Convex Lenses Practice Worksheet **Name** _____

1) An object is placed 8 cm in front of converging lens. A real image is produced at 12 cm. Find the focal distance of the lens.

Diagram: (Given + Unknowns)

f = ???? cm

d_i = 12 cm

d_o = 8 cm

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

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

$\frac{1}{f} = \frac{1}{12} + \frac{1}{8}$

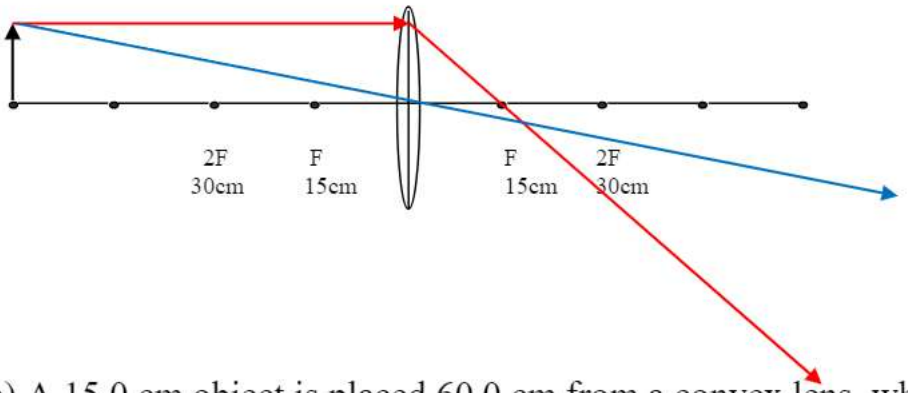
$\frac{1}{f} = 0.08333 + .125$

$\frac{1}{f} = .20833$ **(DO A SWITCHAROO)**

$\frac{1}{.20833} = f$

Solve: **f = 4.8 cm**

2a) A 15.0 cm object is placed 60.0 cm from a convex lens, which has a focal length of 15.0 cm. Draw a ray diagram and use the information from the ray diagram to fill in the box.



Type of Image **REAL**

Orientation of Image **INVERTED**

Size of Image **SMALLER**

Image Distance **close to 20 cm**

2b) A 15.0 cm object is placed 60.0 cm from a convex lens, which has a focal length of 15.0 cm. Use the thin lens equation to find the distance of the image.

Diagram: (Given + Unknowns)

f = 15 cm

d_i = ??? cm

d_o = 60 cm

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

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

$\frac{1}{15} = \frac{1}{d_i} + \frac{1}{60}$

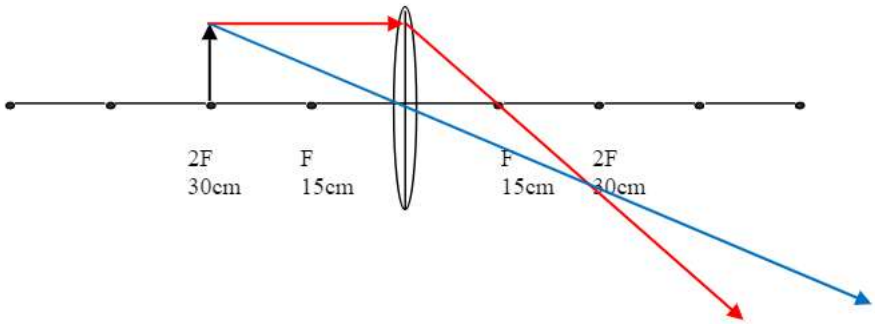
$.0667 = \frac{1}{d_i} + .01667$ **(subtract .01667 (both sides)**

$.0500 = \frac{1}{d_i}$ **(DO A SWITCHAROO)**

$d_i = \frac{1}{.0500}$

Solve: **d_i = 20 cm**

3a) A 15.0 cm object is placed 30.0 cm from a convex lens, which has a focal length of 15.0 cm. Draw a ray diagram and use the information from the ray diagram to fill in the box.



Type of Image **REAL**

Orientation of Image **INVERTED**

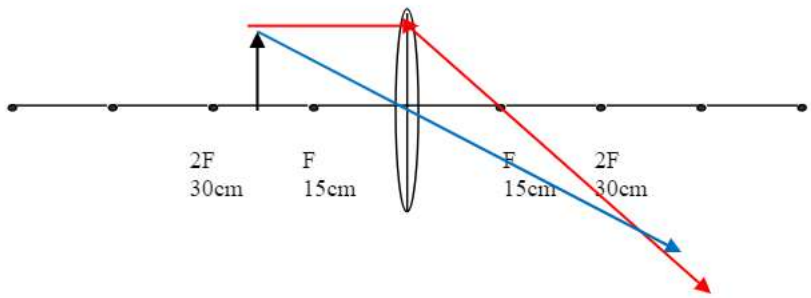
Size of Image **SAME SIZE**

Image Distance **close to 30 cm**

3b) A 15.0 cm object is placed 30.0 cm from a convex lens, which has a focal length of 15.0 cm. Use the thin lens equation to find the distance of the image.

Diagram: (Given + Unknowns)	Equation: $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$
$f = 15$ cm **$d_i = ???$ cm** **$d_o = 30$ cm**	Sub $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$ $\frac{1}{15} = \frac{1}{d_i} + \frac{1}{30}$ $.0667 = \frac{1}{d_i} + .0333$ **(subtract .0333 (both sides)** $.0334 = \frac{1}{d_i}$ **(DO A SWITCHAROO)** $d_i = \frac{1}{.0334}$ Solve: **$d_i = 30$ cm**

4a) A 15.0 cm object is placed 25.0 cm from a convex lens, which has a focal length of 15.0 cm. Draw a ray diagram and use the information from the ray diagram to fill in the box.



Type of Image **REAL**

Orientation of Image **INVERTED**

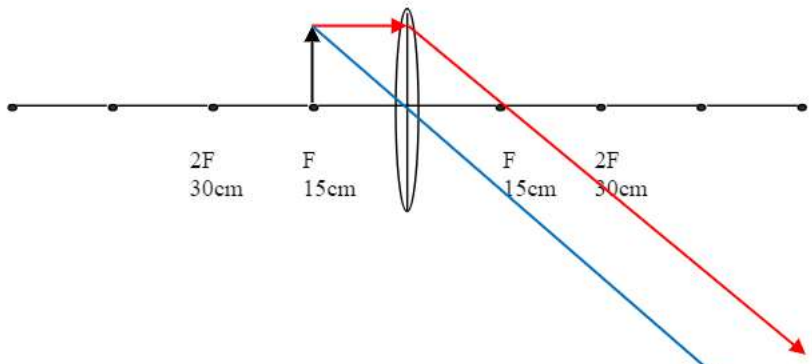
Size of Image **ENLARGED**

Image Distance **close to 37.5 cm**

4b) A 15.0 cm object is placed 25.0 cm from a convex lens, which has a focal length of 15.0 cm. Use the thin lens equation to find the distance of the image.

Diagram: (Given + Unknowns)	Equation: : $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$
$f = 15$ cm **$d_i = ???$ cm** **$d_o = 25$ cm**	Sub $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$ **$.0667 = \frac{1}{d_i} + .04$ (subtract .04) (both sides)** **$\frac{1}{15} = \frac{1}{d_i} + \frac{1}{25}$ $.0267 = \frac{1}{d_i}$ (DO A SWITCHAROO)** **$d_i = \frac{1}{.0267}$** Solve: **$d_i = 37.4$ cm**

5a) A 15.0 cm object is placed 15.0 cm from a convex lens, which has a focal length of 15.0 cm. Draw a ray diagram and use the information from the ray diagram to fill in the box.



Type of Image **NONE**

Orientation of Image **NONE**

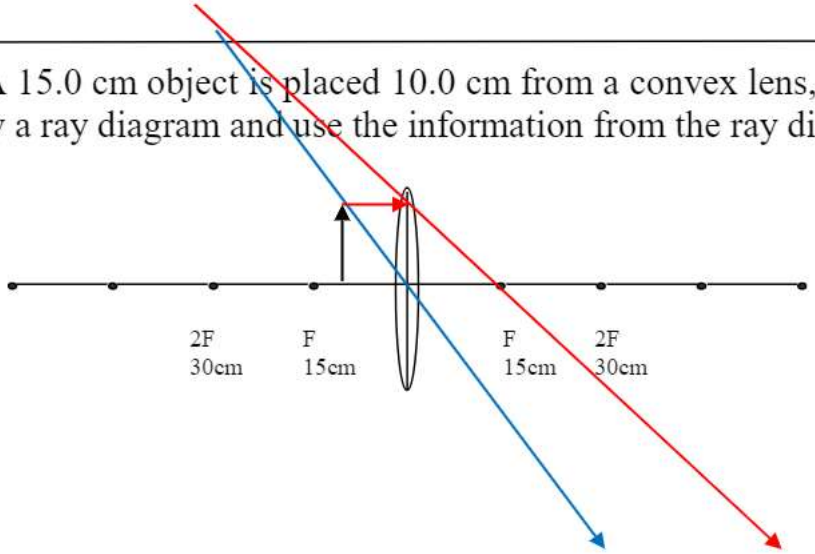
Size of Image **NONE**

Image Distance **NONE**

5b) Explain why no image can be formed when the object is placed at the focal point.

The light rays never intersect, so no image is formed.

6a) A 15.0 cm object is placed 10.0 cm from a convex lens, which has a focal length of 15.0 cm. Draw a ray diagram and use the information from the ray diagram to fill in the box.



Type of Image **VIRTUAL**

Orientation of Image **UPRIGHT**

Size of Image **ENLARGED**

Image Distance **close to -30 cm**

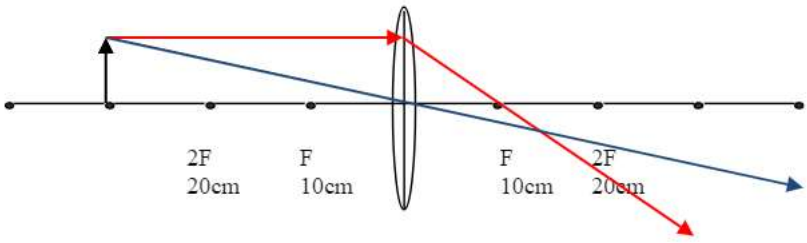
6b) A 15.0 cm object is placed 10.0 cm from a convex lens, which has a focal length of 15.0 cm. Use the thin lens equation to find the distance of the image.

Diagram: (Given + Unknowns)	Equation: $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$
$f = 15$ cm **$d_i = ???$ cm** **$d_o = 10$ cm**	Sub $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$ **$.0667 = \frac{1}{d_i} + .1$ (subtract .1) (both sides)** **$\frac{1}{15} = \frac{1}{d_i} + \frac{1}{10}$ $-.033 = \frac{1}{d_i}$ (DO A SWITCHAROO)** **$d_i = \frac{1}{-.033}$** **This is a virtual image since d_i is a negative number.** **Solve: $d_i = -30.0$ cm**

7) A 2-meters-tall person is located 5 meters from a camera lens (camera lenses are convex lenses). The lens has a focal length of 35 millimeters. Do not forget to convert millimeters to meters before substituting into the equation. Find the distance where the image would appear.

Diagram: (Given + Unknowns)	Equation:
$f = 35$ mm $= .035$ m **$d_i = ???$ m** **$d_o = 5$ m**	Substitute: $\frac{1}{f} = \frac{1}{d_i} + \frac{1}{d_o}$ **$28.57 = \frac{1}{d_i} + .2$ (subtract .2) (both sides)** **$\frac{1}{.035} = \frac{1}{d_i} + \frac{1}{5}$ $28.37 = \frac{1}{d_i}$ (DO A SWITCHAROO)** **$d_i = \frac{1}{28.37}$** Solve: **$d_i = .03525$ m**

8) A 1.0 cm object is placed 30.0 cm from a convex lens, which has a focal length of 10.0 cm. (Notice, I did not label the F distance and 2F distance…. Label these first and it help you determine where to put your object. Use an arrow for your object..)
Draw a ray diagram and use the information from the ray diagram to fill in the box.



Type of Image **REAL**

Orientation of Image **INVERTED**

Size of Image **SMALLER**

Image Distance **close to 15 cm**

9) Punch Line Points (Making Conclusions)

****For a convex lens, if the object is in front of the focal point, the type of image is **virtual** while the orientation of the image is **upright**.*****

***** For a convex lens, if the object is behind the focal point, the type of image is **real** while the orientation of the image is **inverted**.*****