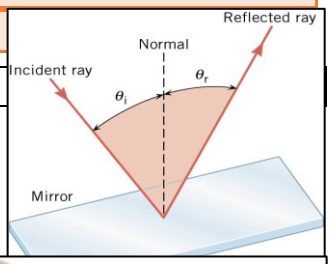
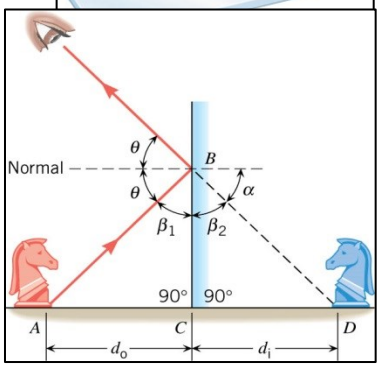
Physics 11-02 Reflection **Name: _____**

Reflection

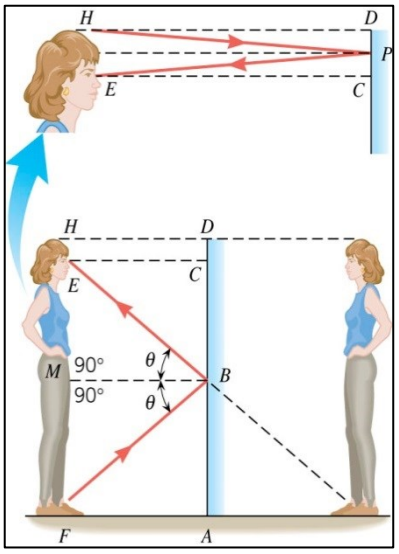


Law of Reflection: $\theta_r = \theta_i$

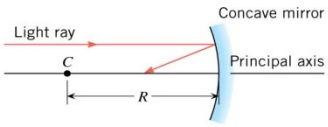
- _____ Reflection
  - _____ light rays are reflected _____
- _____ Reflection
  - _____ light rays are _____ by irregularities in the surface.
- Plane Mirror
  - Image is _____
  - Image is _____ size
  - Image is _____ as far _____ the mirror as you are in _____ of it
- Since light rays appear to come from _____ mirror, the image is called a _____ image.
- If light rays _____ to come from a _____ location, the image is called a _____ image.
- Real images can be _____ on a screen, virtual images _____.
- _____ mirrors only produce _____ images.

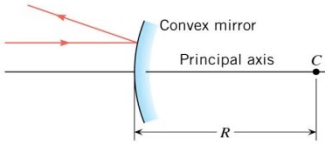


How long must a plane mirror be to see your whole reflection?

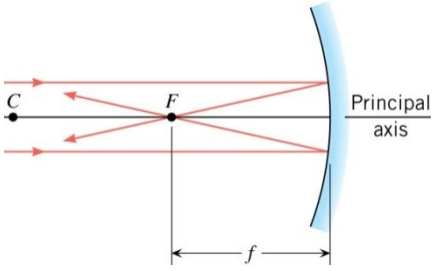


Spherical Mirrors



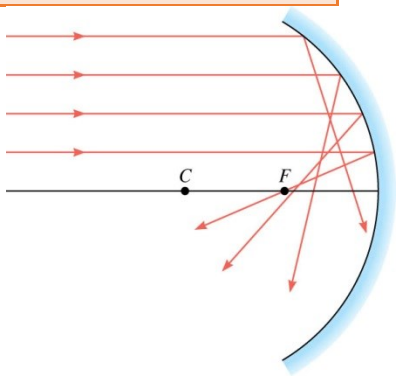


- Concave: bends _____
- Convex: bends _____
- _____are always _____ to the surface and pass through the _____ of curvature, C.
  - Law of Reflection says that the _____ to the _____ is the same for the _____ and _____ rays
- Principal axis: imaginary line through _____ and the _____ of the mirror.
- Focal point (F): _____ rays strike the mirror and _____ at the focal point.
- Focal length (f): distance between _____ and _____
- Concave mirrors: $f = \frac{1}{2}R$
- Convex mirrors: $f = -\frac{1}{2}R$



Physics 11-02 Reflection **Name:** _____

Spherical aberration



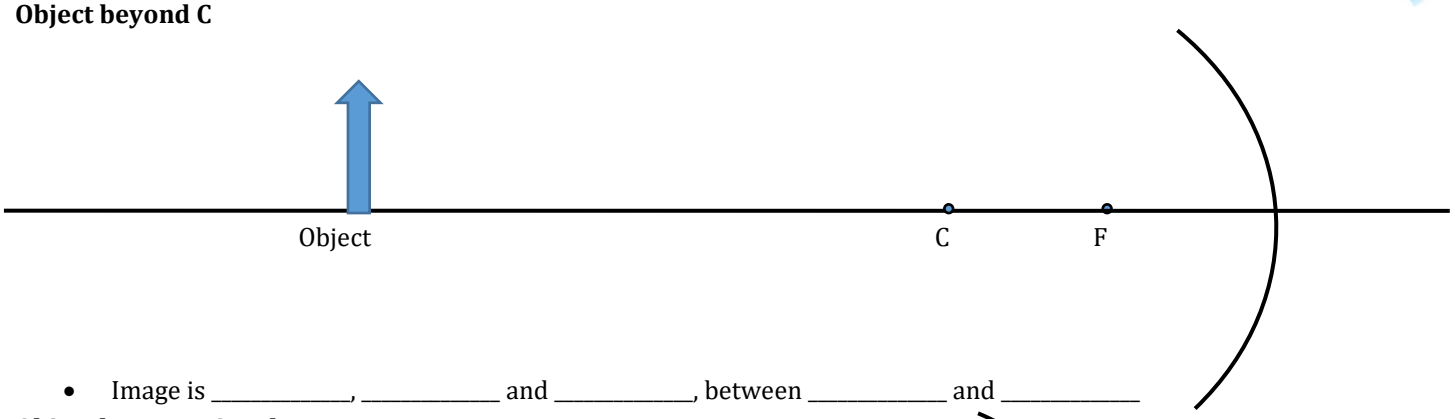
- Rays _____ from the principle axis actually cross between _____ and the _____.
- Fix this by using a _____ mirror.

Ray Diagrams

Concave Mirror

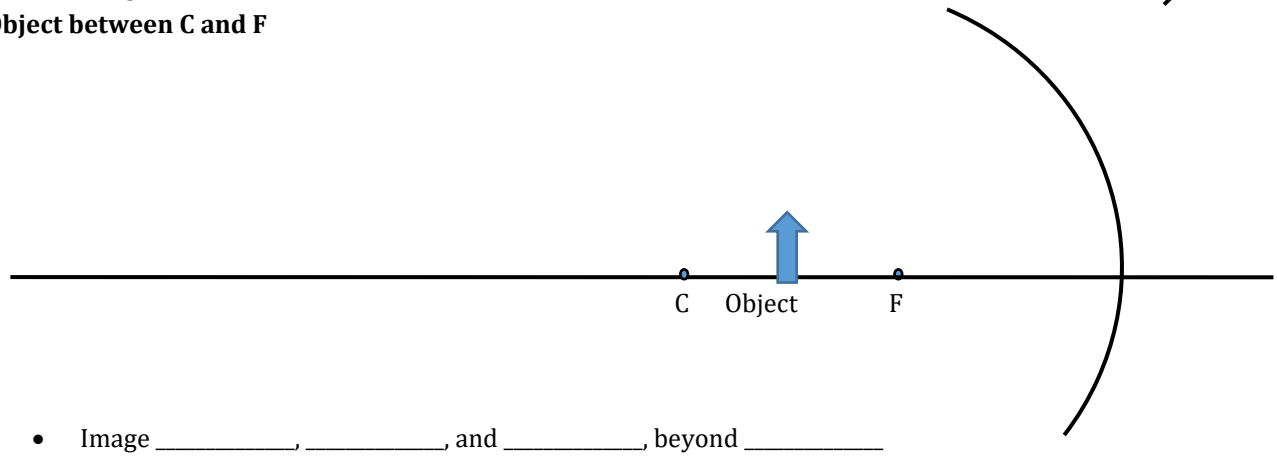
- Ray 1 – _____ to principal axis, strikes mirror and reflects through _____
- Ray 2 – Through _____, strikes mirror and reflects _____ to principal axis
- Ray 3 – Through _____, strikes mirror and reflects back through _____

Object beyond C



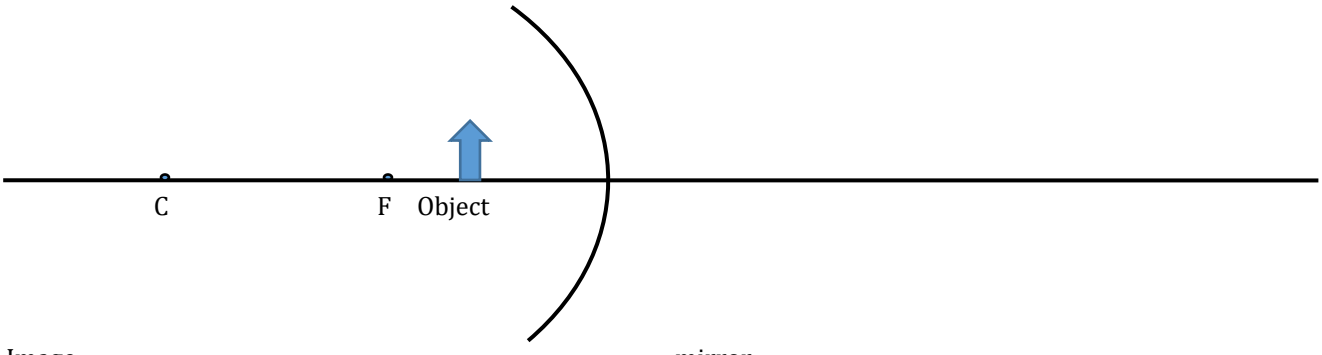
- Image is _____, _____ and _____, between _____ and _____

Object between C and F



- Image _____, _____, and _____, beyond _____

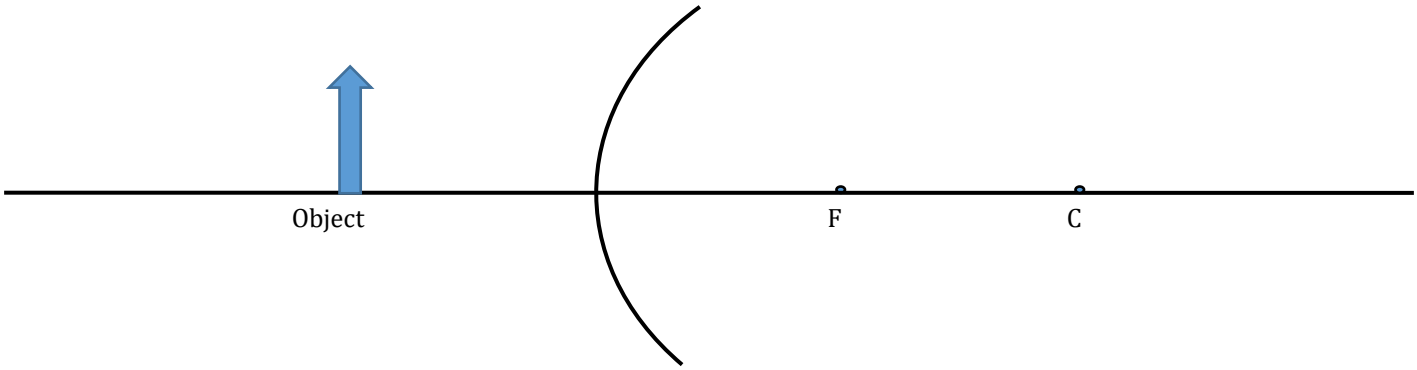
Object between F and mirror



- Image _____, _____, _____, _____ mirror

Physics 11-02 Reflection *Name:* _____

Convex Mirrors



- Image _____, _____, _____, _____ mirror between F and _____

Mirror Equation

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

- Where f = focal length (negative if _____), d_o = object distance, d_i = image distance (negative if _____)

Magnification Equation

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

- Where m = magnification, h_o = object height, h_i = image height (negative if _____), d_o = object distance, d_i = image distance (negative if _____)

A 0.5-m high toddler is playing 10 m in front of a concave mirror with radius of curvature of 7 m.
What is the location of his image?

What is the height of his image?

A 0.5-m high toddler is playing 10 m in front of a convex mirror with radius of curvature of 7 m.
What is the location of his image?

What is the height of his image?

Physics 11-02 Reflection **Name: _____**

Practice Work

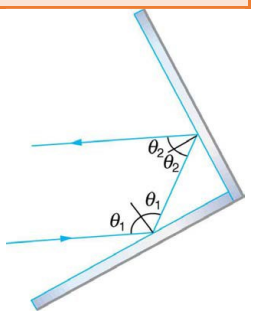


Figure 1

1. Using the law of reflection, explain how powder takes the shine off of a person's nose. What is the name of the optical effect?
2. Show that when light reflects from two mirrors that meet each other at a right angle, the outgoing ray is parallel to the incoming ray, as illustrated in figure 1. (OpenStax 25.2) **See below**
3. Light shows staged with lasers use moving mirrors to swing beams and create colorful effects. Show that a light ray reflected from a mirror changes direction by 2θ when the mirror is rotated by an angle θ. (OpenStax 25.3) **See below**
4. What are the differences between real and virtual images? How can you tell (by looking) whether an image formed by a single lens or mirror is real or virtual?
5. Can you see a virtual image? Can you photograph one? Can one be projected onto a screen with additional lenses or mirrors? Explain your responses.
6. Is it necessary to project a real image onto a screen for it to exist?
7. Under what circumstances will an image be located at the focal point of a lens or mirror?
8. What is meant by a negative magnification? What is meant by a magnification that is less than 1 in magnitude?
9. Suppose a man stands in front of a mirror. His eyes are 1.65 m above the floor, and the top of his head is 0.13 m higher. (a) Find the height above the floor of the top and bottom of the smallest mirror in which he can see both the top of his head and his feet. (b) How is this distance related to the man's height? (OpenStax 25.1) **bottom 0.825 m, top 1.715 m; not related**
10. Some telephoto cameras use a mirror rather than a lens. What radius of curvature mirror is needed to replace a 800 mm focal length telephoto lens? (OpenStax 25.54) **+1.60 m**
11. Calculate the focal length of the mirror formed by the shiny back of a spoon that has a 3.00 cm radius of curvature. (OpenStax 25.55) $\mathbf{-1.50 \times 10^{-2}\ m}$
12. Electric room heaters use a concave mirror to reflect infrared (IR) radiation from hot coils. Note that IR follows the same law of reflection as visible light. Given that the mirror has a radius of curvature of 50.0 cm and produces an image of the coils 3.00 m away from the mirror, what is the magnification of the heater element. Note that its large magnitude helps spread out the reflected energy. (OpenStax 25.56) **-11.0**
13. What is the focal length of a makeup mirror that produces a magnification of 1.50 when a person's face is 12.0 cm away? (OpenStax 25.57) **0.360 m**
14. A shopper standing 3.00 m from a convex security mirror sees his image with a magnification of 0.250. (a) Where is his image? (b) What is the focal length of the mirror? (c) What is its radius of curvature? (OpenStax 25.58) **-0.750 m, -1.00 m, 2.00 m**
15. An object 1.50 cm high is held 3.00 cm from a person's cornea, and its reflected image is measured to be 0.167 cm high. (a) What is the magnification? (b) Where is the image? (c) Find the radius of curvature of the convex mirror formed by the cornea. (Note that this technique is used by optometrists to measure the curvature of the cornea for contact lens fitting. The instrument used is called a keratometer, or curve measurer.) (OpenStax 25.59) **+0.111, -0.334 cm, -0.752 cm**

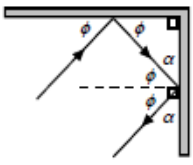
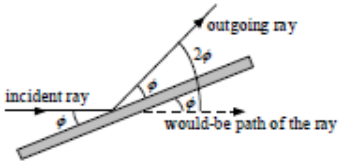


Figure 2 Answer to #2



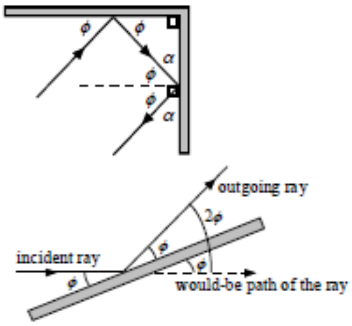


Figure 3 Answer to #3