$n_2 = 1$

$n_1 = 1.33$

$\textcircled{\theta} + \alpha = 45°$
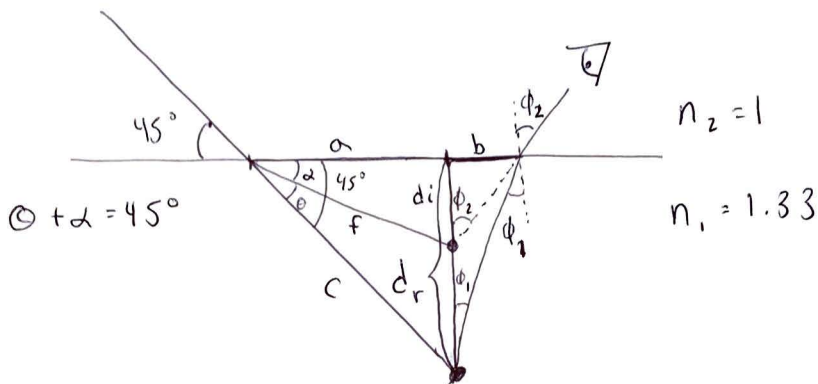
(a)

$$n_1 \sin\phi_1 = n_2 \sin\phi_2$$

$$n_1 \tan\phi_1 \approx n_2 \tan\phi_2$$
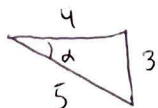
$$n_1 \frac{b}{d_r} = n_2 \frac{b}{d_i} \implies \boxed{\frac{d_i}{d_r} = \frac{n_2}{n_1} = \frac{3}{4}}$$

(b) To make things more concrete (and easier)
say $a = 4$. This means $d_r = 4$ (due
to the 45° angle) and $c = 4\sqrt{2}$.
Also, $d_i = 3$ (from part (a)). So $f = \sqrt{a^2 + d_i^2} = 5$

$\alpha = \arctan\left(\frac{3}{4}\right) = 36.9°$

$\implies \theta = 45° - \alpha = 8.1°$