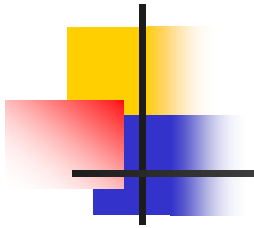


Learning Objectives

-to calculate the index of refraction

-To understand the phenomenon of total internal reflection

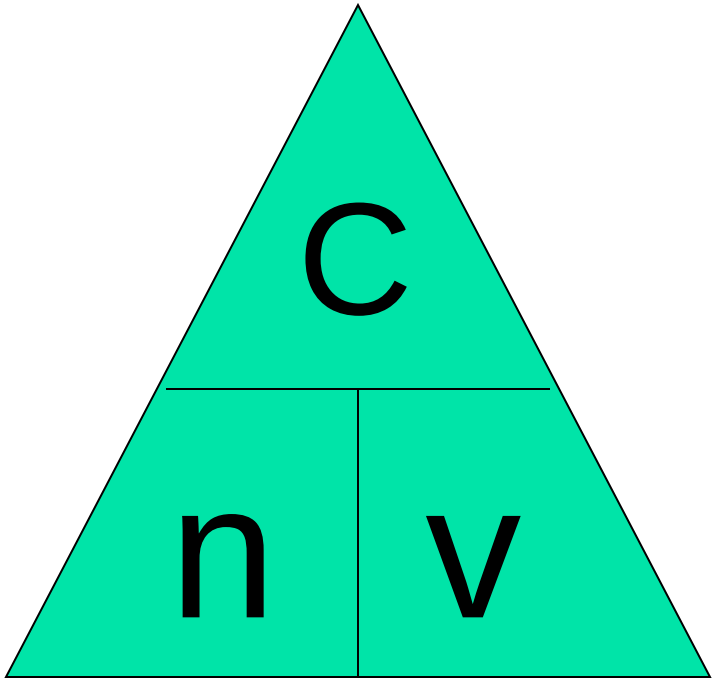
The Index of Refraction

- The ratio of the speed of light in a vacuum to the speed of light in that medium.
- Formula: $$n = \frac{c}{v}$$

n is the index of refraction

c is the speed of light a vacuum (3.00×10^8 m/s)

v is the speed of light in a given medium.


c
n
v

Another way to determine Index of Refraction

$$n = \frac{\sin \angle i}{\sin \angle R}$$

(In a vacuum)

(In a medium)

Example 1: Calculate the speed of light in diamond.

Note: $n_{diamond} = 2.42$ (from table 1 on p. 524)

1.24×10^8 m/s

Example 2: The speed of light in water is 2.25×10^8 m/s. Determine the index of refraction.

$n = 1.33$

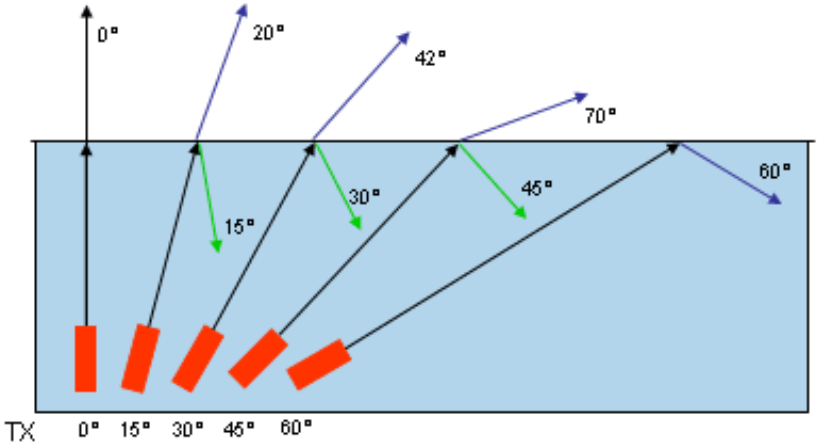
Example 3: Calculate the speed of light in olive oil. $N_{olive\ oil} = 1.48$

2.03×10^8 m/s

12.5 Total Internal Reflection

Total Internal Reflection

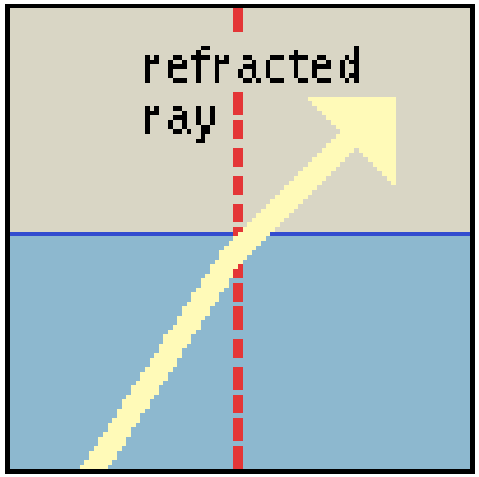
- Light **bends away** from the normal when it **speeds up** at a boundary of two media.
- As the angle of incidence **increases**, the angle of refraction will also **increase**.



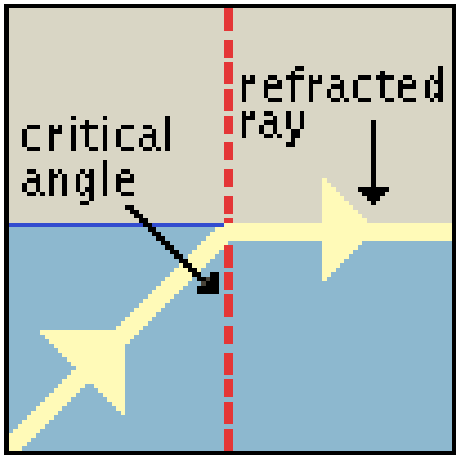
Total Internal Reflection

- The **critical angle** is the angle of incidence which gives an angle of refraction of 90º.
- If you increase the angle of incidence **past the critical angle**, the refracted ray no longer exits the medium. This is called **total internal reflection**.

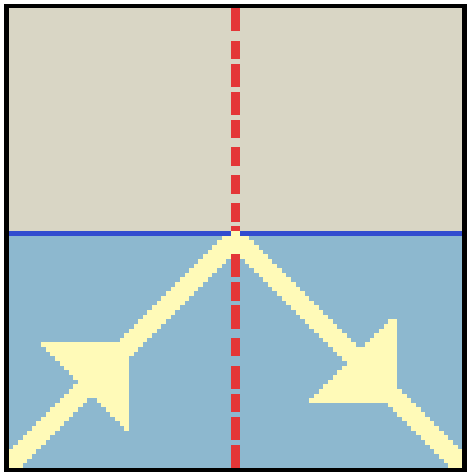
Total Internal Reflection



Ordinary refraction



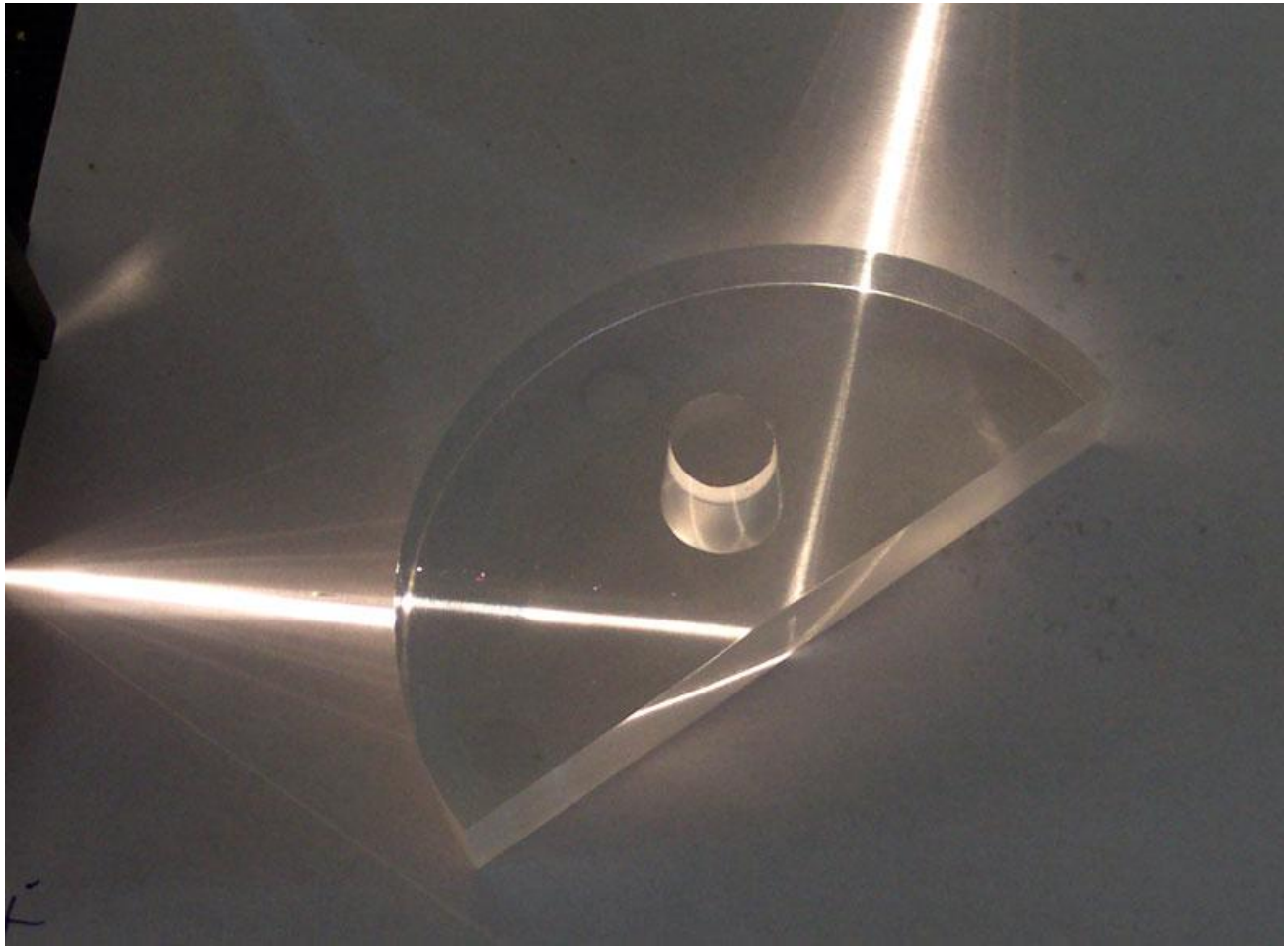
Refraction at critical angle

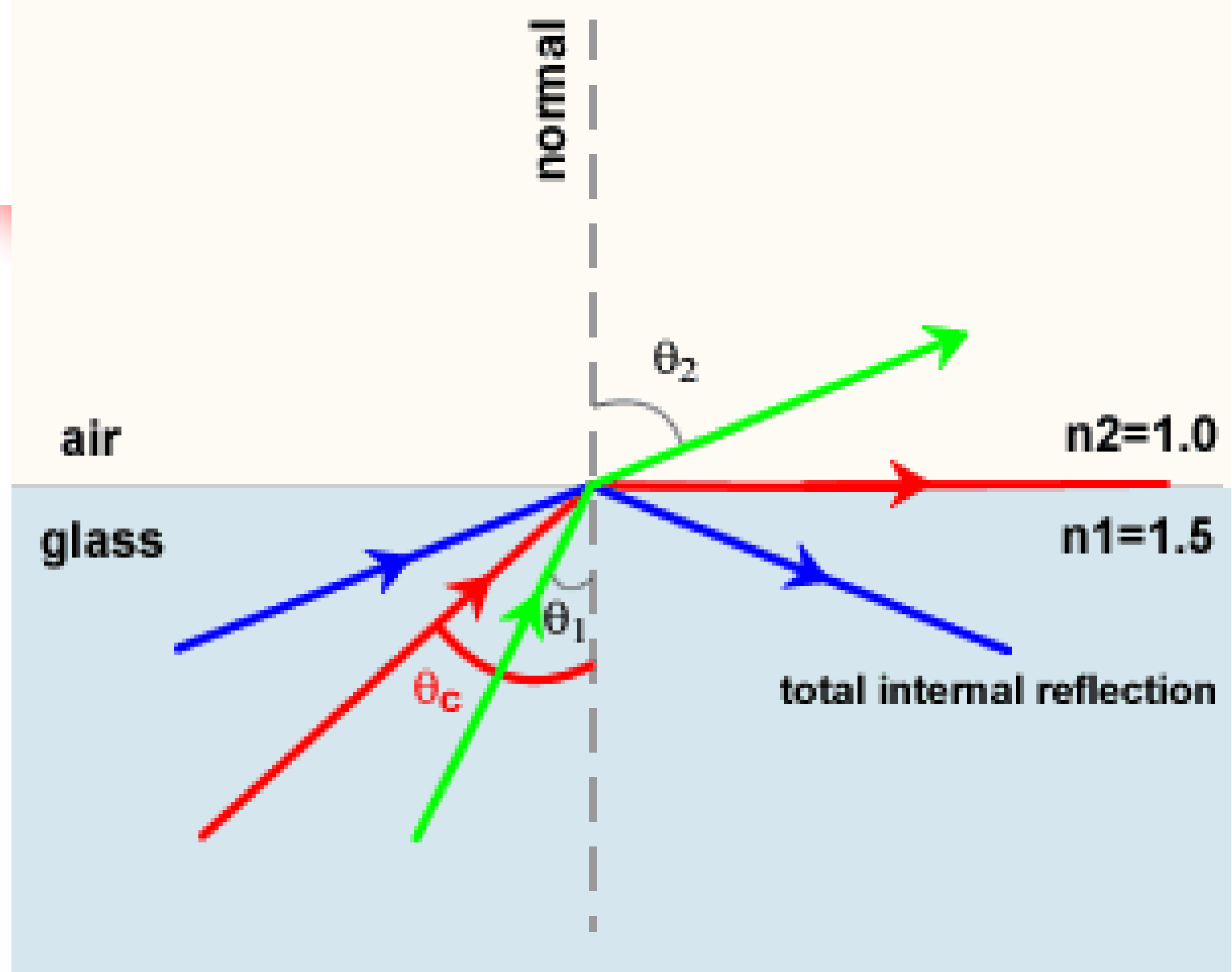


Total reflection

https://phet.colorado.edu/sims/html/bending-light/latest/bending-light_en.html

Total Internal Reflection



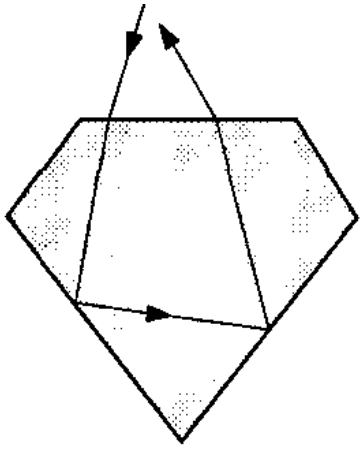

normal
θ2
air
n2=1.0
glass
n1=1.5
θ1
θc
total internal reflection

Conditions for Total Internal Reflection

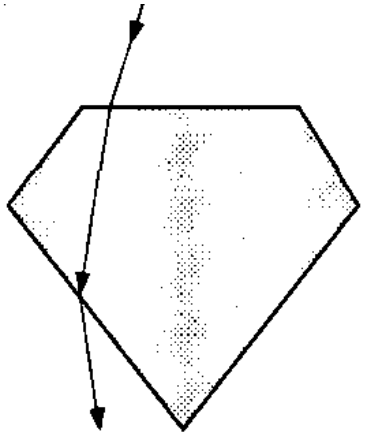
1. Light is travelling **more slowly** in the **first** medium than in the **second**.
2. The angle of incidence is **greater** than the **critical angle** (no refraction occurs; all light is reflected back into the medium)

Applications / Examples of Total Internal Reflection

- Diamonds

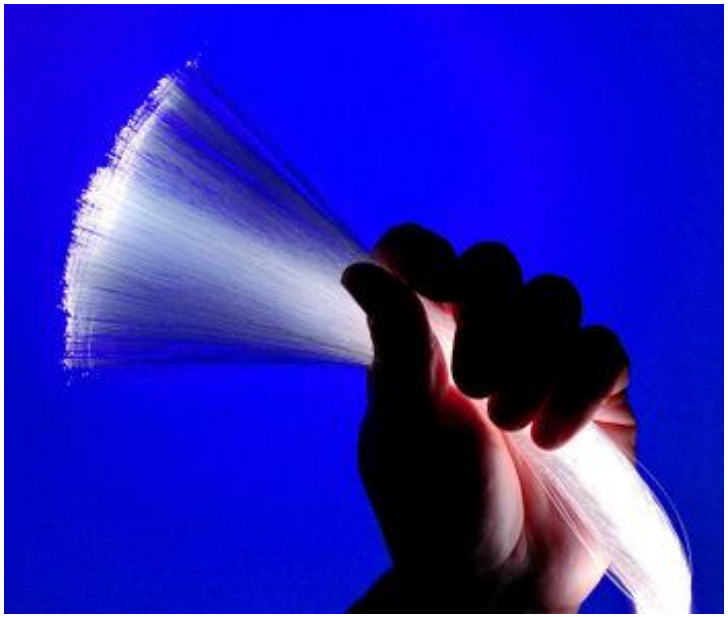


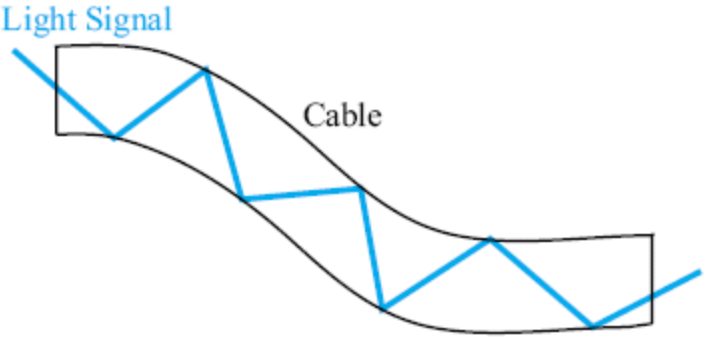
Diamond

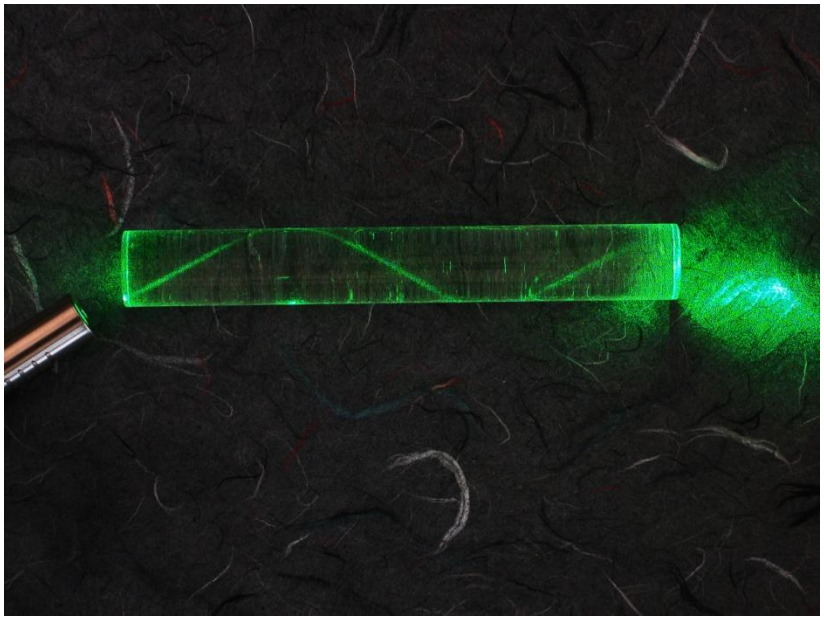


Glass

Fibre Optics







Triangular Prisms

- Exhibit total internal reflection.
- Reflect almost 100% of light internally.

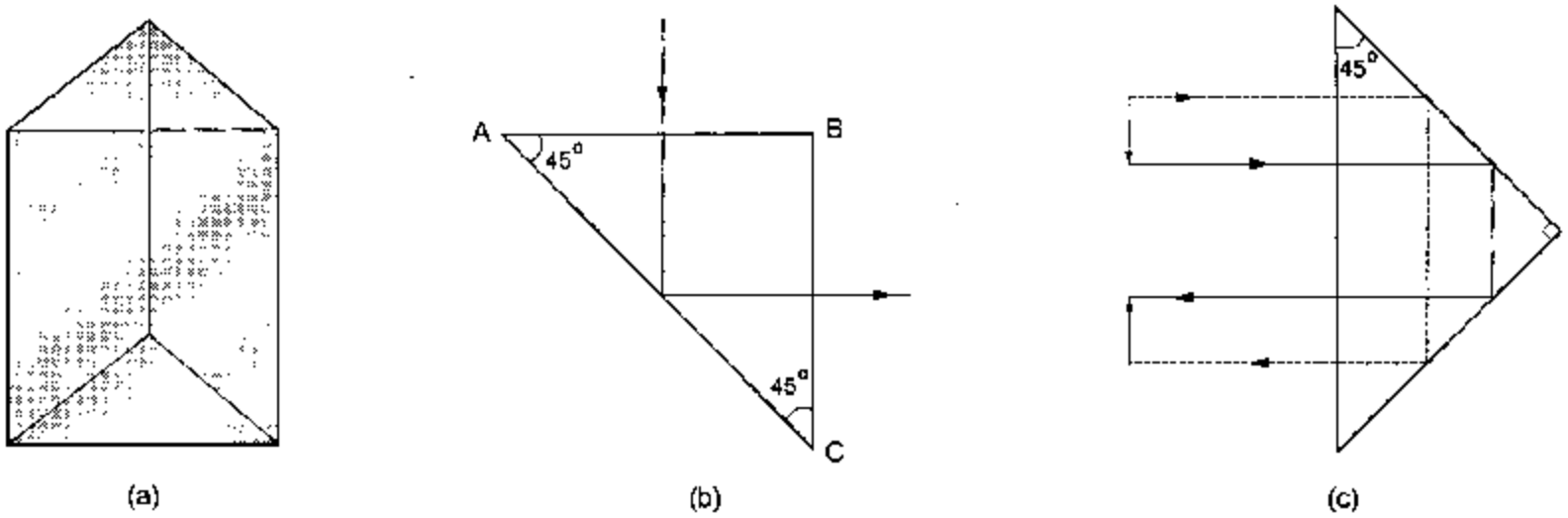
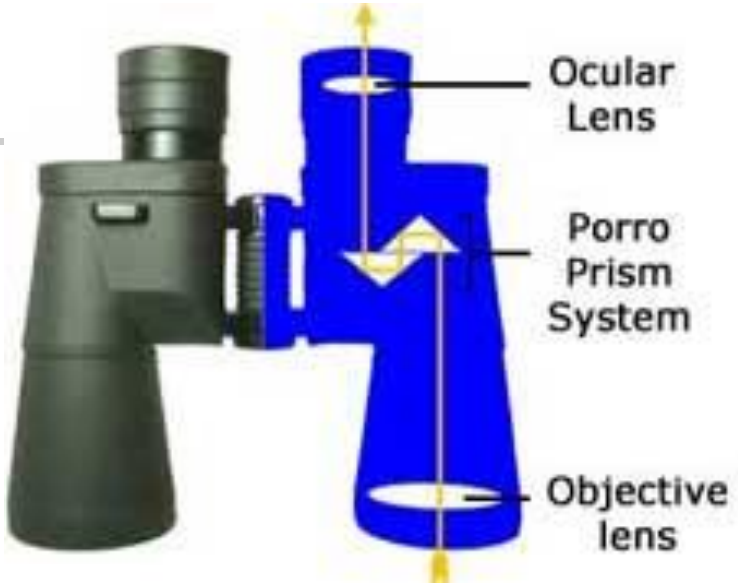


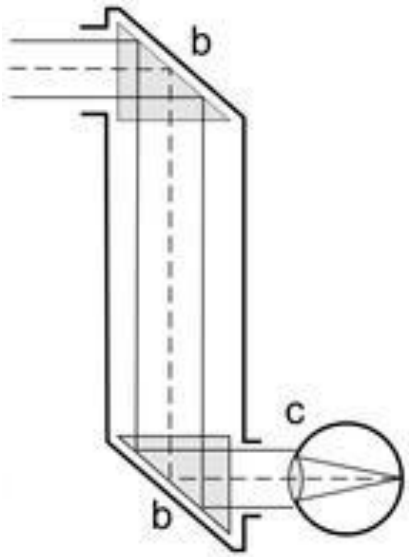
Fig. 2.13

Applications of triangular prisms

- Binoculars



- Periscopes

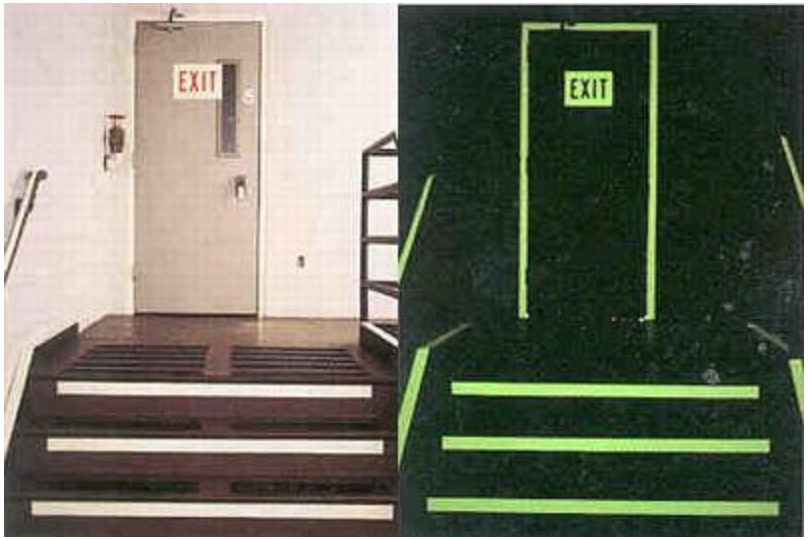


Retro-reflectors

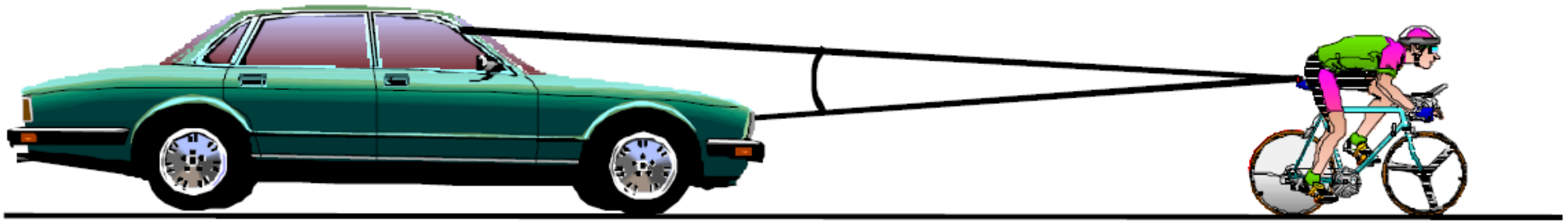
- A **retro-reflector** is an optical device in which the **emergent** ray is **parallel** to the **incident ray**.
- i.e. they reflect light back the way it came.
- Occurs as a result of **two total internal reflections.**
- Applications of retro-reflectors include…


NEXT 4 km


Amber and Red
warning lights
Working
lights

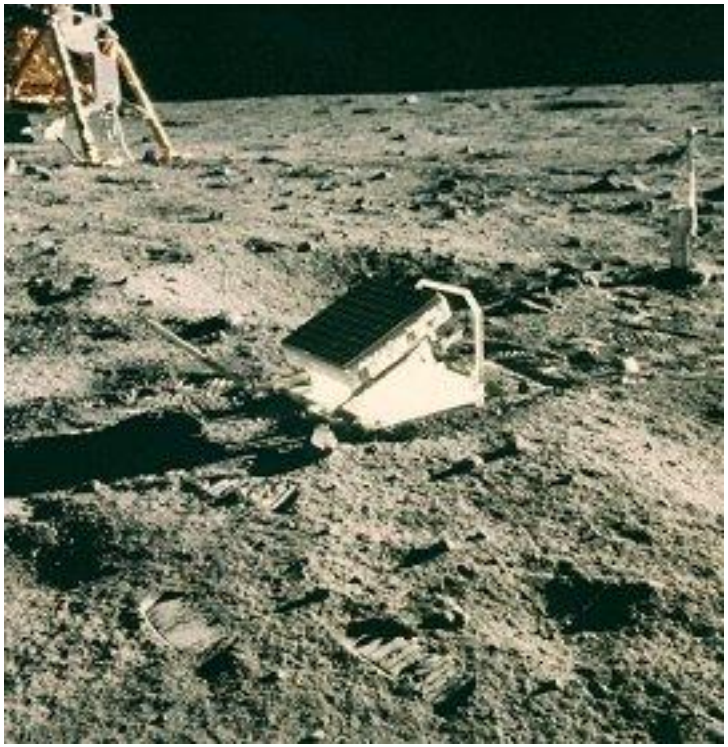

EXIT
EXIT


Shimano
Shimano



LR^3

- An array of retro-reflectors placed on the moon.
- Used to accurately determine the distance to the moon



Reflect on this:

- P. 525 # 1 - 9
- P. 531 # 1 - 5, 8
- Refraction Practice worksheet