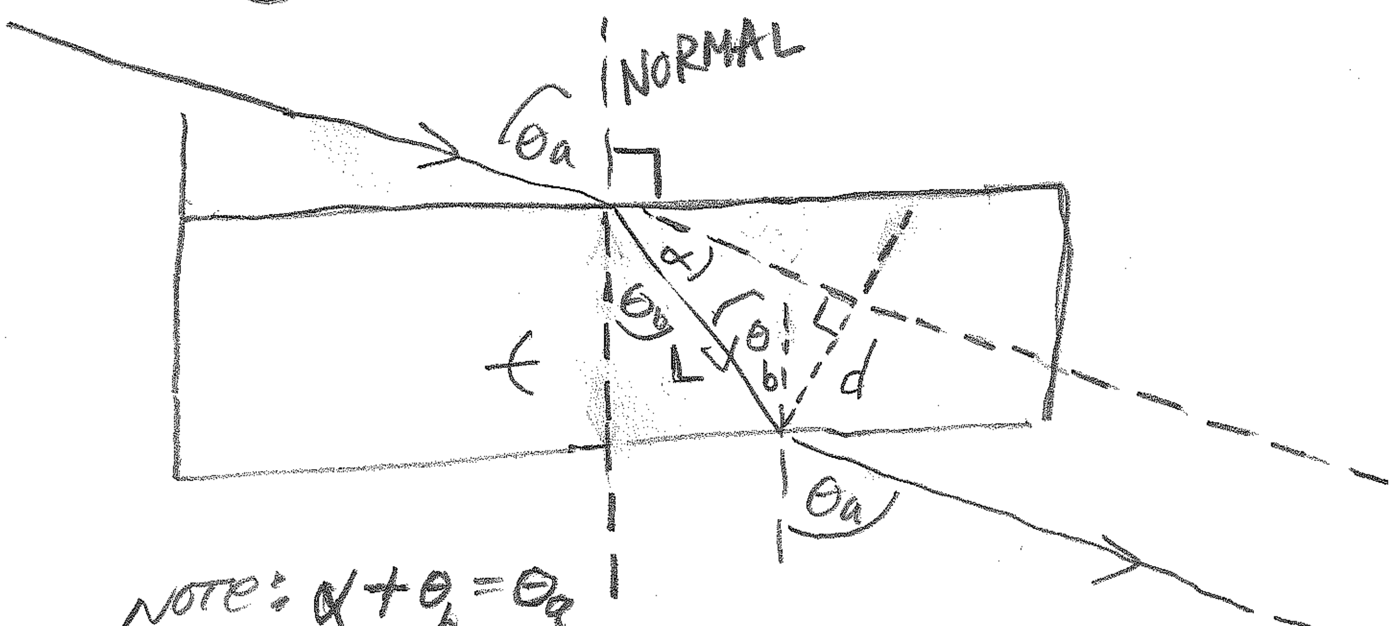
4C 10-13-13

HINTS TO #58 and #60: 1

CH33

#58 (a) WAS COVERED IN CLASS – SEE PHOTO-IMAGE.

(c)

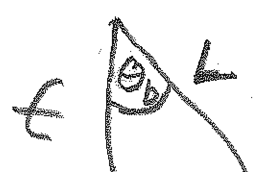


NOTE: $\alpha + \theta_b = \theta_a$

Thus: $\alpha = \theta_a - \theta_b$; ALSO $d = L \cdot \sin\alpha$

$\Rightarrow d = L \cdot \sin(\theta_a - \theta_b)$

and $L = \dfrac{t}{\cos\theta_b}$ since $L\cos\theta_b = t$



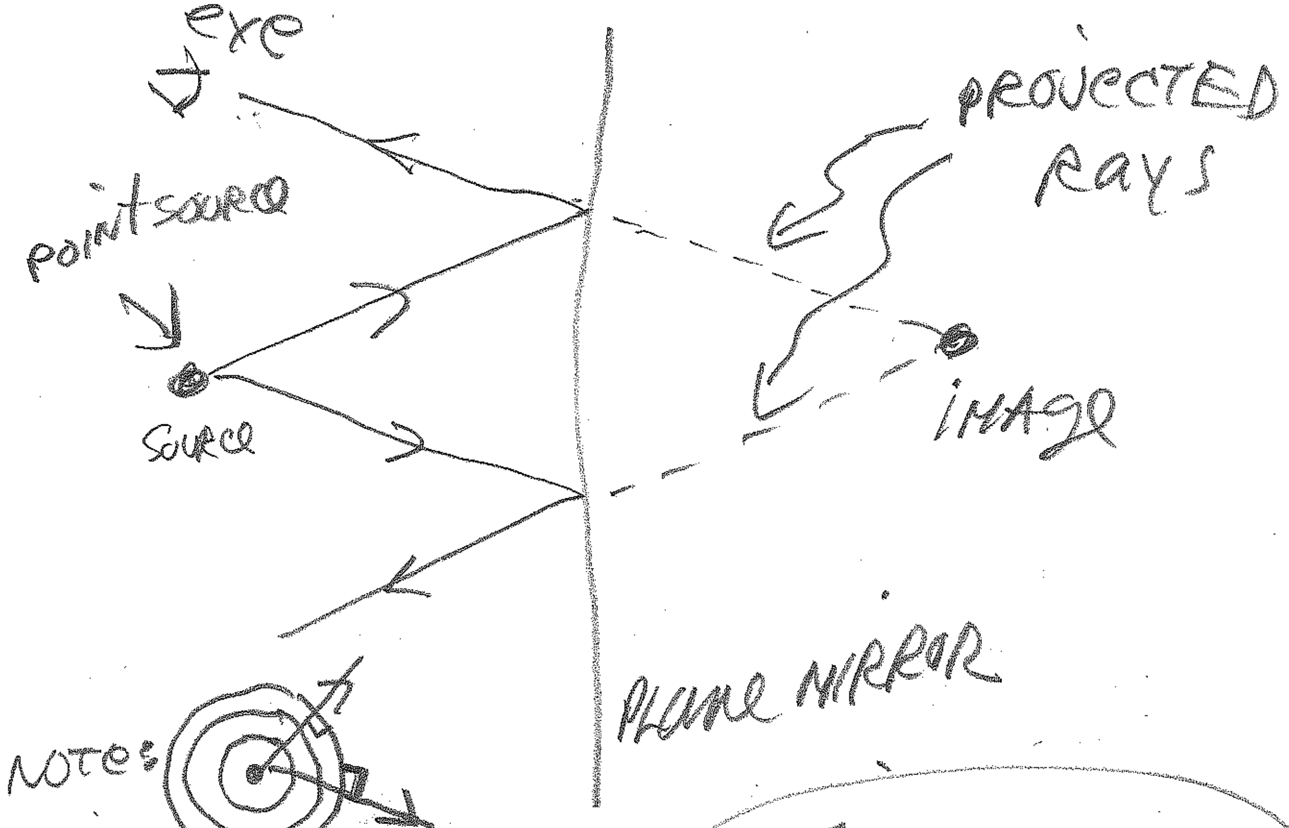
THUS: $d = \dfrac{t}{\cos\theta_b} \cdot \sin(\theta_a - \theta_b)$

$$d_{Blue} = \frac{t}{\cos\theta_{b_{blue}}} \cdot \sin\left(\theta_a - \theta_{b_{blue}}\right)$$

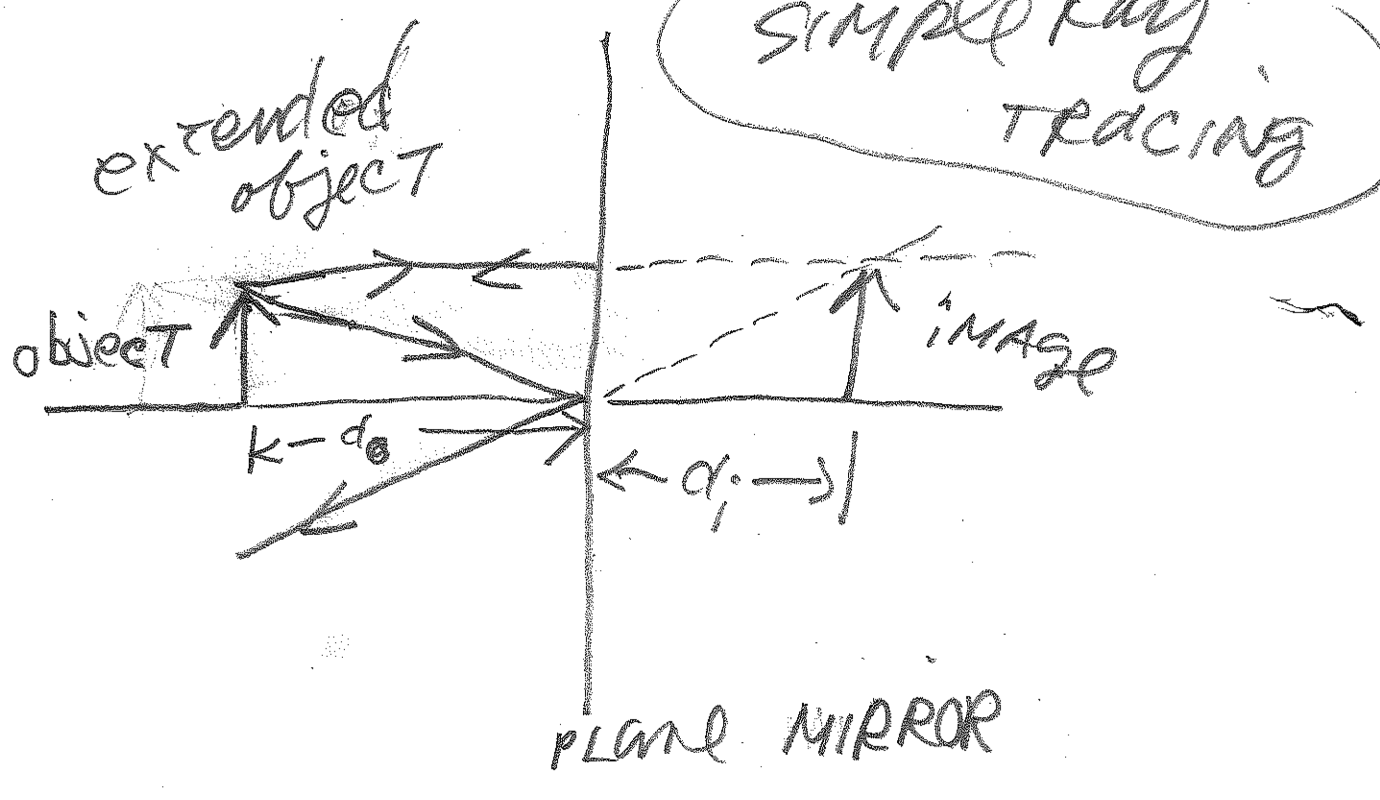
$$d_{red} = \frac{t}{\cos\theta_{b_{red}}} \cdot \sin\left(\theta_a - \theta_{b_{red}}\right)$$

$$\left| d_{blue} - d_{red} \right| = t \cdot \left[\frac{1}{\cos\theta_{b_{blue}}} \cdot \sin\left(\theta_a - \theta_{b_{blue}}\right) - \frac{1}{\cos\theta_{b_{red}}} \cdot \sin\left(\theta_a - \theta_{b_{red}}\right) \right]$$

Reflection: fig. 34.2

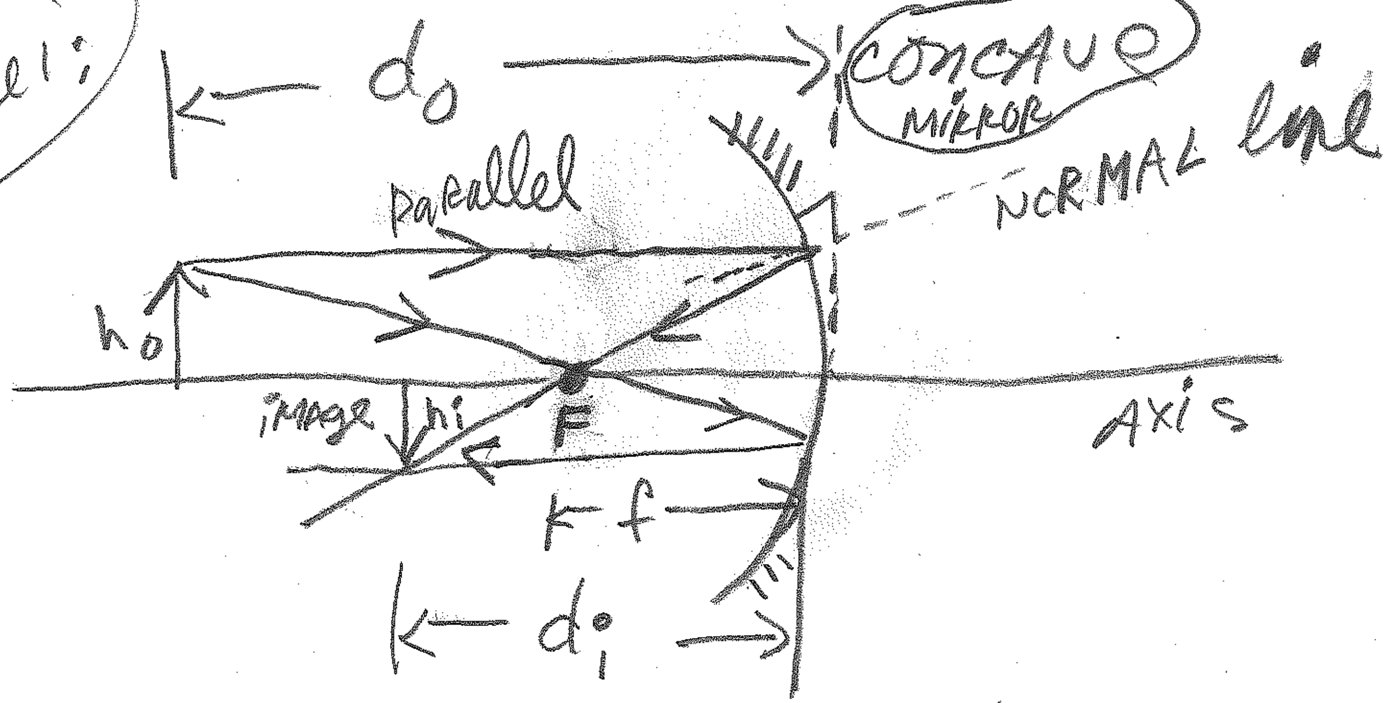


SIMPLE RAY TRACING



SPHERICAL MIRRORS

case 1:



NOTE: Height of image is SMALL.
ALL angles are SMALL.

$\sin\theta \approx \theta$

$\cos\theta \approx 1$

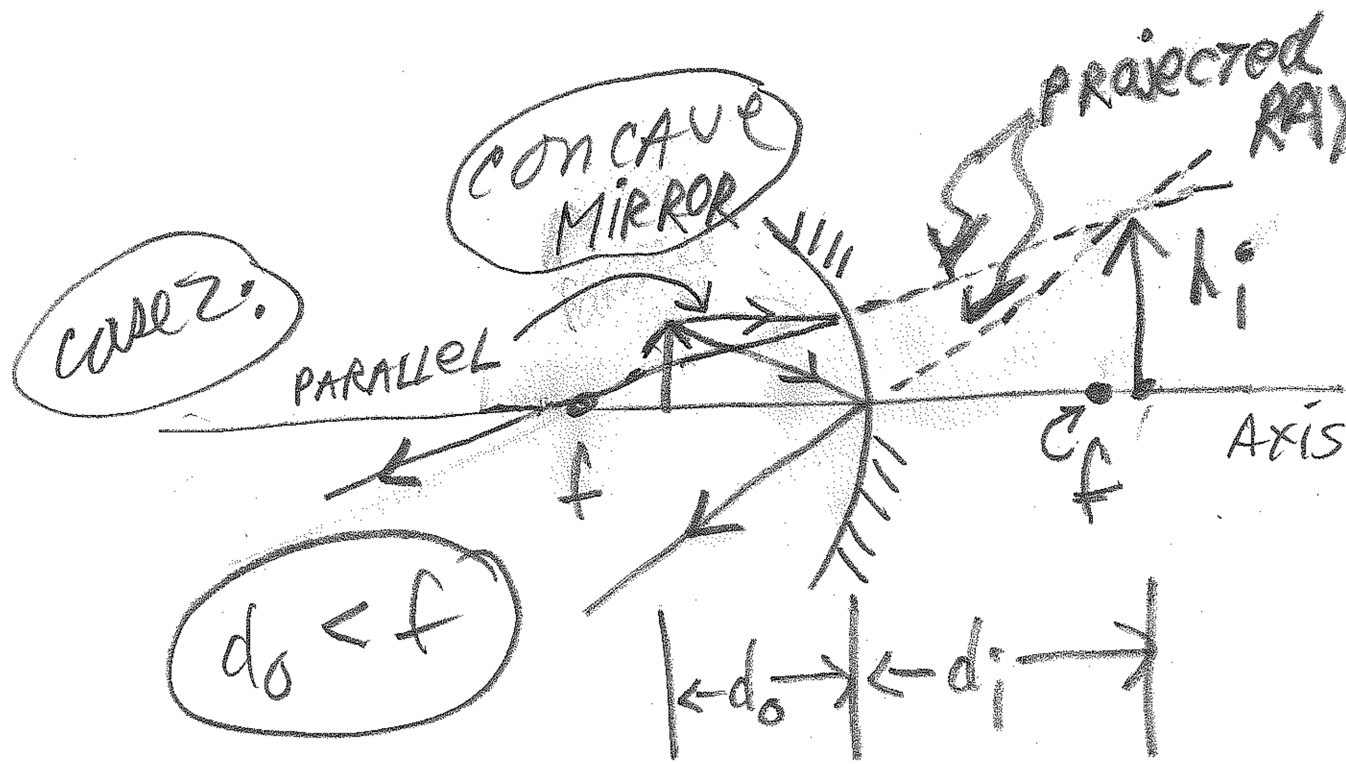
$d_0 > f$ ⇒ image is real

$$\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_0};$$

NOTE $d_i > 0$, $d_0 > 0$

$$m = -\frac{d_i}{d_0} = \frac{h_i}{h_0} < 0$$

(5



$$m = -\frac{d_i}{d_0} > 0 \text{ since}$$

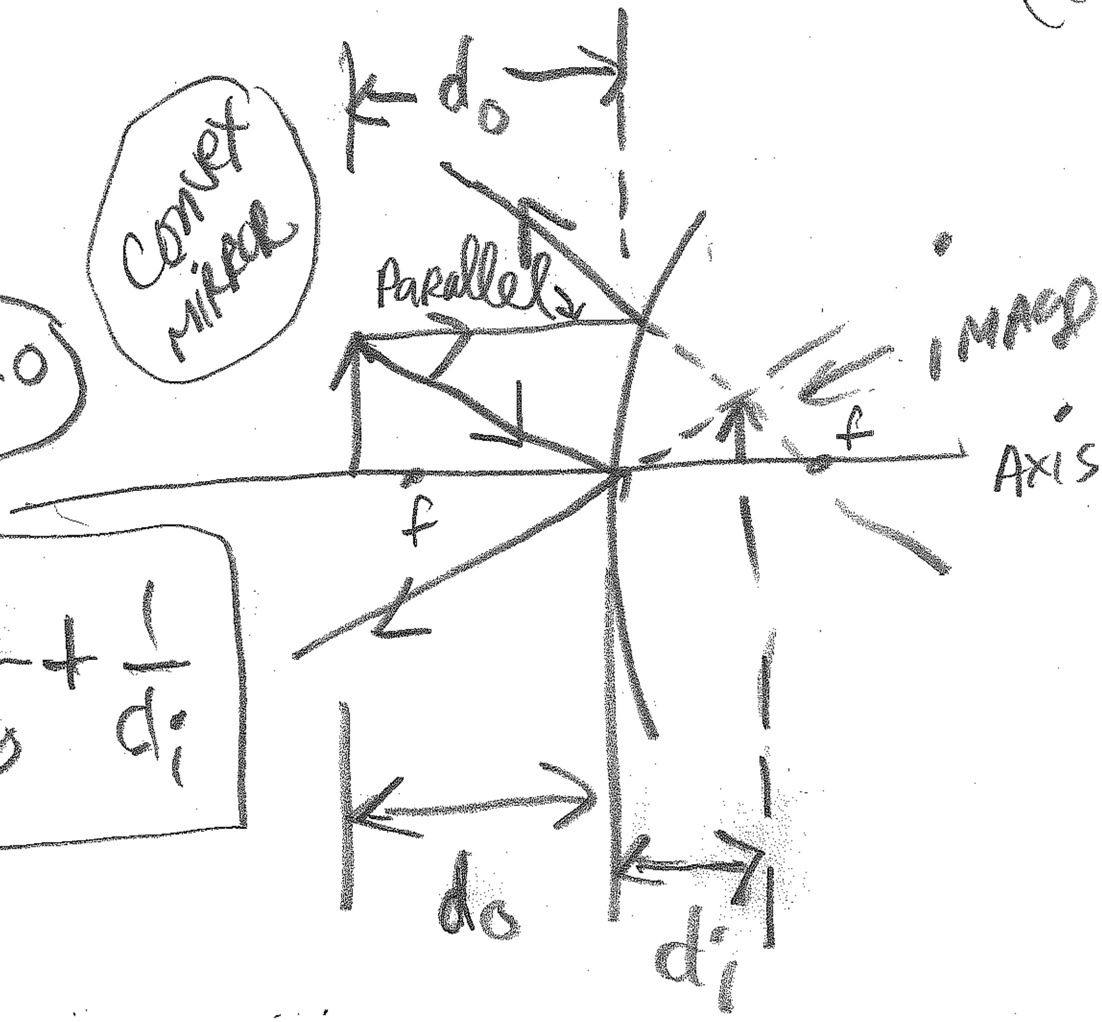
$d_0 > 0$ and $d_i < 0$.

VIRTUAL IMAGE

$$\frac{1}{f} = \frac{1}{d_0} + \frac{1}{d_i}$$

Case 3:

Note: f<0



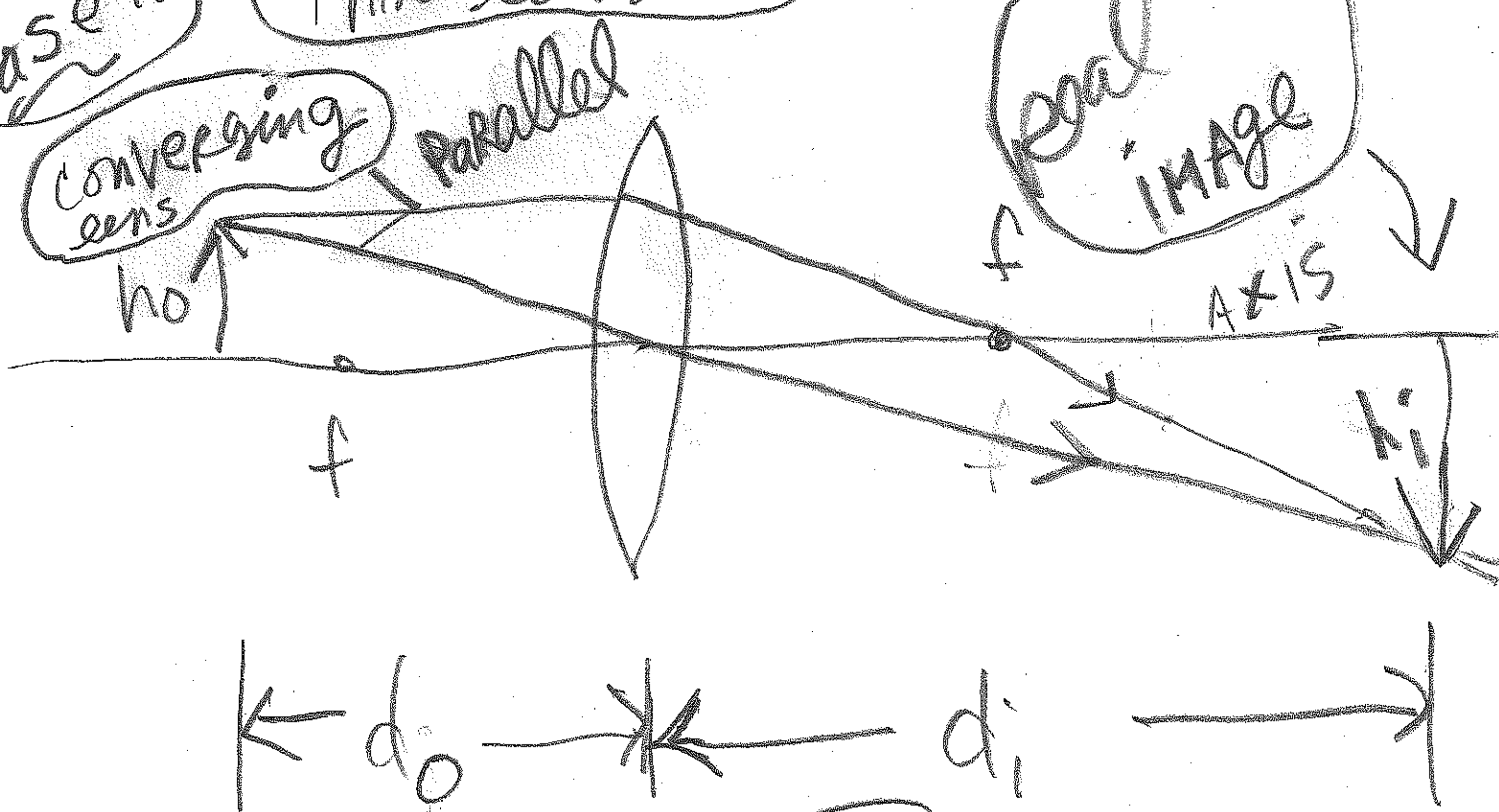
$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$m = -\frac{d_i}{d_o} > 0$$

$d_i < 0$ (virtual image)

THIN lenses

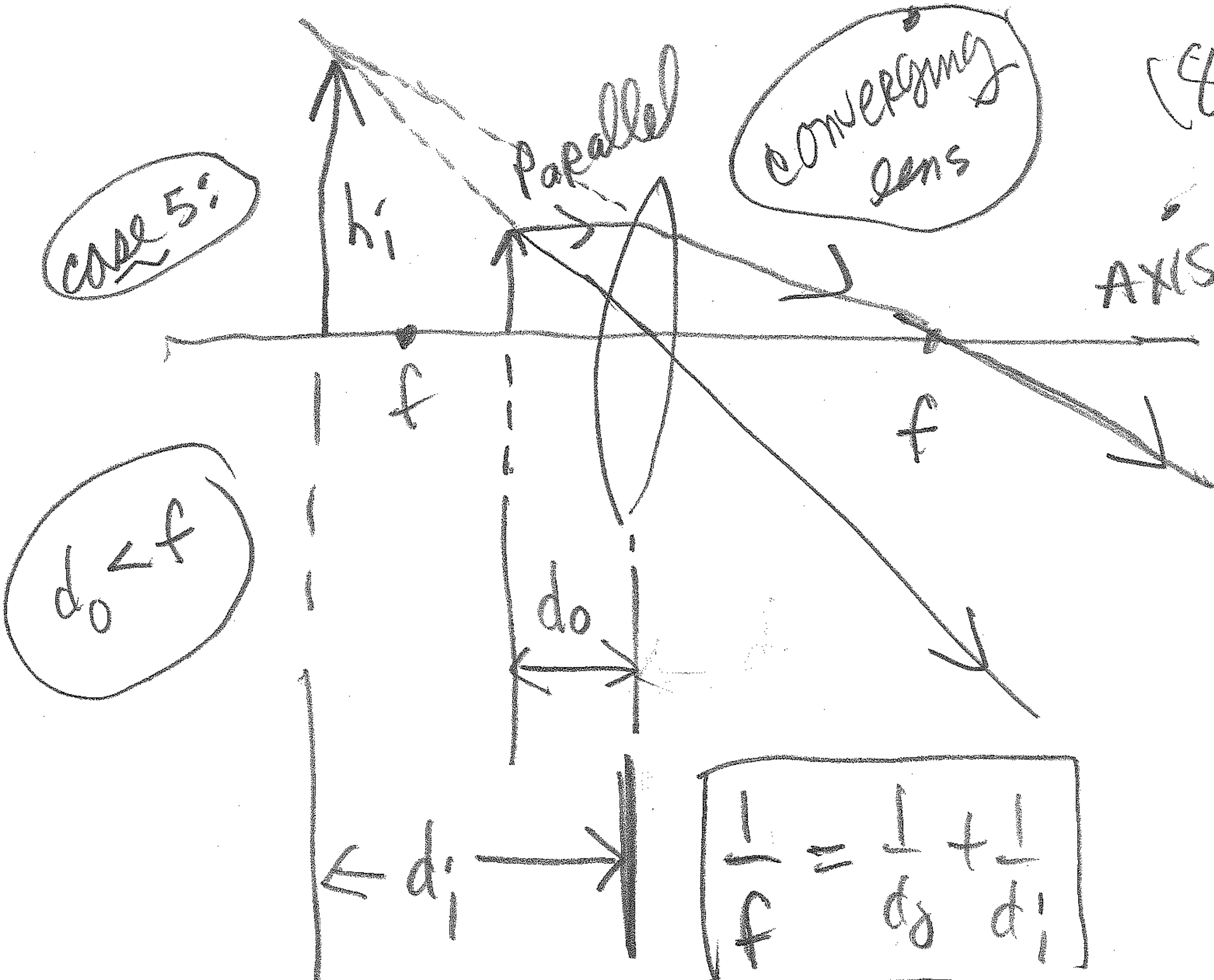
case 4:



$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$m = -\frac{d_i}{d_o} ; d_i > 0$$

$$m < 0$$



$$\frac{1}{f} = \frac{1}{d_0} + \frac{1}{d_i}$$

$$m = -\frac{d_i}{d_0} > 0 \; ; \; d_i < 0$$

(VIRTUAL IMAGE)

diverging lens: $f < 0$

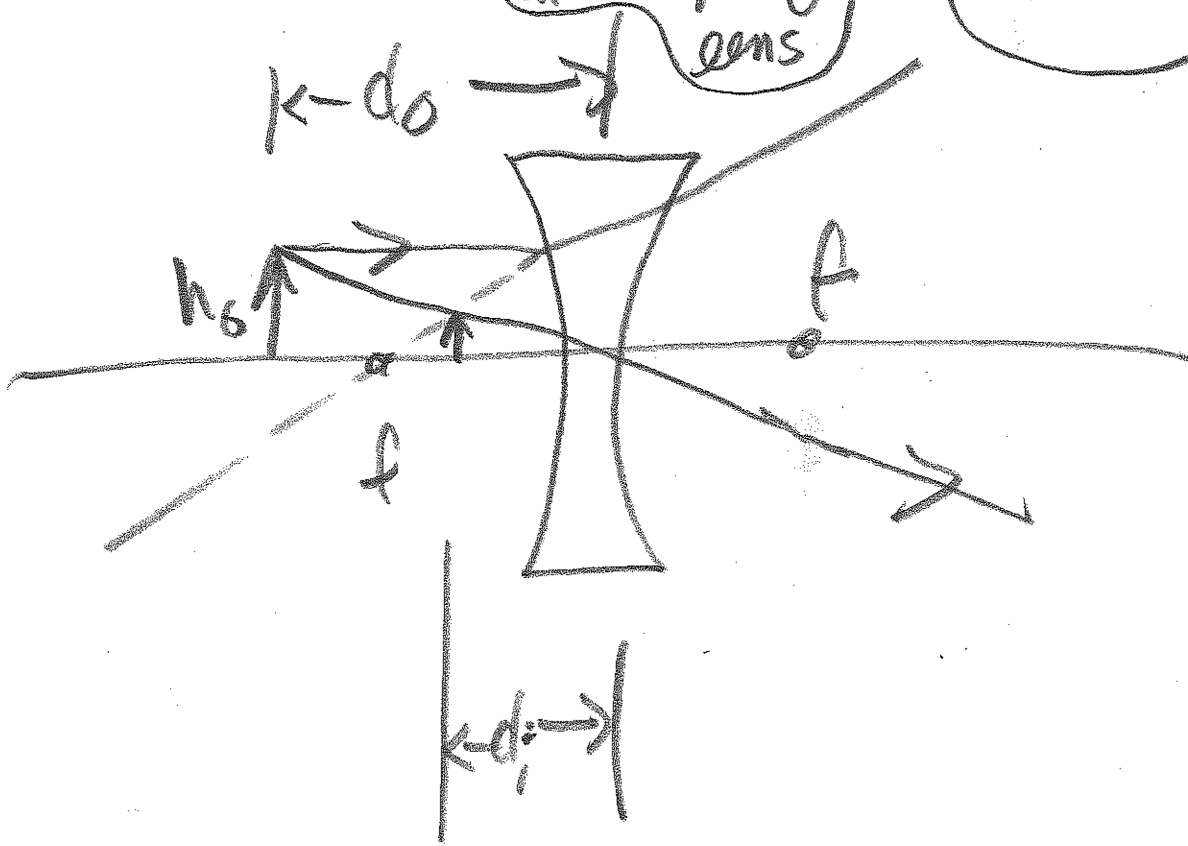


IMAGE: virtual $\Leftrightarrow$ $d_i < 0$

$$m = -\frac{d_i}{d_o} > 0$$

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example: converging lens; $f = 12\,cm$

Let $d_o = 12\,cm$; $d_i = ?$

See PAGE 1146:

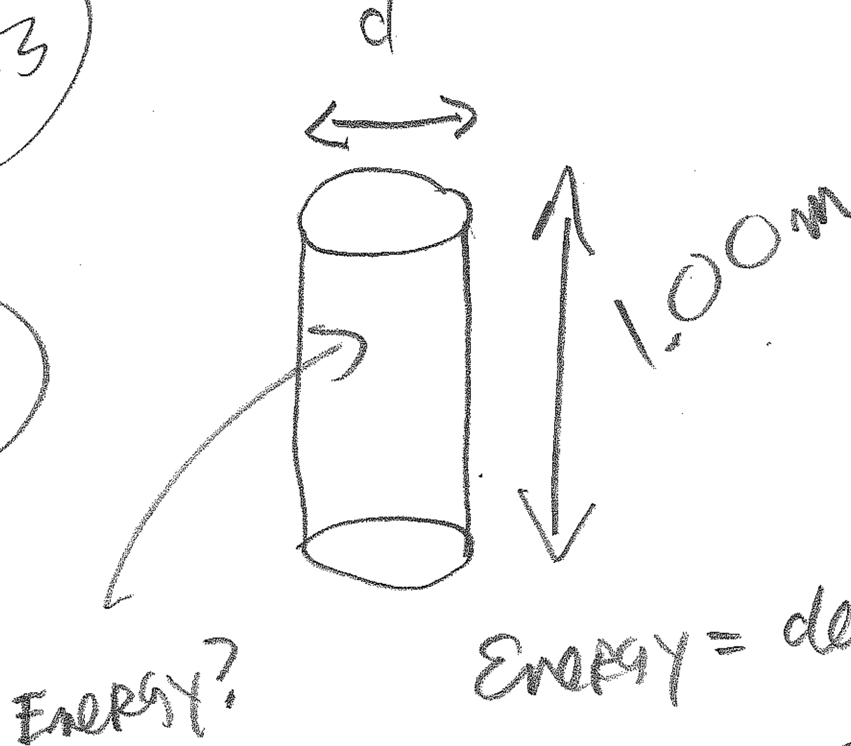
fig 34.51 (b): MAGNIFIER

ch 32

(43)

test 2 review

(c)



ENERGY = density · volume

$$\text{ENERGY} \equiv \varepsilon \frac{E_m^2}{2} \cdot \frac{\pi}{4} d^2 \cdot (1m)$$

$$\text{density} = \varepsilon_0 E^2 \quad (\text{p } 1065)$$

(instantaneous)

$$E = E_m \sin(kx - \omega t)$$

$$E \propto \sin(kx - \omega t)$$

$$\langle E \rangle = E_m^2 / 2 \equiv \text{time average}$$

Classic Example:

Bead perfectly reflects.

Bead of Ag

Bead floats

Bead suspended by a laser beam

Laser light (optical)

Beam Power $= 4.6\,mW \rightarrow 10\,W$

$D = 3\,mm$

$d = 1\,mm$

What is m?

$$mg = \frac{2I}{c} \cdot \frac{\pi}{4} d^2 \; ; \quad I = \frac{\text{Power}}{\frac{\pi}{4} \cdot D^2}$$

$$m = \frac{2 \cdot \left[4.6\times10^{-3} \big/ \left\{ \frac{\pi}{4} \cdot (3\times10^{-3})^2 \right\} \right] \cdot \left[\frac{\pi}{4} (10^{-3})^2 \right]}{(9.8)(3\times10^8)} = 3.47\times10^{-13}\,kg$$