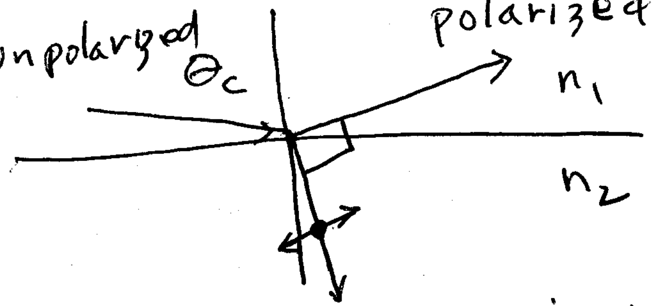
Physics 1C Spring 2010

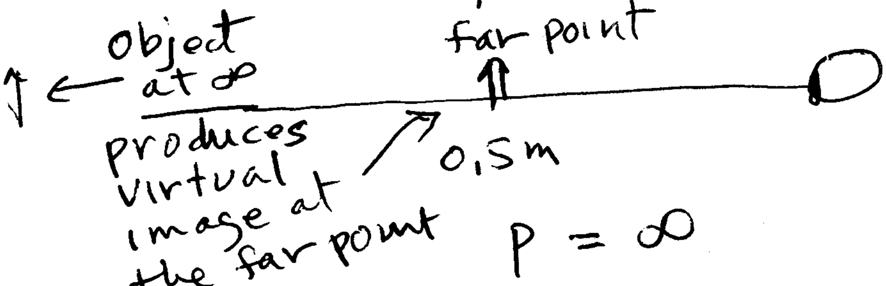
Quiz 2 form A

1)



The completely polarized beam must be perpendicular to the refracted beam. The oscillations of the E field in the refracted beam ~~don't~~ along the direction of the reflected beam don't propagate - (Light is a transverse wave)

2) Near-sighted Vision



$p = \infty$

$q = -0.5\ m$

Solve for f

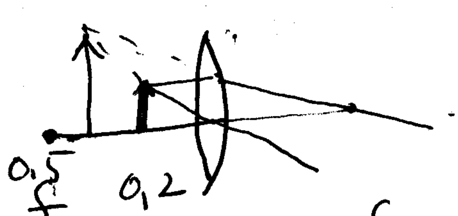
$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

$$\frac{1}{\infty} + \frac{1}{-.50} = \frac{1}{f}$$

$f = -0.5\ m$

$P = 1/f = \frac{1}{-0.5\,m} =$ **−2 diopters**

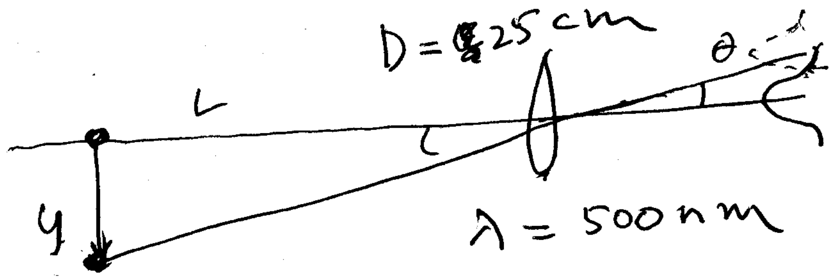
3)



$$q = \frac{pf}{p-f} = \frac{(0.2\,m)(0.5\,m)}{(0.2\,m - 0.5\,m)} = -0.33$$

The image is virtual and enlarged

4) Spy camera – Diffraction Limit

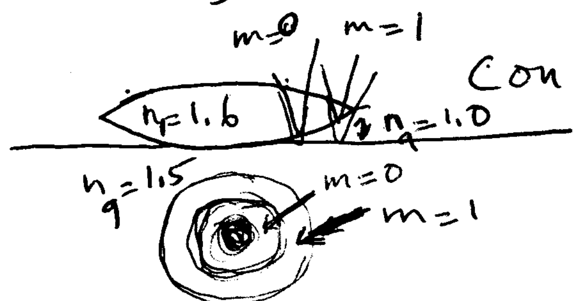


$$\frac{y}{L} = \theta = 1.22\,\frac{\lambda}{D}$$

$$y = 1.22\,\frac{\lambda}{D}L = 1.22\,\frac{(500\times10^{-9}\,m)}{25\times10^{-2}\,m}\,4\times10^{3}\,m$$

$$y = 1.0\times10^{-2}\,m \quad \boxed{1.0\,cm}$$

5) constructive interference



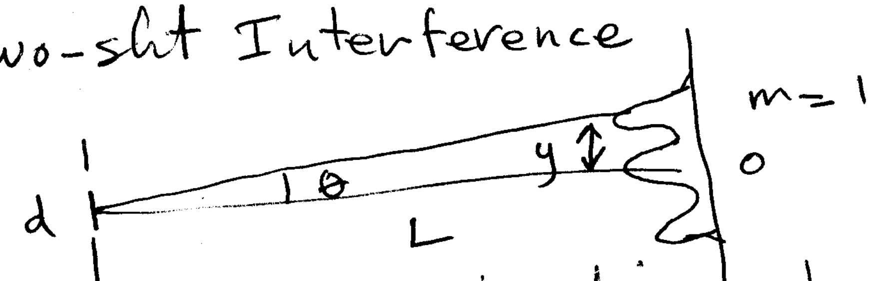
The light reflected from the lens-air interface has no phase shift. The light from the air-glass interface is phase shifted by 180°. There is a net phase shift of 180°. The condition for constructive interference is

$$2t = (m + \tfrac{1}{2})\lambda \quad (m = 0, 1, 2 \ldots)$$

for the second bright ring $m = 1$

$$t = \frac{3}{2}\,\frac{\lambda}{2} = \frac{3}{4}(500\,nm) = \boxed{375\,nm}$$

6) Two-slit Interference



condition for constructive interference

$$d \sin\theta = m\lambda$$

$$d \sin\theta = \lambda \quad \text{for } m = 1$$

small angle

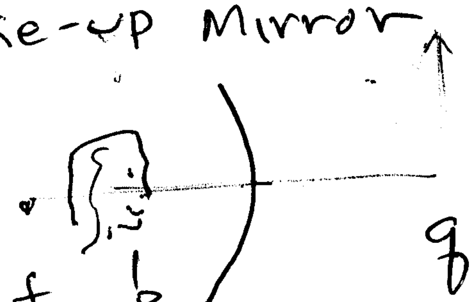
$$\sin\theta = \frac{y}{L}$$

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

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

$$y' = \frac{2\lambda}{d/2}L = 4\frac{\lambda}{d}L = \boxed{4y}$$

7) Make-up Mirror



$0.5\,m = f \quad p$

$$m = -\frac{q}{p} = 2.5$$

$$q = -2.5\,p$$

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

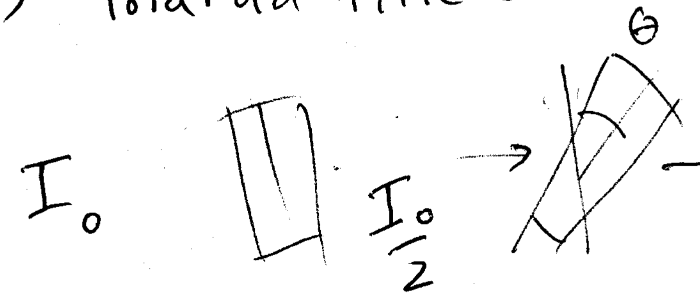
$$\frac{1}{p} + \frac{1}{-2.5p} = \frac{1}{f}$$

$$\frac{2.5-1}{2.5p} = \frac{1}{f}$$

$$p = \frac{2.5-1}{2.5}f = \frac{2.5-1}{2.5}(0.5\,m)$$

$$p = \boxed{0.30\,m}$$

8) Polaroid filters



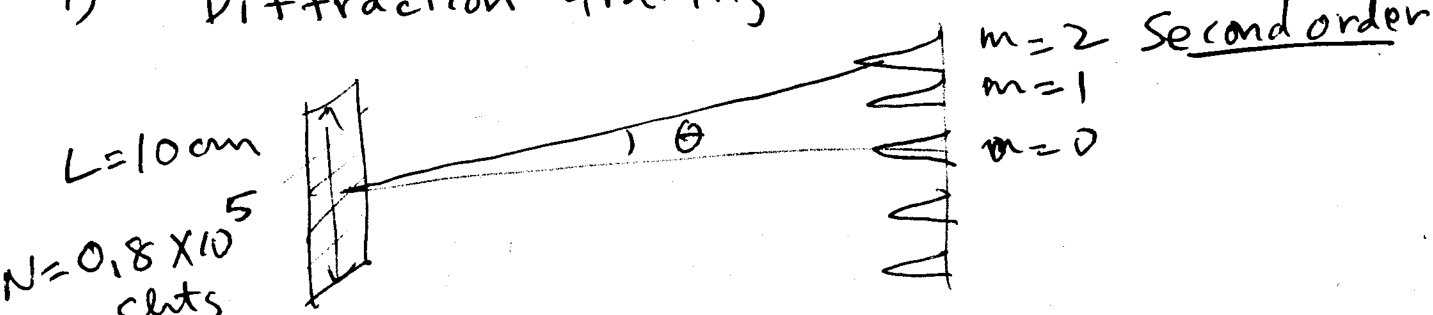
$$\frac{I_0}{2}\cos^2\theta = \frac{I_0}{3}$$

$$\cos^2\theta = \frac{2}{3}$$

$$\cos\theta = \sqrt{\frac{2}{3}} = 0.816$$

$$\theta = \boxed{35^\circ}$$

9) Diffraction Grating



$$d = \frac{L}{N}$$

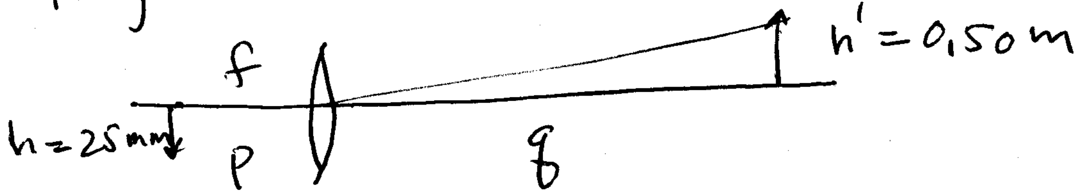
$$d\sin\theta = m\lambda$$

$$\sin\theta = \frac{m\lambda}{d} = \frac{m\lambda N}{L} = \frac{2(500\times10^{-9})(0.8\times10^{5})}{10\times10^{-2}\text{ m}}$$

$$\sin\theta = 0.80$$

$$\theta = \boxed{53^\circ}$$

10) Projector



$$m = -\frac{h'}{h} = \frac{0.5}{-25\times10^{-3}} = -\frac{q}{p} = -20$$

~~$q = 20p$~~ $p = q/20$

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

$$\frac{1}{q/20} + \frac{1}{q} = \frac{1}{f}$$

$$\frac{20+1}{q} = \frac{1}{f}$$

$$f = \frac{q}{21} = \frac{3.0\,m}{21} = 0.143\,m$$

143 mm