1. \( \frac{1}{4\pi\varepsilon_0} = 9 \times 10^9 \text{ Nm}^2/C^2 \), \( \mu_0/4\pi = 10^{-7} \text{ Tm/A}, \ c = 3 \times 10^8 \text{ m/s} \)

2. 

3. 

4. 

Total 

Work all four problems.

1. The objective lens of an astronomical telescope has a 25 cm diameter objective lens with a focal length of 100 cm. The eyepiece lens has a focal length of 2.5 cm. The final image formed by the eyepiece is located at infinity.

(A) What is the angular magnification of the telescope?

(B) What is the diameter of the exit pupil?

(C) What is the eye relief?
2. A thick lens is shown. The radius of both surfaces is 4 cm. The vertex to vertex thickness of the lens is 2 cm. The index of refraction of the glass is 1.50.

(A) What is the focal length of the lens?

(B) Where are the principal planes located with respect to the vertices?

(C) An object is located 6 cm to the left of the first vertex. Where is the final image located?

(D) What is the lateral magnification of the final image?
3. (A) A beam of unpolarized light of intensity 1 W/m² is incident along the \( \mathbf{i} \) axis of a right hand coordinate system in the direction from negative \( x \) toward positive \( x \). The beam passes through an ideal linear polarizer with the easy transmission axis along the \( \mathbf{j} \) axis. What is the intensity of the light after passing through the polarizer?

(B) What is the direction of the electric field after the polarizer? What is the direction of the magnetic field after the polarizer?

(C) A second ideal linear polarizer is placed after the first polarizer with its easy transmission axis along the \( \mathbf{k} \) axis. What is the intensity of light after the second polarizer?

(D) A \( \lambda/2 \) plate is placed between the two linear polarizers. The fast axis of the \( \lambda/2 \) plate is along the \( \mathbf{j} + \mathbf{k}/\sqrt{2} \) axis and the slow axis is along the \( \mathbf{j} - \mathbf{k}/\sqrt{2} \) axis. What is the intensity of the light after the \( \lambda/2 \) plate? What is the polarization after the \( \lambda/2 \) plate?

(E) What is the intensity of the light after the second linear polarizer?

(F) What is the variation of the intensity after the second linear polarizer as the \( \lambda/2 \) plate is rotated?
4. Sketch how one can observe both Fizeau and Haidinger fringes using a Michelson interferometer. Describe how one can use the Fizeau fringes to align the interferometer. After alignment describe how one can find zero path length. Describe how one can measure the wavelength of a single line in a spectrum using a Michelson interferometer.