Physics 322, Winter Quarter 2016
Electrodynamics: Homework Assignment 9
(a) Turn in all problems and clearly note all constants and assumptions you use.
(1-point penalty each otherwise)
(b) Use 8½ x 11 paper & staple
(1-point penalty each otherwise)
(c) Due March 10 either 9:00 am in class or 8:45 am in the instructor's mailbox;
late homework gets 0.

1. Bob Shaw has written science fiction stories about "slow glass", a glass whose index-of-refraction is so big that it takes, say, a year for light to travel a distance of 1cm. He envisions you position the glass overlooking a picturesque scene for a year, then move the glass to your home. For a year you'd then enjoy the scene at home. Assume no reflection in question 1.
a. What's the index-of-refraction of this glass?
b. Suppose you took a square meter of this glass and exposed its face "24/7" over a year to the full light of the sun. How much energy is stored in the glass.
c. Estimate the electric and magnetic RMS fields in the glass.

2. For the "slow glass" in problem 1, find the reflection coefficient. Thence, explain why useful slow glass would be very hard to realize.

3. Consider isotropic electromagnetic radiation within a hollow cavity having absorptive walls. The RMS energy density of the radiation is W. What's the radiation pressure normal to the wall (say, in the x-direction). Hint: you can assume the free-space wavelength of the radiation is much smaller than the cavity dimensions, so the radiation is mostly in free space. Hint: you can guess the answer from thermodynamics. Hint: Recall a similar problem in thermodynamics.

4. Consider a plane wave with wave number **k** and angular frequency ω. The non-magnetic non-conductive medium through which the wave propagates is unusual: the dispersion relation is such that $k^2-(\omega/c)^2 \neq 0$, and we also have the relation $|\mathbf{D}| = \varepsilon_0 |\mathbf{E}|$. (a) Find which of the electromagnetic vectors **E**, **D**, **B** and **H** are transverse to the propagation direction. (b) What kind of medium is this?