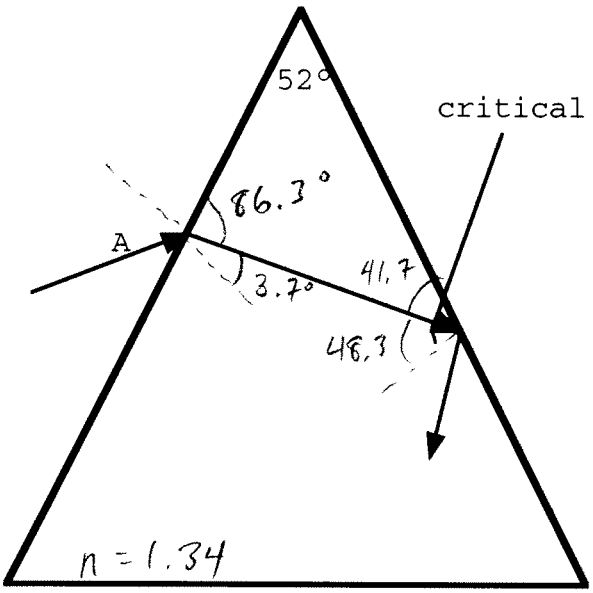
Physics 10164 - Exam 4

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. The prism below is surrounded by air, symmetric and has an apex angle of 52°. Light enters from the left at some unknown angle of incidence and then it internally reflects off the right hand face after striking it at an angle of incidence exactly equal to the critical angle. What is the original angle of incidence of the light as it enters the prism?



$\theta_c = \sin^{-1}\left(\frac{1}{1.34}\right)$

$= 48.3°$

$1.0 \sin A = 1.34 \sin 3.7°$

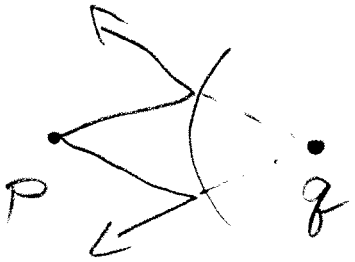
$\boxed{A = 5.0°}$

2. A person holds a coin 8.0 cm in front of a convex mirror and notices the image is only one-half the size of the coin.

a) Will the image be real or virtual? Explain.

b) What is the radius of curvature of the mirror?

Virtual image. If rays diverging upon contact with convex mirror, they will diverge more upon reflection



$M = -\frac{q}{p} = +0.50$

since q is neg.

So $p = -2q$

or $q = -\frac{p}{2}$

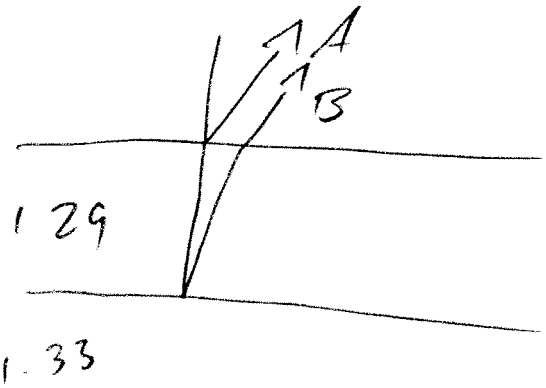
$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$

$\frac{1}{8} + \frac{1}{-4} = \frac{1}{f}$

$f = -8$ cm

$R = 16$ cm

3. A thin film of oil (n = 1.29) on the surface of water (n = 1.33) produces a bright reflection of green light of wavelength 510 nm. Determine the minimum possible thickness of the oil (not zero).



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

$$\phi_B = \frac{2tn}{\lambda_0} + \frac{1}{2}$$

$$\phi_B - \phi_A = \frac{2tn}{\lambda_0} = 0, 1, 2, 3 \ldots$$

$$t = 0, \left(\frac{\lambda_0}{2n}\right), \frac{2\lambda_0}{2n}, \ldots$$

$$t = \frac{\lambda_0}{2n} = \boxed{198 \text{ nm}}$$

use 1.29

4. Light of wavelength 510 nm is sent through a single slit that is 0.250 mm wide. The light illuminates a wall 1.5 meters away. What is the width of the central maximum on the screen, in mm?

1st min

$$a \sin\theta = 1\lambda$$

$$\frac{ay}{L} = \lambda$$

$$y = \frac{L\lambda}{a}$$

$$= \frac{(1.5)(510\times10^{-9})}{.250\times10^{-3}}$$

$$= 3.06\text{ mm}$$

$$\text{width} = 2y = \boxed{6.12\text{ mm}}$$