

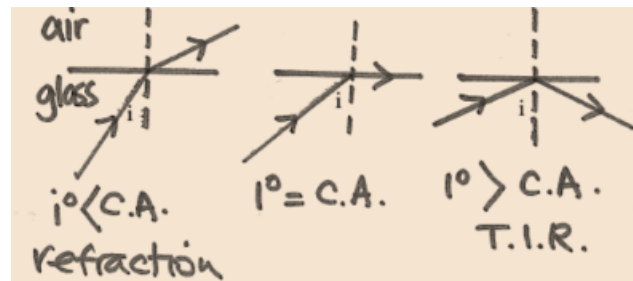
## Wave Refraction: Total Internal Reflection

### Definitions

**Total Internal Reflection occurs when:**

Light travels from a medium to a less dense medium (e.g. glass to air)  
AND

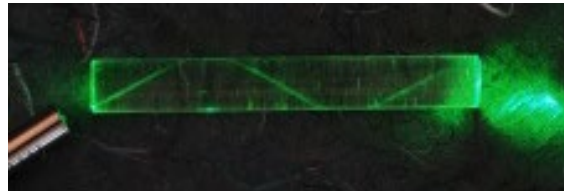
the angle of incidence is greater than the **critical angle**



### Equations

$$n_1 \sin \theta_1 = n_2 \sin \theta_2$$

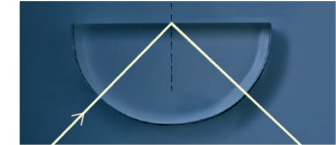
Refractive index of medium 1	$n_1$	-
Angle of ray in medium 1	$\theta_1$	$^\circ$
Refractive index of medium 2	$n_2$	$\text{m s}^{-1}$
Angle of ray in medium 2	$\theta_2$	$^\circ$



### Questions

#### BEHAVIOUR OF LIGHT (2022;1)

(a) Helen uses a semi-circular block and alters the angle that the light hits the straight side, and she

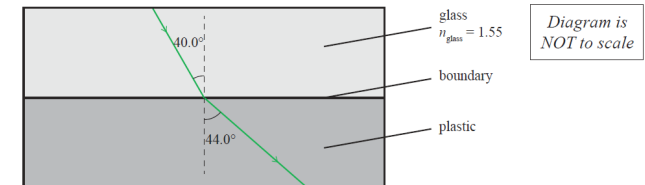


observes the following phenomenon:

Identify the physics phenomenon occurring at the straight boundary and describe the two conditions required for this phenomenon to occur.

#### Refraction and lenses (2017;2)

Sarah places a transparent glass and a transparent plastic rectangular block together and shines a green laser beam, as shown below.



(b) The refractive index of plastic is determined to be 1.43. Calculate the critical angle for the glass-plastic boundary.

### Terms

**angle of incidence:** The angle between the incident ray and the normal line.

**critical angle:** Smallest angle of incidence at which a light ray passing from one medium to another less refractive medium can be totally reflected.

**total internal reflection:** Reflection of a ray at the boundary of two media, when the ray comes from greater refractive index.

**Refraction:** Deviation of the path of a wave as it passes across the boundary separating two media.

### Tips

For Total Internal Reflection:

$$\theta_2 = 90^\circ \text{ so } \sin \theta_2 = 1$$

$$\sin \theta_c = n_2/n_1$$

### Answers

(a) Total internal reflection. More optically dense to less optically dense medium, and incident angle must be greater than critical angle.

$$(b) \quad n_1 \sin \theta_1 = n_2 \sin \theta_2$$

$$1.55 \times \sin \theta_c = 1.43 \times \sin 90^\circ$$

$$\sin \theta_c = \frac{1.43}{1.55}$$

$$\theta_c = 67.7^\circ \leftrightarrow 67.3^\circ \text{ (depending on rounding)}$$