

Student Name: _____

OPTI 201R

Homework 9--Point Sheet

_____ TOTAL POINTS (out of 100 points)

7.01 Locate the Cardinal Points for the Newport Lenses measured in lab:

For the [KBX058](#) bi-convex lens:

Paraxial Raytrace

_____ (1) Refract the ray at surface 1: $n'u'$ (or u'): $n'u' = -.00669$; $u' = -.00441$

_____ (1) y_2 at surface 2: $y_2 = .977\text{mm}$
(or .0977cm, etc., depending on your choice of y_1)

_____ (1) Refract the ray at surface 2: $n''u''$ (or u''): $n''u'' = -.01323$; $u'' = -.01323$

_____ (1) Transfer to F^* : $\text{BFD} = 73.87\text{ mm}$

_____ (1) Transfer backwards to P^* : $\delta^* = -1.70\text{ mm}$

Correct answers for the locations of the cardinal points:

_____ (1) $\overline{V_1F} = -73.87\text{ mm}$

_____ (1) $\overline{V_1P} = 1.70\text{ mm}$

_____ (1) $\overline{V_1N} = 1.70\text{ mm}$

_____ (1) $\overline{V_2F^*} = +73.87\text{ mm}$

_____ (1) $\overline{V_2P^*} = -1.70\text{ mm}$

_____ (1) $\overline{V_2N^*} = -1.70\text{ mm}$

Gaussian Reduction

_____ (2) $\phi_1 = \frac{n' - 1}{R_1} = \frac{1.517 - 1}{.077265\text{m}}$ $\phi_1 = +6.691\text{D}$

_____ (2) $\phi_2 = \frac{1 - n'}{R_2} = \frac{1 - 1.517}{-.077265\text{m}}$ $\phi_2 = +6.691\text{D}$

_____ (2) $\phi_{12} = \phi_1 + \phi_2 - \frac{t}{n'} \phi_1 \phi_2 = (2)(6.691) - \frac{.005102}{1.517} (6.691)^2$ $\phi_{12} = 13.2314\text{D}$

_____ (2) $\delta = \frac{t}{n'} \frac{\phi_2}{\phi_{12}} \cdot n = \frac{.005102}{1.517} \left(\frac{6.691}{13.2314} \right) (1)$ $\delta = +1.700\text{mm}$

_____ (2) $\delta^* = -\frac{t}{n'} \frac{\phi_1}{\phi_{12}} \cdot n'' = \frac{-0.005102}{1.517} \left(\frac{6.691}{13.2314} \right) (1)$ $\delta^* = -1.700 \text{ mm}$

_____ (2) $f = \frac{-n}{\phi_{12}} = \frac{-1}{13.2314 \text{ m}^{-1}}$ $f = -75.57 \text{ mm}$

_____ (2) $f^* = \frac{n''}{\phi_{12}} = \frac{1}{13.2314 \text{ m}^{-1}}$ $f^* = 75.57 \text{ mm}$

_____ (2) $FFD = f + \delta = -75.57 \text{ mm} + 1.7 \text{ mm}$ $\overline{V_1 F} = FFD = -73.87 \text{ mm}$

_____ (2) $BFD = f^* + \delta^* = 75.57 \text{ mm} - 1.7 \text{ mm}$ $\overline{V_2 F^*} = BFD = 73.87 \text{ mm}$

KBX058 Raytrace Table

_____ (5) Did you fill out a table?

For the [KPX088](#) plano-convex lens:

Paraxial Raytrace (curved surface to the left)

_____ (1) Refract the ray at surface 1: $n'u'$ (or u'): $n'u' = -.01323$; $u' = -.00872$

_____ (1) y_2 at surface 2: $y_2 = .95 \text{ mm}$
(or .095cm, etc., depending on your choice of y_1)

_____ (1) Refract the ray at surface 2: $n''u''$ (or u''): $n''u'' = -.01323$; $u'' = -.01323$

_____ (1) Transfer to F*: $BFD = 72.19 \text{ mm}$

_____ (1) Transfer backwards to P*: $\delta^* = -3.37 \text{ mm}$

Paraxial Raytrace (curved surface to the right)

_____ (1) Refract the ray at surface 1: $n'u'$ (or u'): $n'u' = 0$; $u' = 0$

_____ (1) y_2 at surface 2: $y_2 = 1 \text{ mm}$
(or .1cm, etc., depending on your choice of y_1)

_____ (1) Refract the ray at surface 2: $n''u''$ (or u''): $n''u'' = -.01323$; $u'' = -.01323$

_____ (1) Transfer to F: $FFD = (-)75.57 \text{ mm}$

_____ (1) Transfer backwards to P: $\delta = 0 \text{ mm}$

Correct answers for the locations of the cardinal points:

_____ (1) $\overline{V_1F} = -75.57 \text{ mm}$

_____ (1) $\overline{V_1P} = 0 \text{ mm}$

_____ (1) $\overline{V_1N} = 0 \text{ mm}$

_____ (1) $\overline{V_2F^*} = +72.19 \text{ mm}$

_____ (1) $\overline{V_2P^*} = -3.37 \text{ mm}$

_____ (1) $\overline{V_2N^*} = -3.37 \text{ mm}$

Gaussian Reduction

_____ (2) $\phi_1 = \frac{n' - 1}{R_1} = \frac{1.517 - 1}{.039070 \text{ m}}$

$\phi_1 = +13.23266 \text{ D}$

_____ (2) $\phi_2 = \frac{1 - n'}{R_2} = \frac{1 - 1.517}{\infty}$

$\phi_2 = 0 \text{ D}$

_____ (2) $\phi_{12} = \phi_1 + \phi_2 - \frac{t}{n'} \phi_1 \phi_2 = \phi_1$

$\phi_{12} = 13.23266 \text{ D}$

_____ (2) $\delta = \frac{t}{n'} \frac{\phi_2}{\phi_{12}} \cdot n = \frac{.005122}{1.517} \left(\frac{0}{13.2314} \right) (1)$

$\delta = 0 \text{ mm}$

_____ (2) $\delta^* = -\frac{t}{n'} \frac{\phi_1}{\phi_{12}} \cdot n'' = \frac{-.005122}{1.517} \left(\frac{13.23266}{13.23266} \right) (1)$

$\delta^* = -3.376 \text{ mm}$

_____ (2) $f = \frac{-n}{\phi_{12}} = \frac{-1}{13.23266 \text{ m}^{-1}}$

$f = -75.57 \text{ mm}$

_____ (2) $f^* = \frac{n''}{\phi_{12}} = \frac{1}{13.23266 \text{ m}^{-1}}$

$f^* = 75.57 \text{ mm}$

_____ (2) $FFD = f + \delta = -75.57 \text{ mm} + 0 \text{ mm}$

$\overline{V_1F} = FFD = -75.57 \text{ mm}$

_____ (2) $BFD = f^* + \delta^* = 75.57 \text{ mm} - 3.376 \text{ mm}$

$\overline{V_2F^*} = BFD = 72.19 \text{ mm}$

KPX088 Raytrace Table

_____ (5) Did you fill out a table?

7.7 _____ (3) Correct answer for the total power:

$$\phi_{12} = 1.3719 D$$

7.8 (a) What is the power of each lens?

_____ (2) $\phi_A = -8.23 D$

_____ (2) $\phi_B = 10.94 D$

(b) Determine their cardinal points:

The 6 cardinal points for Lens “A” are located at:

_____ (1) $\overline{V_1F} = 127.8 mm$

_____ (1) $\overline{V_1P} = \delta_A = 6.28 mm$

_____ (1) $\overline{V_1N} = \delta_A = 6.28 mm$

_____ (1) $\overline{V_2F^*} = -118.8 mm$

_____ (1) $\overline{V_2P^*} = \delta_A^* = 2.69 mm$

_____ (1) $\overline{V_2N^*} = \delta_A^* = 2.69 mm$

The 6 cardinal points for Lens “B” are located at:

_____ (1) $\overline{V_1F} = -93.72 mm$

_____ (1) $\overline{V_1P} = \delta_B = -2.32 mm$

_____ (1) $\overline{V_1N} = \delta_B = -2.32 mm$

_____ (1) $\overline{V_2F^*} = 85.99 mm$

_____ (1) $\overline{V_2P^*} = \delta_B^* = -5.41 mm$

_____ (1) $\overline{V_2N^*} = \delta_B^* = -5.41 mm$

7.11 _____ (1) $f = -3.31 cm$

_____ (1) $f^* = 4.70 cm$

_____ (1) $\overline{V_1F} = -2.36 cm$

_____ (1) $\overline{V_2F^*} = 3.18 cm$

_____ (1) $\delta_{12} = .947 cm$

_____ (1) $\delta_{12}^* = -1.52 cm$

_____ (1) $\overline{V_1N} = 2.34 cm$

_____ (1) $\overline{V_2N^*} = -.13 cm$