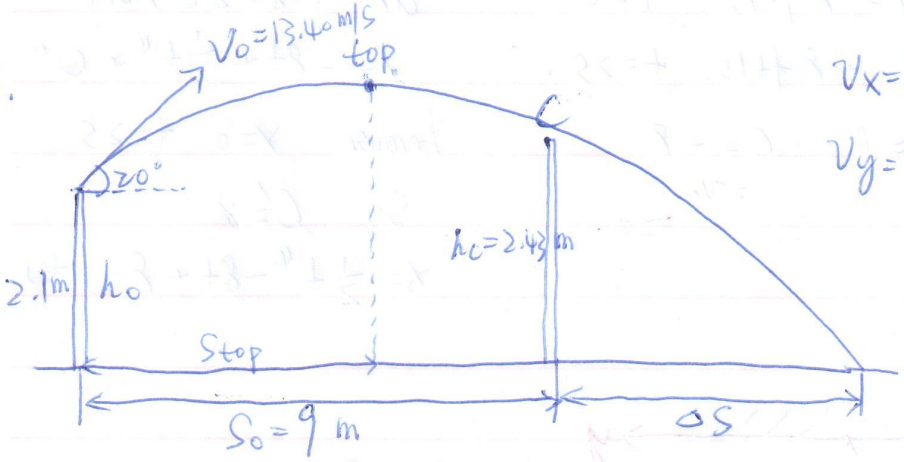
$\Delta X_A = 3\ in$

$\Delta X_B = V_B \cdot t = -3\ in$

$\Delta X_D = 3\ in$

$\Delta X_C = -3\ in$

3.



$V_x = V_0 \cos 20° = 12.59\ m/s$

$V_y = V_0 \cos 20° = 4.58\ m/s$

(a) $h_{top} = \frac{V_y^2}{2g} + h_0 = 3.17\ m$

$(g = 9.81\ m/s^2)$

$t_{top} = \frac{V_y}{g} = 0.47\ s$

$t_{net} = \frac{S}{V_x} = 0.71\ s$

$\Delta t = t_{net} - t_{top} = 0.24\ s$

$h_{net} = h_{top} - \frac{1}{2} g \Delta t^2 = 2.89\ m$

$h_{net} > h_C = 2.43\ m$

$\therefore$ the ball could clear the net

(b) $S_{top} = V_x \cdot t_{top} = 5.92\ m$

$h_{top} = \frac{1}{2} g t^2$

$t = 0.80\ s$

$S = V_x \cdot t = 10.01\ m$

$S_{total} = S_{top} + S$

$= 15.93\ m$

$\Delta S = S_{total} - S_0$

$= 6.93\ m$