PHYC/ECE 463 Advanced Optics I
Fall 2007
Homework #7, Due Wednesday Oct. 10

1-Problem 3.68 (K&F)

2-Problem 3.71 (K&F)

3-Problem 4.4 (K&F)

4-Problem 4.11 (K&F)

#1   3.68 (KF)

$$M_{sys.} = \begin{pmatrix} 1 & P \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 \\ d & 1 \end{pmatrix} \begin{pmatrix} 1 & -P \\ 0 & 1 \end{pmatrix}$$

$$\begin{pmatrix} 1 & P \\ 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & -P \\ d & 1-dP \end{pmatrix}$$

$$\begin{pmatrix} 1+Pd & -P+P-dP^2 \\ d & 1-dP \end{pmatrix}$$

$$\begin{pmatrix} 1+Pd & -dP^2 \\ d & 1-dP \end{pmatrix} = \begin{pmatrix} M_{11} & M_{12} \\ M_{21} & M_{22} \end{pmatrix}$$

$$P_{sys} = -M_{12} = dP^2 > 0 \quad \text{always positive}$$

#2　KF 3.7°
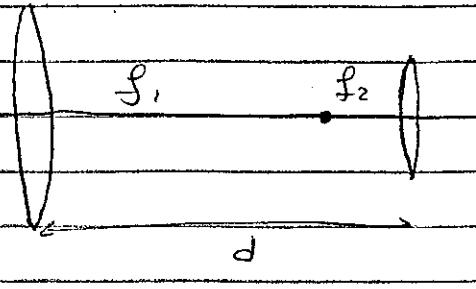
$$d = f_1 + f_2$$

$$M = \begin{pmatrix} m_\alpha & 0 \\ d & \frac{1}{m_\alpha} \end{pmatrix}$$

If the observer's eye is at lens 2 (Exit pupil of the system), then the image distance S' has to be less than or equal to the near point of the eye (250 mm). i.e. $S' \leq 0.25\,m$

$$\tilde{M} = \begin{pmatrix} 1 & 0 \\ S' & 1 \end{pmatrix} \begin{pmatrix} m_\alpha & 0 \\ d & \frac{1}{m_\alpha} \end{pmatrix} \begin{pmatrix} 1 & 0 \\ S & 1 \end{pmatrix} = \begin{pmatrix} \tilde{M}_{11} & \tilde{M}_{12} \\ \tilde{M}_{21} & M_{22} \end{pmatrix}$$

where $\tilde{M}_{21} = S' m_\alpha + \frac{S}{m_\alpha} + d \equiv 0$ for image formation

$$S = m_\alpha \left(-d - m_\alpha S' \right)$$

(a)　$S_{min} = -10 \left[-1 - (-10) \times (-0.25) \right] = +35\,m$

(b)　$S_{min} = 10 \left[-0.8 - (10)(-0.25) \right] = 17\,m$

KF. 4.4

$x' = x$

β'

c_R

c_R

M_R

M_R

x

A.S. (entrance pupil)

exit pupil

$s = s' = 2\frac{e}{f}$
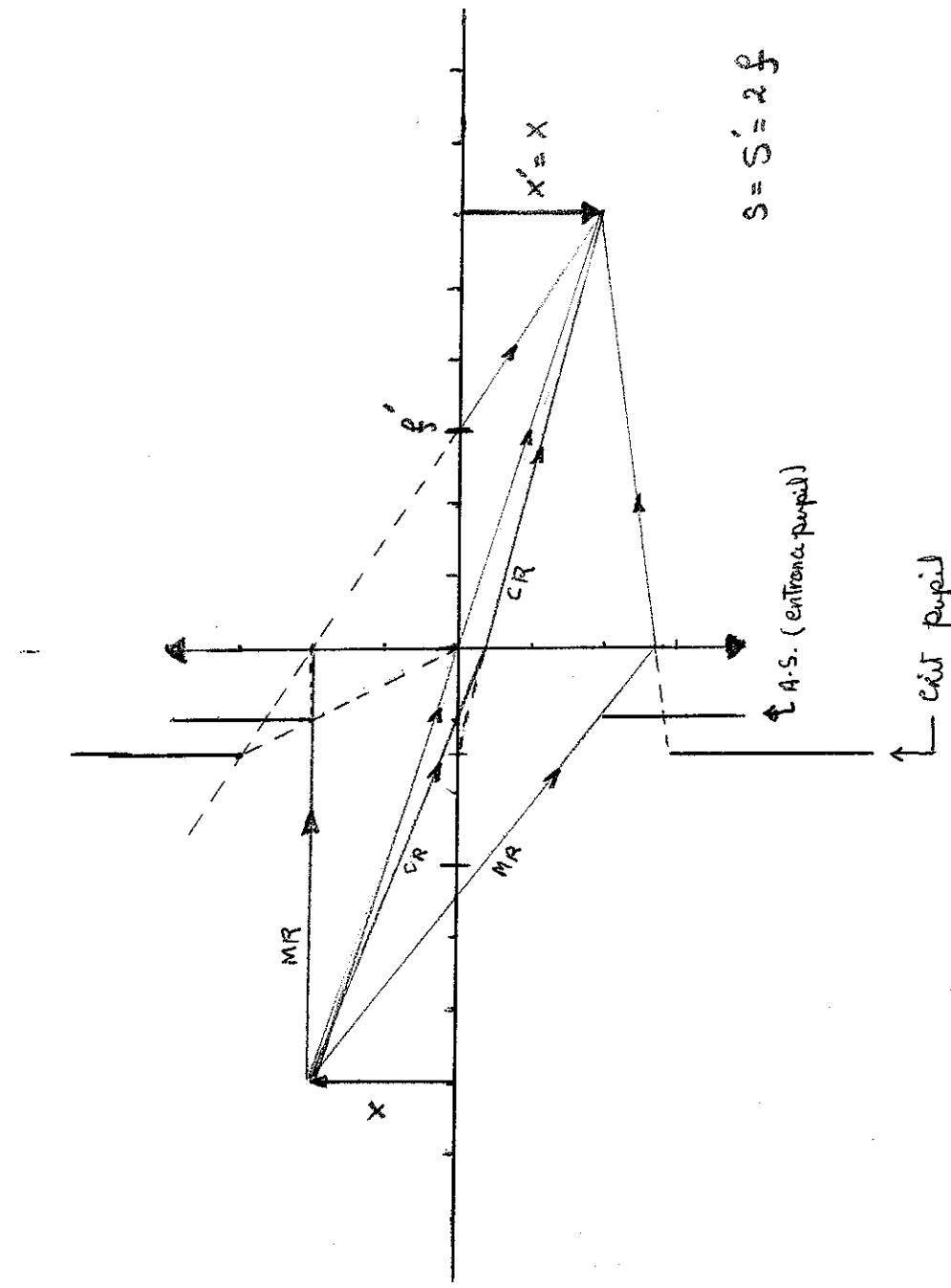
4.11
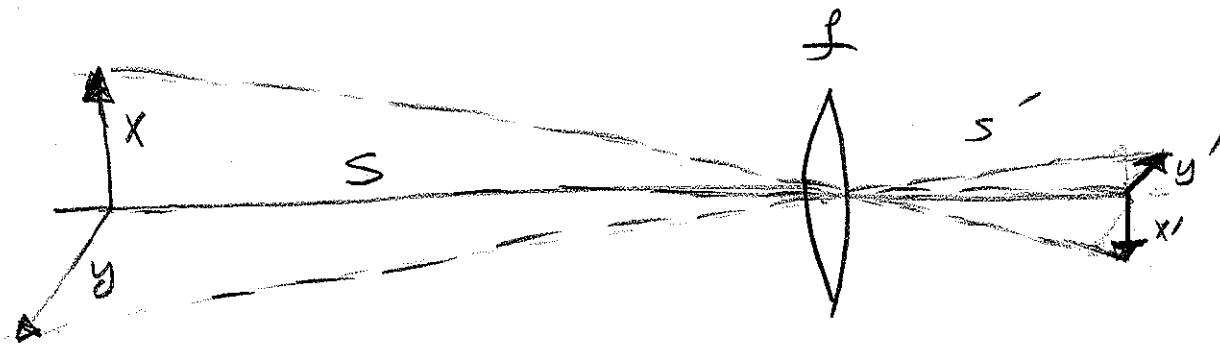
$$\frac{x'}{x} = \frac{y'}{y} = -\frac{s'}{s} = \frac{f}{f-s}$$

$$x' = 24 \, mm$$
$$y' = 37 \, mm$$

$$|x| = |x'| \times \frac{s-f}{f} = |x'| \times M$$

$$f = 50 \, mm \qquad S = 1 \, m \qquad M = 19$$
$$\qquad\qquad\qquad S = 30 \, m \qquad M = 599$$

$S = 1 \, m$

$$X = 19 \times 24 = 456 \, mm \qquad y = 19 \times 37 = 703 \, mm$$

$S = 30 \, m$

$$X = 599 \times 24 / \approx 14 \, m \qquad y = (599 \times 37) = 22 \, m$$
$$\qquad\qquad\qquad mm$$