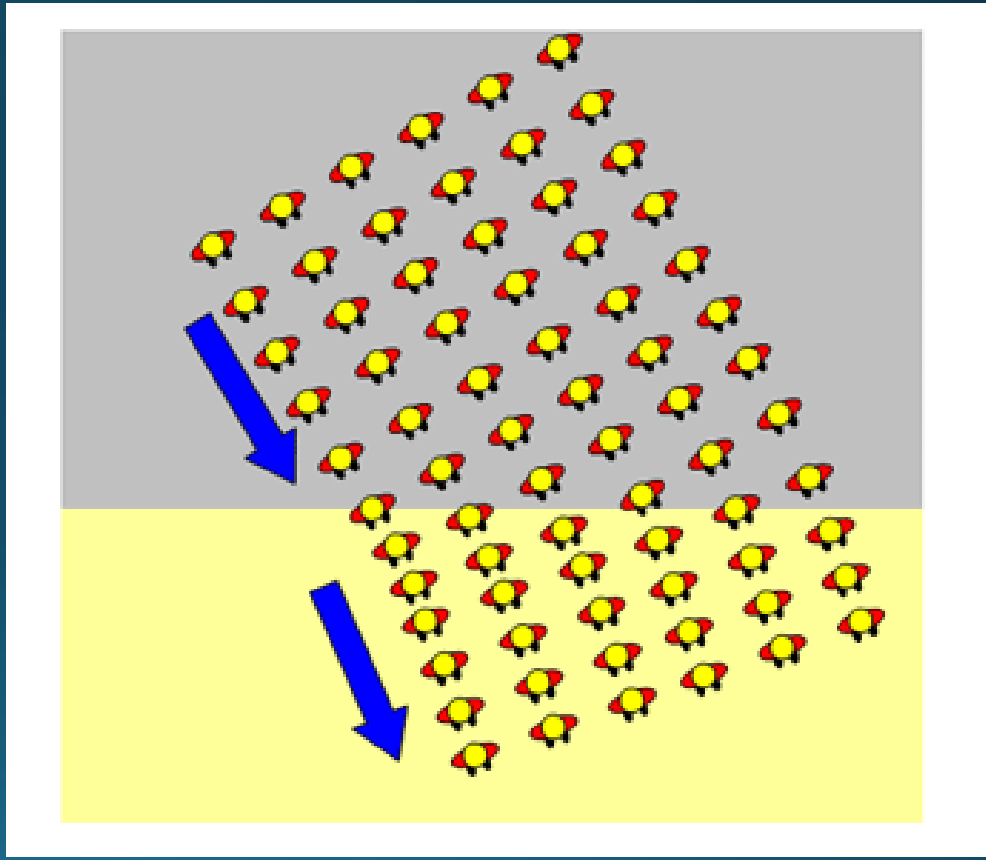
Snell's Law

Recall…

- As waves travel from deep to shallow water, the direction of motion of the wavefront changes because the speed of the wavefront changes.
- The degree of this change depends on how much the speed of the waterfront changes.

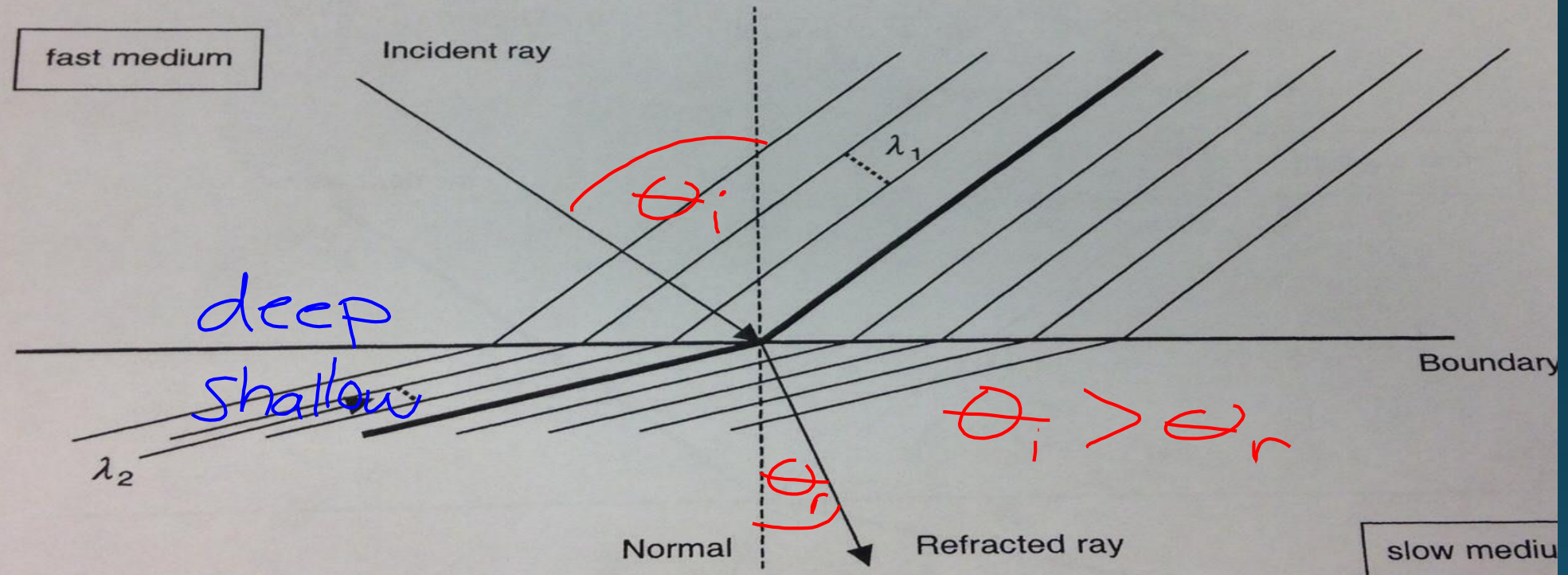


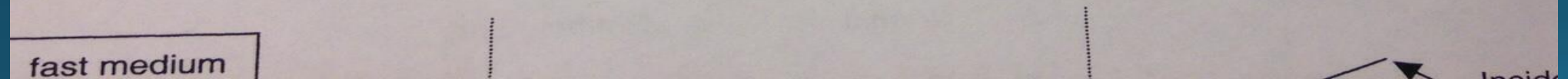
BLM
Blackline Master

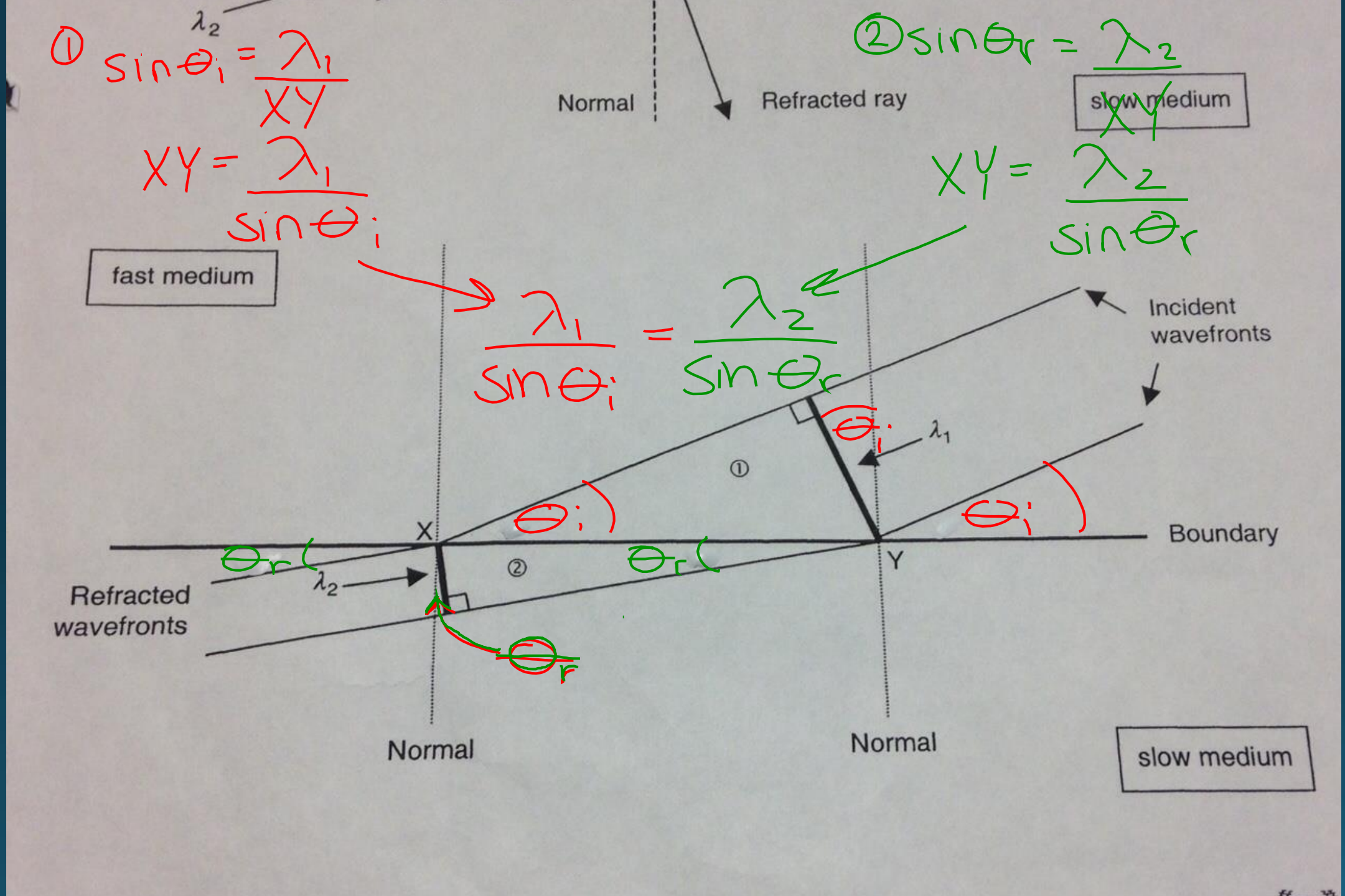
Appendix 1.5: Derivation of Snell's Law

The diagram represents the incident and refracted wavefronts and wave rays. As the wavefront passes from the fast ("lighter") medium to the slow ("heavier") medium, the wavefront slows down and bends.

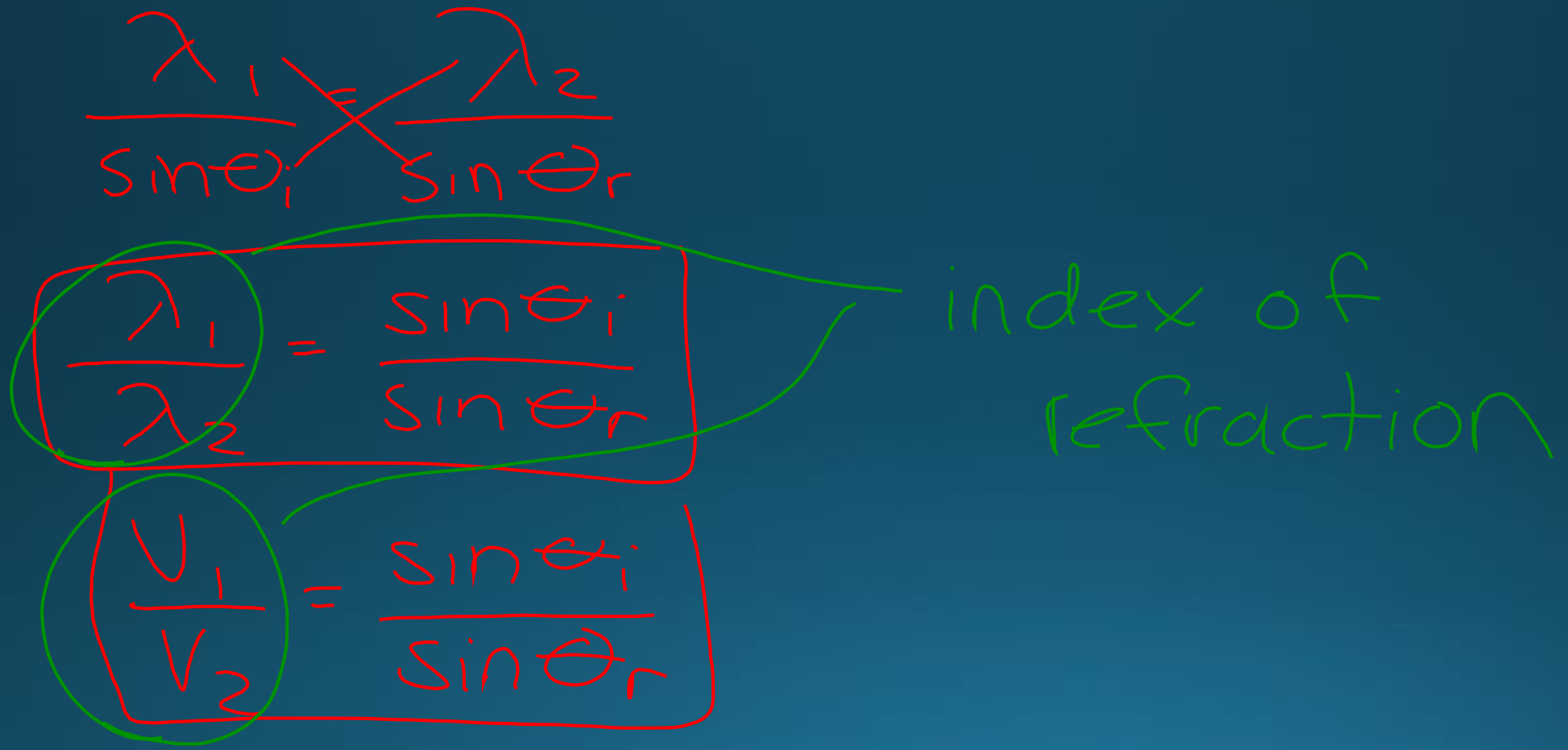
Consider the wavefronts.





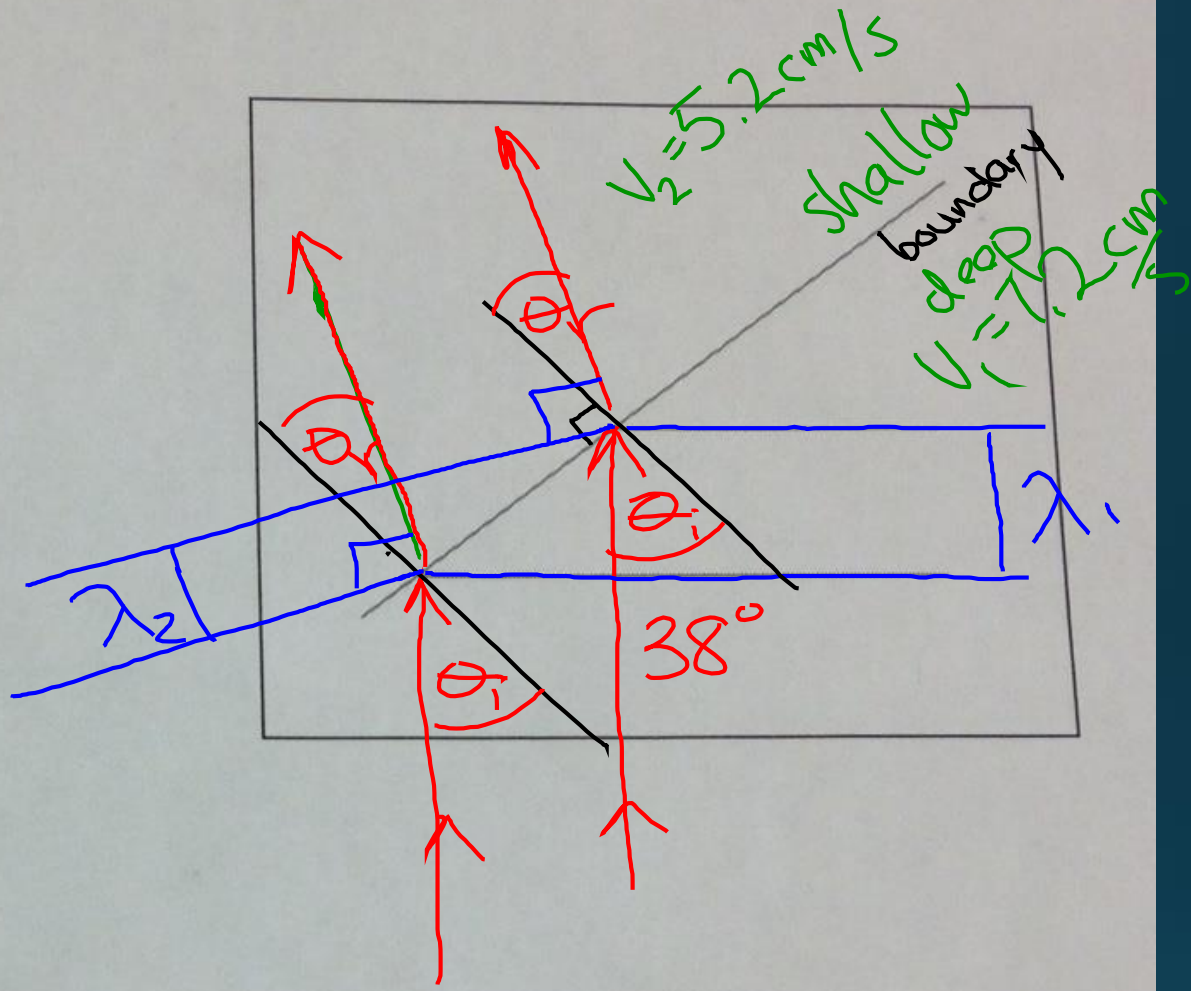

λ2
① sinθi = λ1 / XY
XY = λ1 / sinθi
Normal
Refracted ray
② sinθr = λ2 / XY
slow medium
XY = λ2 / sinθr
fast medium
λ1 / sinθi = λ2 / sinθr
Incident wavefronts
θi
λ1
①
θi
θi
X
Boundary
θr
θr
λ2
②
Y
Refracted wavefronts
θr
Normal
Normal
slow medium

From the diagram...



Example:

a) Draw the direction of motion and θi
b) Find the index of refraction
c) Find θr
d) Draw refracted wavefronts



b) $\frac{V_1}{V_2} = \frac{7.2}{5.2} = 1.4$

c) $\frac{V_1}{V_2} = \frac{\sin\theta_i}{\sin\theta_r}$

$1.4 = \frac{\sin\theta_i}{\sin\theta_r}$

$\sin\theta_r = \frac{\sin 38°}{1.4}$

$\theta_r = 26°$