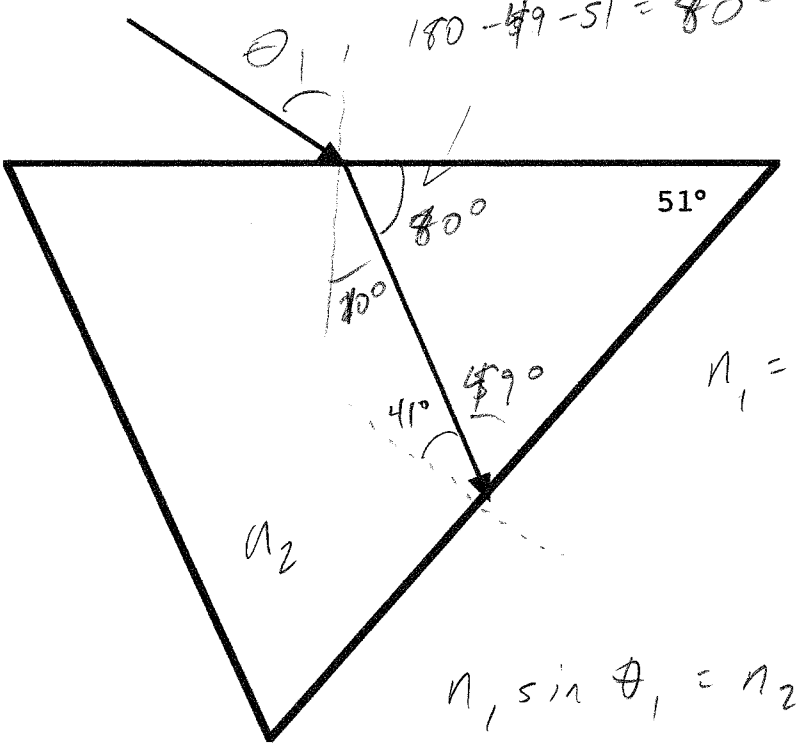
Physics 10164 - Exam 3B

Each problem is worth 25 points. 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 of a box and remember to include correct units and significant figures.

1. A ray of light is incident on a glass prism as shown below. Upon reaching the lower right surface at an angle of incidence of 41°, it reflects back internally since 41° is the critical angle of this prism surrounded by air. What is the original angle of incidence when the ray first enters the prism?



$180 - 49 - 51 = 80°$

$\theta_c = \sin^{-1}\left(\frac{1}{n_2}\right)$

$\sin\theta_c = \frac{1}{n_2}$

$n_1 = 1.0$ $\quad n_2 = 1.52$

$n_1 \sin\theta_1 = n_2 \sin 10°$

$\sin\theta_1 = 1.52 \sin 10$

$= 0.264$

$\boxed{\theta_1 = 15°}$

2. A concave mirror forms a real image of an object 17 cm in front of the mirror, and the image is 3.0 times larger in height than the object. What is the radius of curvature of the mirror?

$q +$

$p +$

$$M = -\frac{q}{p} = -3.0$$

so $q = 3p$

$p = 17$ cm

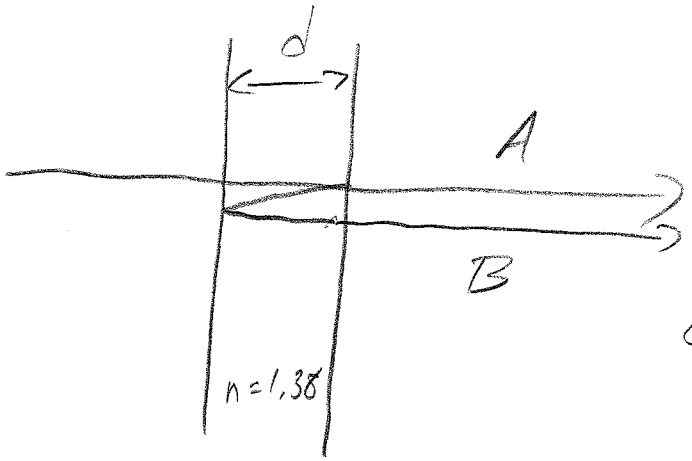
$q = 51$ cm

$$\frac{1}{17} + \frac{1}{51} = \frac{1}{f}$$

$f = 12.75$ cm

$$R = 2f = \boxed{26 \text{ cm}}$$

3. A thin film of soap (n = 1.38) has a thickness of 1650 nm, and it is surrounded on both sides by air. What wavelength or wavelengths of transmitted light in the visible part of the spectrum (between 400 and 700 nm) appear dimmed thanks to destructive interference by the film?



$$\delta_A = 0$$

$$\delta_B = 0 + 0 + \frac{2dn}{\lambda_0}$$

$$\delta_B - \delta_A = \frac{2dn}{\lambda_0} = \frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \text{etc}$$

$$\lambda_0 = 4dn, \frac{4dn}{3}, \frac{4dn}{5}, \frac{4dn}{7}, \ldots$$

$$= 9108, 3036, 1820, 1301, 1012,$$

$$828, 701, 607, 536, 479, 434,$$

$$396$$

4. The normal far point for a person is infinity. If Jason's far point is 35 cm, what is the optical power (in diopters) needed for his lenses to correct his vision?

$p = \infty$

Need $q = -35$ cm

$$\frac{1}{\infty} + \frac{1}{-35} = \frac{1}{f}$$

$f = -35$ cm

or -0.35 m

$$P = \frac{1}{f} = \boxed{-2.9\ d}$$