

State Any Assumptions You Need To Make -- Show All Work -- Circle Any Final Answers
Use Your Time Wisely - Work on What You Can - Be Sure to Write Down Equations
BOLDFACE Variables Are Vectors - Feel Free to Ask Any Questions

Track 7 • Any Colour You Like PINK FLOYD—THE DARK SIDE OF THE MOON (50,000 points)

1.) (a) For a particular kind of glass, $n_2 = 1.55$. If light came in from the air side, $n_1 = 1.00$, at an angle $\theta_1 = 45^\circ$, then find the angle θ_2 .

(b) If you could see the Pink Floyd *The Dark Side of the Moon* CD cover in color, the white ray at the left splits in colored rays (ROYGBIV) with *red* at the top and *violet* at the bottom. This is due to the phenomena called *dispersion*. If the index of refraction for red light is $n_{red} = 1.5500$ and violet light is $n_{violet} = 1.5656$, explain whether the order of colors as shown on the CD cover is correct or inverted.

(c) Given the information in (a) and (b), briefly explain whether the picture on the CD cover is accurate or flawed. You may wish to do a couple of calculations to prove your point. Do not write long paragraphs – make short comments that are easy to read. Use the Worksheet on Page 5 if you need more room.



(d) Before there were Compact Disc players, we had things called “albums” and “LP records”. People I knew in the dorm at Northwestern University would play *The Dark Side of the Moon* on their huge speakers at 300 W. With the speakers blasting that loud, find the current in the speaker wire at 12.0 V.A.C. and find how much current that represents coming from the 120. V.A.C. electrical outlet.

(e) With the primary side of a transformer at 120. V.A.C. and the secondary side at 12.0 V.A.C., find the number of windings on the primary side if there are 100. windings on the secondary side.

Time to Get Serious About Starship and Keanu Reeves? (50,000 points)

2.) Sirius – the Dog Star – is 8.60 light years from Earth. (a) How many meters is this?

Sir-i-us (sīr'ē-es) *noun*
A star in the constellation Canis Major, the brightest star in the sky, approximately 8.6 light-years distant from Earth. Also called *Dog Star*, *Sothis*.
[Latin *Sirius*, from Greek *Seirios*, from *seirios*, burning.]



Dogstar / Happy Ending

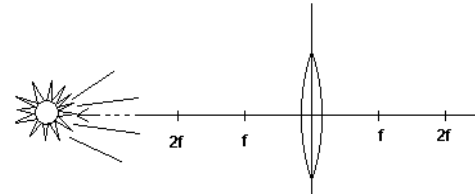
(b) The Jefferson Starship is heading to Sirius at a speed of 0.860 that of light. How many years will they think the trip takes?

(c) Show that Music Impresario Dick Clark sees the same amount of time pass on the Earth whether you use the distance as seen from Earth or convert the time as seen on the Jefferson Starship.



Jefferson Airplane / Freedom at Point Zero

(d) The light from Sirius shines on a lens with a focal length $f = 10,000. \text{ mm} = 10.0 \text{ m}$. Although the star is huge, it is very far away and so the in-focus image will still be that of a point. Where is the image, q , of Sirius located? *If you did not get an answer to (a), use $p = \infty$.*



(e) This lens contains an anti-reflection coating ($n_{\text{coating}} = 1.38$) on glass ($n_{\text{glass}} = 1.55$) in air ($n_{\text{air}} = 1.00$). If the coating is 200. nm thick, for what wavelength of light is this an anti-reflection coating in air?