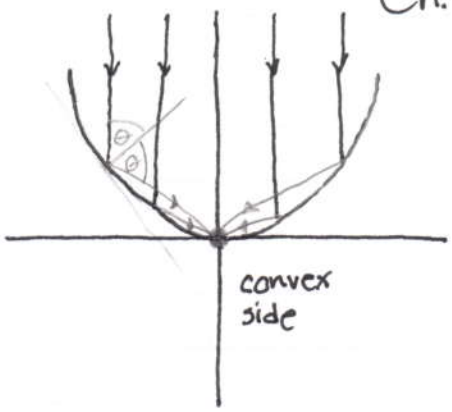
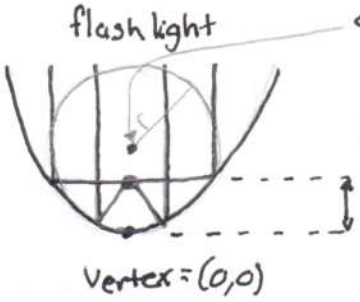
Ch. 32. Geometric Optics.



parabolic mirror (concave side)

$y = ax^2$

E.g. $a = 8$



center $= (0, r) = (0, \frac{1}{2a})$

$y = ax^2$

f = focal length $= \frac{1}{4a}$

$(x-0)^2 + (y-r)^2 = r^2$

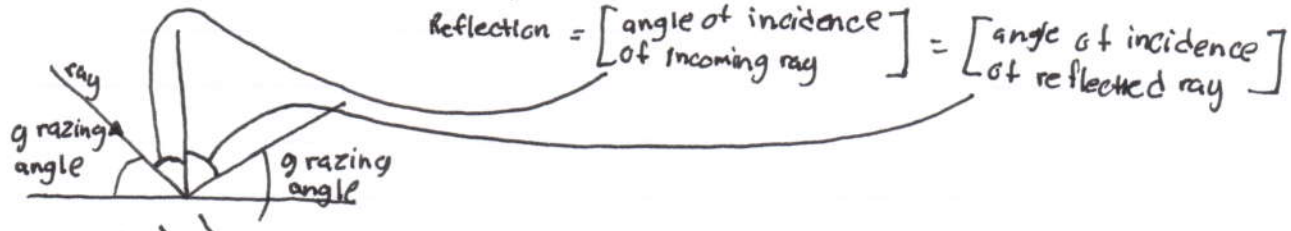
$x^2 + (y - \frac{1}{2a})^2 = (\frac{1}{2a})^2$

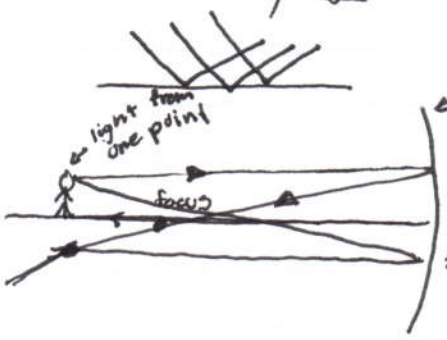
$y = \frac{1}{2a} \pm \sqrt{\frac{1}{4a^2} - x^2}$

$\frac{r}{2} = f = \frac{1}{4a} \iff r = 2f = \frac{1}{2a}$

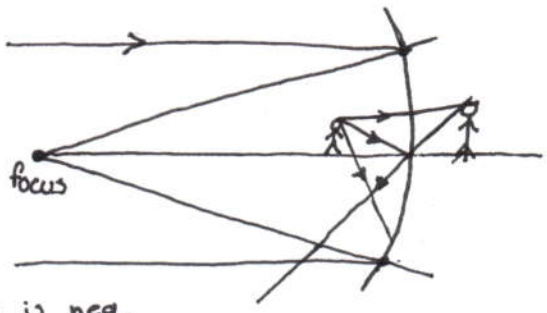
r = radius of curvature at the vertex

Spherical $\simeq$ parabolic when mirror width $\ll$ focal length ($= \frac{1}{2}$ radius of curvature), which is roughly same as mirror width $\ll$ radius of curvature.





← like fig. 32-1c light bounces off of rough surfaces in all directions:



h_i is neg.

di is negative

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

$$m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

↑ magnification

E.g. $h_o = 1.5m$, $d_o = 7m$, $\frac{f}{2} = f = 2m$ $\Rightarrow$ $d_i = 2.8m$, $m = 0.4$

$h_i = m h_o = 0.6m$

index of refraction: $n = \frac{c}{v}$ — c - speed of light in vaccum; v - speed of light in medium

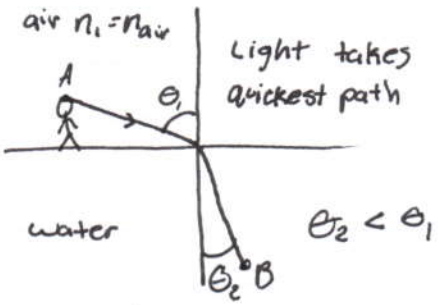
$$c = \frac{1}{\sqrt{\mu_0 \epsilon_0}}$$

air: $n = 1.0003 \Rightarrow v = c$

Eg, H_2O = $\begin{cases} n = 1.33 \\ v = \frac{c}{n} = 0.75c \end{cases}$

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$\frac{n_1}{n_2} \sin\theta_1 = \sin\theta_2$$



$n_{2O} = n_{H_2O}$

Critical angle