Name: KEY

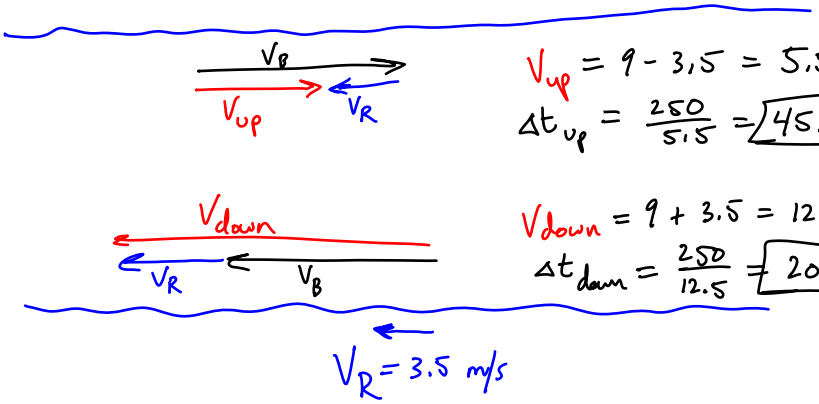
Date:

Section C D F

The Masters School
Mr. Alex Rawson
Physics

Relative Velocity II

1. A boat moves through a river at 9.0 m/s relative to the water, regardless of the boat's direction. If the water in the river is flowing at 3.5 m/s, how long does it take the boat to make a round trip consisting of a 250 m displacement downstream followed by a 250 m displacement upstream?



$V_{up} = 9 - 3.5 = 5.5$ m/s

$\Delta t_{up} = \frac{250}{5.5} = 45.45$ sec

$V_{down} = 9 + 3.5 = 12.5$ m/s

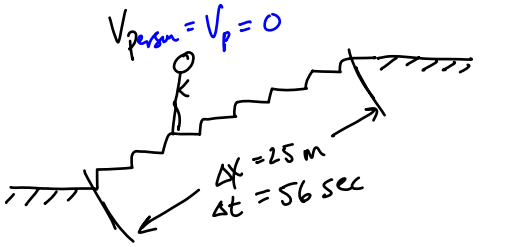
$\Delta t_{down} = \frac{250}{12.5} = 20$ sec

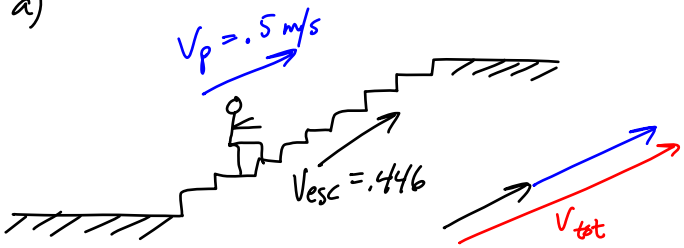
$\Delta t_{tot} = \Delta t_{up} + \Delta t_{down}$

$\Delta t_{tot} = 65.45$ sec

2. An escalator going up to the next floor is 25.0 m long. If a person stands on the escalator, it takes 56.0 s to ride up to the next floor.
   a. If a person runs up the escalator with a speed of 0.500 m/s relative to the escalator, how long does it take the person to get to the top?
   b. If a person tries to run down the escalator with a speed of 0.500 m/s relative to the escalator, how long does it take to reach the bottom?

a)



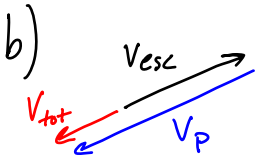


$V_{esc} = \frac{\Delta x}{\Delta t} = .446$ m/s

$V_{tot} = .446 + .5 = .946$ m/s

$\Delta t = \frac{\Delta x}{V_{tot}} = \frac{25 \text{ m}}{.946} = 26.43$ s

b)



$V_{tot} = V_p - V_{esc}$

$= .5 - .446$

$V_{tot} = .054$

$\Delta t = \frac{\Delta x}{V_{tot}} = \frac{25}{.054} = 463$ sec

3. The escalator in a department store can usually carry a person to the next floor in 20.0 s. However, on one particular day, the escalator was broken, and so our shopper simply walked up the motionless escalator, taking 30 seconds to reach the next floor. If our shopper combined their walking speed with the speed of the escalator, how long would it take the shopper to get up to the next floor? *(Hint: you do not know the length of the elevator; use system of equations)*

$V_{esc} = \frac{\Delta x}{20\ sec.}$

$V_p = \frac{\Delta x}{30\ sec.}$

} Δx is the same, so set Δx's equal

$\Delta x = 20\ V_{esc}$

$\Delta x = 30\ V_p$

$20\ V_{esc} = 30\ V_p$

$V_{esc} = 1.5\ V_p$

$V_p + V_{esc} = \frac{\Delta x}{\Delta t}$

$V_p + 1.5\ V_p = \frac{30\ V_p}{\Delta t}$

$2.5\ V_p = \frac{30\ V_p}{\Delta t}$

$\Delta t = \frac{30\ V_p}{2.5\ V_p} = 12\ sec$