RELATIVE VELOCITY

Relative velocity of A wrt B $\vec{V}_{AB} = \vec{V}_A - \vec{V}_B$

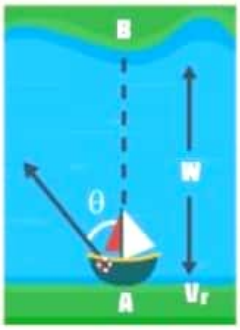
Relative acceleration of A wrt B $\vec{a}_{AB} = \vec{a}_A - \vec{a}_B$

RIVER-BOAT PROBLEM

$\vec{V}_r$ = absolute velocity of river

$\vec{V}_{br}$ = velocity of boatman with respect to river or velocity of boatman in still water

$\vec{V}_b$ = absolute velocity of boatman.



$$\vec{V}_b = \vec{V}_{br} + \vec{V}_r$$

Time taken by boatman to cross the river:

$$t = \frac{w}{V_{br}\cos\theta}$$

Displacement along x-axis when he reaches on the other bank:

$$x = (V_r - V_{br}\sin\theta)\frac{w}{V_{br}\cos\theta}$$

1. Condition when the boatman crosses the river in shortest interval of time-

$$t_{min} = \frac{w}{V_{br}}$$

2. Condition when the boatman wants to reach point B, i.e., at a point just opposite from where he started

$$\theta = \sin^{-1}\left(\frac{V_r}{V_{br}}\right)$$

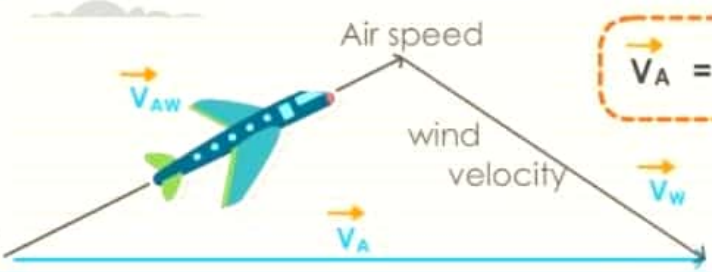
3. Shortest Path

when $V_r < V_{br} \rightarrow S_{min} = w$

when $V_r > V_{br} \rightarrow$

$$S_{min} = w\left(\frac{V_r}{V_{br}}\right)$$

AIRCRAFT WIND PROBLEM



$$\vec{V}_A = \vec{V}_{AW} + \vec{V}_W$$

$\vec{V}_{AW}$ = Velocity of aircraft wrt wind

$\vec{V}_W$ = Velocity of wind

$\vec{V}_A$ = Absolute Velocity of aircraft

RAIN PROBLEM

$\vec{V}_{r,g}$ = Velocity of river wrt ground

$\vec{V}_{r,m}$ = Velocity of river wrt man

$\vec{V}_{m,g}$ = Velocity of man wrt ground

$$\vec{V}_{r,g} = \vec{V}_{r,m} + \vec{V}_{m,g}$$