PHYS 1150: Quiz #3 – SOLUTIONS

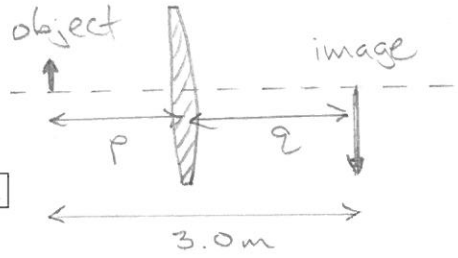
/6 **Problem 1:** A lens is used to project a (real) magnified image of an apple onto a screen. The apple is 10.0 cm high and its image is to be 25.0 cm high. The screen is 3.0 m from the apple.

(a) How far from the object is the lens?

/2

Both p and q are positive so $M = -q/p$ is negative. This gives the magnification factor

$$M = -\frac{25}{10} = -\frac{q}{p} \implies q = 2.5p.$$



Since $p + q = 3.0$ we have

$$3.0 = p + 2.5p = 3.5p \implies p = \frac{3}{3.5} = \boxed{0.86\,\text{m}}$$

(b) Calculate the required focal length of the lens. Is the lens converging or diverging?

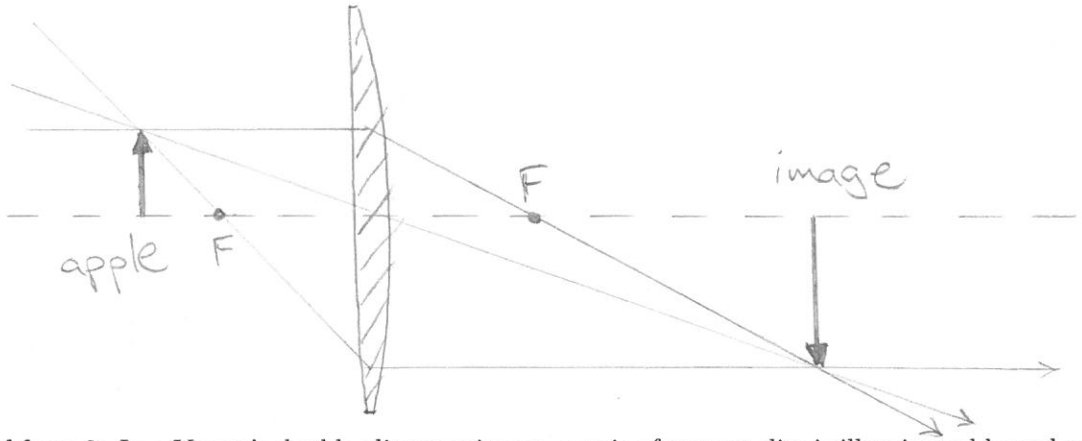
/2

$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f} \implies f = \left(\frac{1}{0.86} + \frac{1}{2.14}\right)^{-1} = \boxed{0.61\,\text{m}}$$

Since $f > 0$ we know then lens is *converging*.

(c) Draw a principal ray diagram that illustrates why the image appears where it does.

/2



/4 **Problem 2:** In a Young's double-slit experiment, a pair of narrow slits is illuminated by coherent light of wavelength 620 nm. The resulting interference pattern illuminates a screen certain distance away. The second bright fringe of the interference pattern appears at an angle 13.0° from the center line. Calculate the separation between the slits.

The bright fringes occur at angles θ where

$$\sin\theta = m\frac{\lambda}{d} \quad (m = 0, \pm 1, \pm 2, \ldots)$$

In this case $\theta = 13.0°$ when $m = 2$ so

$$\sin 13.0° = 2 \cdot \frac{620}{d} \implies d = 2 \cdot \frac{620}{\sin 13.0°} = 5512\,\text{nm} \approx \boxed{5.5\,\mu\text{m}}$$