

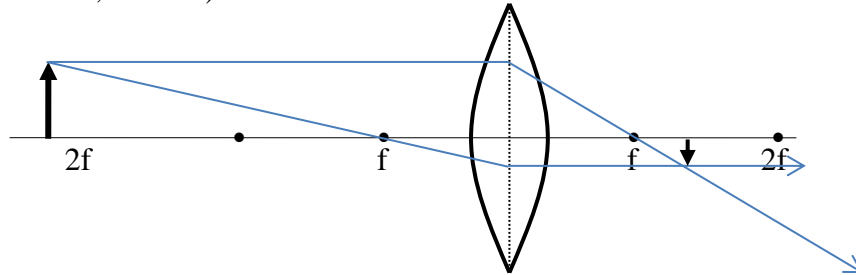
# Physics 30 – Lesson 9

## Optics – Lenses

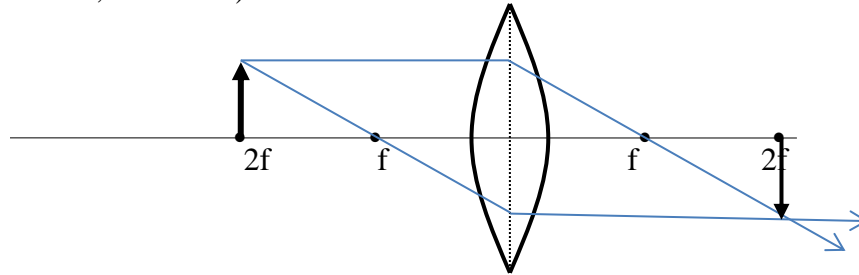
/60

### Practice problems

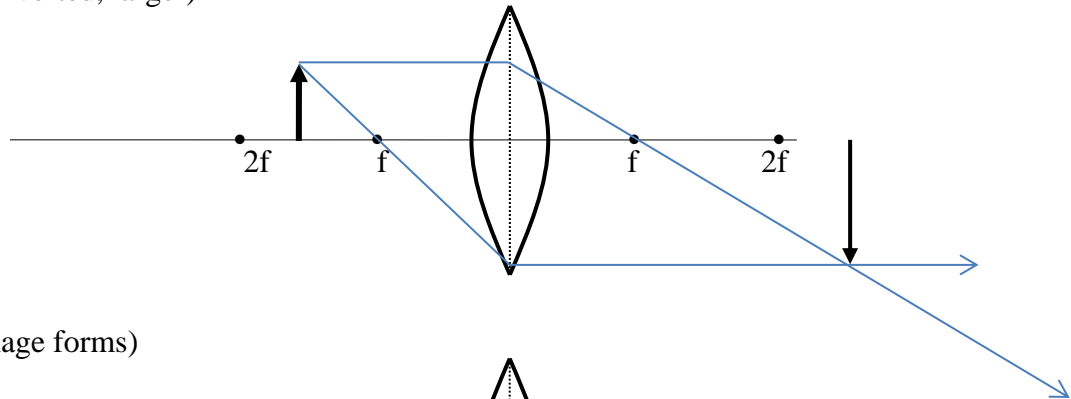
- a. (real, inverted, smaller)



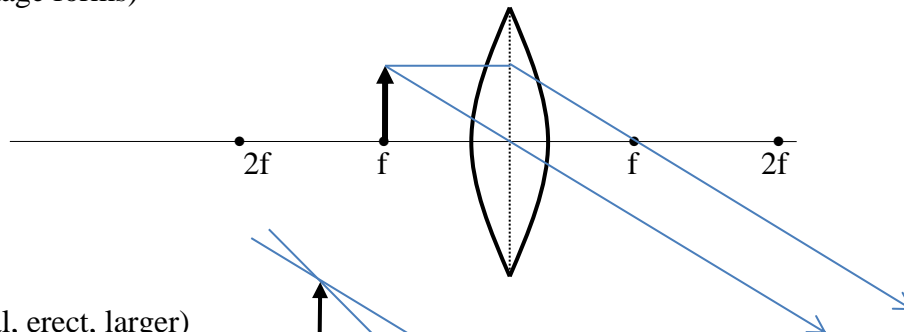
- b. (real, inverted, same size)



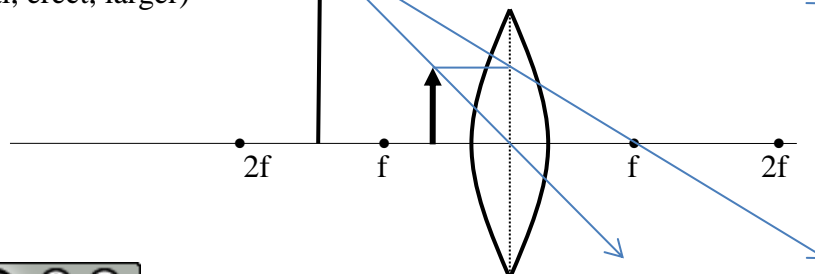
- c. (real, inverted, larger)



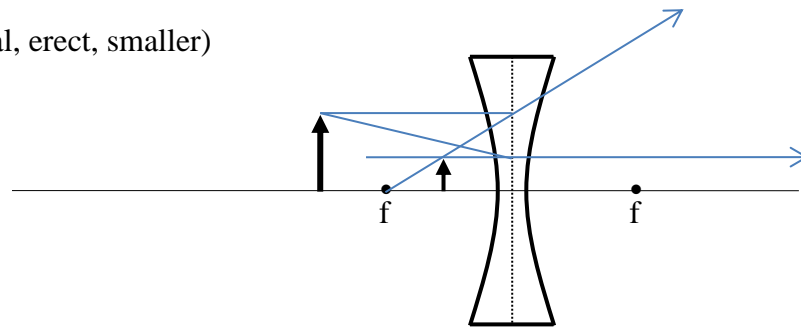
- d. (no image forms)



- e. (virtual, erect, larger)

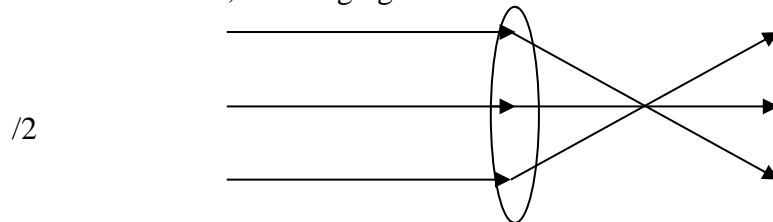


f. (virtual, erect, smaller)



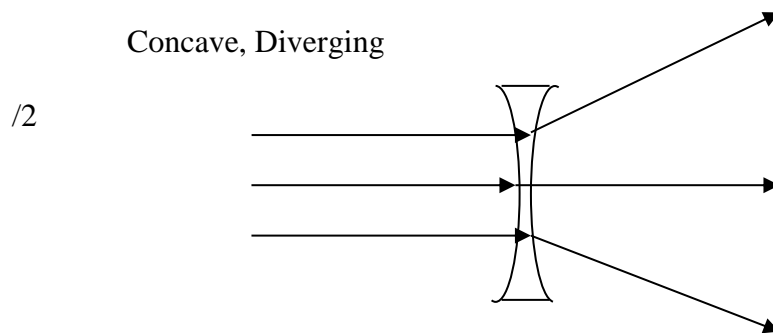
## Assignment

1) Convex, Converging



/2

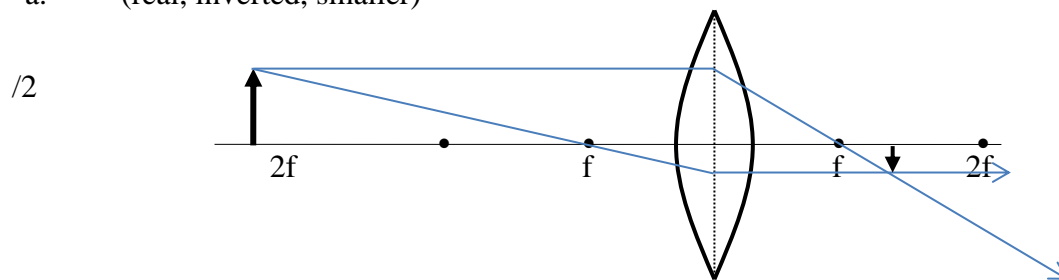
Concave, Diverging



/2

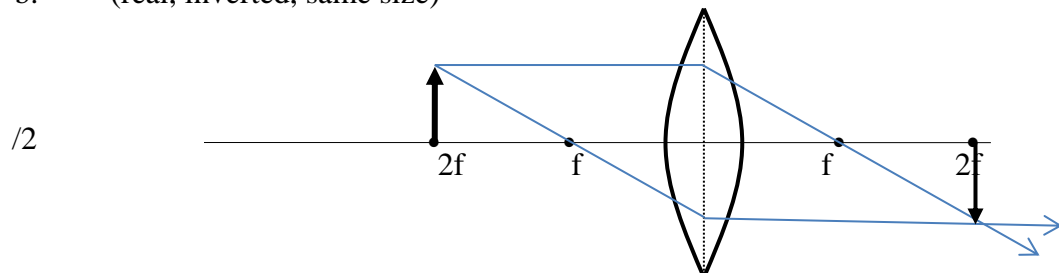
2.

a. (real, inverted, smaller)



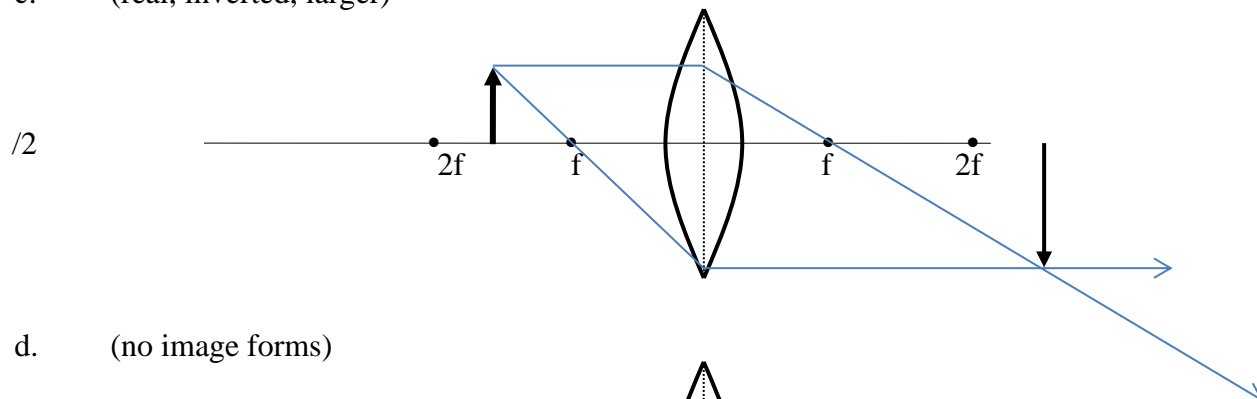
/2

b. (real, inverted, same size)

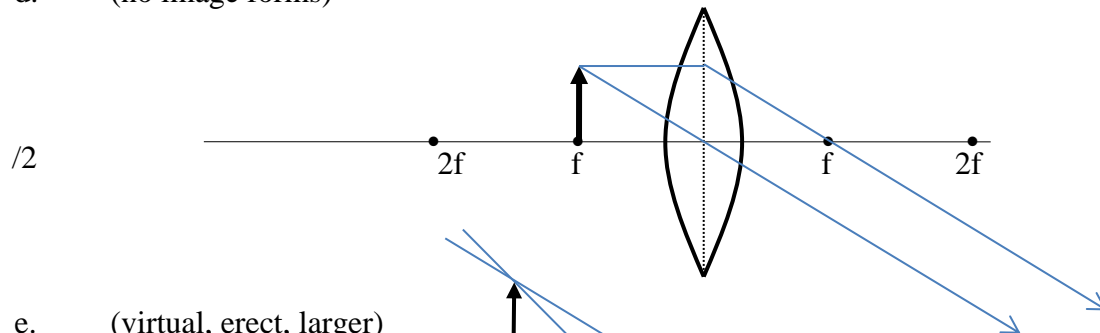


/2

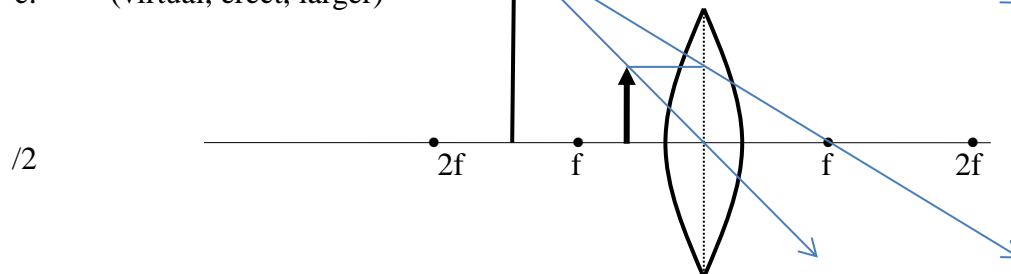
c. (real, inverted, larger)



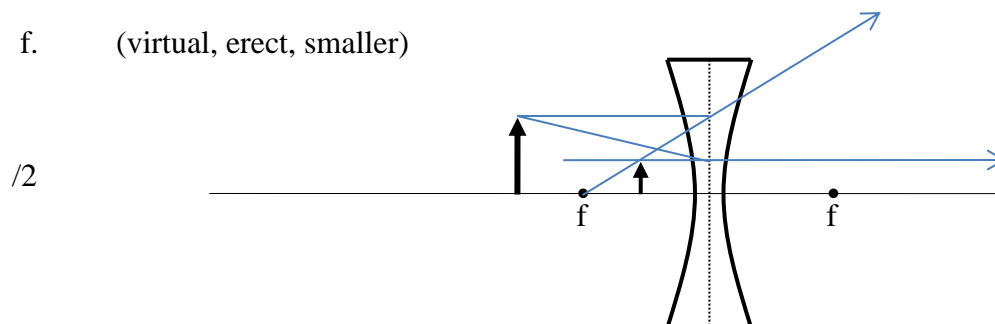
d. (no image forms)



e. (virtual, erect, larger)



f. (virtual, erect, smaller)



3)  $h_o = 8.00\text{cm}$

$d_o = 80\text{cm}$

$f = 25\text{cm}$

/4

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

$$\frac{1}{d_i} = \frac{1}{25\text{cm}} - \frac{1}{80\text{cm}}$$

$$\boxed{d_i = 36\text{cm}}$$

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

$$h_i = \frac{-(36\text{cm})(8.0\text{cm})}{80\text{cm}}$$

$$\boxed{h_i = -3.6\text{cm}}$$

$$\begin{array}{lll}
 4) & h_o = 10.0\text{cm} & \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} & h_i = \frac{-d_i h_o}{d_o} \\
 & d_o = 60\text{cm} & & \\
 /4 & f = -20\text{cm} & \frac{1}{d_i} = \frac{1}{-20\text{cm}} - \frac{1}{60\text{cm}} & h_i = \frac{-(-15\text{cm})(10\text{cm})}{60\text{cm}} \\
 & & \boxed{d_i = -15\text{cm}} & \boxed{h_i = 2.5\text{cm}}
 \end{array}$$

$$\begin{array}{lll}
 5) & h_o = 25\text{cm} & \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} & h_i = \frac{-d_i h_o}{d_o} \\
 & d_o = 100\text{cm} & & \\
 /4 & f = 5.00\text{cm} & \frac{1}{d_i} = \frac{1}{5.00\text{cm}} - \frac{1}{100\text{cm}} & h_i = \frac{-(5.3\text{cm})(25\text{cm})}{100\text{cm}} \\
 & & \boxed{d_i = 5.3\text{cm}} & \boxed{h_i = -1.3\text{cm}}
 \end{array}$$

$$\begin{array}{lll}
 6) & d_o \text{ for the sun is basically infinite} & \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} \\
 /3 & d_o = \infty & \frac{1}{d_i} = \frac{1}{20\text{cm}} - \frac{1}{\infty} \\
 & f = 20\text{cm} & \frac{1}{d_i} = \frac{1}{20} - 0 \\
 & & \boxed{d_i = 20\text{cm}}
 \end{array}$$

$$\begin{array}{l}
 7) \quad d_o = 10.2\text{cm} \\
 \quad f = 10.0\text{cm}
 \end{array}$$

$$\begin{array}{l}
 \text{a)} \\
 /7 \quad \frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} \\
 \quad \frac{1}{d_i} = \frac{1}{10\text{cm}} - \frac{1}{10.2\text{cm}} \\
 \quad \boxed{d_i = 510\text{cm}}
 \end{array}$$

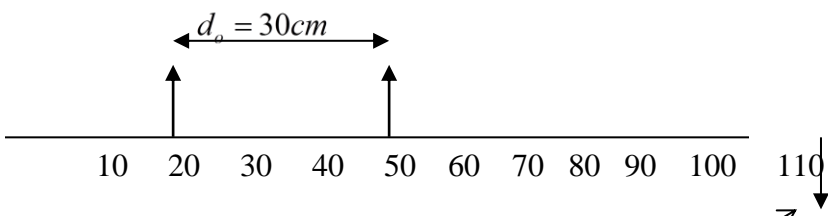
$$\begin{array}{l}
 \text{b)} \\
 h_i = \frac{-d_i h_o}{d_o} \\
 h_i = \frac{-(510\text{cm})(12.5\text{mm})}{10.2\text{cm}} \\
 \boxed{h_i = -62.5\text{mm}}
 \end{array}$$

$$\begin{array}{l}
 \text{c)} \\
 \frac{1}{d_o} = \frac{1}{f} - \frac{1}{d_i} \\
 \frac{1}{d_o} = \frac{1}{10\text{cm}} - \frac{1}{1500\text{cm}} \\
 d_o = 10.07\text{cm}
 \end{array}$$

$$\Delta d = 10.2 - 10.07 = 0.13\text{cm} \text{ closer to lens}$$

8)  $f = 20cm$   $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$   $d_i = 4(25cm)$   
 $d_i = 4d_o$   $d_i = 100cm$   
 /5  $\frac{1}{20} = \frac{1}{4d_o} + \frac{1}{d_o}$  distance between  $d_i$  and  $d_o$   
 $\frac{1}{20} = \frac{5}{4d_o}$   $= 100cm + 25cm$   
 $d_o = 25cm$   $\boxed{= 125cm}$

9)  $h_i = -0.5m = -50cm$   $d_i = \frac{-h_i d_o}{h_o}$   $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$   
 $h_o = 5.0cm$   $d_i = \frac{-(-50cm)(10.0cm)}{5.0cm}$   $\frac{1}{f} = \frac{1}{100cm} + \frac{1}{10cm}$   
 $d_o = 10.0cm$   $d_i = 100cm$   $\boxed{f = 9.1cm}$

10)   
 /5  $\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o}$   $h_i = \frac{-d_i h_o}{d_o}$   
 $\frac{1}{d_i} = \frac{1}{20cm} - \frac{1}{30cm}$   $h_i = \frac{-(60cm)(5.0cm)}{30cm}$   
 $d_i = 60cm \rightarrow 60 + 50 = \boxed{110cm}$   $\boxed{h_i = -10cm}$

11)  $\frac{1}{d_o} = \frac{1}{f} - \frac{1}{d_i}$   
 /2  $\frac{1}{d_o} = \frac{1}{6.0cm} - \frac{1}{7.0cm}$   
 $\boxed{d_o = 42cm}$