Physics 10164 - Spring 2019 Exam 3F

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work even if you get the right answer. Clearly indicate your answer with a circle or a box and remember to include correct units and significant figures.

1. (25 pts) Unpolarized light with an intensity of 240 Watts/m² is incident on a vertically oriented polarizer, then that vertically polarized light is incident on a 2nd polarizer for which the polarization axis makes an angle A with respect to the vertical. The final intensity of light emerging from the 2nd polarizer is 45 Watts/m².

a) What is the angle A?
b) What is the rms value of the electric field of the light that emerges from the 2nd polarizer?

$I_0 = 240$

$I_1 = 120\ W/m^2$

$I_2 = 120 \cos^2\theta = 45$

$\cos^2\theta = 0.375$

$\cos\theta = 0.61$

$\boxed{\theta = 52^\circ}$

b) $U_{tot} = \frac{S}{c} = 1.5 \times 10^{-7} = \epsilon_0 E_{rms}^2$

$\boxed{E_{rms} = 130\ N/C}$

2. (25 pts) When an object is placed 120 cm in front of a mirror, the resulting magnification is -0.40. What object distance would result in a magnification of +1.5?

$$-0.40 = -\frac{q}{120} \Rightarrow q = 48\ cm$$

$$\frac{1}{120} + \frac{1}{48} = \frac{1}{f}$$

$$\Rightarrow f = 34.3\ cm$$

$$1.5 = -\frac{q}{p} \Rightarrow q = -1.5p$$

$$\frac{1}{p} - \frac{1}{1.5p} = \frac{1}{34.3}$$

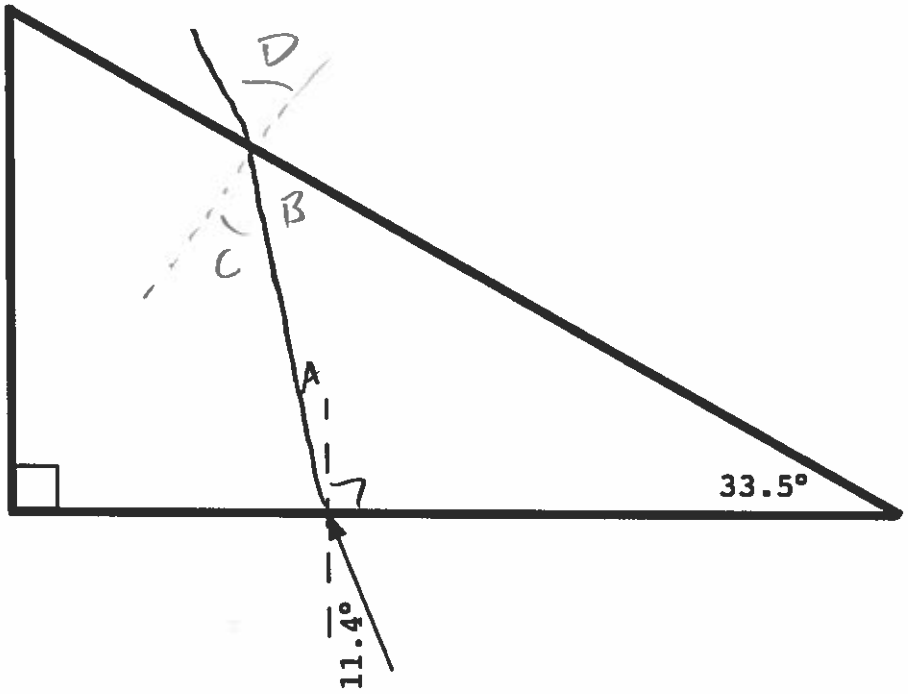
$$\frac{1.5}{1.5p} - \frac{1}{1.5p} = \frac{1}{34.3}$$

$$\frac{0.5}{1.5p} = \frac{1}{34.3}$$

$$1.5p = 17.1$$

$$\boxed{p = 11\ cm}$$

3. (25 pts) The prism below has an index of refraction of 1.44 and is surrounded by air. Light is incident on the bottom face of the prism as shown. Through what face of the prism does the light exit, and what is the final angle of refraction?



$1.0 \sin 11.4 = 1.44 \sin A \Rightarrow A = 7.9°$

$A + 90° + 33.5° + B = 180° \Rightarrow B = 48.6°$

$B + C = 90° \Rightarrow C = 41.4°$

$1.44 \sin C = 1.0 \sin D \Rightarrow \boxed{D = 72.2°}$

4. (25 pts) A person has a near point of 18 cm and a far point of 43 cm. We want to prescribe eyeglasses for this person to correct the far point to be infinity. The eyeglasses will sit 2.0 cm in front of the eye.

a) What must be the focal length of these lenses?
b) What is the new near point for this person wearing the glasses? Keep in mind that the new near point must account for the extra 2.0 between the lenses and the eye! I am asking what the near point is for the eye, not the lenses.

a) Need $q = 43$ cm from eye

41 cm from lenses

for $p = \infty$

$$\frac{1}{\infty} + \frac{1}{-41} = \frac{1}{f} \Rightarrow \boxed{f = -41 \text{ cm}}$$

b) What p results in $q = 18$ cm in front of eye

$q = 16$ cm in front of lens?

$$\frac{1}{p} + \frac{1}{-16} = \frac{1}{-41} \Rightarrow p = 26 \text{ cm}$$

in front of lens

$$\boxed{p = 28 \text{ cm in front of eye}}$$