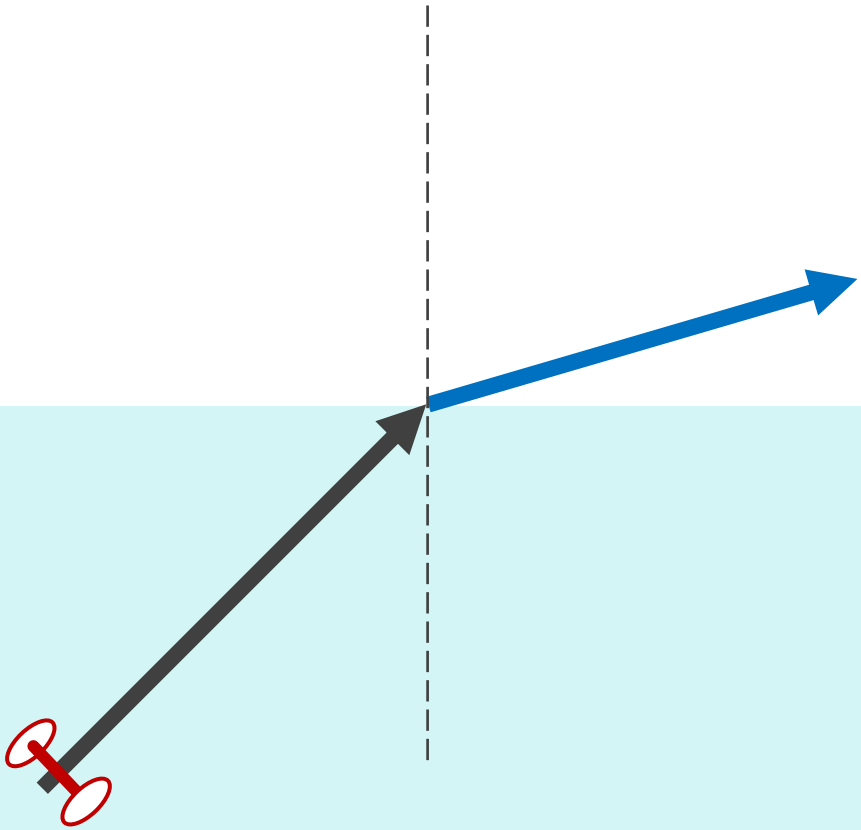
Snell’s Law & Critical Angle

IB PHYSICS | WAVES - LIGHT

Remember the Bend



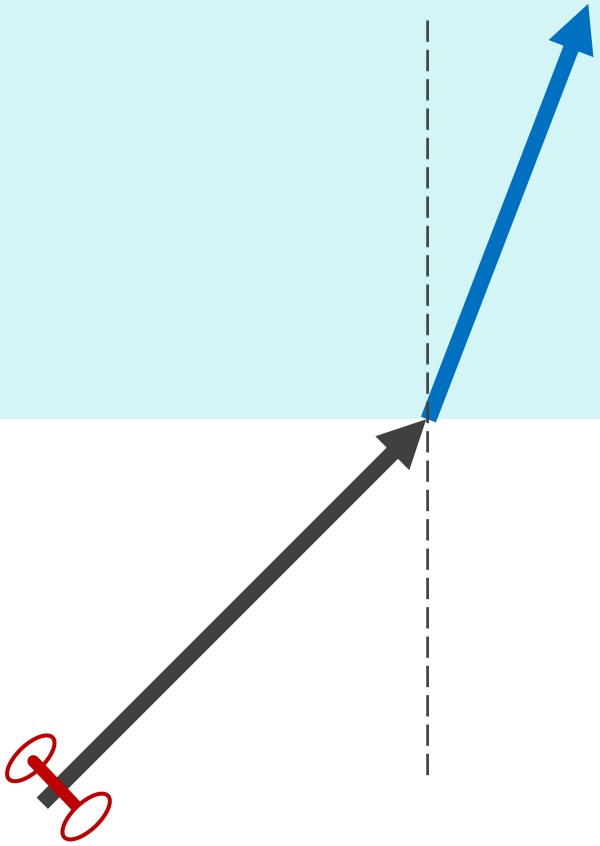
faster

n = 1

n = 1.33

slower

Remember the Bend



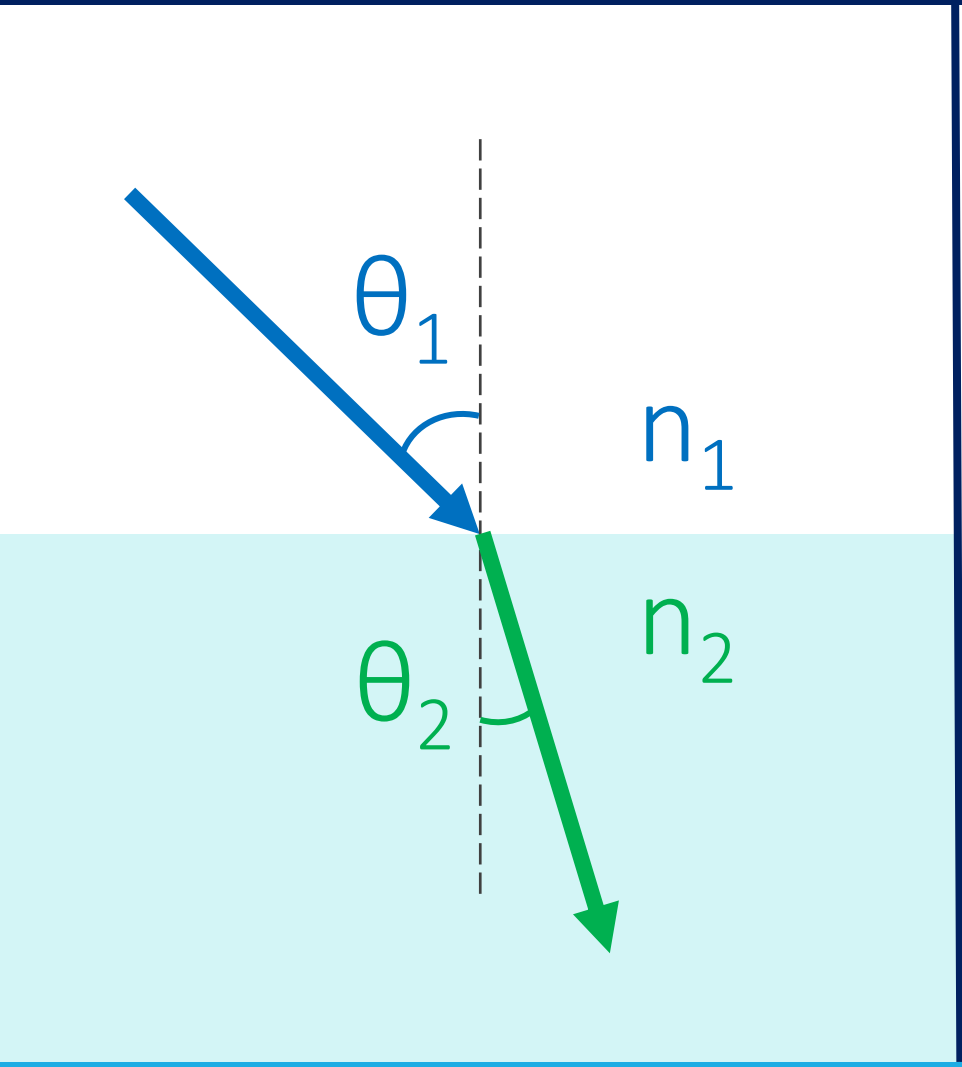
slower

n = 1.33

n = 1

faster

Snell's Law



$$\frac{n_1}{n_2} = \frac{sin\theta_2}{sin\theta_1}$$

IB Physics Data Booklet

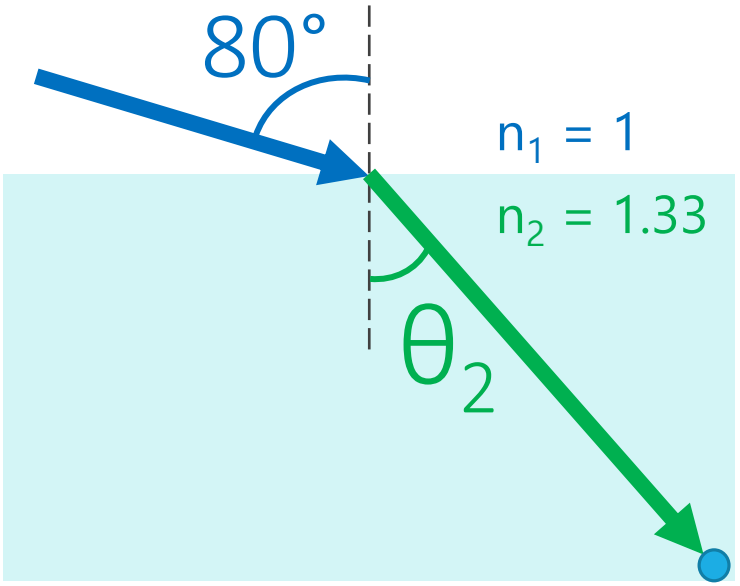
Sub-topic 4.1 – Oscillations	Sub-topic 4.4 – Wave behaviour
$T = \frac{1}{f}$	$\frac{n_1}{n_2} = \frac{\sin\theta_2}{\sin\theta_1} = \frac{v_2}{v_1}$
Sub-topic 4.2 – Travelling waves	$s = \frac{\lambda D}{d}$
$c = f\lambda$	Constructive interference: path difference $= n\lambda$
Sub-topic 4.3 – Wave characteristics	Destructive interference: path difference $= (n + \frac{1}{2})\lambda$
$I \propto A^2$	
$I \propto x^{-2}$	
$I = I_0 cos^2\,\theta$	

$$\frac{n_1}{n_2} = \frac{v_2}{v_1} \qquad \frac{n_1}{n_2} = \frac{sin\theta_2}{sin\theta_1} = \frac{v_2}{v_1} \qquad \frac{n_1}{n_2} = \frac{sin\theta_2}{sin\theta_1}$$

Using Snell's Law

While aiming at a marble at the bottom of a fish tank filled with water (n_2 = 1.33), you point so that you can measure the angle of your incident rays. What is the angle of refraction?

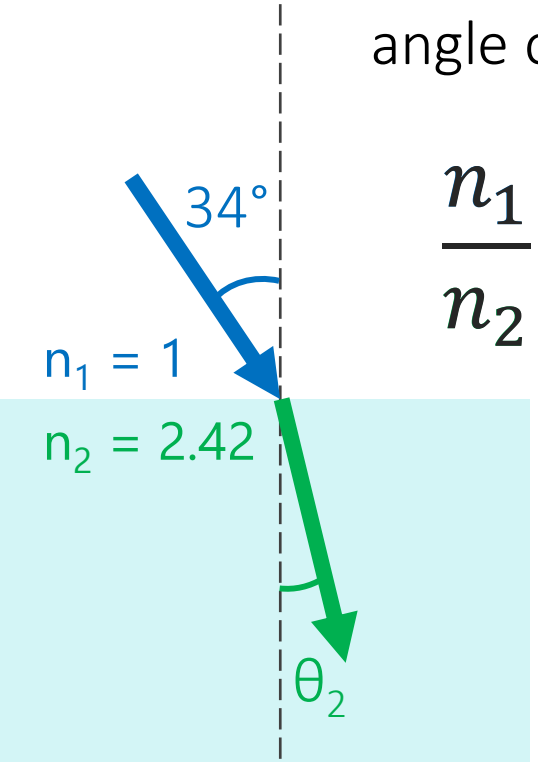
$$\frac{n_1}{n_2} = \frac{sin\theta_2}{sin\theta_1} = \frac{v_2}{v_1}$$



Where does it "appear" the marble is?

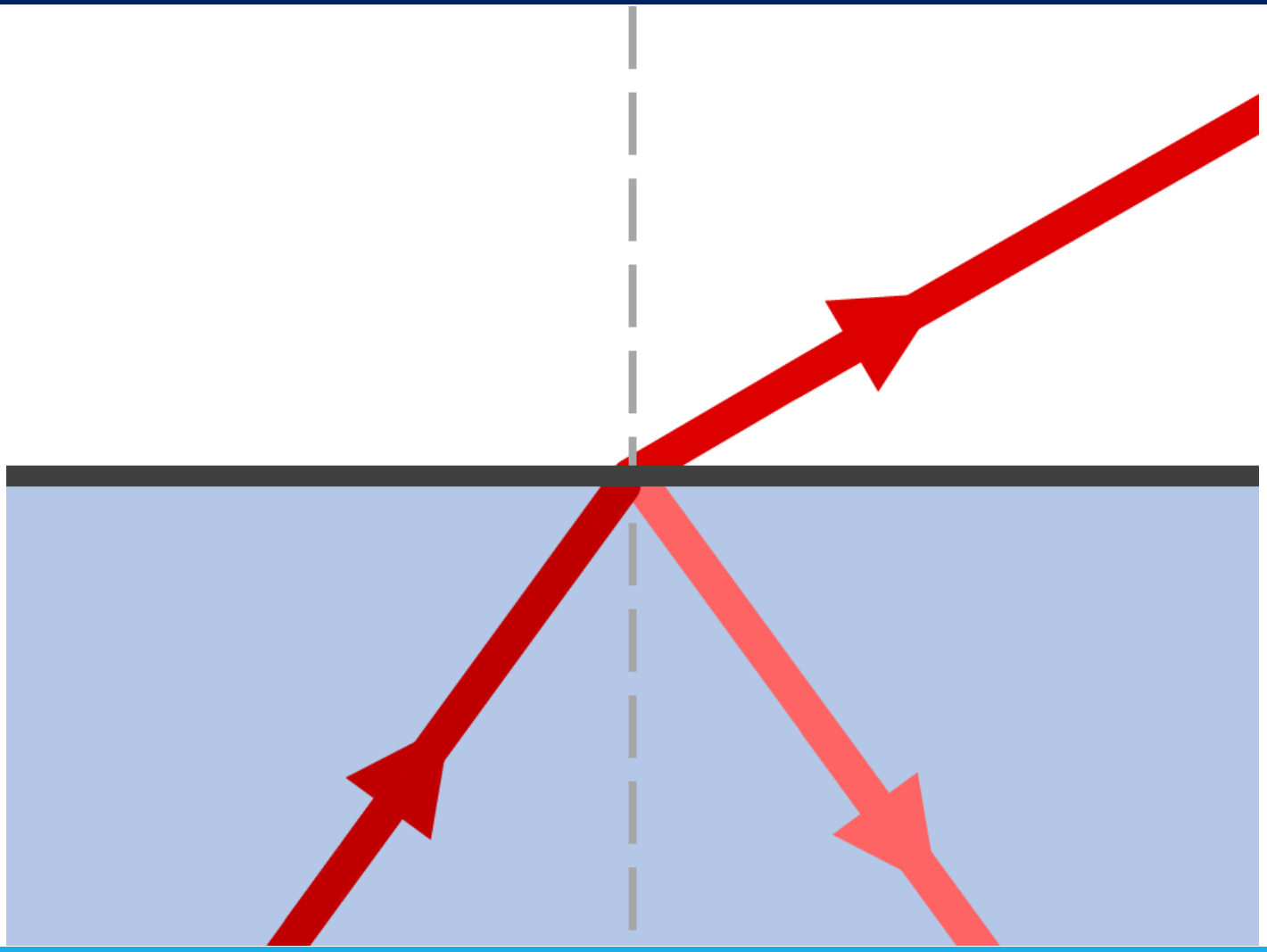
Try this…

If the light travels from air to diamond (n = 2.42) at an angle of incidence of 34°, find the angle of refraction.



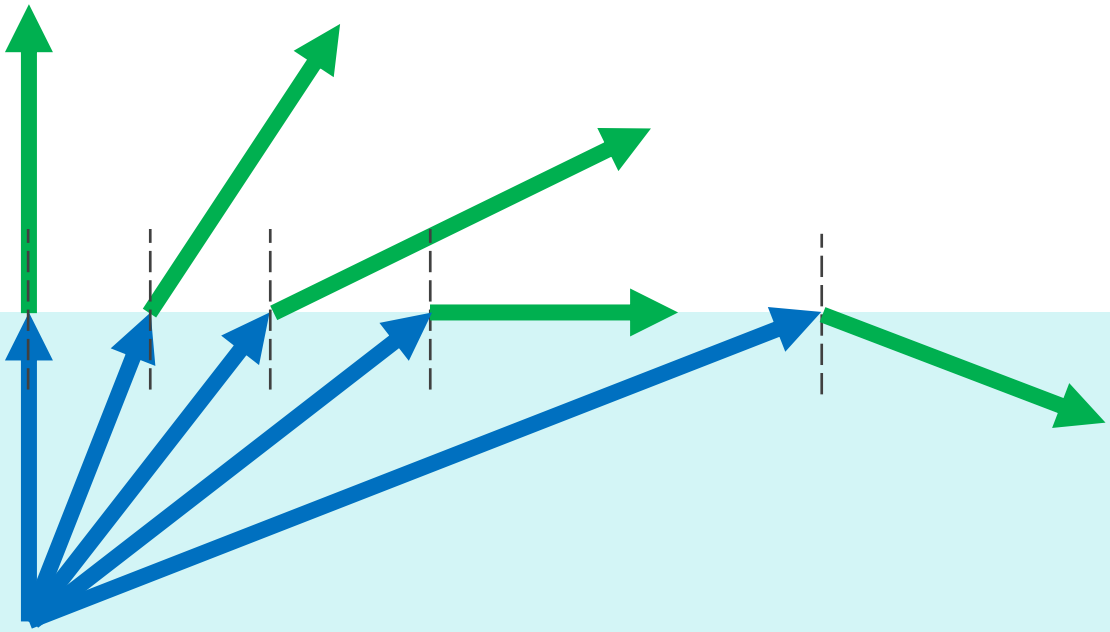
$$\frac{n_1}{n_2} = \frac{sin\theta_2}{sin\theta_1} = \frac{v_2}{v_1}$$

Refraction AND Reflection



Critical Angle

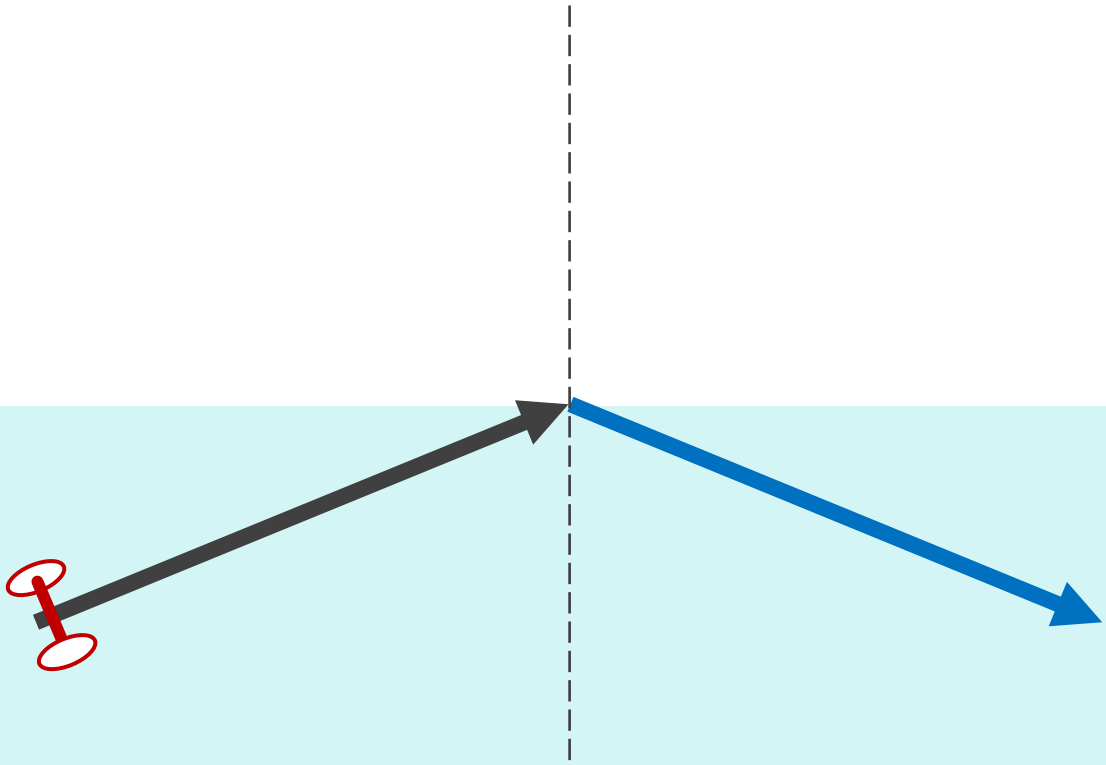
Critical Angle:



$n_2 = 1$

$n_1 = 1.33$

Remember the Bend



faster

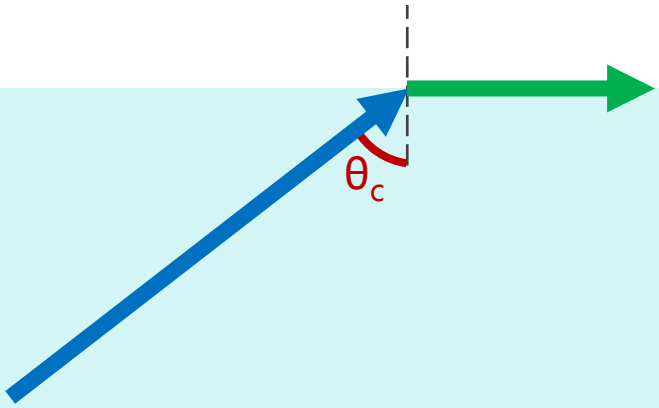
n = 1

n = 1.33

slower

Critical Angle

$$\frac{n_1}{n_2} = \frac{sin\theta_2}{sin\theta_1}$$



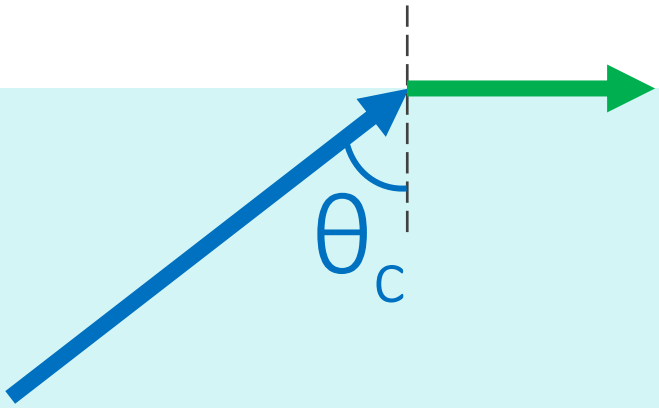
$n_2 = 1$

$n_1 = 1.33$

Try This

What's the critical angle between glass and air?

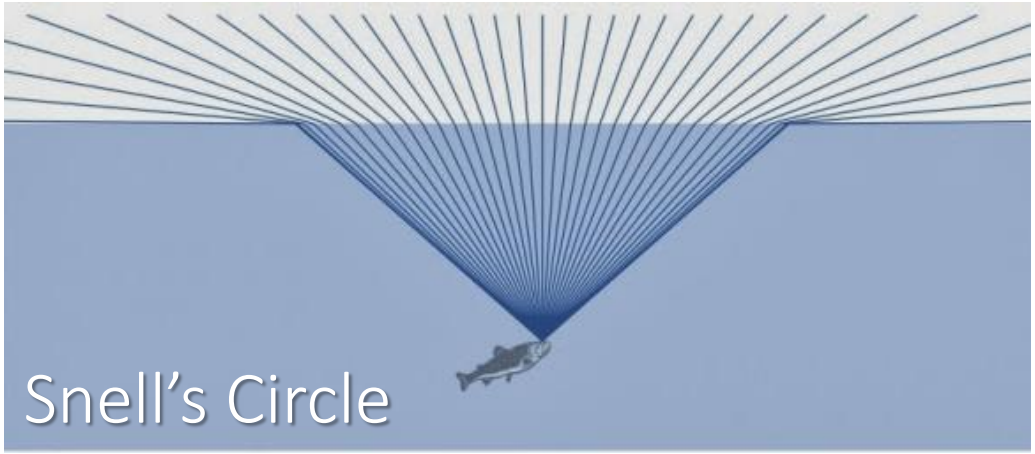
$$\frac{n_1}{n_2} = \frac{sin\theta_2}{sin\theta_1}$$

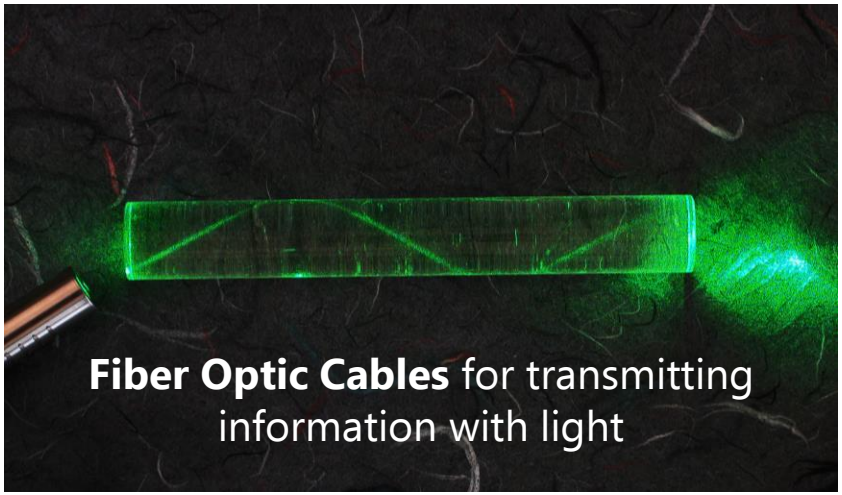


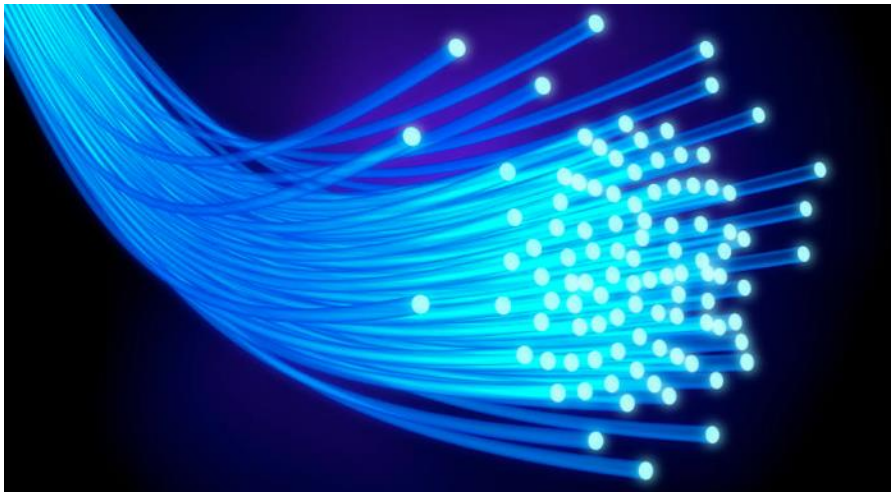
$n_2 = 1$

$n_1 = 1.52$

Why does it matter?



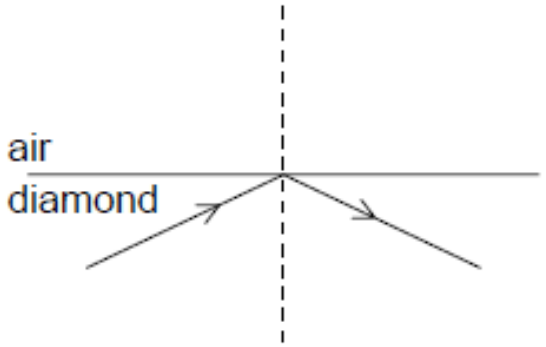




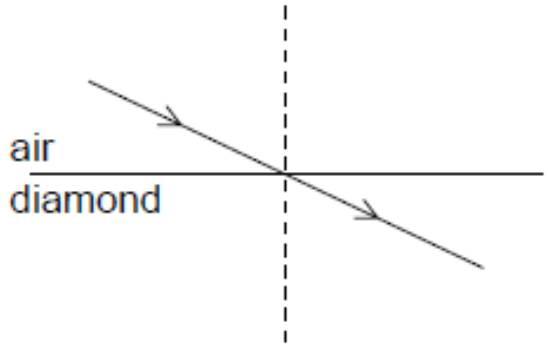
Sample IB Question

A light ray is incident on an air–diamond boundary. The refractive index of diamond is greater than 1. Which diagram shows the correct path of the light ray?

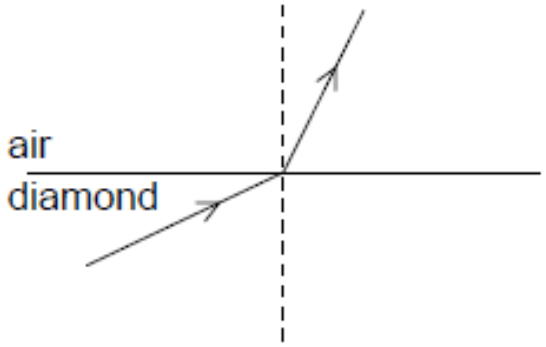
A.



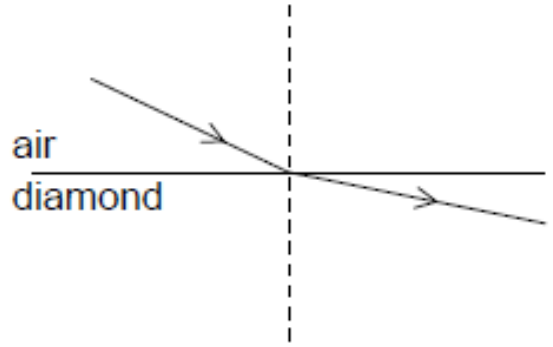
B.



C.



D.



Lesson Takeaways

- ❑ I can mathematically relate the angles of refraction to the indices of refraction for the materials
- ❑ I can describe the phenomenon of total internal reflection
- ❑ I can calculate the critical angle of incidence so that the light cannot escape the medium