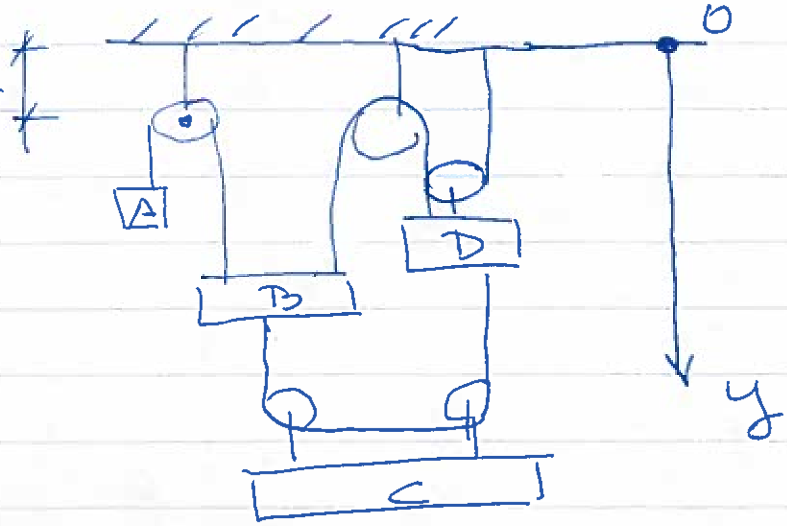
1. There are three ropes.

$L_1 = L_{A-B}$, $L_2 = L_{BDO}$, $L_3 = L_{BCD}$.

(O = top wall).



this is constant.

Pick O on top, y ↓

Rope L_1:

$$L_1 = (y_A - 0) + (y_B - 0).$$

$$L_2 = (y_B - 0) + (y_D - 0) + (y_D - 0)$$

$$L_3 = (y_C - y_B) + (y_C - y_D)$$

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

$$\begin{cases} a_A + a_B = 0 & (1) \\ a_B + 2a_D = 0 & (2) \\ 2a_C - a_B - a_D = 0 & (3) \end{cases}$$

Eliminate a_B between (2) and (3)

$\longrightarrow$ $a_B = -2a_D$

$2a_C + a_D = 0$.

So $a_D = -2a_C$.

Eliminate a_B between (1) and (2)

$a_A - 2a_D = 0$.

$a_A = 2a_D = -4a_C$

$a_{A/D} = a_A - a_D$

$= -4a_C + 2a_C = -2a_C$

Likewise, $v_{A/D} = -2v_C$ $(v_C \downarrow)$

At $t=0$, $v_C = 0 \rightarrow v_{A/D} = 0$

$v_{A/D} = a_{A/D}\, t$ $(v_{A/D} \uparrow)$

$8 \text{ ft/s} = a_{A/D} \times 5\text{s}$.

$a_{A/D} = 1.6 \text{ ft/s} \uparrow$

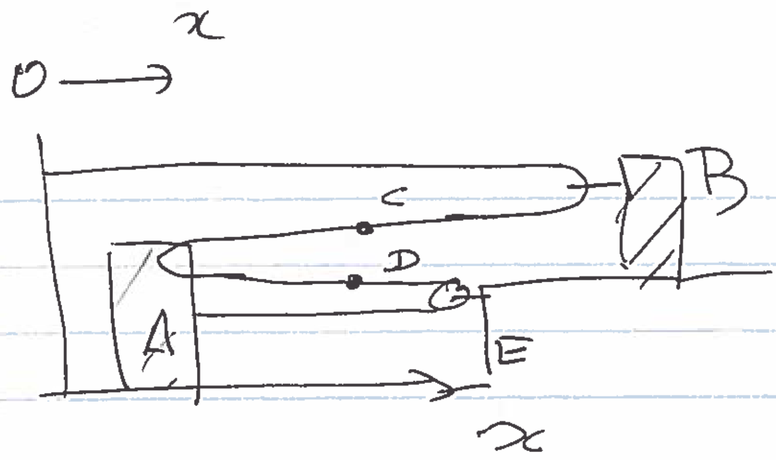
$a_C = -\dfrac{a_{A/D}}{2} = 0.8 \text{ ft/s} \downarrow$

$$a_E = 2\,a_D$$

$$a_D = -2\,a_C = 1.6 \text{ ft/s} \uparrow$$

$$a_E = 3.2 \text{ ft/s} \uparrow$$

2.



a) $L = x_B + (x_B - x_A) + (x_E - x_A) + (x_E - x_A)$

$0 = 2v_B - 3v_A$

$2a_B - 3a_A = 0$.

a_B constant $\rightarrow$ a_A also
and other accelerations too.

At $t = 0$, $v_B = 6$ m/s.
so $v_A = \frac{2}{3} v_B = 4$ m/s.

After moving + 10 in, $v_A = 2.4$ in/s

use $a = \frac{1}{2} \frac{d(v^2)}{dx}$

$2 a_A \Delta x = v_{A2}^2 - v_{A1}^2$

$2 a_A \times 10 = 2.4^2 - 4^2$

$a_A = -0.51$ m/s

$2 a_A = -\frac{16 - 5.76}{10} = -1.02$ in/s^2

$a_B = \frac{3}{2} a_A = -1.53$ m/s^2 = 0.765 m/s^2

b.) $L_D = x_B + x_B - x_A + x_D - x_A$

$$0 = 2v_B - 2v_A + v_D .$$

$$2a_B - 2a_A + a_D = 0$$

$$a_D = 2(a_A - a_B) = \frac{2}{2}(-1.02 + 1.53) = \cancel{1.02}\ 0.51\ \text{m/s}^2$$

c). $v_B = v_{B0} + a_B t$

$$\Delta x_B = v_{B0} t + \frac{1}{2} a_B t^2$$

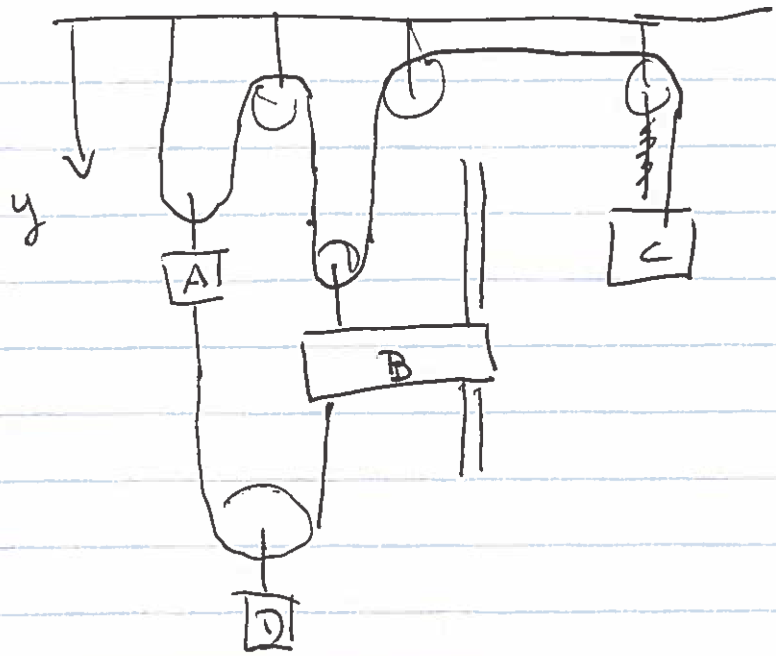
$v_{B0} = 6$ m/s. $a_B = \cancel{-1.53}\ -0.765$ m/s^2

$t = 4$ s

So $v_B = 6 - \frac{1.53}{2} \times 4 = \cancel{-0.12}\ 2.94$ m/s

$$\Delta x_B = 6 \times 4 + \frac{1}{2}\left(\frac{-1.53}{2}\right) \times 16 = \cancel{11.8}\ 17.9\ \text{m}$$

3.



Observe: two cables.

$$L_1 = y_A + y_A + 2y_B + y_C$$

$$L_2 = y_D - y_A + y_D - y_B.$$

$$2a_A + 2a_B + a_C = 0 \qquad (1)$$

$$2a_D - a_A - a_B = 0 \qquad (2)$$

Also: $a_{C/B} = a_C - a_B = -120 \text{ mm/s}^2$ (3)

$a_{D/A} = a_D - a_A = 220 \text{ mm/s}^2$ (4)

Four eqns, four unknowns

a_A a_B, a_C, a_D

Solve.

Eliminate a_B and a_A.

$$a_B = a_C + 120$$
$$a_A = a_D - 220.$$

$$2a_D - 440 + 2a_C + 240 + a_C = 0$$
$$2a_D - a_D + 220 - a_C - 120 = 0.$$

$$2a_D + 3a_C = 200$$
$$a_D - a_C = -100$$

$$5a_C = 200 + 200 = 400 \text{ mm/s}^2$$
$$\begin{cases} a_C = 80 \text{ mm/s}^2 \\ a_D = -20 \text{ mm/s}^2. \end{cases}$$

a) $v_C(0) = 0$

$v_C = a_C t$

After 6 s, $v_C = 80 \times 6$

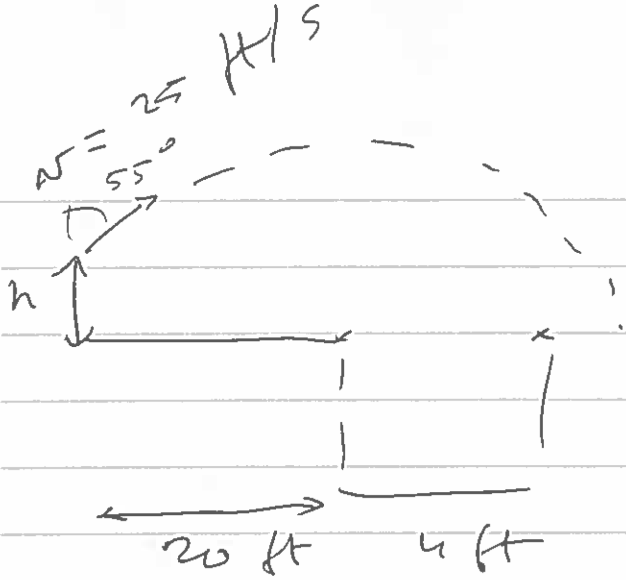
$= 480$ mm/s

b) $\Delta y_D = \underbrace{v_D(0)}_{=0} t + \frac{1}{2} a_D t^2$

$= \frac{1}{2} \times (-20) \times 100 =$

-1000 mm

4:



$$v_{0x} = 25 \sin 55^\circ$$

$$v_{0y} = 25 \cos 55^\circ \qquad y_0 = h.$$

For C: $x = 25 \sin 55 \, t = 24$ ft.

$$y = h + 25 \cos 55 \, t - \frac{1}{2} g t^2$$

$$t = \frac{24}{25 \sin 55}$$

$$0 = h + \frac{24}{\tan 55} - \frac{1}{2} g \frac{24^2}{25^2 \sin^2 55}$$

$$h = 24 \left[\frac{-1}{\tan 55} + \frac{32.2}{2} \frac{24}{(25 \sin 55)^2} \right]$$

$$h_c = 5.31 \text{ ft.}$$

$= $ ~~[illegible] ft~~.

For B, replace 24 ft by 20 ft.

$\longrightarrow h_B = $ ~~[illegible]~~ 1.35 ft.

$1.35 \le h \le 5.31$ ft.