$\vec{v}_{AB}$(velocity of A with respect to B) $= \vec{v}_A - \vec{v}_B$

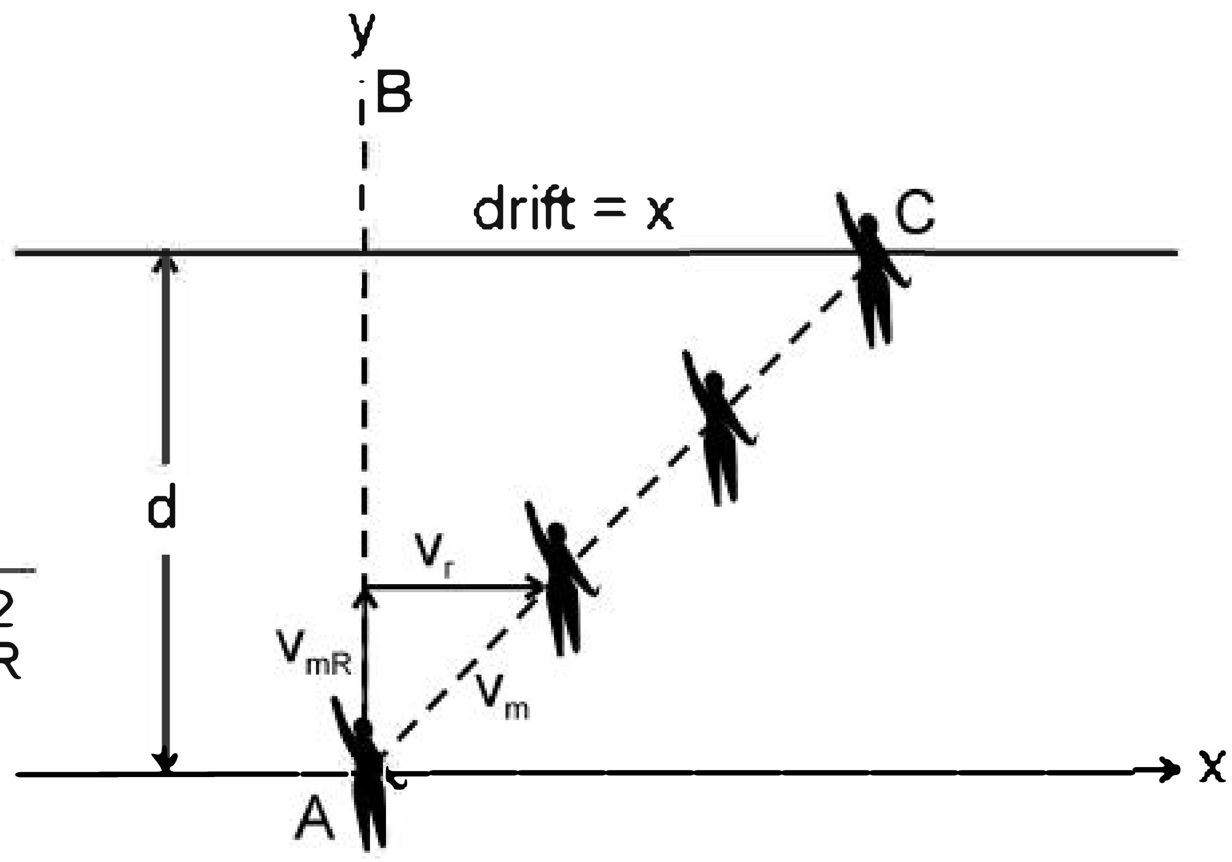
$\vec{a}_{AB}$(acceleration of A with respect to B) $= \vec{a}_A - \vec{a}_B$

Relative motion along straight line - $\vec{x}_{BA} = \vec{x}_B - \vec{x}_A$

CROSSING RIVER

A boat or man in a river always moves in the direction of resultant velocity of velocity of boat (or man) and velocity of river flow.

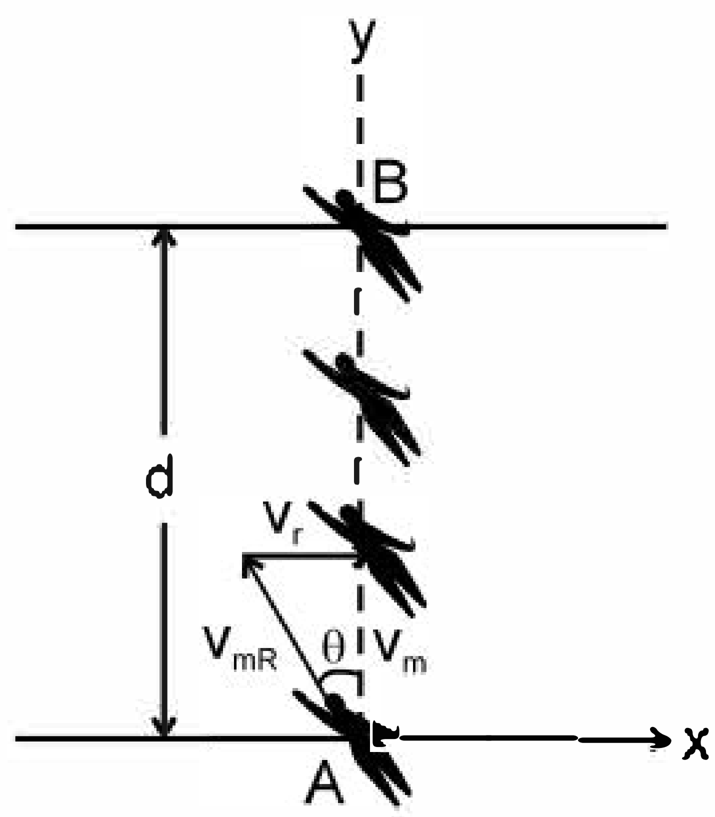
1. Shortest Time :



Velocity along the river, $v_x = v_R$.
Velocity perpendicular to the river, $v_f = v_{mR}$

The net speed is given by $v_m = \sqrt{v_{mR}^2 + v_R^2}$

2. Shortest Path :



velocity along the river, $v_x = 0$

and velocity perpendicular to river $v_y = \sqrt{v_{mR}^2 - v_R^2}$

The net speed is given by $v_m = \sqrt{v_{mR}^2 - v_R^2}$

at an angle of 90° with the river direction.
velocity v_y is used only to cross the river,

therefore time to cross the river, $t = \dfrac{d}{v_y} = \dfrac{d}{\sqrt{v_{mR}^2 - v_R^2}}$

and velocity v_x is zero, therefore, in this case the drift should be zero.

$\Rightarrow \quad v_R - v_{mR}\sin\theta = 0 \quad$ or $\quad v_R = v_{mR}\sin\theta$

or $\quad \theta = \sin^{-1}\left(\dfrac{v_R}{v_{mR}}\right)$

RAIN PROBLEMS

$\vec{v}_{Rm} = \vec{v}_R - \vec{v}_m \quad$ or $\quad v_{Rm} = \sqrt{v_R^2 + v_m^2}$