

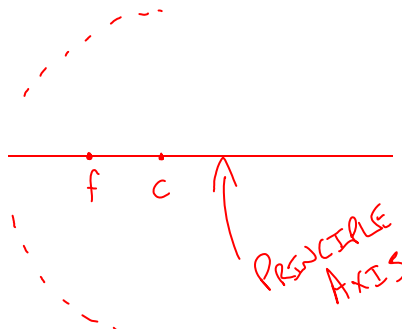
## Curved Mirrors

- Types of Mirrors
  - Convex (Diverging)
  - Concave (Converging)



## Curved Mirrors

- Parts
  - Focal Point – where parallel rays are focused.
  - Center of curvature (R or C = 2f)



## Spherical Mirrors

- Spherical Aberration
  - Incident rays farther away from the principal axis do not pass exactly through the focal point



## Curved Mirrors

- Rays
  - Parallel  $\Rightarrow$  in  $\parallel$  out through  $f$
  - Focal  $\Rightarrow$  in through  $f$  out  $\parallel$
  - Central in and out through the center



# Curved Mirrors

- Equations

- Mirror Equation  $\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$

- Magnification  $M = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$

$d_i < d_o$  = closer

$d_i > d_o$  = farther

+  $d_i$  = real image

-  $d_i$  = virtual image

+ M = upright

- M = inverted

M > 1 = larger

M < 1 = smaller

R = 12 cm  
 $d_o = 12$  cm  
 $h_o = 2$  cm

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

$$\frac{1}{6} = \frac{1}{12} + \frac{1}{d_i}$$

$$\frac{2}{12} = \frac{1}{12} + \frac{1}{d_i}$$

$$\frac{1}{12} = \frac{1}{d_i} \Rightarrow d_i = 12 \text{ cm}$$

$$M = -\frac{d_i}{d_o} = -\frac{12}{12} = -1$$

+ UPRIGHT  
 - INVERTED  
 # SIZE

+ REAL  
 - VIRTUAL  
 # DISTANCE

Parallel      Focal      Central

REAL, INVERTED  
 SAME SIZE, SAME SIZE

$R = 12 \text{ cm}$   
 $d_o = 9 \text{ cm}$   
 $h_o = 1 \text{ cm}$

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

$$\frac{1}{6} = \frac{1}{9} + \frac{1}{d_i}$$

$$\frac{3}{18} = \frac{2}{18} + \frac{1}{d_i}$$

$$\frac{1}{18} = \frac{1}{d_i} \Rightarrow d_i = +18 \text{ cm}$$

REAL  
 FURTHER

$$M = -\frac{d_i}{d_o} = -\frac{18}{9} = -2$$

$$M = \frac{h_i}{h_o}$$

$$-2 = \frac{h_i}{1 \text{ cm}} \Rightarrow h_i = -2 \text{ cm}$$

INVERTED  
 LARGER

INVERTED  
 REAL  
 FURTHER  
 LARGER

Parallel      Focal      Central

$R = 12 \text{ cm}$      $f = 6 \text{ cm}$   
 $d_o = 18 \text{ cm}$   
 $h_o = 2 \text{ cm}$

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

$$\frac{1}{6} = \frac{1}{18} + \frac{1}{d_i}$$

$$\frac{3}{18} = \frac{1}{18} + \frac{1}{d_i}$$

$$\frac{2}{18} = \frac{1}{d_i} \Rightarrow d_i = 9 \text{ cm} = \text{CLOSER}$$

REAL

$$M = -\frac{d_i}{d_o} = -\frac{9 \text{ cm}}{18 \text{ cm}} = -\frac{1}{2}$$

INVERTED    SMALLER

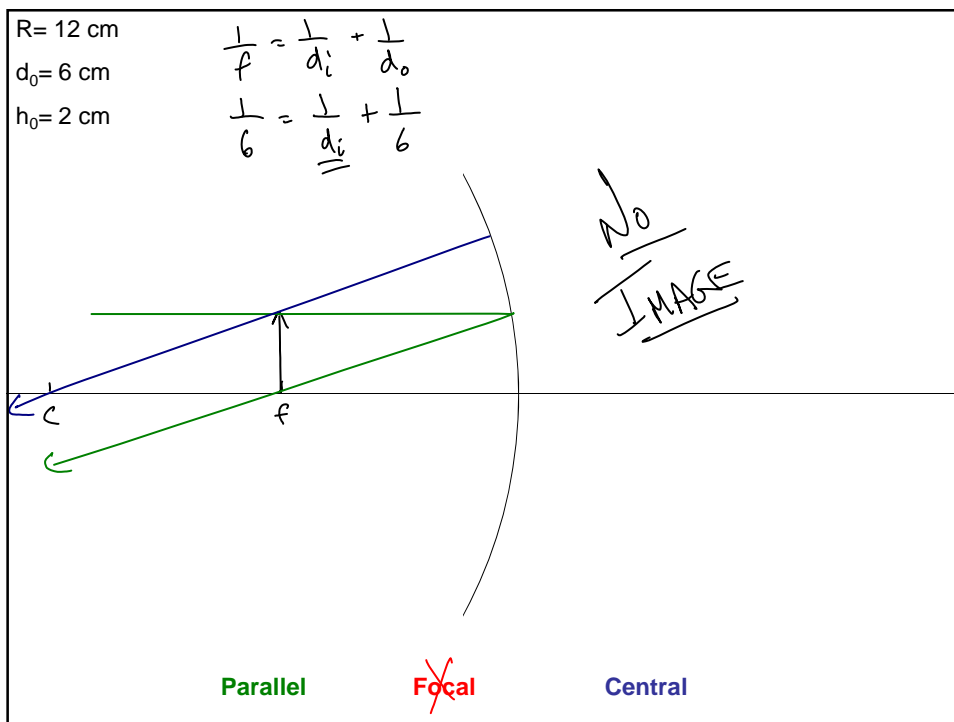
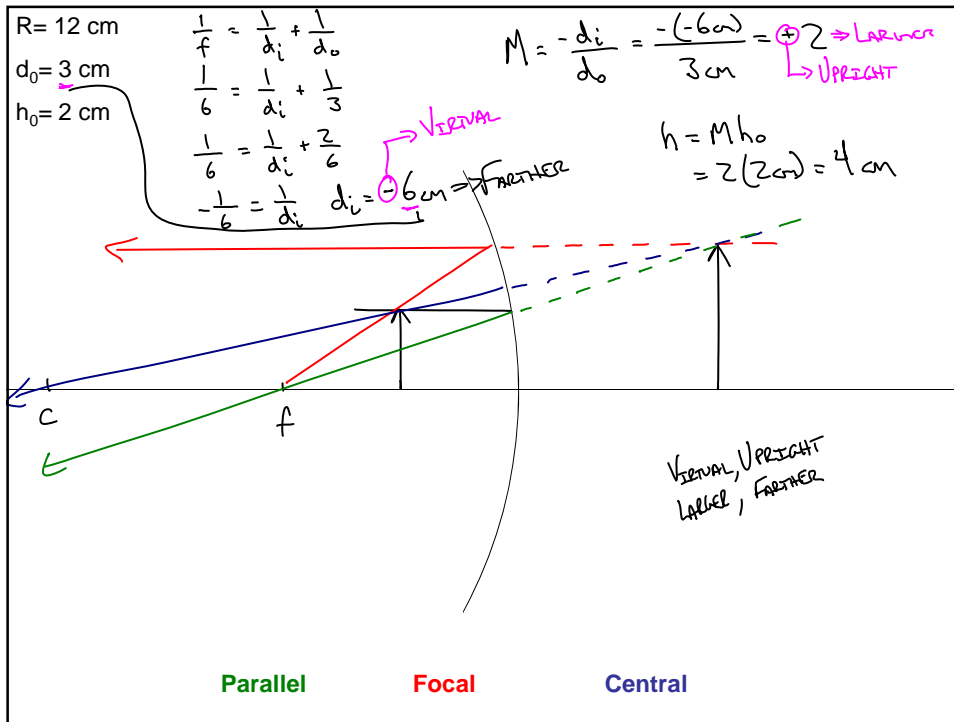
$$h_i = M(h_o)$$

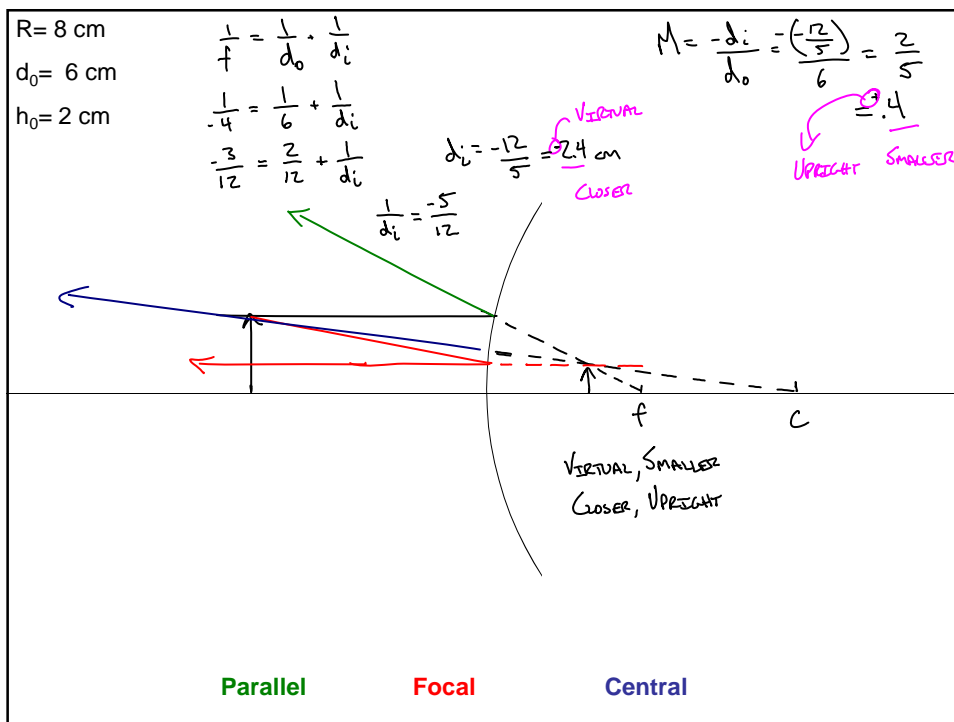
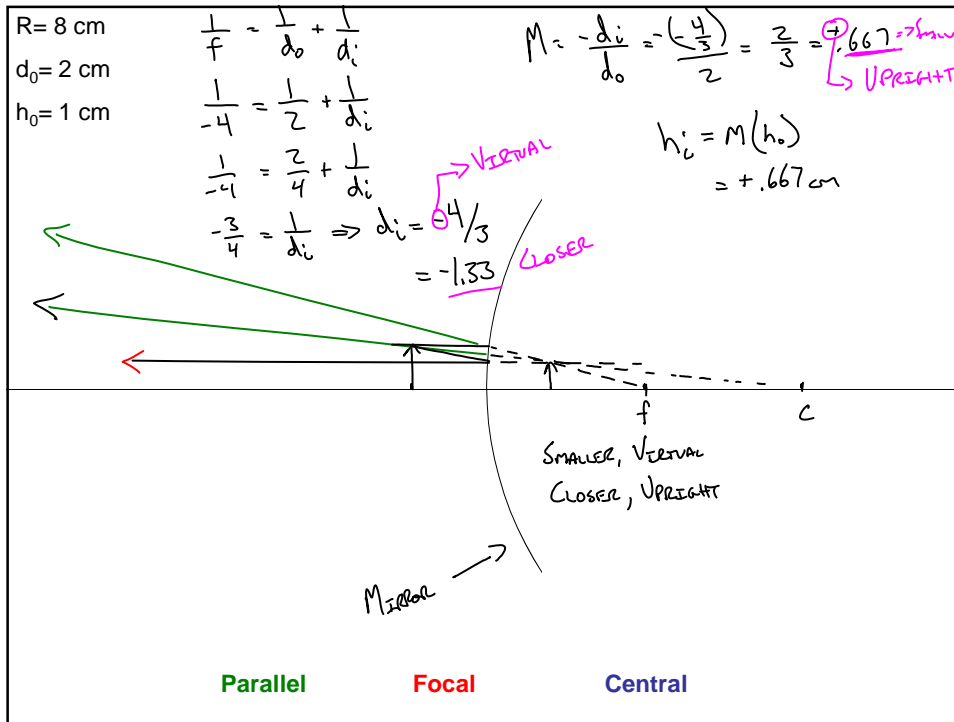
$$= \left(-\frac{1}{2}\right)(2 \text{ cm})$$

$$= -1 \text{ cm}$$

REAL, INVERTED  
 CLOSER, SMALLER

Parallel      Focal      Central





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