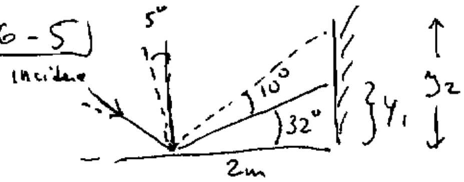
Physics 116
Winter 07
Vilches

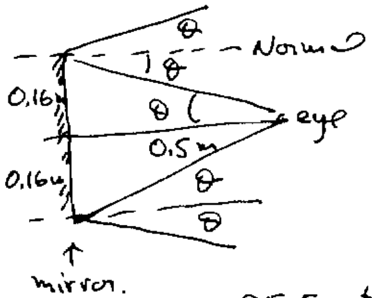
Solutions to a few problems from Walker's, 3rd Ed.

Ch. 26-5)



$$y_1 = 2m \tan 32°$$
$$y_2 = 2m \tan 42°$$
$$\Delta y = 2m(\tan 42° - \tan 32°) = 0.55\ m$$

26-13 Question is: what angle θ can be seen?



$$\tan\theta = \frac{0.16}{0.50} = \cancel{0.}.32 \Rightarrow \theta = 17.74°$$

So $H = 2 \times 95.5\ m \times \tan 17.74 + 0.32$
$= 61.4\ m$.

Moving the mirror closer to eye increases $\tan\theta$, and θ, so H increases

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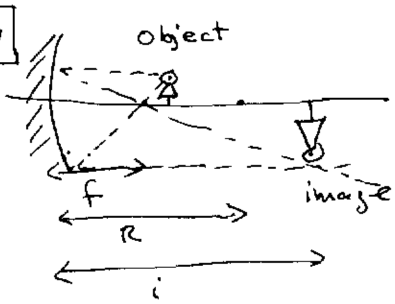
26-19 $\frac{1}{o} + \frac{1}{i} = \frac{2}{R} \Rightarrow \frac{1}{30} + \frac{1}{i} = \frac{2}{40} \Rightarrow \frac{1}{i} = \frac{1}{20} - \frac{1}{30} = \frac{30-20}{600} = \frac{10}{600} = \frac{1}{60}$

$i = +60$ cm (real image), in front of mirror.

26-29



not to scale!

(a) $\frac{1}{o} + \frac{1}{i} = \frac{1}{f} \Rightarrow \frac{1}{20} + \frac{1}{i} = \frac{1}{16.9} \Rightarrow \frac{1}{i} = \frac{1}{16.9} - \frac{1}{20} = 9.17 \times 10^{-3}\ \frac{1}{m}$

$i = 109$ meters in front of mirror

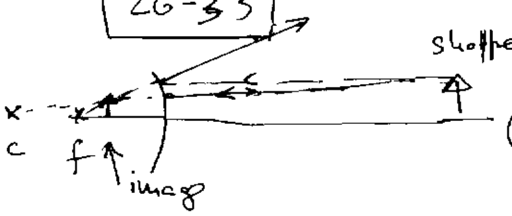
(b) $i > 0$, image is real

(c) $M = -\frac{i}{o} = -\frac{109}{20} = -5.5$

inverted

6.5 times larger than her

26-33



(a) Convex mirrors make VIRTUAL images, right side up -

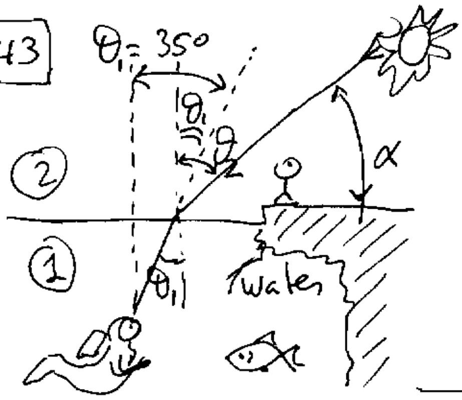
(b) $\frac{1}{o} + \frac{1}{i} = \frac{2}{R}$ $\qquad M = \frac{H_i}{H_o} = -\frac{i}{o}$

So $i = -o\frac{H_i}{H_o} = -17\ ft\left(\frac{6.4 in}{12 in/ft}\right)\frac{1}{5.7 ft} = 1.59 ft$

$$\frac{1}{17 ft} - \frac{1}{1.59 ft} = \frac{2}{R} = -0.57\ \frac{1}{ft} \Rightarrow \boxed{R = -\frac{2}{0.57} = -3.5\ ft.}$$

"Virtual" Space (Convex mirror)

26-43



$\alpha = 90° - \theta_2$

$n_{water} \sin\theta_1 = n_{air} \sin\theta_2 = 1.33 \sin 35° = 0.763$

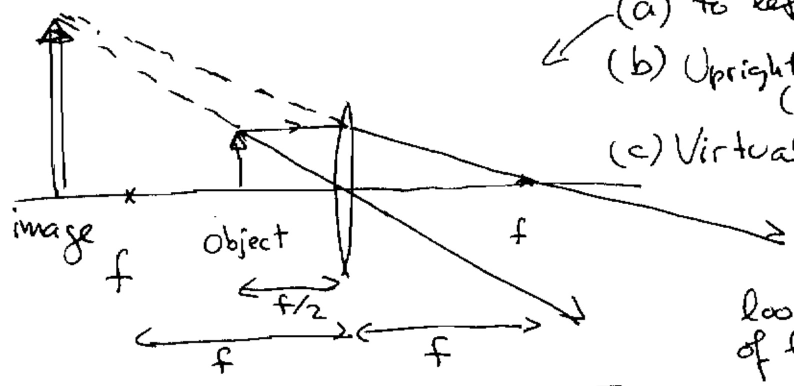
$\theta_2 \simeq 49.7° \Rightarrow \alpha = 40.3°$

26-49 Angle of incidence is fixed at 45° with respect to the normal

$n_{glass} \sin 45° = n_{air} \sin 90° = 1$

$n_{glass} = \dfrac{1}{\sin 45°} = 1.41$

26-59



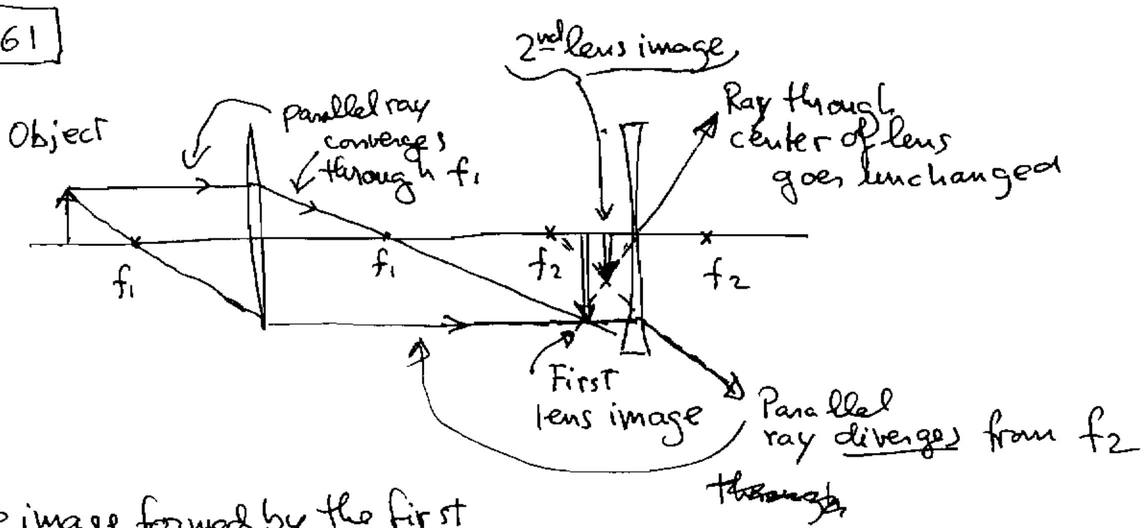
(a) to left of f

(b) Upright, enlarged image (magnifying glass)

(c) Virtual (no light rays through image)

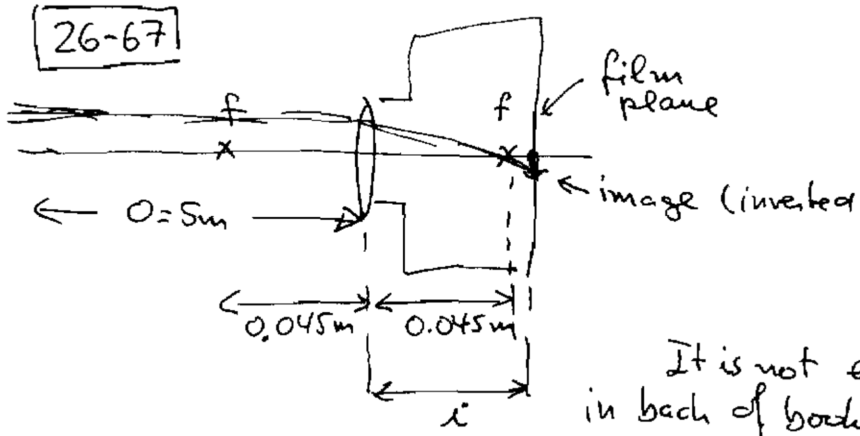
look from other side of lens.

26-61



The image formed by the first (left) lens is real, inverted, slightly magnified. This image acts as the object for the second lens (right). The right lens is a diverging one, its image is virtual, closer to the lens than the object. Final image is inverted, virtual.

26-67



$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f}$$

$$\frac{1}{i} = \frac{1}{f} - \frac{1}{o} = \frac{1}{0.045} - \frac{1}{5} = 22\ m^{-1}$$

$$i = 0.0454\ m \equiv 45.4\ mm.$$

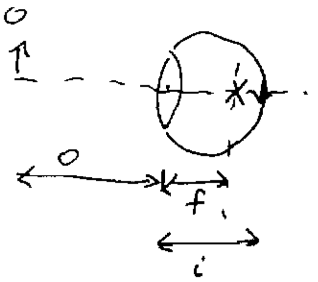
It is not exactly 45 mm as per answers in back of book because the object distance is not infinite. This is why cameras need to be focused. $\boxed{M = -\frac{i}{o} = -\frac{45.4}{5000} = -0.0091}$

image is inverted ($M<0$) and quite small.

26-73 (a) They have to be concave. Concave glasses always produce images closer to the lens than the object, right side up, so they bring objects closer to the eyes. Eyes see images

(b) $\frac{1}{o} + \frac{1}{i} = \frac{1}{f} \Rightarrow \frac{1}{\infty} + \frac{1}{-2.2m} = \frac{1}{f} \Rightarrow f = -2.2\ m.$

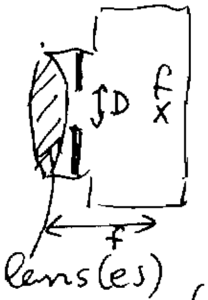
27-3



$f = 2.2\ cm$
$i = 2.6\ cm.$

$$\frac{1}{o} + \frac{1}{i} = \frac{1}{f} \Rightarrow o = \frac{if}{i-f} = \frac{2.6 \times 2.2}{2.6 - 2.2} = 14\ cm.$$

27-7



The f-stop of a camera $= \frac{\text{Focal length}}{\text{Diameter of aperture}}$ and is a dimensionless number.

(a) Here $f = 55\ mm \equiv$ constant. So smaller f-stop (2.8) has largest D

(b) $D = \frac{f}{\text{f-stop number}} = \frac{55\ mm}{2.8} = 19.6\ mm.$

$\frac{55\ mm}{16} = 3.4\ mm$

27-11 $\text{f-stop} = \frac{\text{focal length}}{D} \rightarrow$ area that lets light in $= \pi D^2 = \frac{f^2}{(\text{f-stop})^2}$

Energy into film through lens and apperture is proportional to Area × time $\Rightarrow \pi D^2 \times \Delta t = \frac{f^2}{(\text{f-stop})^2}\Delta t$

So if this energy is right for correct exposure

$$\frac{f^2}{(\text{f-stop}1)^2}\frac{1}{125} = \frac{f^2}{(\text{f-stop}2)^2}\frac{1}{X} \Rightarrow X = \frac{125 \times 8^2}{(2.4)^2} = 1390 \approx \underline{1000}$$

or $\frac{1}{1000}$ seconds.
