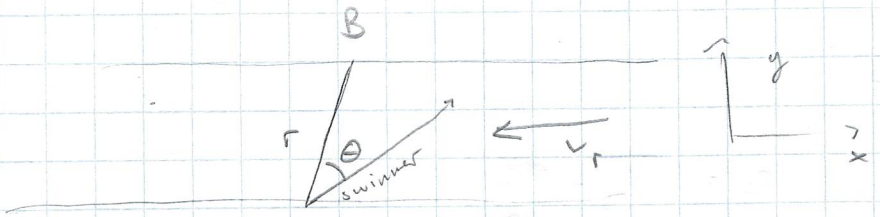
20-P-KM-AF-029

Relative Motion: Advanced

Q: Olympians are finding new creative ways to train. One swimmer uses their local river, a river that moves a velocity of A m/s downstream. The olympians speed moves out at B m/s. What angle must the swimmer leave at in order to get directly across the river?



What is the time to cross?

A: $V_m = V_r + V_{m/r}$

$V_m\hat{i} + V_m\hat{j} = V_r\hat{i} + V_{m/r} \cdot (\sin\theta\hat{i} + \cos\theta\hat{j})$

↳ equate $\hat{i}$ and $\hat{j}$

$\hat{i}$

$0 = A\hat{i} + B\hat{i}(\sin\theta)$

$\theta = \sin^{-1}\left(\frac{-A}{B}\right)$

$\hat{j}$

$V_m = B\cos(\theta)$

$t = \frac{r}{V_m}$