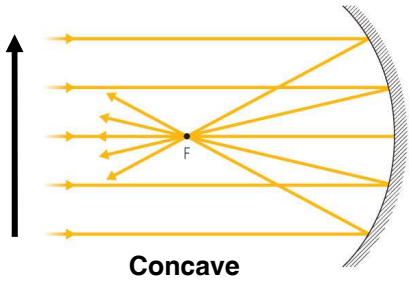
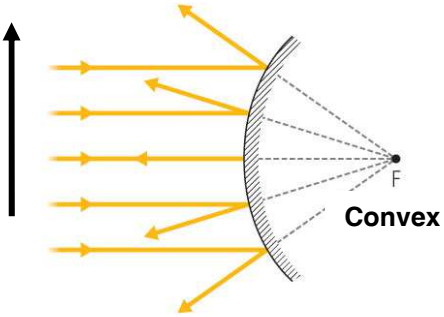
Curved Mirrors

Although straight mirrors are by far the most common, there are also curved mirrors.

Concave – reflecting surface curves inward. They are also called **converging mirrors**.
Convex – reflecting surface curves outwards. They are also called **diverging mirrors**.

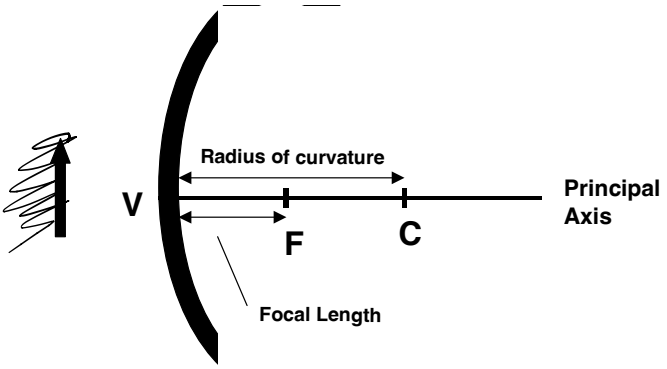


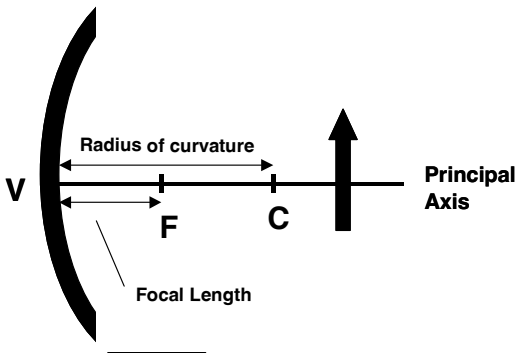


Where have you seen curved mirrors?

Security mirrors, outside car mirrors, telescopes, headlights.

Concave and convex mirrors are parts of circles so there are special definitions for some points.





Centre of curvature – **C** – the centre of the circle that is the curved mirror

Radius of curvature – **r** – the distance from the centre of curvature to the reflecting surface.

Principal Axis – **PA** – a line drawn through **C** that strikes the mirror.

Vertex – **V** - the point where PA meets the mirror

Focal point – **F**- the position where parallel incoming rays meet when they reflect

Focal length – **f** – the distance from F to the reflecting surface

Other Variables

Height of Object – $\mathbf{h_o}$ Height of Image - $\mathbf{h_i}$
Distance to object from vertex – $\mathbf{d_o}$ Distance to image from vertex – $\mathbf{d_i}$

Note the Relationship: C = 2F

The law of reflection ($\angle i = \angle r$) still holds true but the curve of the mirror makes it difficult to find the normal so it is not very useful but… there are certain points that have interesting properties.

Determining Curved Mirror Rules

1. Trace edge of mirror on a piece of paper
2. Locate C by finding a ray that reflects back on itself. Repeat for a second ray.
3. Locate F using the triple beam input with middle ray through center along approximate principal axis.
4. Draw the principal axis

Convex Mirror	Concave Mirror

Now, use your setup to complete the following statements.

Concave Mirrors

1. An incident ray parallel to the principle axis reflects **back through the focal point.**

2. An incident ray through the focal point comes **out parallel to PA**

3. An incident ray through C reflects **back on itself.**

Convex Mirrors – simply point raybox from other side of mirror

1. An incident ray parallel to the principle axis reflects **as if it came from the focal point.**

2. An incident ray pointed at the focal point comes **out parallel to PA.**

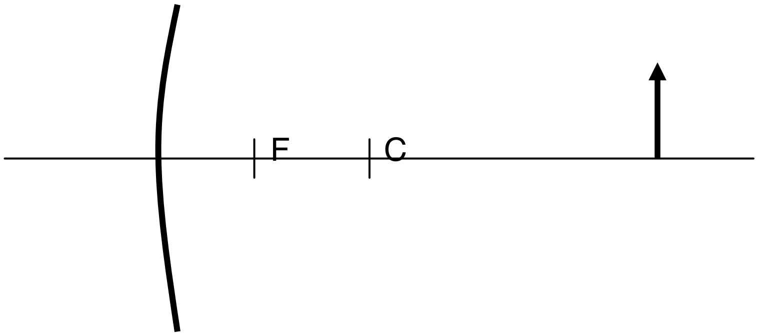
3. An incident ray pointed at C **reflects back on itself.**

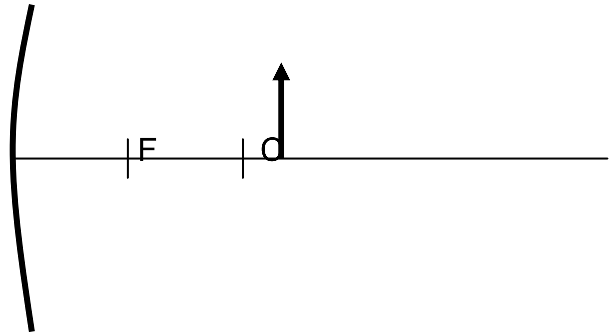
DRAWING RAY DIAGRAMS FOR CURVED MIRRORS

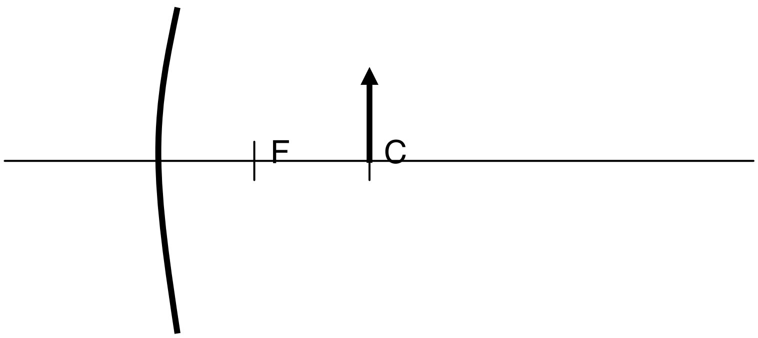
Images in Curved Mirrors - can be real, imaginary, upright, inverted, larger smaller, in front of or behind all depending on how far the object is from the mirror.

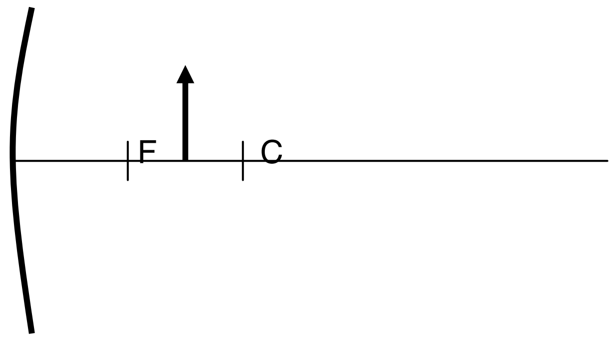
1. The eye can only see an image where two light rays cross or appear to cross.
2. Draw three light rays coming from a point on an object.
    a. going through or towards C
    b. going through or towards F
    c. going parallel to PA
3. Draw the reflected rays using the rules.
4. Find the crossing point, extensions are imaginary, to locate image.
5. Anything on the PA stays on the PA.

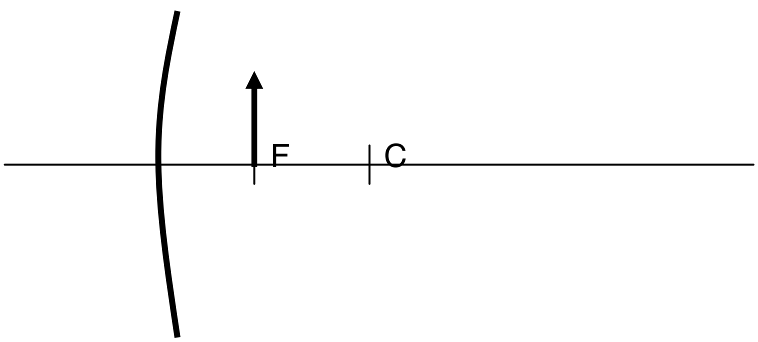
Concave Mirrors - Find the image and state the image characteristics.

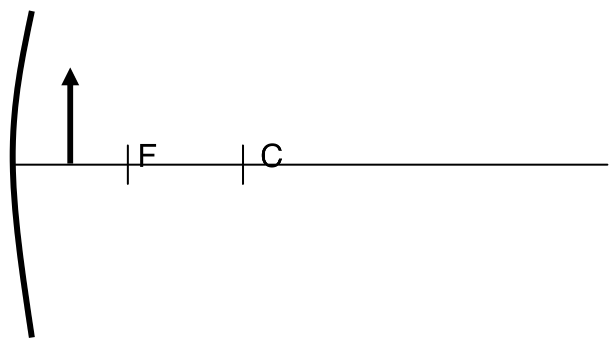


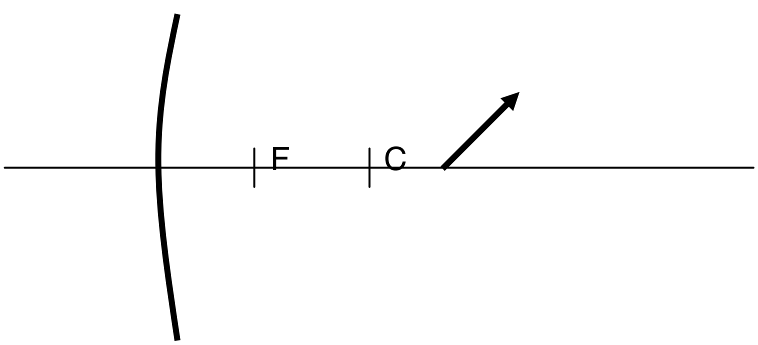


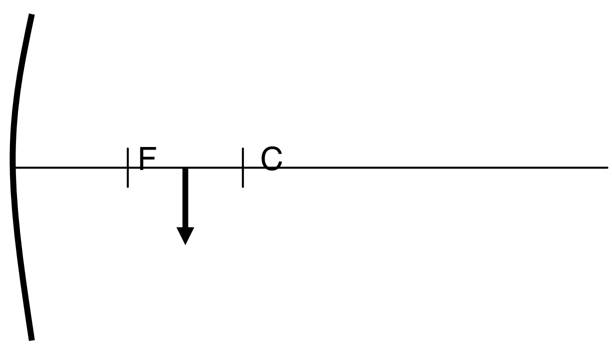


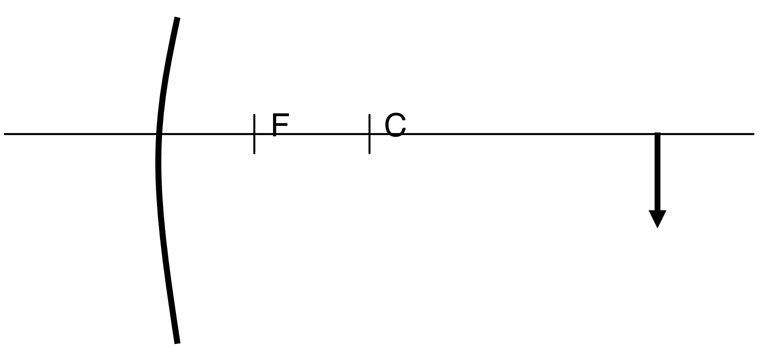


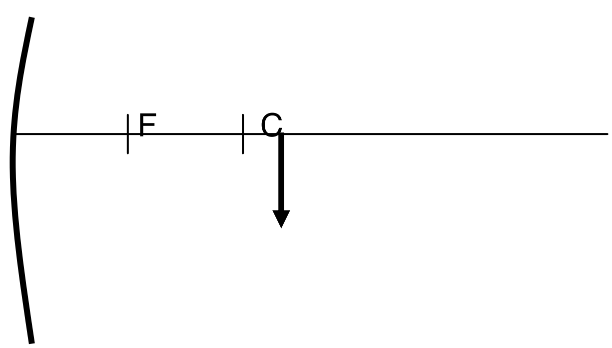


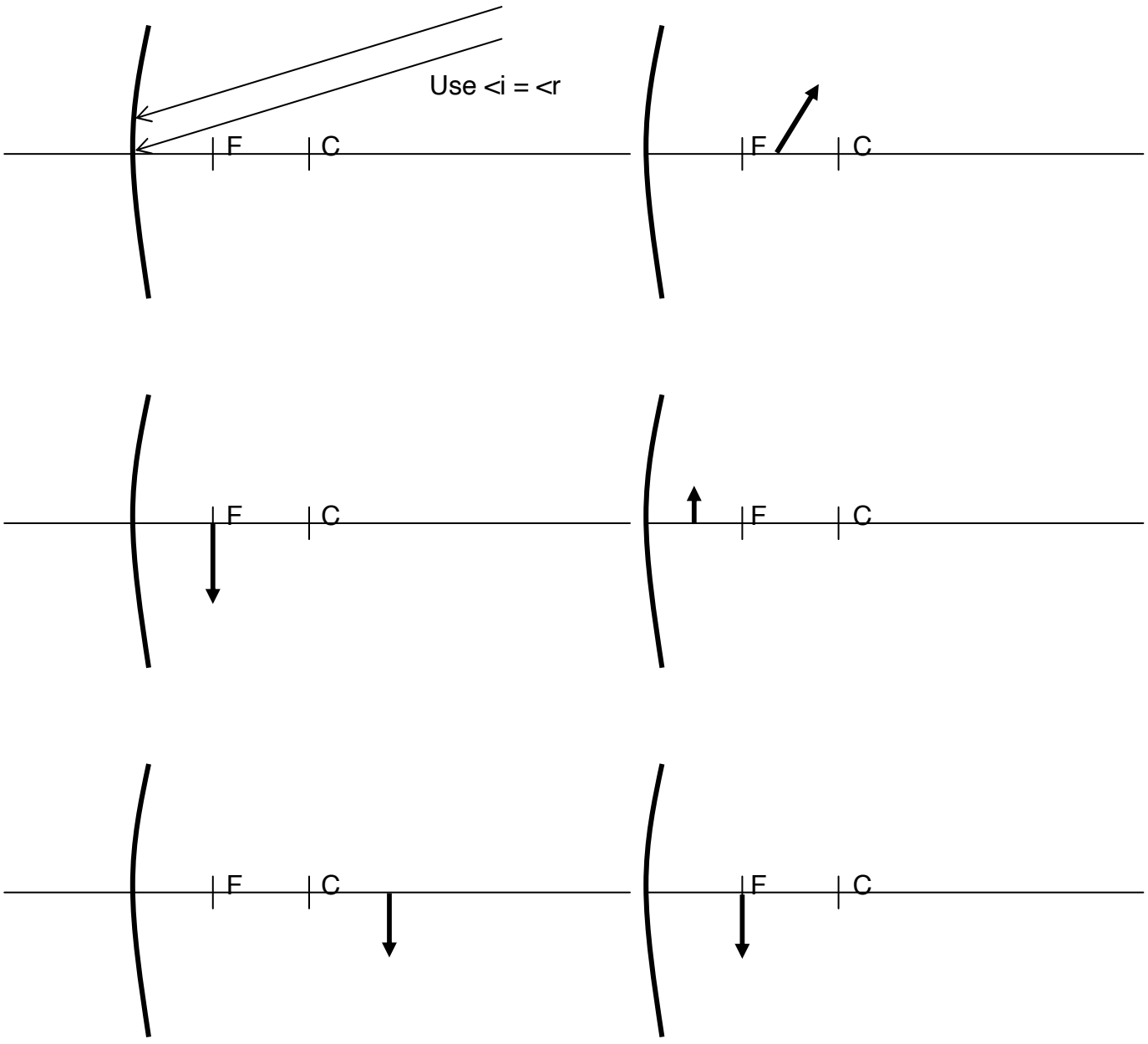








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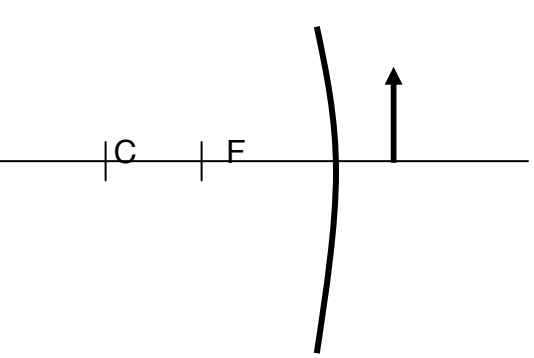
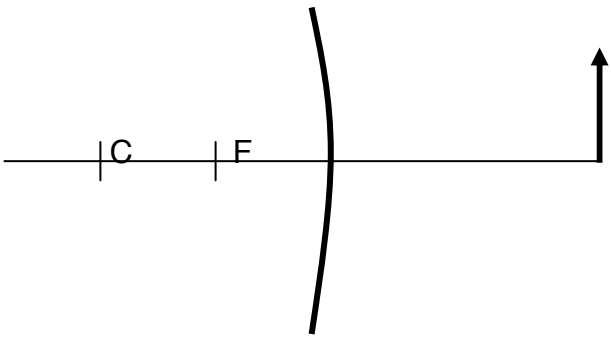
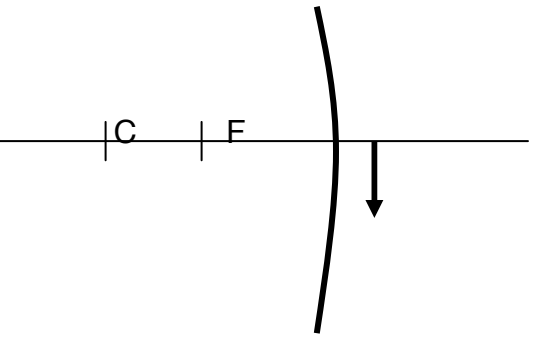
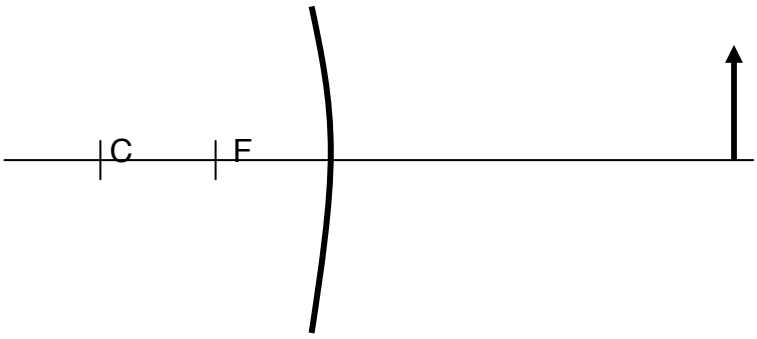
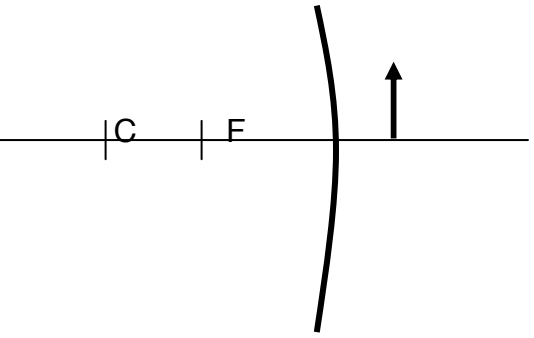
Convex Mirrors – Find the image and state the image characteristics.

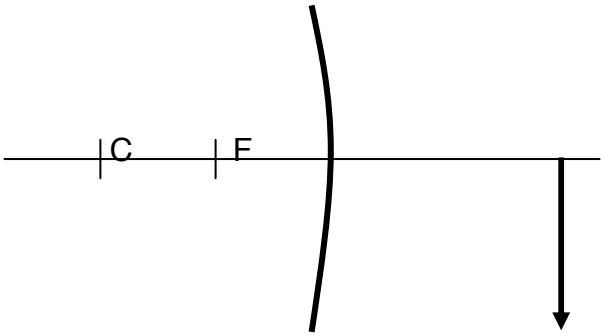












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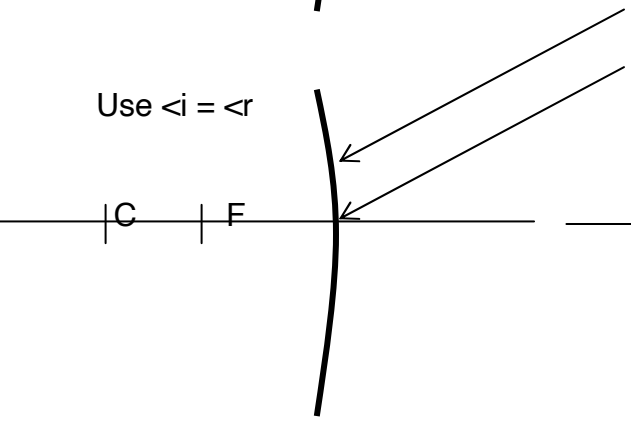
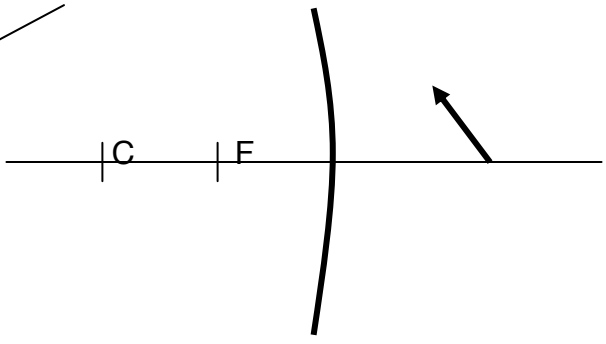




Drawing Ray Diagrams for Concave and Convex Mirrors

CONCAVE MIRRORS

1. Copy Figure 11.23(a) into your notebook.

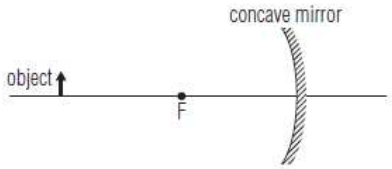


Figure 11.23(a) Draw the object and the mirror.

2. To determine where the image of the tip of the arrow will be, draw two rays. Draw the first ray parallel to the principal axis until it strikes the mirror and reflects through the focal point (Figure 11.23(b)).

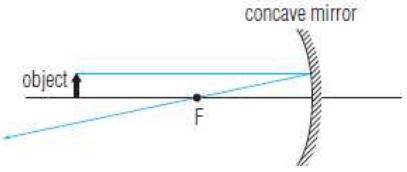


Figure 11.23(b) Draw the first ray.

3. Draw the second ray through the focal point until it strikes the mirror and reflects parallel to the principal axis (Figure 11.23(c)).

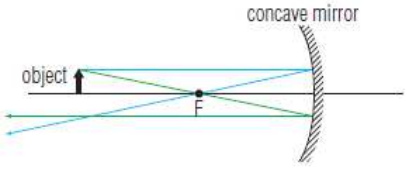


Figure 11.23(c) Draw the second ray.

4. These two rays intersect at only one location. This is where the image of the tip of the arrow is. Draw the inverted image (Figure 11.23(d)).

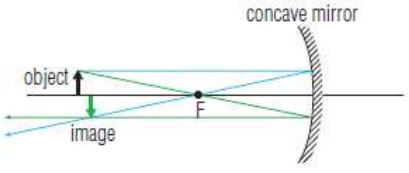
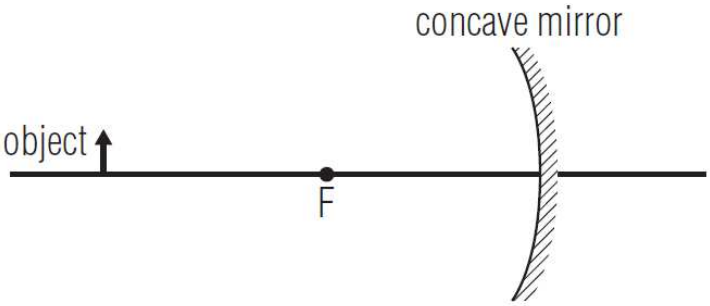
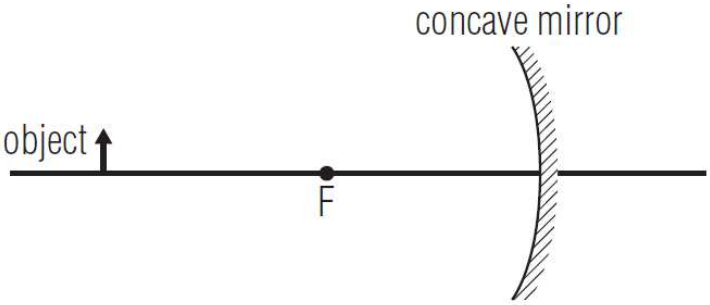
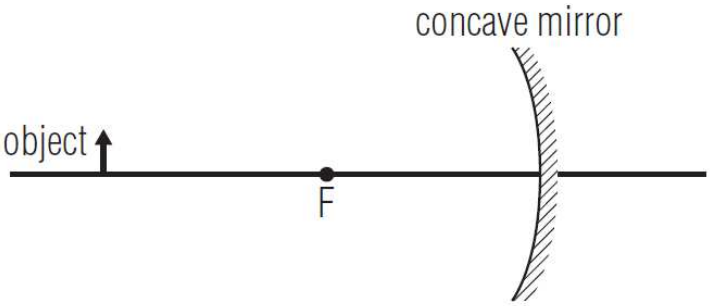


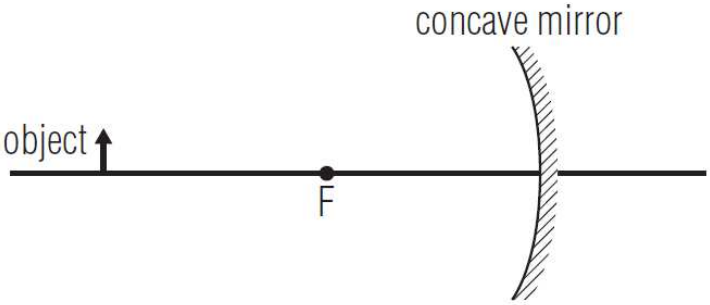
Figure 11.23(d) Draw the inverted real image.

5. Repeat the process for other parts of the object.









Drawing Ray Diagrams for Concave and Convex Mirrors

Convex Mirrors

1. Copy Figure 11.24(a) into your notebook.

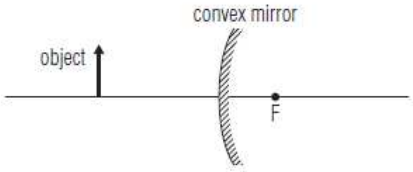


Figure 11.24(a) Draw the object and mirror.

2. Draw the first ray parallel to the principal axis until it strikes the mirror, where it reflects away in a line that appears to come from the focal point. Draw a dashed line from the point on the mirror where the ray strikes through the focal point (Figure 11.24(b)).

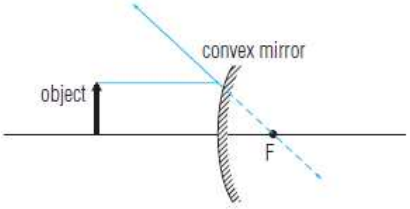


Figure 11.24(b) Draw the first ray.

3. Draw the second ray toward the mirror heading for the focal point until it strikes the mirror and reflects back parallel to the principal axis. Draw a dashed line through the mirror parallel to the principal axis until it intersects the first dashed line (Figure 11.24(c)).

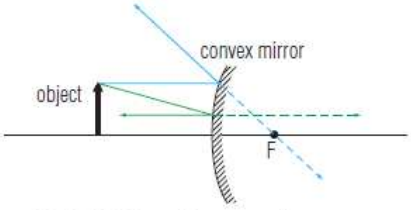


Figure 11.24(c) Draw the second ray.

4. The intersection of both dashed lines represents the virtual image of the tip of the arrow. The image for a convex mirror is always virtual, upright, and smaller.

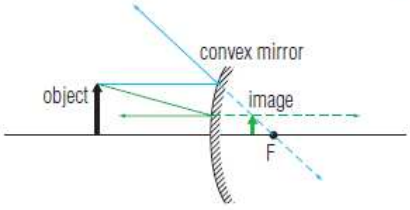


Figure 11.24(d) Draw the upright, virtual image.