Electromagnetic Waves

If the electric field of a plane wave is given by:

$$E(t) = E_0 \sin(ky - \omega t)\,\hat{z}$$

a) What is $B(t)$ in terms of E_0, k, and ω?

b) Let $E_0 = 10^{-6}\ \frac{V}{m}$. What is the intensity?

c) What is the power incident on a plate with an area $1\,m^2$ if it is

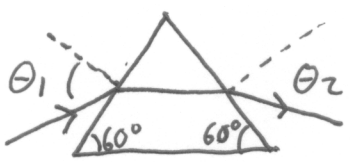
i) Perpendicular to the light wave (Figure A)

ii) At an angle of $30°$ (Figure B)

A B

Refraction

Consider the following situation (angles not to scale!):



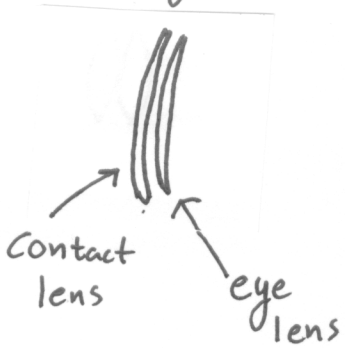
$n_{prism} = 1.3$

a) If $\theta_1 = \theta_2$, what is θ_1?

b) If $\theta_1 = 30°$, what is θ_2?

Contact Lens

A contact lens sits directly on the eye and forms an optical system with the lens of the eye. This may be modelled as two very close lenses:

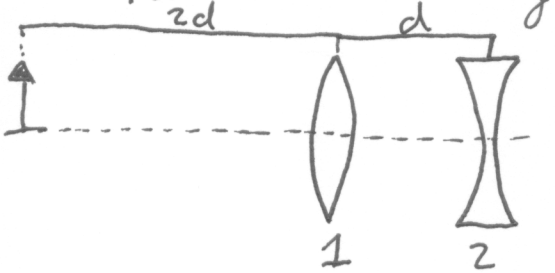


(Food for thought: what kinds of lens might the contact be? The eye?)

In the case where two lenses are very close, they may be replaced by a single lens of focal length f_{eff} for conceptual purposes. What is f_{eff} in terms of f_c and f_e (the focal lengths of the contact and eye, respectively)?

Multiple Lenses

For the following two lens system:



$|f_1| = d$

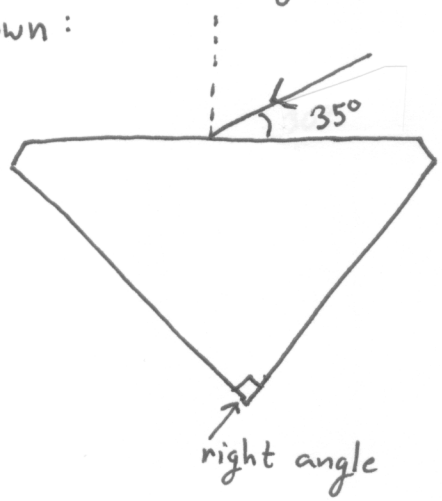
$|f_2| = \frac{d}{2}$

a) Determine the position of the final image by ray tracing.

b) Using the thin lens formulas, check your answer from (a) and compute the magnification.

Refraction and TIR

A ray of light is incident on a diamond as shown:



$n_{diamond} = 2.4$

a) Sketch qualitatively the path of the ray, especially where it exits the diamond.

b) Can you explain why glass is not a good substitute for a diamond in jewelry? (Think about the "sparkle")