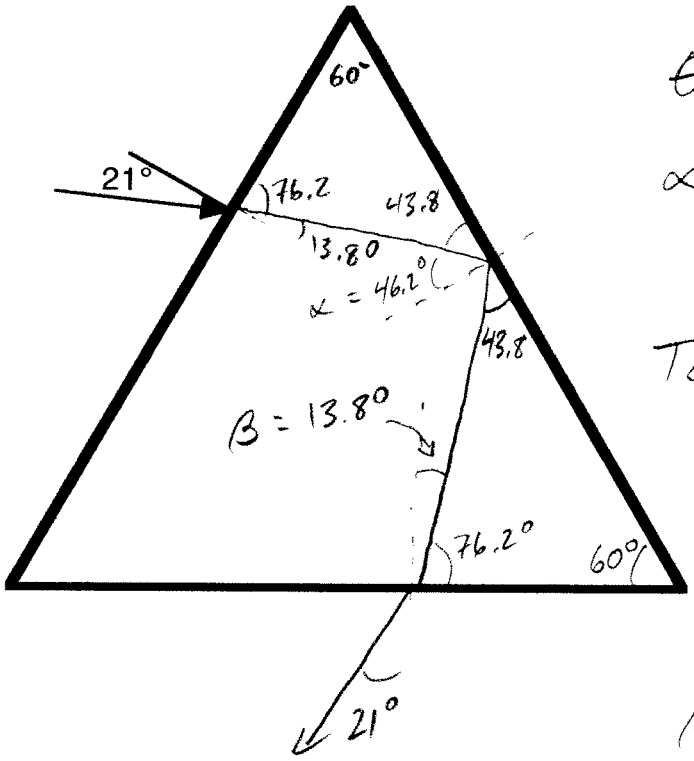
Physics 10164 - Exam 4C

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. (40 pts) A glass (n = 1.5) prism is an equilateral triangle (all three interior angles are 60°) and surrounded by air. Light enters the left side of the prism at an angle of 21° with respect to the normal. Show on the diagram where the light exits the prism and calculate its angle of refraction upon exiting.



$\theta_c = \sin^{-1}\left(\frac{1}{1.5}\right) = 41.8°$

α = ∠ of incidence > 41.8°

so reflection

Top Δ: $76.2° + 60° + 43.8 = 180°$

$90 - 43.8 = 46.2 = \alpha$

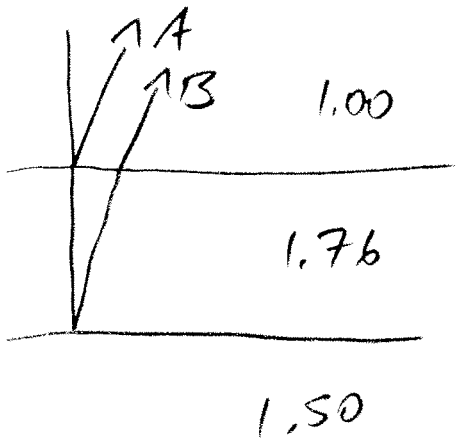
Bottom Δ: $43.8° + 60° + 76.2° = 180°$

$\beta = 90° - 76.2° = 13.8°$

$1.5 \sin 13.8° = 1.0 \sin\theta$

$\theta = 21°$

2. (30 pts) A thin anti-reflective coating (n = 1.76) is applied to a glass surface (n = 1.50). If the coating has a thickness of 490 nm, find what wavelength(s) of light in the visible part of the spectrum experience destructive interference when reflected. The visible spectrum ranges from 400 - 700 nm.



$\delta_A = \frac{1}{2}$

$\delta_B = \frac{2nt}{\lambda_0}$

$\delta_B - \delta_A = \frac{2nt}{\lambda_0} - \frac{1}{2} = \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \ldots$

$\frac{1}{2}: \frac{2nt}{\lambda_0} = 1 \quad \lambda_0 = 2nt = 1725 \text{ nm}$

$\frac{3}{2}: \frac{2nt}{\lambda_0} = 2 \quad \lambda_0 = nt = 862 \text{ nm}$

$\frac{5}{2}: \frac{2nt}{\lambda_0} = 3 \quad \lambda_0 = \frac{2nt}{3} = 575 \text{ nm}$

$\frac{7}{2}: \frac{2nt}{\lambda_0} = 4 \quad \lambda_0 = \frac{2nt}{4} = 431 \text{ nm}$

$\frac{9}{2}: \frac{2nt}{\lambda_0} = 5 \quad \lambda_0 = \frac{2nt}{5} = 345 \text{ nm}$

3. (30 pts) The normal near point for a person is 25 cm, and the normal far point is infinity. Andy has myopia, and his near point is measured to be 15 cm while his far point is measured to be 38 cm.

a) What is the focal length of the lenses needed to give Andy a normal far point?

b) What is the new near point Andy experiences with these lenses?

For object at ∞, want $q = -38$ cm

$$\frac{1}{\infty} + \frac{1}{-38} = \frac{1}{f} \qquad \boxed{f = -38 \text{ cm}}$$

For image at $q = -15$ cm, $p = ?$

$$\frac{1}{p} + \frac{1}{-15} = \frac{1}{-38}$$

$$\frac{1}{p} = \frac{1}{15} - \frac{1}{38} \Rightarrow \boxed{p = 25 \text{ cm}}$$