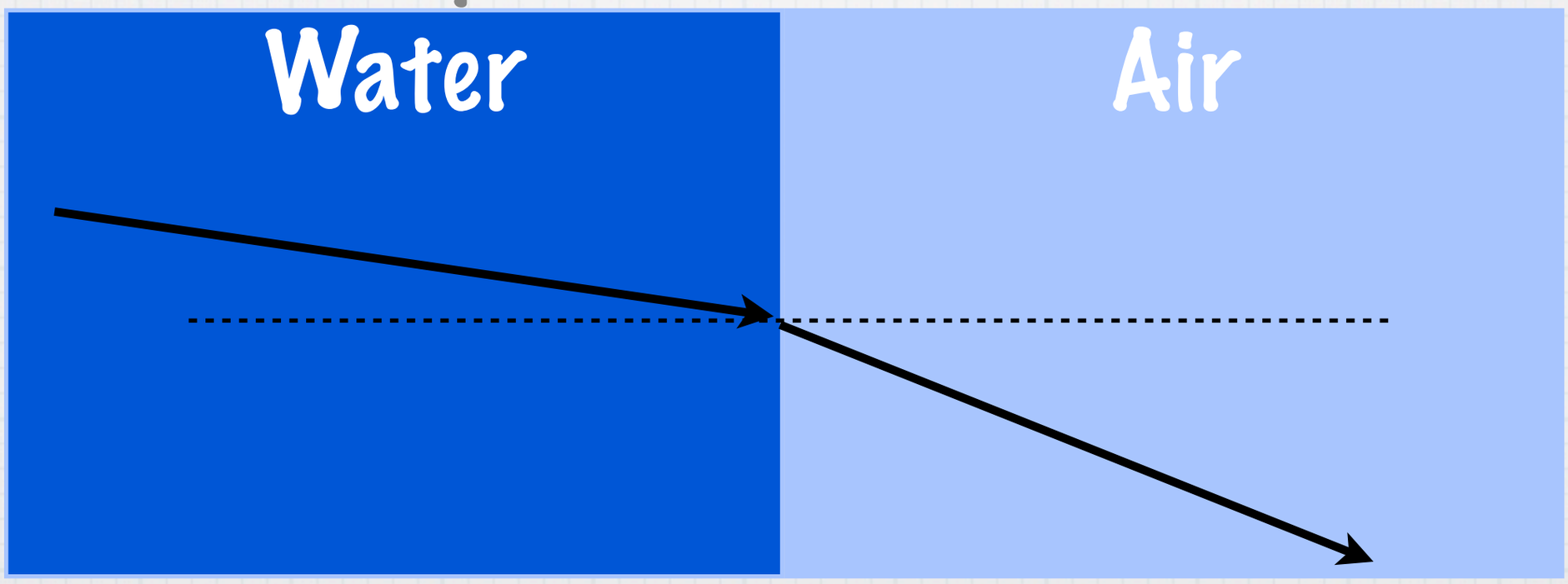
Total Internal Reflection

Total Internal Reflection

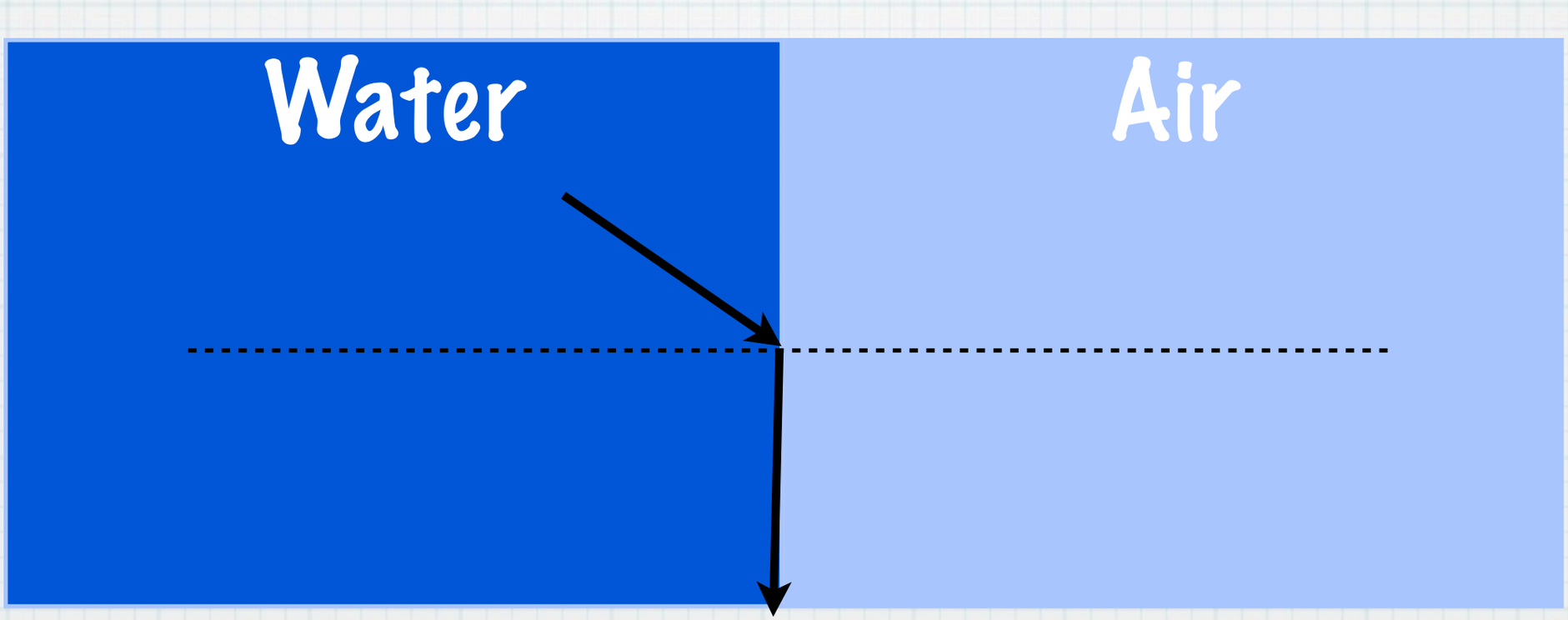
* When light travels from one medium to another, some is reflected and some is refracted.

* As light enters a lighter medium, it bends away from the normal



Total Internal Reflection

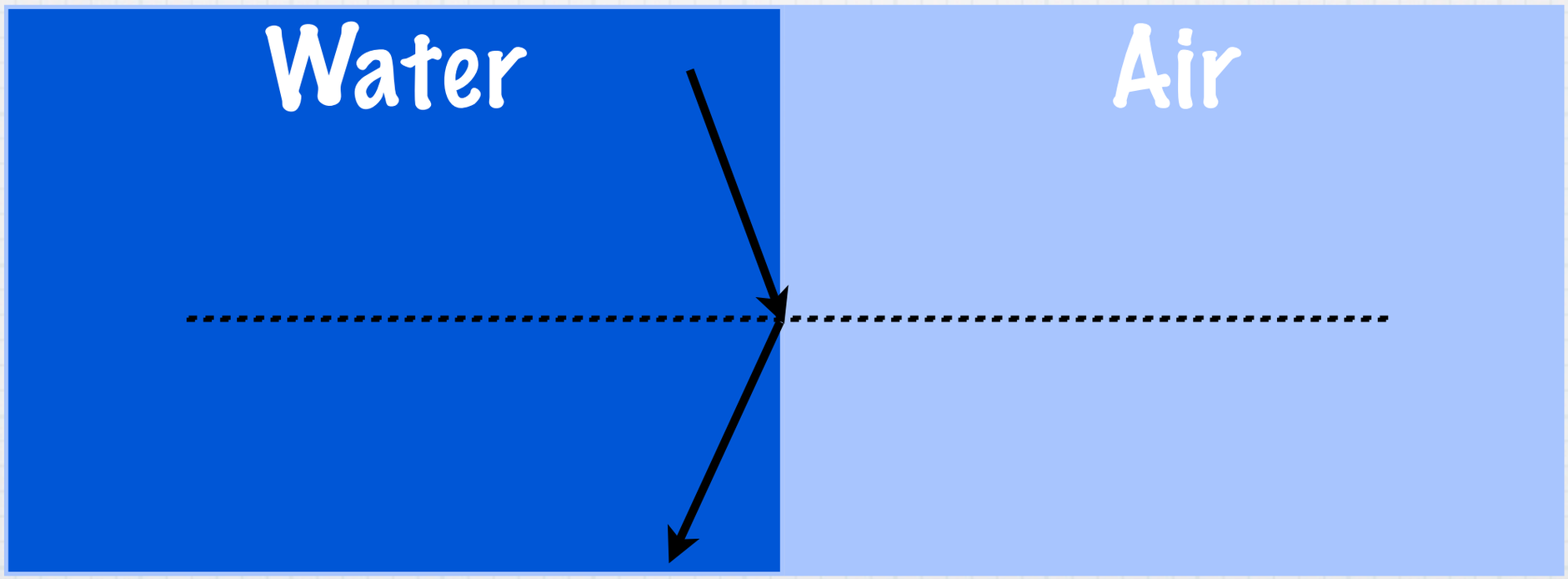
* Critical angle: the angle of incidence that will result in a refraction of 90°



Total Internal Reflection

* If you increase the angle of incidence past the critical angle, the refracted ray will no longer exit the medium

* Instead it will reflect back



Total Internal Reflection

* If you increase the angle of incidence past the critical angle, the refracted ray will no longer exit the medium

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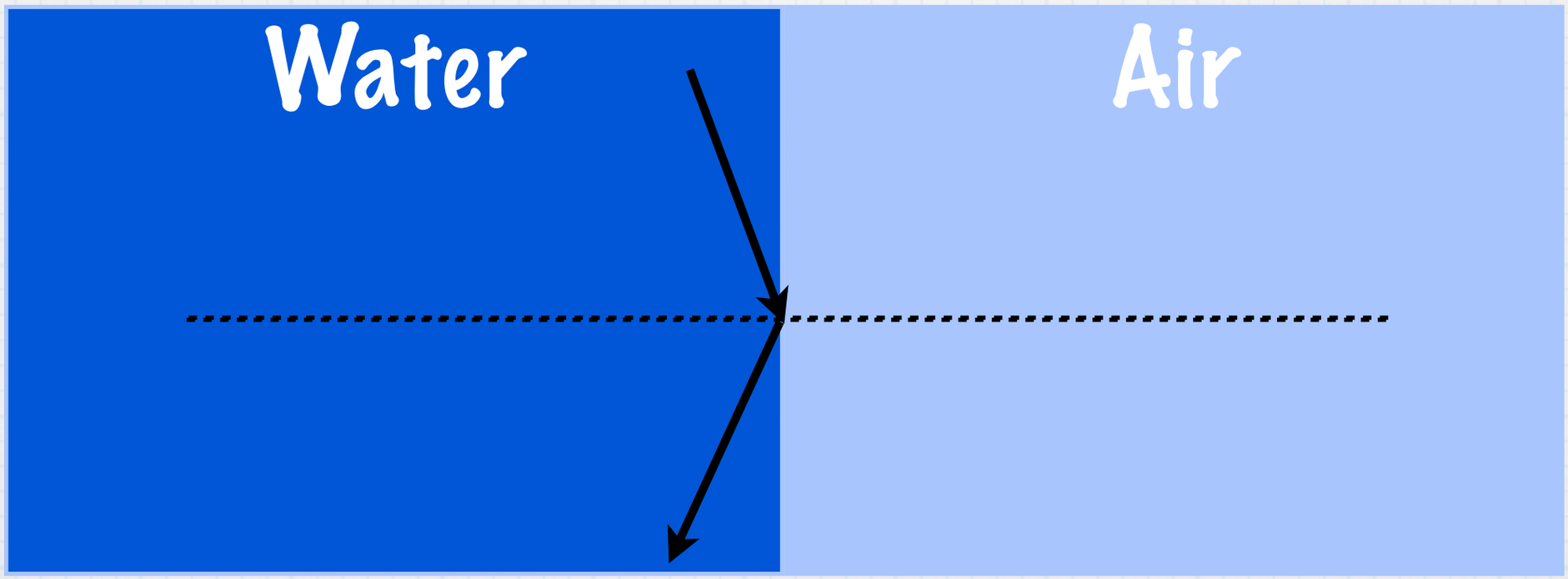


* Total Internal Reflection occurs when two conditions are met:
    * i) Light is travelling more slowly in the first medium than in the second
    * ii) The angle of incidence is larger than the critical angle

Index of Refraction

Index of Refraction

* Every medium has an index of refraction (n), which is the ratio of the speed of light in a vacuum to the speed of light in the medium

Index of Refraction

* $n_{medium} = c/V$

* Where:
  * v = speed of light in any medium
  * c = speed of light in a vacuum = 3.00×10^8 m/s

Example

* The speed of light of sodium chloride is 1.96×10^8 m/s. Calculate the index of refraction for sodium chloride.

Solution

* Given:
  * $c = 3.0 \times 10^8$ m/s
  * $v = 1.96 \times 10^8$
* Analysis and Solution:
  * $n = c/v$
  * $n = 3.00 \times 10^8 / 1.96 \times 10^8$
  * 1.53

Angle of Refraction

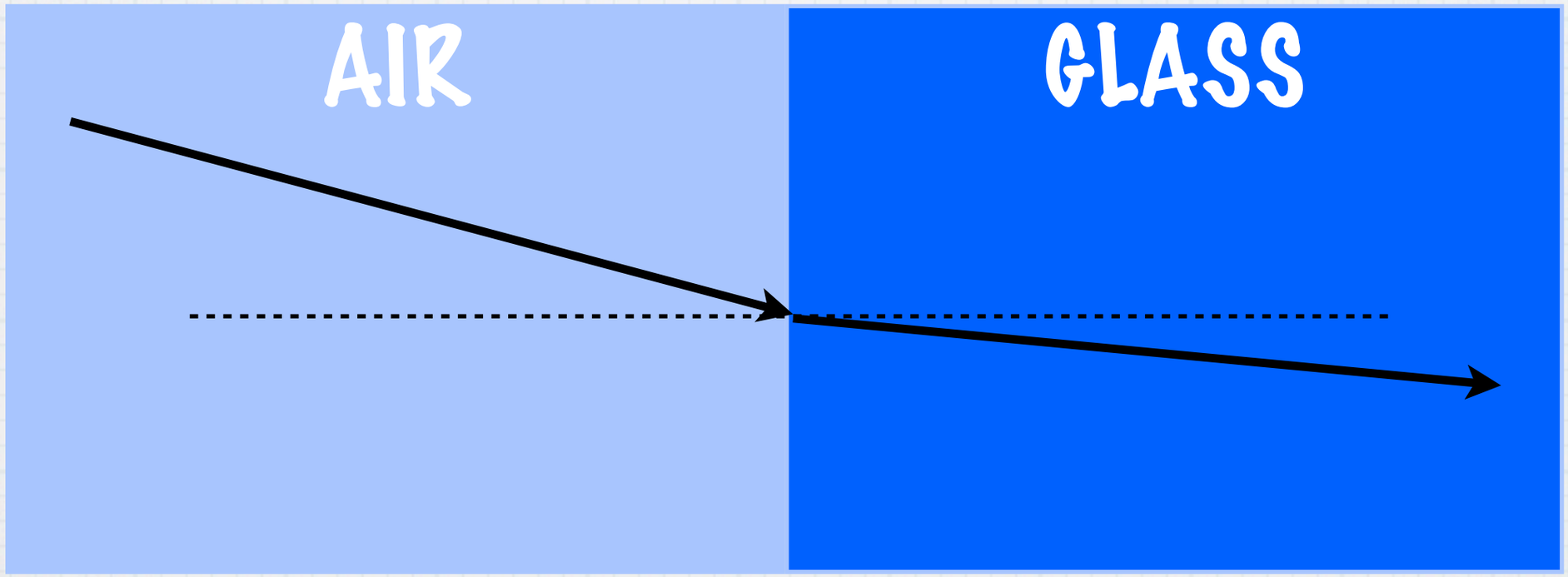
* The angle of refraction can be found using: **Snell's Law**
    * $n_1 \sin\theta_1 = n_2 \sin\theta_2$
* or
    * $n_2 v_2 = n_1 v_1$

Example

* Light travels from air into glass. Glass has an index of refraction of 1.52 and air has an index of refraction of 1.00.
    * a) Which direction does the light bend?
    * b) If the angle of incidence entering is 22^{o}, what is the angle of refraction?

Solution

* a) Which direction does the light bend?
  * The light will be moving slower in glass, so it will bend toward the normal



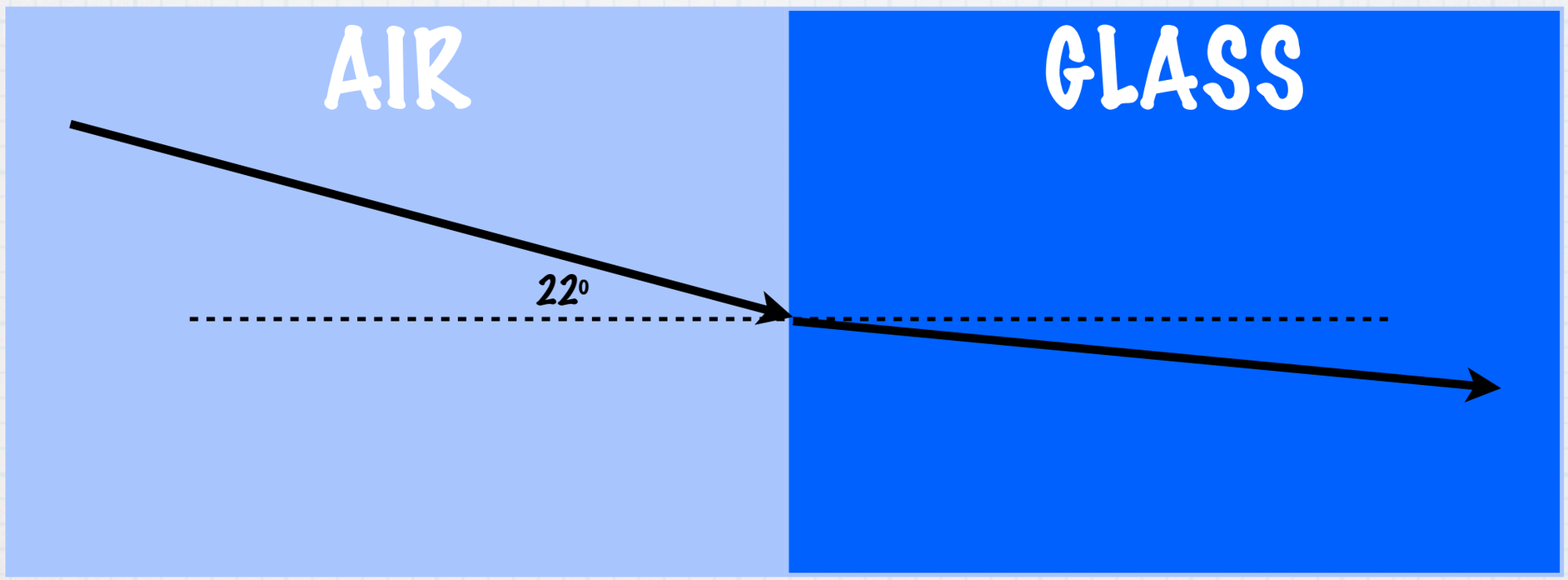
Solution

* b) If the angle of incidence entering is 22^{o}, what is the angle of refraction?

  * Given:

    * n_{air}= 1.00

    * n_{glass}=1.52



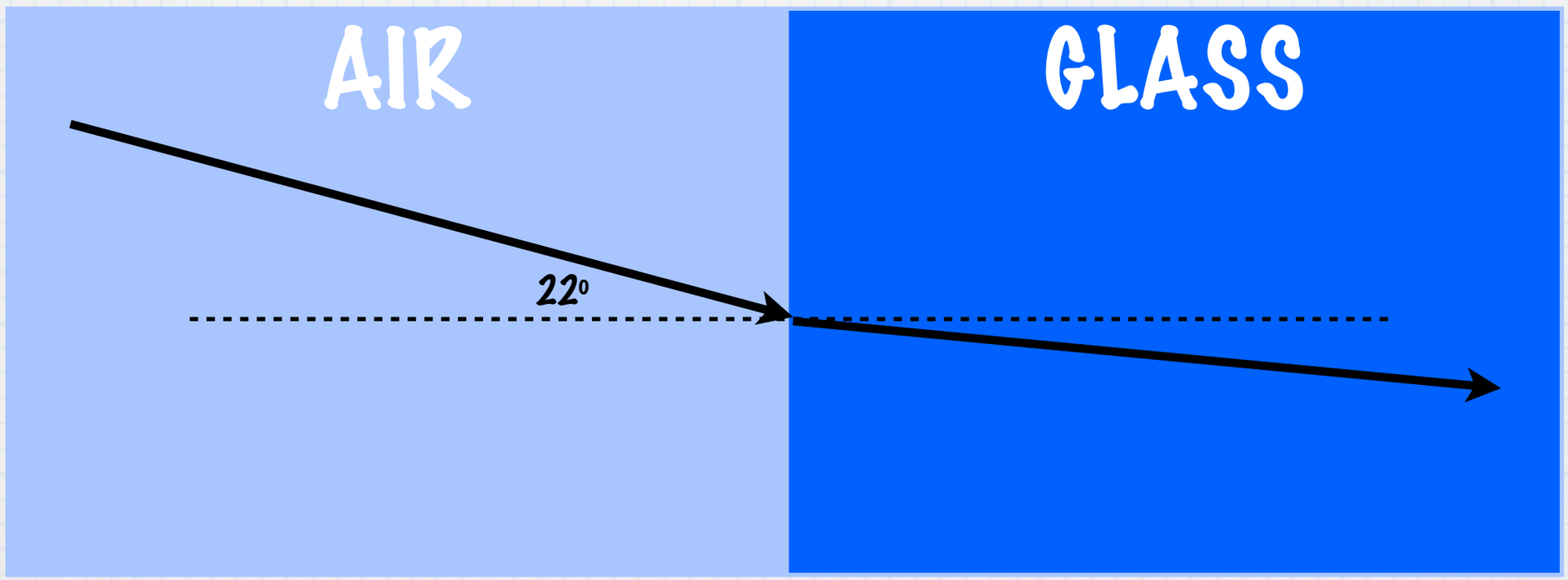
Solution

* b) If the angle of incidence entering is 22^{o}, what is the angle of refraction?

  * Given:

    * n_{air}= 1.00

    * n_{glass}=1.52



Solution

* $n_1 \sin\theta_1 = n_2 \sin\theta_2$
* $(1.00)(\sin 22) = 1.52(\sin\theta_2)$
* $(1.00)(0.3746) = 1.52(\sin\theta_2)$
* $0.3746 = 1.52(\sin\theta_2)$
* $\sin\theta_2 = 0.3746/1.52$
* $\sin\theta_2 = 0.247$
* $\theta_2 = \sin^{-1}(0.247)$
* $\theta_2 = 14.3$

Homework

* p. 525 # 2, 3, 6, 9

Index of Refraction Lab

* p. 520 in your textbook
* Work in partners
* Purpose
* Materials
* Observations
* Analyze: a & c