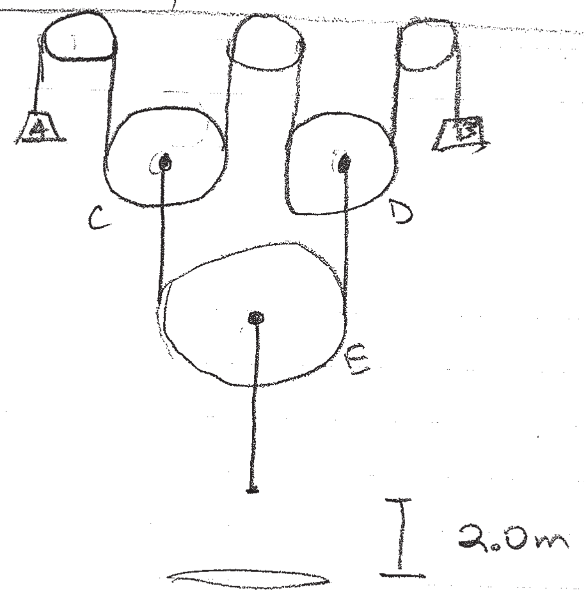
$\frac{10}{10}$ ss

TAM212
The Pulley System Strikes Back

Given:



$\ddot{y}_A = 3 m/s^2 \downarrow$

$\ddot{y}_B = 5 m/s^2 \uparrow$

$d = 2.0 m$

Find: time it takes for pulley E to go down 2.0m

Solution:

+1.5 $l_1 = y_A + 2y_C + 2y_D + y_B$

+1.5 $l_2 = (y_E - y_C) + (y_E - y_D) = 2y_E - y_C - y_D$

+1.5 $\ddot{l}_1 = \ddot{y}_A + 2\ddot{y}_C + 2\ddot{y}_D + \ddot{y}_B = 0$

+1.5 $\ddot{l}_2 = 2\ddot{y}_E - \ddot{y}_C - \ddot{y}_D = 0$

$\therefore \quad -4\ddot{y}_E + 2\ddot{y}_C + 2\ddot{y}_D = 0$

$\ddot{y}_A + \ddot{y}_B + 2\ddot{y}_C + 2\ddot{y}_D = -4\ddot{y}_E + 2\ddot{y}_C + 2\ddot{y}_D$

$\ddot{y}_A + \ddot{y}_B = -4\ddot{y}_E$

$3 m/s^2 - 5 m/s^2 = -4\ddot{y}_E$

$\ddot{y}_E = .5 m/s^2$ +0.5

$d = v_0 t + \frac{1}{2}at^2$ +3

$2.0 m = 0(t) + \frac{1}{2}(.5 m/s^2) t^2$ +0.5

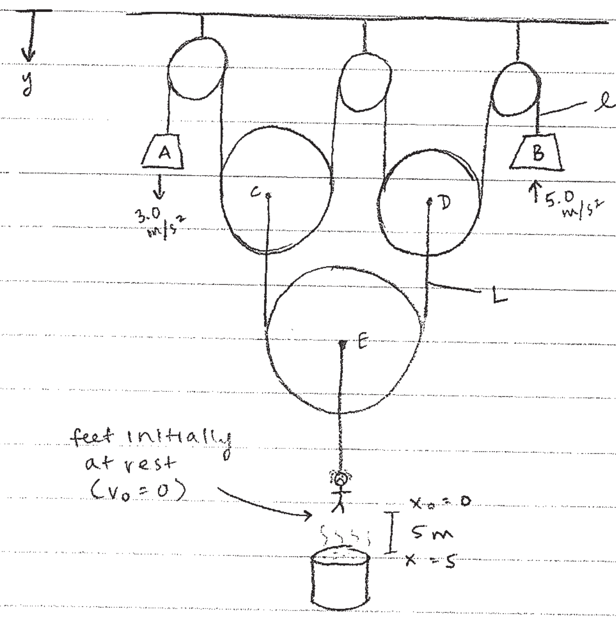
$8.0 m = t^2$

$\boxed{t = 2\sqrt{2} \text{ sec}}$

$\frac{10}{10}$ SS

TAM 212, AD1
RECTILINEAR MOTION
9/7/12

2. The Pulley System Strikes Back



Find: time (t) for Aunt May to enter serum.

Solve: $l = y_A + 2y_C + 2y_D + y_B + c_1$ +1.5

$L = (y_E - y_C) + (y_E - y_D) + c_2$ +1.5

$l + 2L = y_A + y_B + 4y_E + c_3$ +1.5

$0 = \dot{y}_A + \dot{y}_B + 4\dot{y}_E$

$0 = \ddot{y}_A + \ddot{y}_B + 4\ddot{y}_E$ +1.5

$\ddot{y}_E = -\frac{1}{4}(\ddot{y}_A + \ddot{y}_B) \implies -\frac{1}{4}(3-5)$

$= -\frac{1}{4}(-2)$

$\ddot{y}_E = \frac{1}{2} m/s^2$ +0.5

+1.5 $\dot{y}_E = \int \frac{1}{2} dt = \frac{1}{2}t + C_v$ $[C_v = v_0 = 0]$

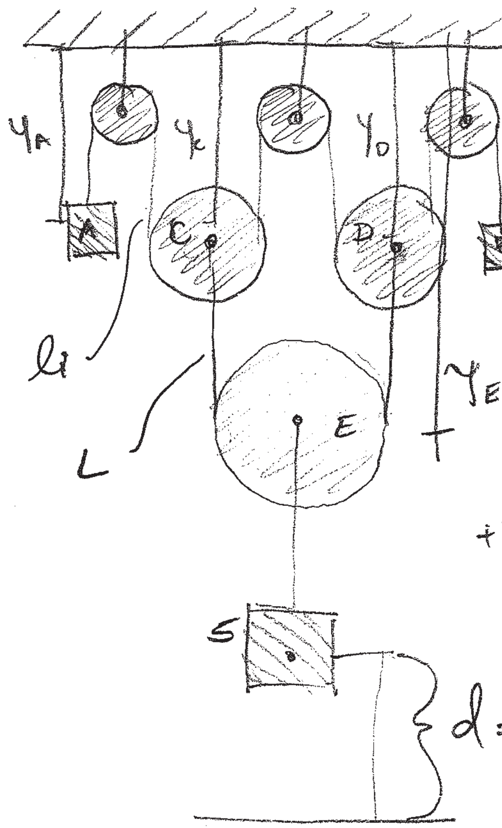
+1.5 $y_E = \int \dot{y}_E dt = \frac{1}{4}t^2 + C_v t + C_x$ $[C_x = x_0 = 0]$

$5 = \frac{1}{4}t^2 + 0(t) + 0$

$\implies \boxed{t = 4.472 s}$ +0.5

THE PULLEY STRIKES BACK. $\frac{10}{10}$ SS

AD4



$\boxed{\text{GIVEN}}$ $a_A(t) = -3.0 m/s^2 = \ddot{y}_A$
$a_B(t) = 6.0 m/s^2 = \ddot{y}_B$
$d = 4.0 m$

$\boxed{\text{FIND}}$ TIME (t) BEFORE MASS (S) REACHES GROUND.

$$l = y_A + y_C + y_C + y_D + y_D + y_B + \text{const}_1$$

$$+1.5 \quad = y_A + 2y_C + 2y_D + y_B + \text{const}_1$$

$$L = (y_E - y_C) + (y_E - y_D) + \text{const}_2$$

$$+1.5 \quad \left[L = 2y_E - y_C - y_D + \text{const}_2\right] \times 2$$

$$2L = 4y_E + 2y_C - 2y_D + 2\,\text{const}_2.$$

$$d = 4m \quad \left[2L + l \overset{+1.5}{=} y_A - y_B + 4y_E + \text{const}_3\right] \frac{dy}{dx}$$

$$\left[0 = \dot{y}_A + \dot{y}_B + 4\dot{y}_E\right] \frac{dy}{dx}$$

$$+1.5 \quad 0 = \ddot{y}_A + \ddot{y}_B + 4\ddot{y}_E$$

$$0 = -3.0 m/s^2 + 6.0 m/s^2 + 4\ddot{y}_E$$

$$\frac{4\ddot{y}_E}{4} = \frac{3.0 m/s^2}{4} \quad +0.5$$

$$\int_0^t\int_0^4 \ddot{y}_E = \int_0^t\int_0^4 -3/4 \; dt \quad +3$$

FIND HOW LONG IN (t) IT TAKES TO MOVE 4m.

$$\frac{8}{3}(4m) = \left(-3/8\, t^2\right) \cdot \frac{8}{3}$$

$$\sqrt{\frac{32}{3}} = \sqrt{t^2}$$

$$\boxed{3.27 s = t} \quad +0.5$$