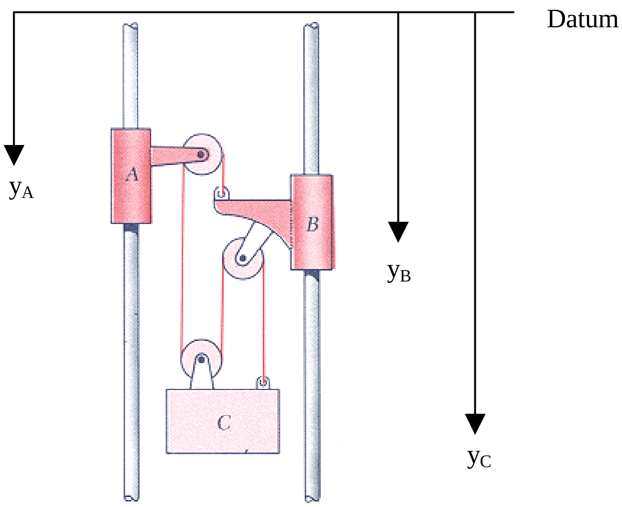
Example Problem - Le 02

11.48 Collar A starts from rest at t=0 and moves upward with a constant acceleration of 3.6 in/s^2. Knowing that collar B moves downward with a constant velocity of 16 in/s, determine:

(a) the time at which the velocity of block C is zero,
(b) the corresponding position of block C.

(*taken from Vector Mechanics for Engineers, 5th Edition by Beer & Johnston*)



<u>Known</u>: at t=0, v_A=0
a_A=3.6 in/s^2 (const)
v_B = 16 in/s (const) a_B = 0

<u>Find</u>: time when v_C = 0
corresponding position of C

<u>Strategy</u>: This problem only involves velocities and accelerations, therefore only kinematics are required. We'll probably need to start with dependent motion and then do clever things with integration.

Dependent Motion:

Based on the above selection of datum and position vectors, make sure you can come up with

$$L = (y_B - y_A) + (y_C - y_A) + 2(y_C - y_B) + Const$$
$$= -2y_A - y_B + 3y_C + Const$$

Differentiating:

$$0 = -2v_A - v_B + 3v_C \quad (1)$$
$$0 = -2a_A - a_B + 3a_C \quad (2)$$

We are interested in block C, what can we find out? How about acceleration from (2)

$$a_C = -2.4\ in/s^2 \quad (3)$$

Knowing acceleration, we can get velocity

$$a_C = \frac{dv_C}{dt} \;\Rightarrow\; a_C dt = dv_C \;\Rightarrow\; \int_0^t -2.4dt = \int_{v_{Co}}^{v_C} dv_C \;\Rightarrow\; -2.4t = v_C - v_{Co} \quad (4)$$

where v_{Co} is the initial velocity of C. We can get the initial velocity of C from equation (1) as v_{Co}=5.33 in/s, thus we can solve (4) for the time when v_C=0 to be

$$\boxed{t_{v_C=0} = 2.22\ s}$$

I'll leave it to you to use the kinematic relationship between position and velocity along with (4) to come up with the distance traveled from C's original position to be

$$\boxed{x = 5.93\ in}$$

what is the direction?