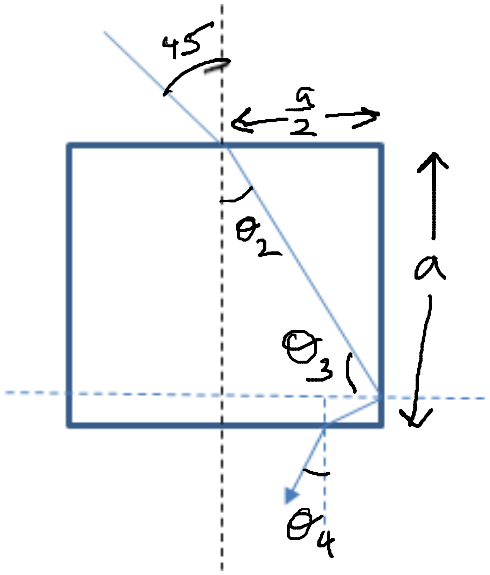
Monday, September 09, 2013
3:08 PM

HW #1

1.



$n_{air} \sin 45^\circ = n_{glass} \sin\theta_2$

$\frac{1}{\sqrt{2}} = 1.414 \sin\theta_2$

$\theta_2 = 30^\circ$

If $\tan^{-1}\frac{a/2}{a} = \theta_3 \Rightarrow$ ray hits corner

$= 26.5^\circ$

$\therefore$ ray hits side face

At θ_3: Is it TIR?

$\theta_3 = 60^\circ \rightarrow 1.414 \sin 60 > 1$

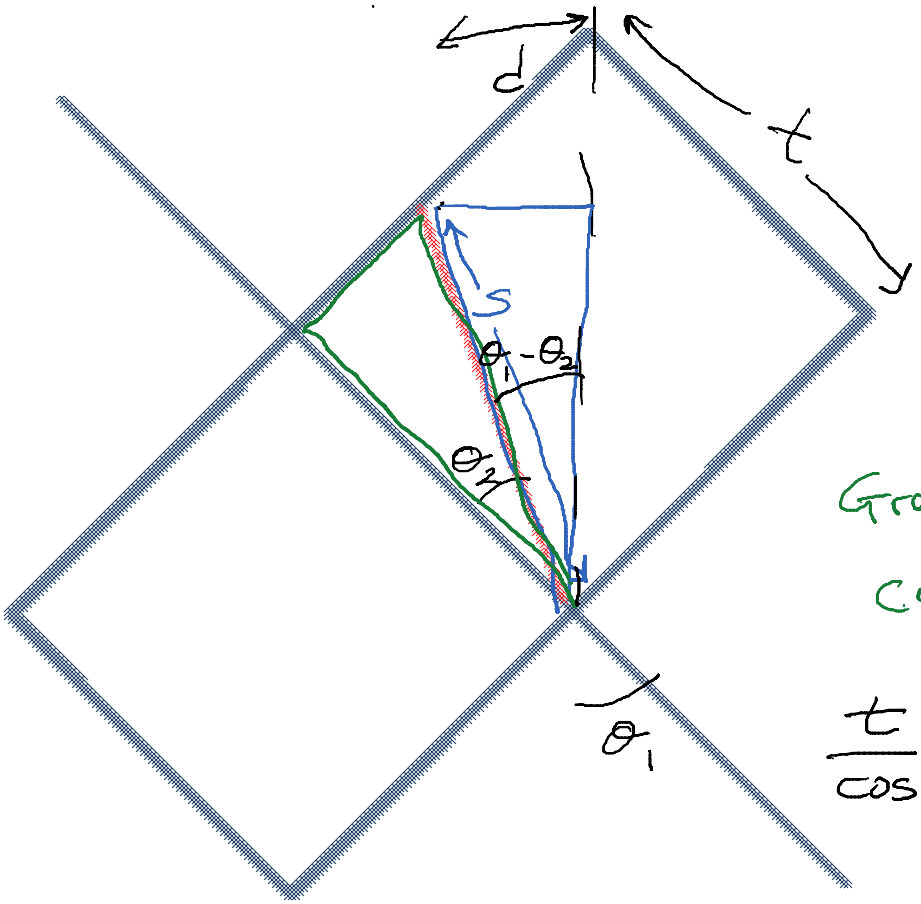
$1.22 > 1$ ✓ TIR

$\therefore$ Ray reflects at $\theta_3 = 60$

At bottom face: $1.414 \sin 30 = \sin\theta_4$

$\theta_4 = 45^\circ$

2. a)



Blue triangle

$$\sin(\theta_1 - \theta_2) = \frac{d}{s}$$

Green triangle

$$\cos\theta_2 = \frac{t}{s}$$

$$\frac{t}{\cos\theta_2} = \frac{d}{\sin(\theta_1 - \theta_2)}$$

$$d = \frac{t\sin(\theta_1 - \theta_2)}{\cos\theta_2}$$

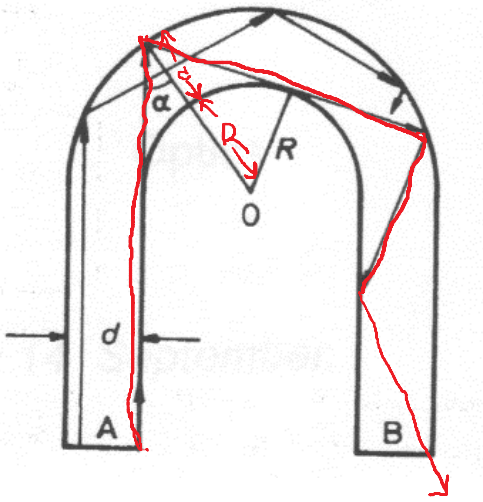
b) $n_2 = 1.5$ $\theta_1 = 60$ $t = 6$ cm

$$\sin 60 = 1.5 \sin\theta_2$$

$$\theta_2 = 35.2^\circ$$

$$d = \frac{6 \cdot \sin(24.7)}{\cos(35.2)} = 3.1 \text{ cm}$$

3.



Using the red path, will get TIR at angle α

if $n_1 \sin\alpha > 1$

$$\sin\alpha > \frac{1}{1.5}$$

$$\sin\alpha = \frac{R}{R+d}$$

$$\therefore \quad \frac{R}{R+d} > \frac{1}{1.5}$$

$$\frac{R+d}{R} < 1.5$$

$$1 + \frac{d}{R} < 1.5 \qquad \frac{d}{R} < 0.5$$

$$\frac{R}{d} > 2$$

All other reflection angles are bigger.

HW #1

4.

$n_1 = 1.5, \quad n_2 \approx 1$

$R = -2$ cm

$s_0 = 1$ cm

$$s_i = \frac{n_2}{\left(\frac{n_2 - n_1}{R} - \frac{n_1}{s_0}\right)}$$

$$= \frac{1}{\frac{-0.5}{-2} - \frac{1.5}{1}} = \frac{1}{+\frac{1}{4} - \frac{6}{4}} = -\frac{4}{5}\text{ cm}$$