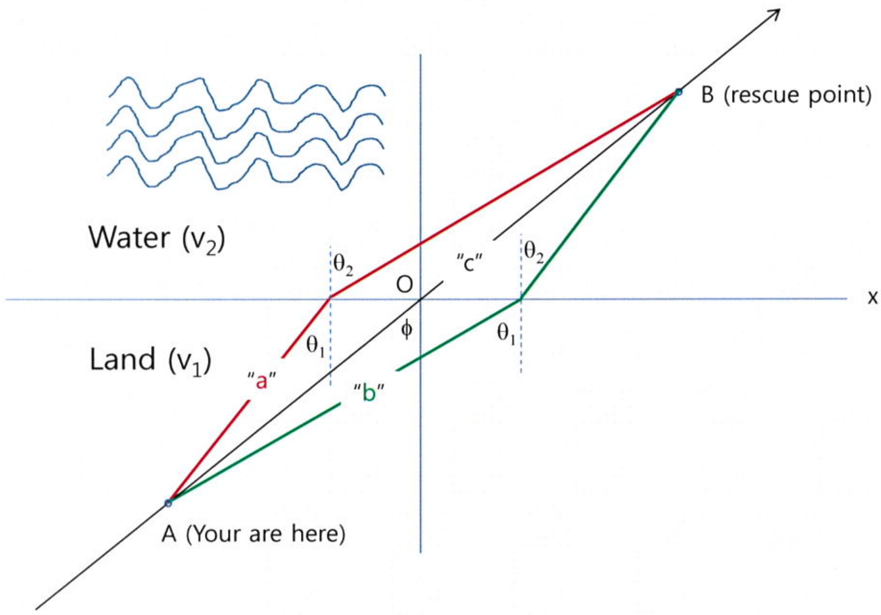
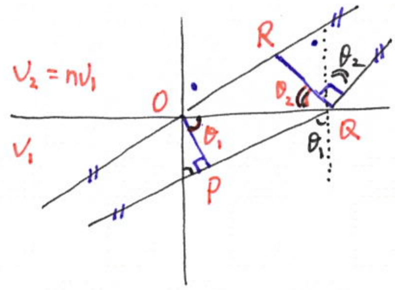
Quiz 1 (EC5103) March 13, 2017

Name:



You are at position A and rush to position B to save a drowning person across the shoreline x. Your velocity is given by v_1 in land and v_2 in water. Assume $\phi \sim \theta$.

1. What is the best way to go there in a shortest time among path a, b, and c?
2. If $v_2 = nv_1$, where $n<1$, which is correct between $\theta_1 < \theta_2$ and $\theta_1 > \theta_2$? The "v" is a velocity.
3. Derive the Snell's law from the above case.
   (Hint 1: Prove the relatioin $n\sin\theta_1 = \sin\theta_2$.)
   (Hint 2: Apply the least time principle for two different regions.)



Solution)

1. b
2. $\theta_1 > \theta_2$
3. $\overline{OR} = \overline{OQ}\sin\theta_2$; $\overline{PQ} = \overline{OQ}\sin\theta_1$

$= V_2 t_2 = nV_1 t_2$ $\qquad = V_1 t_1$

$\rightarrow t_2 = \dfrac{\overline{OQ}}{nV_1}\sin\theta_2$; $t_1 = \dfrac{\overline{OQ}}{V_1}\sin\theta_1$

$t = t_1 + t_2 = \dfrac{\overline{OQ}}{V_1}\left(\dfrac{\sin\theta_2}{n} + \sin\theta_1\right)$

Here, the fastest time for $\overline{OR}$ must be the same as it taken for $\overline{PQ}$ (land speed > water speed).

∴ To minimize t, $t_1 = t_2$.

$\rightarrow \dfrac{1}{n}\sin\theta_2 = \sin\theta_1 \rightarrow n\sin\theta_1 = \sin\theta_2$ $(n<1)$ Snell's law.