

This is a 1-D problem involving relative motion.

A person walks up an escalator that has stopped, in 100 seconds. When the escalator is moving, it takes the person 75 seconds to be carried up when they are standing on it. If the escalator is 20 m long, how long would it take that same person to walk up the moving escalator?

Solution:

Use the scalar equation:  $v_p = v_B + v_{PB}$

$v_p = ?$  (velocity of the person with respect to ground, while on the moving escalator, and walking at the same time)

$v_B = ?$  (velocity of the escalator with respect to ground, when it is moving)

$v_{PB} = ?$  (velocity of the person with respect to the escalator, while he/she is walking on it)

$$v_B = \frac{20 \text{ m}}{75 \text{ s}} = 0.267 \text{ m/s}$$

$$v_{PB} = \frac{20 \text{ m}}{100 \text{ s}} = 0.20 \text{ m/s}$$

} both are in the same direction

Therefore,  $v_p = v_B + v_{PB} = 0.267 \text{ m/s} + 0.20 \text{ m/s} = 0.467 \text{ m/s}$

$$v_p = \frac{20 \text{ m}}{\Delta t}, \quad \Delta t = \frac{20 \text{ m}}{v_p} = \frac{20 \text{ m}}{0.467 \text{ m/s}} = 42.8 \text{ seconds (answer)}$$

(This does not depend on escalator length)