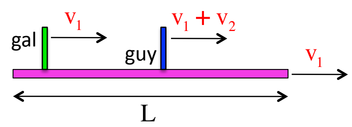
Problem 4.36

You need a frame of reference from which to view the motion. I will take the frame to be that of the ground, so the guy, the gal and the escalator are all moving with some velocity *relative to the ground* (see sketch).



a.) How long does it take the gal to travel "L?":

$$v_1 = \frac{L}{\Delta t_1}$$

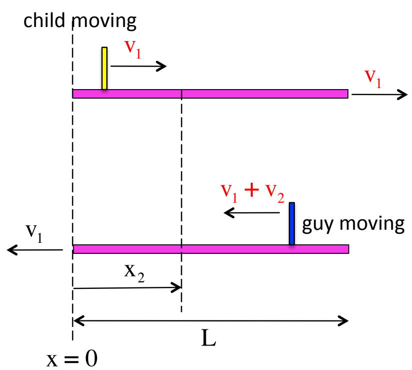
$$\Rightarrow \quad \Delta t_1 = \frac{L}{v_1}$$

b.) How long does it take the guy to travel "L?":

$$v_1 + v_2 = \frac{L}{\Delta t_2}$$

$$\Rightarrow \quad \Delta t_1 = \frac{L}{v_1 + v_2}$$

c.) A second escalator is provided. Again, relative to the ground, the situation is as shown in the new sketch. Note that in this situation, you really need a coordinate axis to work with. That has been provided. Relative to that axis, the guy's *<u>initial position</u>* is at "L", the child's *initial position* is at zero and the point where they pass is "x." Notice also that the amount of time it takes to get to "x" will be the same for both. With all that, we can use kinematics to write:



for the child:

$$x_2 = \cancelto{0}{x_1} + v_1 \Delta t + \frac{1}{2}\cancelto{0}{a_x} \Delta t^2$$

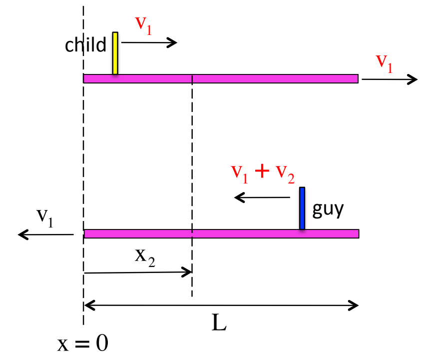
$$\Rightarrow \quad \Delta t = \frac{x_2}{v_1}$$

for the guy:

$$x_2 = \cancelto{L}{x_1} + v_{1,x}\Delta t + \frac{1}{2}\cancelto{0}{a_x}\Delta t^2$$

$$= L + \left(-(v_1 + v_2)\right)\Delta t$$

$$\Rightarrow \quad \Delta t = \frac{-x_2 + L}{(v_1 + v_2)}$$



Combining the two time relationships yields:

$$\Delta t = \frac{-x_2 + L}{(v_1 + v_2)} = \frac{x_2}{v_1}$$

$$\Rightarrow \quad (-x_2 + L)v_1 = x_2(v_1 + v_2)$$

$$\Rightarrow \quad x_2 = \frac{Lv_1}{2v_1 + v_2}$$

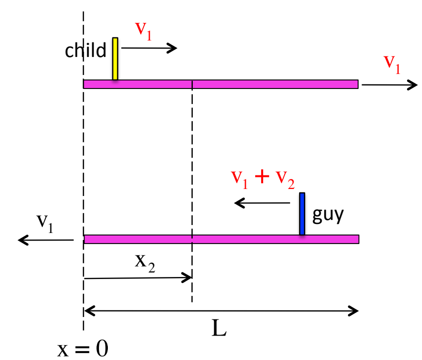
As

$$x_2 = v_1 \Delta t$$

we can write:

$$x_2 = v_1 \Delta t = \frac{Lv_1}{2v_1 + v_2}$$

$$\Rightarrow \quad \Delta t = \frac{L}{2v_1 + v_2}$$



Does this problem meander? You bet! That is why you sometimes have to chew on problems, gathering bits and pieces of information as you go, until you have enough to finish off the task.