

Refraction Problems

****Remember****

“n” for air is always 1.0

$c = 3.0 \times 10^8$ m/s

- 1) Use the given information to solve for the unknowns in the chart below.

Material	Index of refraction (n)	Speed of light in the given medium (v)
Ruby		1.95×10^8 m/s
Sapphire		1.69×10^8 m/s
Diamond	2.42	
Water (liquid)	1.33	
Water (ice)	1.30	

- 2) Why is the index of refraction different for water as a liquid as compared to solid state?

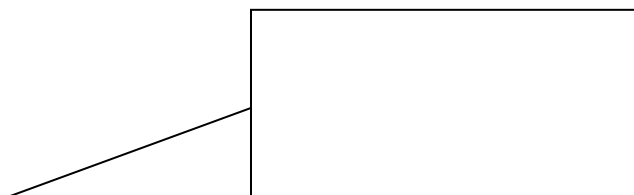
- 3) Complete the chart below. Make you calculations on another page.

Medium 1	Medium 2	Index of refraction (n_1)	Index of refraction (n_2)	Angle of incidence (θ_1)	Angle of refraction (θ_2)
Air	Diamond		2.42	30°	
Air	Zircon		1.90	30°	
Diamond	Air	2.42			10°
Water	Diamond	1.33	2.42		10°

- 4) If the angle of incidence (from crown glass, $n=1.52$) is 30° , find the angle of refraction in diamond ($n=2.42$).

- 5) a) Draw a **ray diagram** to show the path of ray of light as it passes from air into a block of glass ($n=1.61$) then through the block and out the other side.

Be sure to sketch the **normals** and show your **measured angles** and **calculations** using Snell's Law.



- b) What would happen to the angle of refraction if the block was made of ice ($n=1.30$)?

larger smaller same

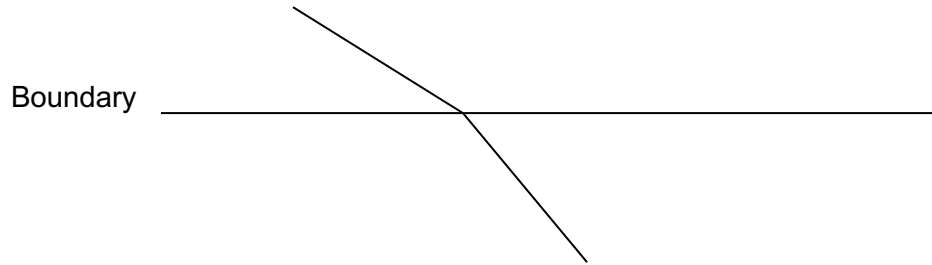
- c) How will the light bend when it passes back into the air?

Toward normal OR away from normal

6) Complete the chart below

Medium 1	Medium 2	Index of refraction (n_1)	Index of refraction (n_2)	Critical Angle (θ_c)
Diamond	Air	2.42	1.00	
Water	Air	1.33	1.00	
Glass	Water		1.33	61.4°

7) In the diagram below, light is crossing a boundary from air to water ($n = 1.33$). Draw the **normal line**, indicate the **direction** of the rays & **label** each medium as air or water.



8) A diagram below shows a ray travelling from air into an object composed of 3 different media. Complete the diagram by continuing the **ray** until it **leaves** the object.

Remember to draw a new normal at the boundary between each medium

