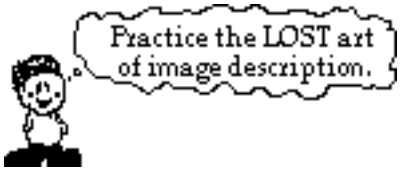
Ray Diagrams for Converging Lenses

Read from **Lesson 5** of the **Refraction and Lenses chapter** at **The Physics Classroom:**

http://www.physicsclassroom.com/Class/refrn/u14l5da.html
http://www.physicsclassroom.com/Class/refrn/u14l5db.html

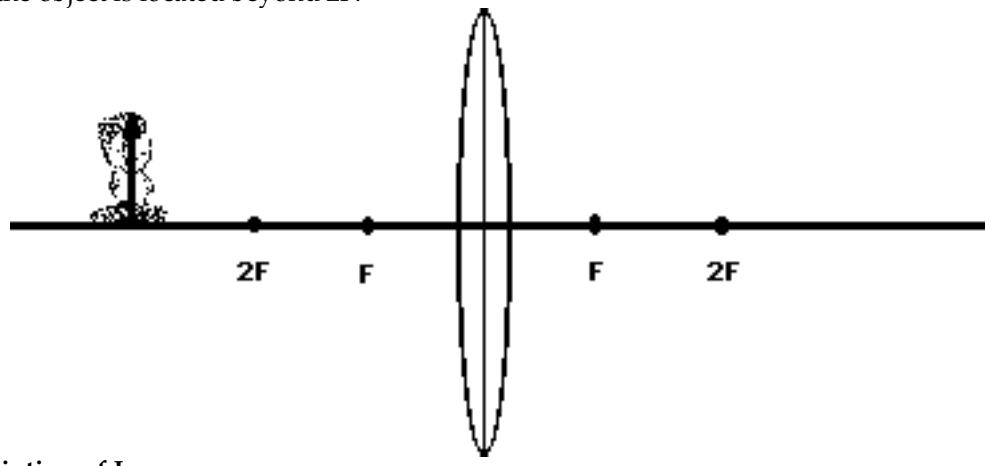
MOP Connection: Refraction and Lenses: sublevels 8 and 9

For the following lenses and corresponding object positions, construct ray diagrams. Then describe the **L**ocation of the image, **O**rientation (upright or inverted) of the image, the relative **S**ize of the image (larger or smaller than object), and the **T**ype of image (real or virtual). For **Case 4**, merely construct the ray diagram.



NOTE: 1) All light rays have arrowheads that indicate the direction of travel of the ray.
2) Always draw in the image once located (an arrow is a good representation).
3) Exactness counts. Use a straight-edge and be accurate.

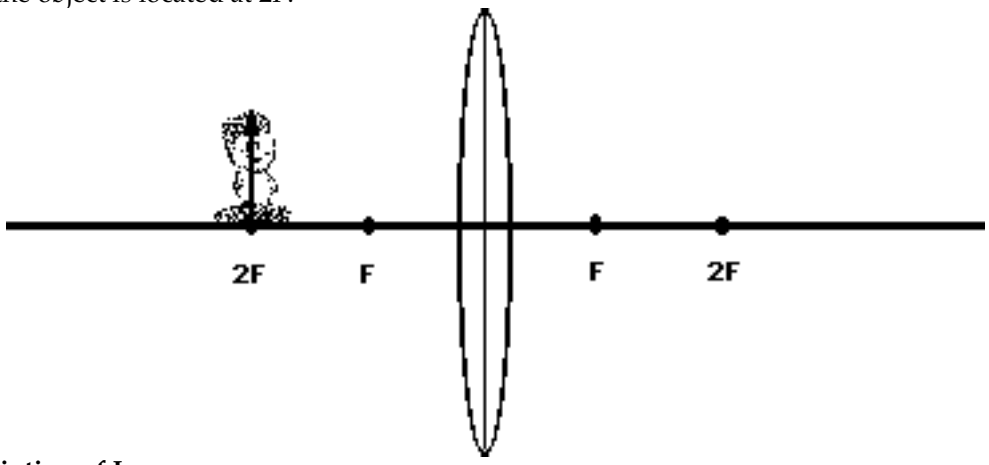
Case 1: If the object is located beyond 2F:



Description of Image:
Location: _____

O: Upright or Inverted **S:** Magnified or Reduced **T:** Real or Virtual

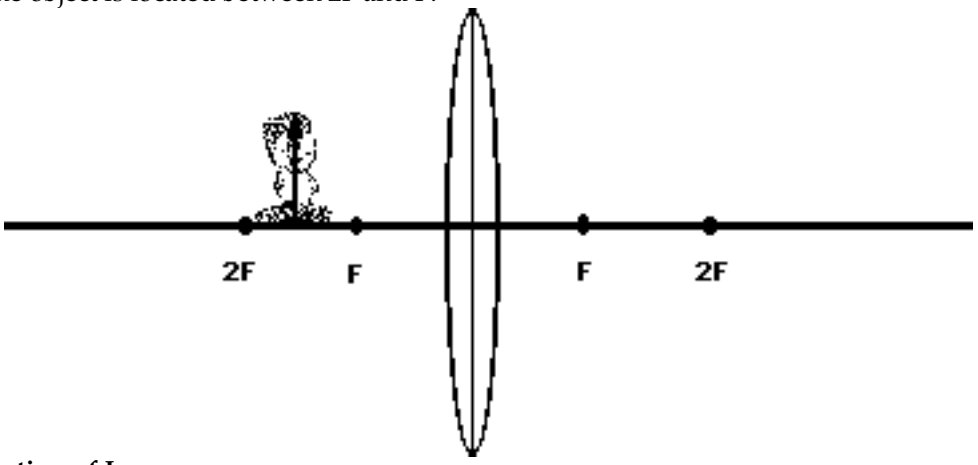
Case 2: If the object is located at 2F:



Description of Image:
Location: _____

O: Upright or Inverted **S:** Magnified or Reduced **T:** Real or Virtual

Case 3: If the object is located between 2F and F:

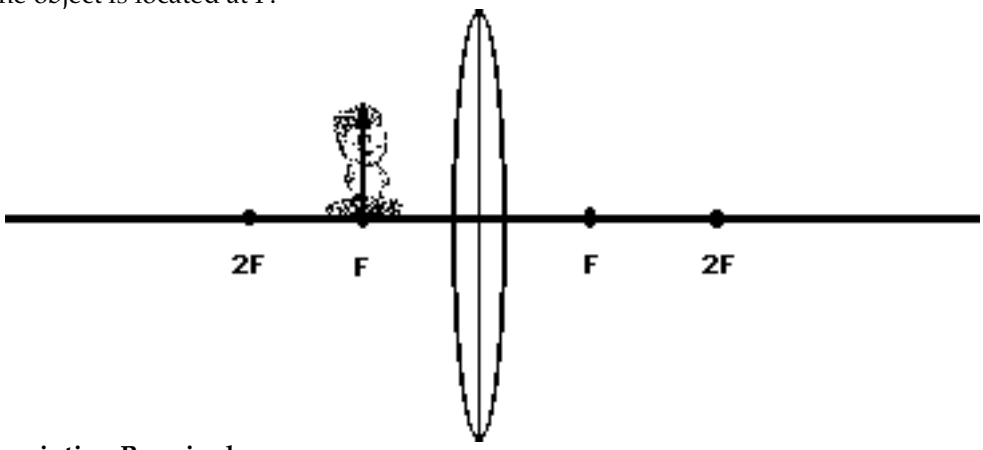


Description of Image:

Location: _____

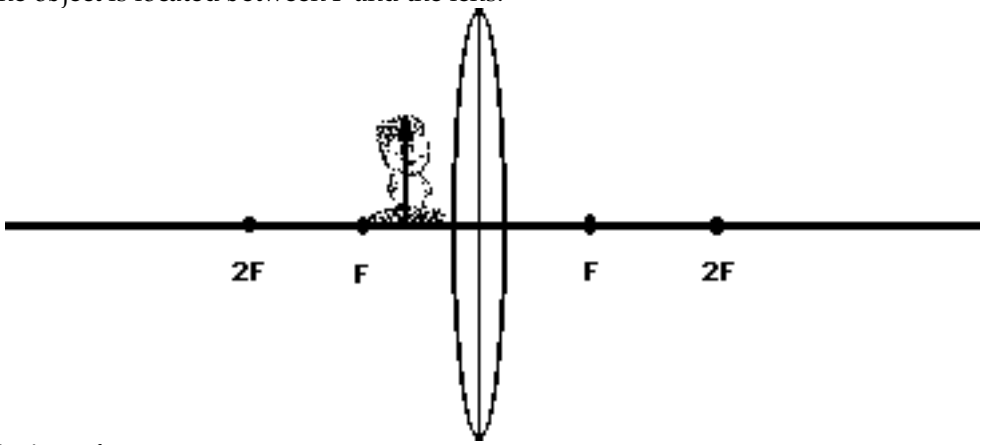
O: Upright or Inverted **S:** Magnified or Reduced **T:** Real or Virtual

Case 4: If the object is located at F:



No Description Required

Case 5: If the object is located between F and the lens:



Description of Image:

Location: _____

O: Upright or Inverted **S:** Magnified or Reduced **T:** Real or Virtual

Ray Diagrams for Diverging Lenses

Read from **Lesson 5** of the **Refraction and Lenses** chapter at **The Physics Classroom:**

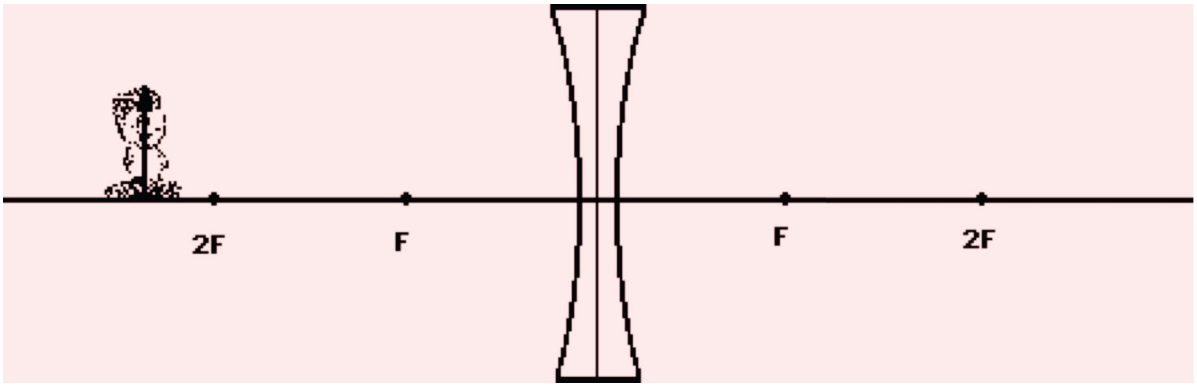
http://www.physicsclassroom.com/Class/refrn/u14l5ea.html
http://www.physicsclassroom.com/Class/refrn/u14l5eb.html

MOP Connection: Refraction and Lenses: sublevels 10 and 11

For the following lenses and corresponding object positions, construct ray diagrams. Then describe the **L**ocation of the image, **O**rientation (upright or inverted) of the image, the relative **S**ize of the image (larger or smaller than object), and the **T**ype of image (real or virtual).

NOTE: 1) All light rays have arrowheads that indicate the direction of travel of the ray.
2) Always draw in the image once located (an arrow is a good representation).
3) Exactness counts. Use a straight-edge and be accurate.

Case 1: If the object is located far away from the lens:

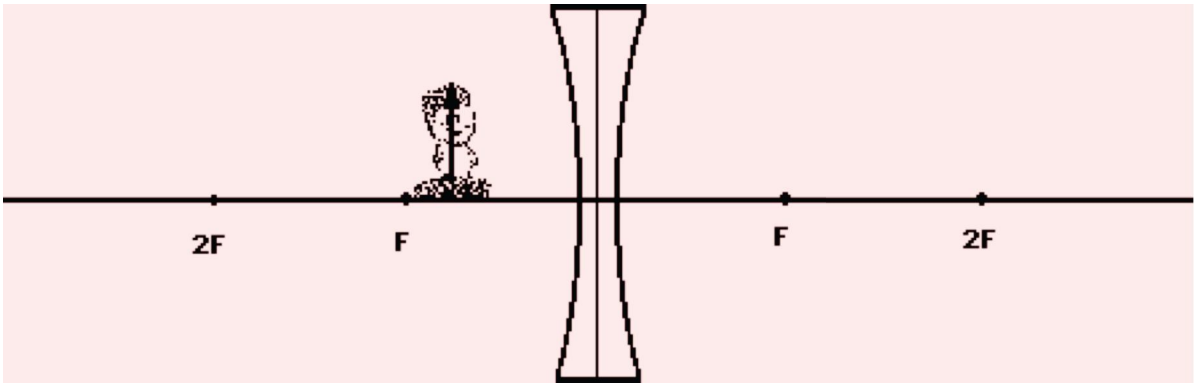


Description of Image:

Location: _____

O: Upright or Inverted **S:** Magnified or Reduced **T:** Real or Virtual

Case 2: If the object is located nearby the lens:



Description of Image:

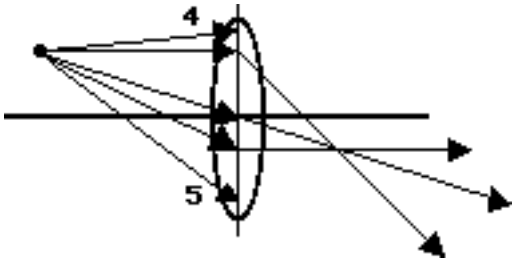
Location: _____

O: Upright or Inverted **S:** Magnified or Reduced **T:** Real or Virtual

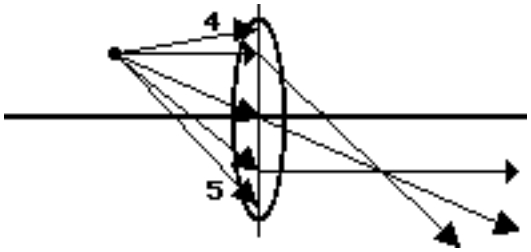
Lenses and Mirrors - Applying Concepts

1. Light emanates in a variety of directions from the following point objects; some of this light is incident towards the mirror or lens. The behavior of a few such incident rays is shown below. Show how the third, fourth and/or fifth incident rays refract or reflect.

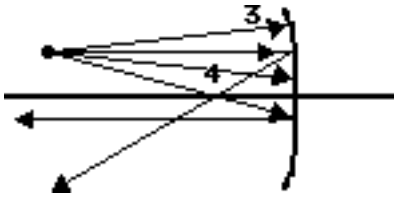
Converging Lens



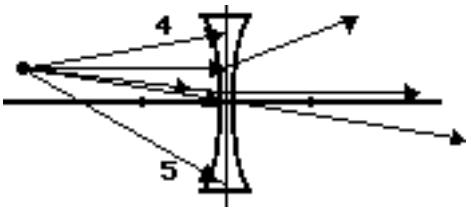
Converging Lens



Concave Mirror



Diverging Lens



2. Several statements about images are given below. Identify which optical device applies to the given statement. Place the appropriate marks in the blanks. Mark all that apply.

A = plane mirrors **B = concave mirrors** **C = convex mirrors**
D = converging lenses **E = diverging lenses**

a. Are capable of producing real images. _____

b. Only produce virtual images. _____

c. Are capable of producing enlarged images. _____

d. Can only produce images that are smaller than the object. _____

e. Capable of producing images the same size as the object. _____

3. Identify the following statements as being either true (**T**) or false (**F**).

a. If reflected or refracted rays diverge, there is no image. _____

b. If an object is located in front of a focal point, there is no image. _____

c. Virtual images cannot be seen. _____

d. All images are formed by the actual convergence of reflected or refracted light. _____

e. Just three rays of light from an object can intersect at the image location. _____

Lens Practice

Read from **Lesson 5** of the **Refraction and Lenses chapter** at **The Physics Classroom:**

http://www.physicsclassroom.com/Class/refrn/u14l5f.html

Use the lens equation and magnification equation to solve the following problems.

1. Determine the image distance and image height for a 4.0-cm tall object placed 54.0-cm from a converging lens having a focal length of 18.0 cm.

2. Determine the image distance and image height for a 4.0-cm tall object placed 36.0-cm from a converging lens having a focal length of 18.0 cm.

3. Determine the image distance and image height for a 4.0-cm tall object placed 24.0-cm from a converging lens having a focal length of 18.0 cm.

4. Determine the image distance and image height for a 4.0-cm tall object placed 12.0-cm from a converging having a focal length of 18.0 cm.

5. A magnified, inverted image is located a distance of 32.0 cm from a converging lens with a focal length of 12.0 cm. Determine the object distance and tell whether the image is real or virtual.

6. **ZINGER:** An inverted image is magnified by 2 when the object is placed 22 cm in front of a converging lens. Determine the image distance and the focal length of the lens.

7. A diverging lens has a focal length of -12.8 cm. An object is placed 34.5 cm from the lens's surface. Determine the image distance.

8. Determine the focal length of a diverging lens that produces an image that is 12.9 cm from the lens (and on the object's side) when the object is 32.4 cm from the lens.

9. A 2.85-cm diameter coin is placed a distance of 31.4 cm from a diverging lens that has a focal length of -11.6 cm. Determine the image distance and the diameter of the image.

10. The focal point is located 20.0 cm from a diverging lens. An object is placed 12.0 cm from the lens. Determine the image distance.