Physics 30 – Lesson 7
Optics – Curved Mirrors

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Practice problems

1) $h_o = 5.0cm$
$d_o = 14cm$
$R = 10cm \rightarrow f = 5cm$

a) $\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o}$

$\frac{1}{d_i} = \frac{1}{5cm} - \frac{1}{14cm}$

$\frac{1}{d_i} = 0.129$

$\boxed{d_i = 7.78cm}$

b) inverted, real, smaller

c) $\frac{h_i}{h_o} = \frac{-d_i}{d_o}$

$h_i = \frac{-(7.78cm)(5.0cm)}{14cm}$

$\boxed{h_i = -2.78cm}$

2) $h_o = 5.0cm$
$d_o = 14cm$
$R = -10cm \rightarrow f = -5cm$

Note that f is (–) for a diverging/convex mirror

a) $\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o}$

$\frac{1}{d_i} = \frac{1}{-5cm} - \frac{1}{14cm}$

$\frac{1}{d_i} = -0.271$

$\boxed{d_i = -3.68cm}$

b) inverted, real, smaller

c) $\frac{h_i}{h_o} = \frac{-d_i}{d_o}$

$h_i = \frac{-(-3.68cm)(5.0cm)}{14cm}$

$\boxed{h_i = 1.32cm}$

3) $m = -0.25$
$d_o = 30cm$

a) The only mirror that can produce an inverted (i.e. real) image is a **converging** or **concave** mirror. In addition, note that the focal length calculation below yields a positive answer (i.e. converging mirror).

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

$-0.25 = \frac{-d_i}{30cm}$

$d_i = 7.5cm$

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

$\frac{1}{f} = \frac{1}{7.5cm} + \frac{1}{30cm}$

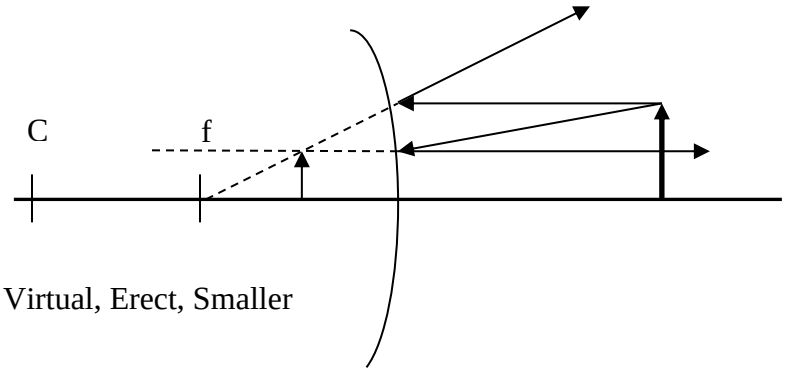
$\frac{1}{f} = 0.167$

$\boxed{f = 6.0cm}$

Assignment

1)

A)



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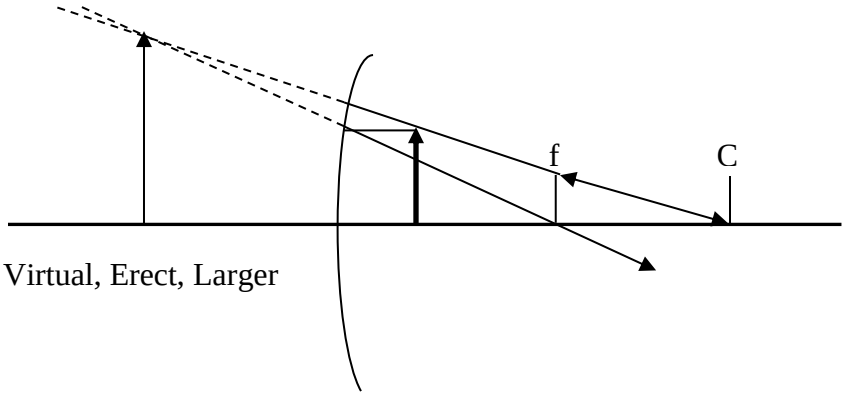
Virtual, Erect, Smaller

B)



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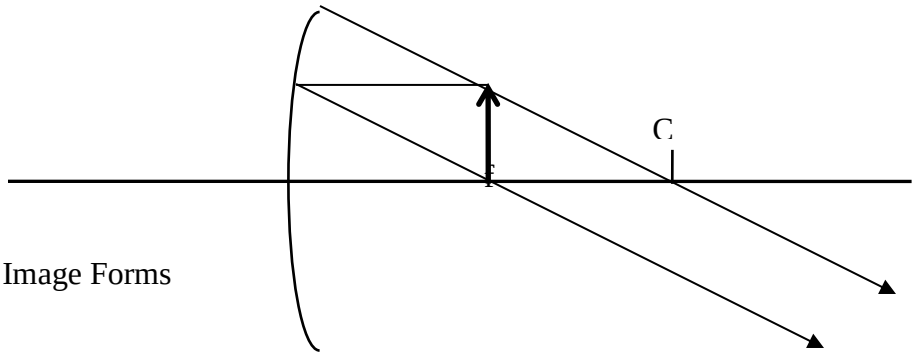
Virtual, Erect, Larger

C)



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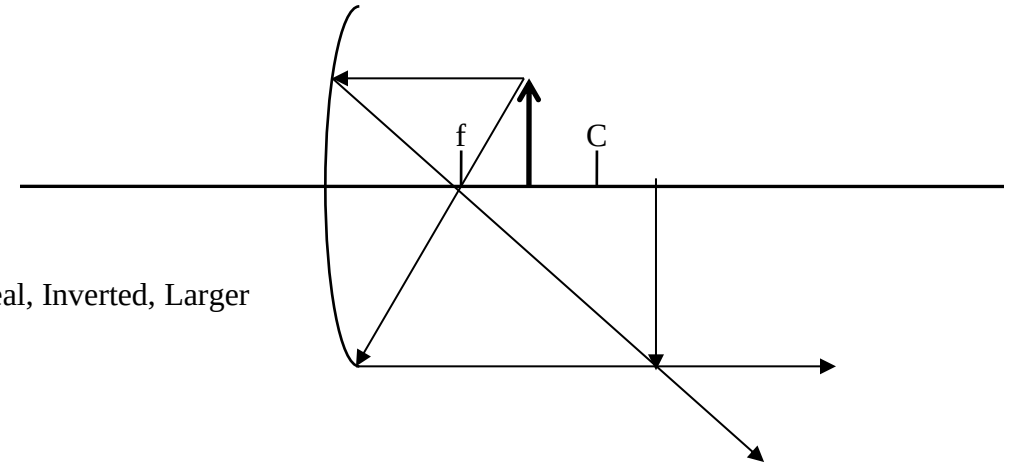
No Image Forms

D)



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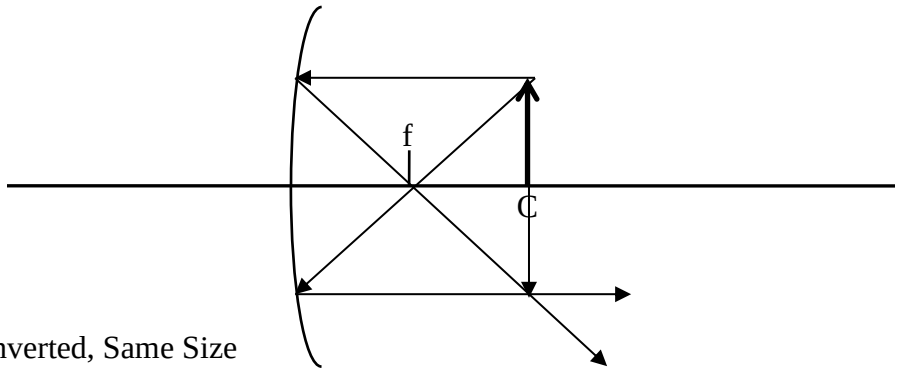
Real, Inverted, Larger

E)



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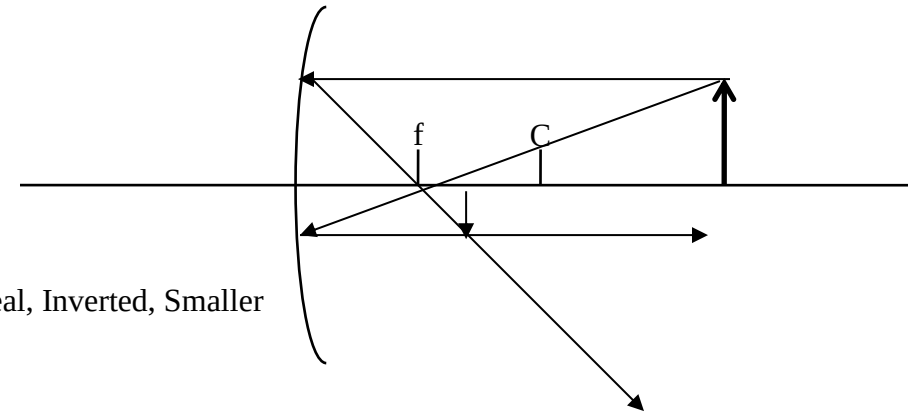
Real, Inverted, Same Size

F)



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Real, Inverted, Smaller

2) $h_o = 6.0cm$

$d_o = 40cm$

$R = 60cm \rightarrow f = 30cm$

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a) $\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o}$

$\frac{1}{d_i} = \frac{1}{30cm} - \frac{1}{40cm}$

$\boxed{d_i = 120cm}$

b) $\frac{h_i}{h_o} = \frac{-d_i}{d_o}$

$h_i = \frac{-(120cm)(6.0cm)}{40cm}$

$\boxed{h = -18cm}$

c) inverted, real, larger

3)

$h_o = 6.0cm$

$d_o = 40cm$

$R = -60cm \rightarrow f = -30cm$

/6

a) $\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o}$

$\frac{1}{d_i} = \frac{1}{-30cm} - \frac{1}{40cm}$

$\boxed{d_i = -17cm}$

b) $h_i = \frac{-d_i h_o}{d_o}$

$h_i = \frac{-(-17cm)(6.0cm)}{40cm}$

$\boxed{h = 2.66cm}$

c) erect, virtual, smaller

4)

$d_o = 40cm$

$d_i = -80cm$

erect $\therefore$ *virtual*

$\therefore (-)$

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a)

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

$\frac{1}{f} = \frac{-1}{80cm} + \frac{1}{40cm}$

$f = 80cm$

$R = 2f = 2 \times 80cm$

$\boxed{R = 160cm}$

b) concave (f is positive)

5)

$d_o = 40cm$

$d_i = +120cm$

inverted $\therefore$ *virtual*

$\therefore (+)$

/5

a)

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

$\frac{1}{f} = \frac{1}{120cm} + \frac{1}{40cm}$

$f = 30cm$

$R = 2f = 2 \times 30cm$

$\boxed{R = 60cm}$

b) concave (f is positive)

6)

$d_o = 40cm$

$d_i = -20cm$

erect $\therefore (-)$

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a)

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

$\frac{1}{f} = \frac{1}{-20cm} + \frac{1}{40cm}$

$f = -40cm$

$R = 2f = 2 \times (-40cm)$

$\boxed{R = -80cm}$

b) convex (f is negative)

7) /8

$h_o = 20cm$

$d_o = 30cm$

$h_i = +10$

erect $\therefore (+)$

$d_o = 30cm + 60cm = 90cm$

a. $\dfrac{-d_i}{d_o} = \dfrac{h_i}{h_o}$

$d_i = \dfrac{-h_i d_o}{h_o}$

$d_i = \dfrac{-10cm(30cm)}{20cm}$

$d_i = -15cm$

b. $\dfrac{1}{f} = \dfrac{1}{d_i} + \dfrac{1}{d_o}$

$\dfrac{1}{f} = \dfrac{-1}{15cm} + \dfrac{1}{30cm}$

$f = -30cm$

c. $\dfrac{1}{d_i} = \dfrac{1}{f} - \dfrac{1}{d_o}$

$\dfrac{1}{d_o} = \dfrac{-1}{30cm} - \dfrac{1}{90cm}$

$d_i = -22.5cm$

d. $h_i = \dfrac{-d_i h_o}{d_o}$

$h_i = \dfrac{-(-22.5cm)(20cm)}{90cm}$

$\boxed{h_i = 5.0cm}$

8) /4

$R = 80cm \rightarrow f = 40cm$

$h_i = -3h_o \rightarrow d_i = 3d_o$

d_i is positive because it is inverted / real

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

$\dfrac{1}{40cm} = \dfrac{1}{3d_o} + \dfrac{1}{d_o}$

$\dfrac{1}{40cm} = \dfrac{1}{3d_o} + \dfrac{3}{3d_o}$

$\dfrac{1}{40cm} = \dfrac{4}{3d_o}$

$3d_o = 160cm$

$d_o = \dfrac{160cm}{3}$

$\boxed{d_o = 53cm}$

9) /4

$R = 180cm \rightarrow f = 90cm$

$h_i = +2h_o \rightarrow d_i = -2d_o$

d_i is negative because it is erect / virtual

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

$\dfrac{1}{90cm} = \dfrac{1}{-2d_o} + \dfrac{1}{d_o}$

$\dfrac{1}{90cm} = \dfrac{-1}{2d_o} + \dfrac{2}{2d_o}$

$\dfrac{1}{90cm} = \dfrac{1}{2d_o}$

$2d_o = 90cm$

$d_o = \dfrac{90cm}{2}$

$\boxed{d_o = 45cm}$

10) /4

$f = -60cm$

(−) because convex mirror

$h_i = \frac{h_o}{6} \rightarrow d_i = \frac{-d_o}{6}$

(−) because virtual

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

$$\frac{-1}{60cm} = \frac{-1}{\frac{d_o}{6}} + \frac{1}{d_o}$$

$$\frac{-1}{60cm} = \frac{-6}{d_o} + \frac{1}{d_o}$$

$$\frac{-1}{60cm} = \frac{-5}{d_o}$$

$$-d_o = -5(60cm)$$

$$\boxed{d_o = 300cm}$$