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Optics - Quiz 8 9/27/2019

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At the Brewster's angle $\theta_i = \theta_B$ we know that $\theta_i + \theta_t = \pi/2$ so they are complementary angles and thus

$$\sin\theta_t = \cos\theta_i$$

and

$$\cos\theta_t = \sin\theta_i$$

Substituting this into the equation for r_s we find

$$\begin{aligned} r_s &= \frac{\sin\theta_t\cos\theta_i - \sin\theta_i\cos\theta_t}{\sin\theta_t\cos\theta_i + \sin\theta_i\cos\theta_t} \\ &= \frac{\cos^2\theta_i - \sin^2\theta_i}{\cos^2\theta_i + \sin^2\theta_i} \\ &= \frac{1 - \tan^2\theta_i}{1 + \tan^2\theta_i} \\ &= \frac{1 - (n_t/n_i)^2}{1 + (n_t/n_i)^2} \\ &= \frac{n_i^2 - n_t^2}{n_i^2 + n_t^2} \end{aligned}$$

So

$$R_s = |r_s|^2 = \left|\frac{n_i^2 - n_t^2}{n_i^2 + n_t^2}\right|^2 = \left|\frac{2^2 - 3^2}{2^2 + 3^2}\right|^2 = \left|\frac{-5}{13}\right|^2 = \frac{25}{169} = 0.148$$