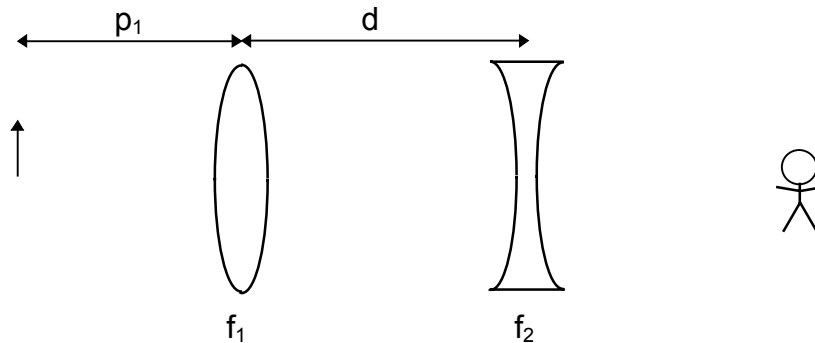
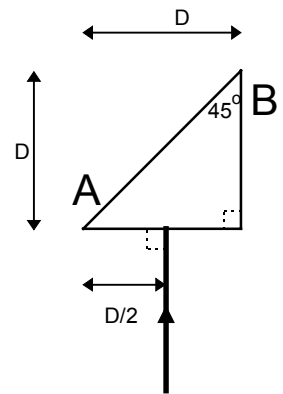


SAMPLE SECOND MIDTERM

Problem 1. Two lenses are arranged as shown. An arrow pointing upwards is placed before the converging lens. The total system magnification is $m = 0.418$. What is f_2 ?
Use, $p_1 = 300$ mm, $f_1 = +500$ mm, $d = 250$ mm.



Problem 2. A beam of light, $\lambda = 500$ nm, enters a right triangle made of glass at normal incidence. The surrounding medium is air. Lengths and angles are as shown in the figure with $D = 1.0$ cm.



- (a) Some of the light will always exit through side B. Depending on the index of refraction, some may also exit through side A. Sketch the path the beam will take for both of these cases. Draw the normal to the surface of the prism where each beam exits.
- (b) What is the speed of the wave in the prism if its index of refraction is the smallest value that results in no light exiting through side A?
- (c) What is the frequency of the light inside the prism?
- (d) Starting from the entrance, how far inside the prism must you go for the wave to have a phase difference of 2π with respect to the wave entering the prism?

Problem 3. In a Young's Two Slit Interference apparatus, the spacing between the slits, d , is 0.15 mm. The interference pattern from it is viewed a distance $D = 1.0$ m from the slits.

- (a) What is the phase difference between waves from the two slits that arrive at the second minimum?
- (b) What is the separation between the point of greatest intensity when both slits are used, and the point of greatest intensity when the bottom slit is blocked?
- (c) Suppose the slits are illuminated with two different wavelengths: $\lambda_A = 500$ and λ_B . It is observed that the second minimum when using λ_A occurs in the same place as the second maximum when using λ_B . What is λ_B ?

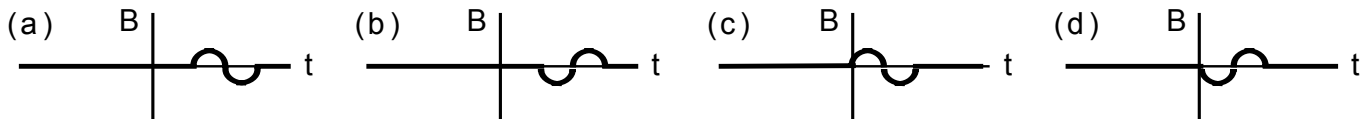
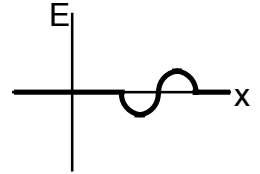
SAMPLE SECOND MIDTERM

Problem 4.

(1) A light beam passes from plastic to glass. As it does so, it bends away from the normal to the interface between them. We can conclude:

- (a) $n_{\text{plastic}} > n_{\text{glass}}$ (b) $n_{\text{plastic}} = n_{\text{glass}}$ (c) $n_{\text{plastic}} < n_{\text{glass}}$
 (d) $n_{\text{plastic}} = n_{\text{air}}$ (e) $n_{\text{glass}} = n_{\text{air}}$

(2) The graph on the right gives the value of the electric field in an EM wave as a function of position at time $t = 0$. Which graph below best describes the magnetic field as a function of time at $x = 0$? The wave is moving in the $-x$ direction.



(3) An EM wave travels in the $+x$ direction. Its electric field has maximum magnitude, E_M . A possible expression for the magnetic field is:

- (a) $\vec{B} = \hat{x} \frac{E_M}{c} \sin(kx - \omega t + \phi_o)$ (b) $\vec{B} = \hat{x} cE_M \sin(kx - \omega t + \phi_o)$
 (c) $\vec{B} = \hat{y} \frac{E_M}{c} \sin(kx - \omega t + \phi_o)$ (d) $\vec{B} = \hat{y} cE_M \sin(kx - \omega t + \phi_o)$

(4) Let the wavelengths of red light and blue light be λ_R and λ_B , respectively. Then,

- (a) $\lambda_R < \lambda_B$.
 (b) $\lambda_R = \lambda_B$ (only their frequencies differ).
 (c) $\lambda_R > \lambda_B$.

(5) The $m = 2$ bright fringe from a two-slit interference apparatus is observed before and after the apparatus is modified. Which of the following will change the phase difference between waves arriving at the $m = 2$ bright fringe?

- (a) immersing the apparatus in water (b) increasing the spacing between slits
 (c) both of the above (d) neither of the above