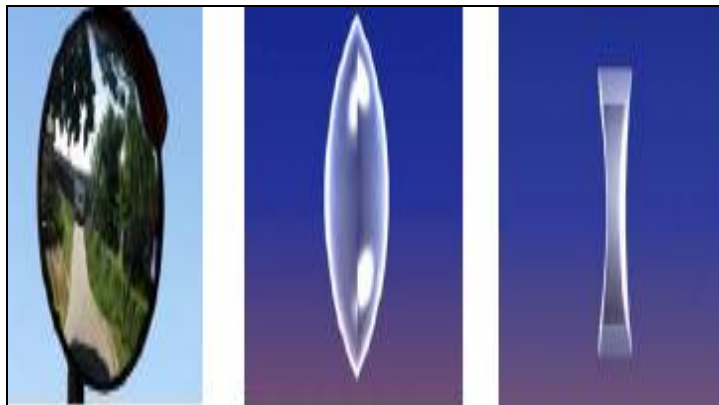


Kirkuk University

Science College

Physics Department

Lectures of
GEOMETRIC OPTICS
Lecture – 5 –



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GEOMETRIC OPTICS LECTURE (5)

Lecture 5 : Spherical Mirrors - Convex Mirror – Part (1)

5 - 1 The Anatomy of a Curved Mirror – Convex Mirror

5 - 2 Two Rules of Reflection - Convex Mirror

5 – 3 Ray Diagrams – Convex Mirror

5 - 1 The Anatomy of a Curved Mirror – Convex Mirror

- The Fig.(5-1) in the below depicts a convex mirror.

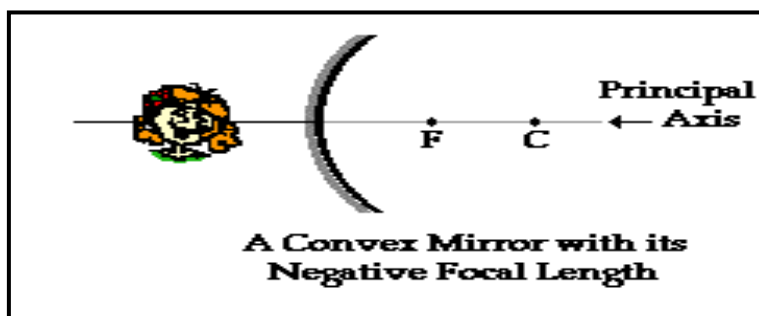


Fig.(5-1) : A Convex Mirror

- In Lecture 2, a convex mirror was described as a portion of a sphere that had been sliced away.
- If the outside of the sphere is silvered such that it can reflect light, then the mirror is said to be **convex**.
- The center of that original sphere is known as the center of curvature (**C**) and the line that passes from the mirror's surface through the sphere's center is known as the principal axis, as shown in Fig (5-1).
- The mirror has a focal point (**F**) that is located along the principal axis, midway between the mirror's surface and the center of curvature as shown in Fig (5-1).
- Note that the center of curvature and the focal point are located on the side of the mirror opposite the object - **behind the mirror**.
- Since the focal point is located behind the convex mirror, such a mirror is said to have a negative focal length value.

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- A convex mirror is sometimes referred to as a diverging mirror due to the fact that incident light originating from the same point and will reflect off the mirror surface and diverge.
- The Fig.(5-2) in the below shows four incident rays originating from a point and incident towards a convex mirror.

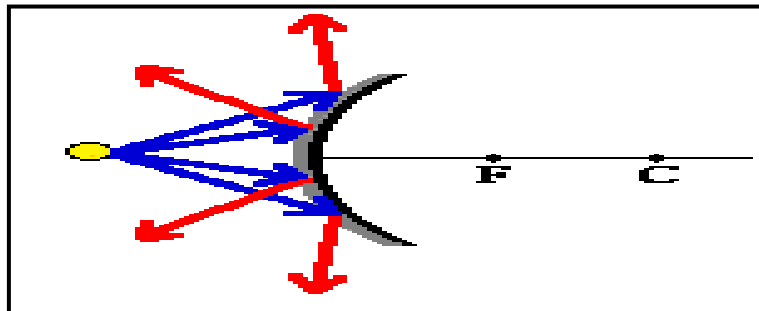


Fig.(5-2) : Four incident rays originating from a point and incident towards a convex mirror

- These four rays will each reflect according to the law of reflection.
- After reflection, the light rays diverge; subsequently they will never intersect on the object side of the mirror.
- For this reason, convex mirrors produce virtual images that are located somewhere behind the mirror.
- Thus, the task of determining the image location of an object is to determine the location where reflected light intersects.

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- The Fig.(5-3) below shows an object placed in front of a convex mirror.

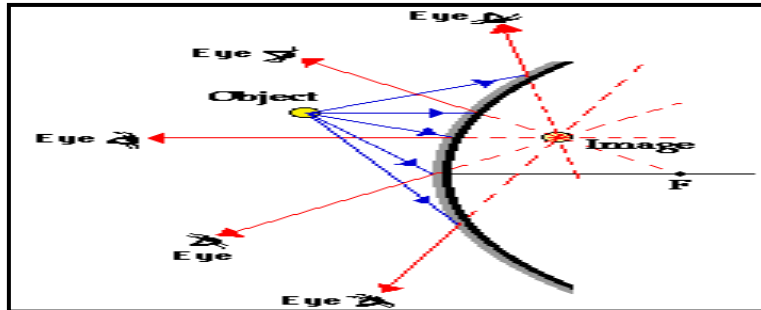


Fig.(5-3) : An object placed in front of a convex mirror

- Light rays originating at the object location are shown approaching and subsequently reflecting from the mirror surface.
- Each observer must sight along the line of a reflected ray to view the image of the object.
- Each ray is extended backwards to a point of intersection - this point of intersection of all extended reflected rays is the image location of the object.
- The image in the diagram above is a **virtual image**.

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5 - 2 Two Rules of Reflection - Convex Mirror

- Of course to determine the image location, only a pair of incident and reflected rays needs to be drawn.
- It is customary to select a pair of rays that is easy to draw.
- Of the five pairs of incident and reflected rays in the Fig.(5-3) above, two correspond to the rays that are customarily drawn.
- In fact, they may closely resemble the two rays that were used in concave mirror ray diagrams.
- Recall from Lecture 3 that there were two rules of ray reflection for **concave mirrors**.
- They are :-
 - 1) Any incident ray traveling parallel to the principal axis on the way to a concave mirror will pass through the focal point upon reflection.
 - 2) Any incident ray passing through the focal point on the way to a concave mirror will travel parallel to the principal axis upon reflection.

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- The revised rules for **convex mirrors** can be stated as follows :-
 - 1) Any incident ray traveling parallel to the principal axis on the way to a convex mirror will reflect in such a manner that its extension will pass through the focal point.
 - 2) Any incident ray traveling towards a convex mirror such that its extension passes through the focal point will reflect and travel parallel to the principal axis.
- In the Fig.(5-3) above, the second and third exemplify these two rules of reflection for convex mirrors.
- Using this pair of incident and reflected rays will greatly simplify the task of drawing ray diagrams and determining the location of images.
- In the next section of this Lecture, such ray diagrams will be shown.

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5 - 3 Ray Diagrams - Convex Mirror

- In the first section of Lecture 5, we learned that there are two simple rules of ray reflection for convex mirrors.
 - These two rules will be used to construct ray diagrams.
 - A ray diagram is a tool that is used to determine the location, size, orientation, and type of image formed by a mirror.
 - The method for constructing ray diagrams for convex mirrors shown in the following steps :-
1. Pick a point on the top of the object and draw two incident rays traveling towards the mirror, as shown in Fig (5-4).

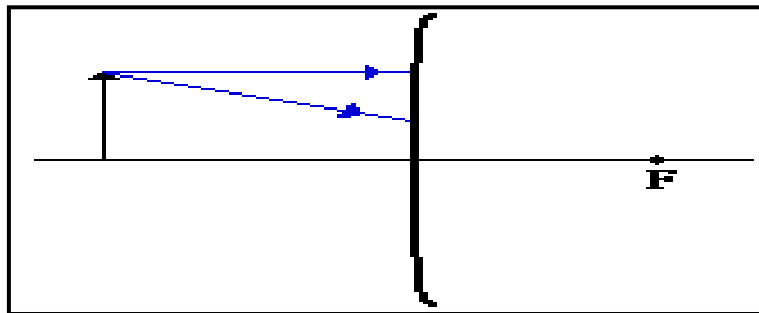


Fig.(5-4) : First step of the method of drawing ray diagrams for convex mirrors

2. Once these incident rays strike the mirror, reflect them according to the two rules of reflection for convex mirrors, as shown in Fig.(5-5).

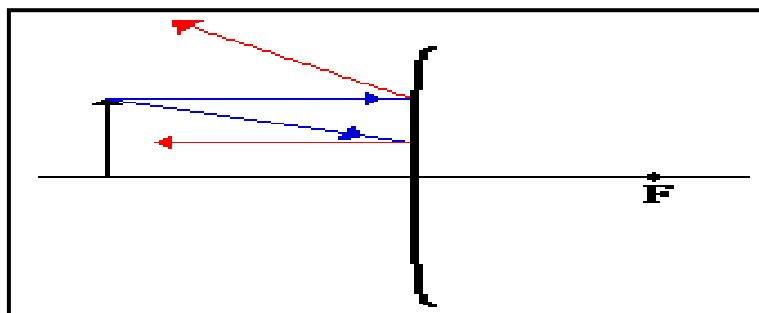


Fig.(5-5) : Second step of the method of drawing ray diagrams for convex mirrors

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3. Locate and mark the image of the top of the object.

- The image point of the top of the object is the point where the two extensions of reflected rays intersect, as shown in Fig.(5-6).

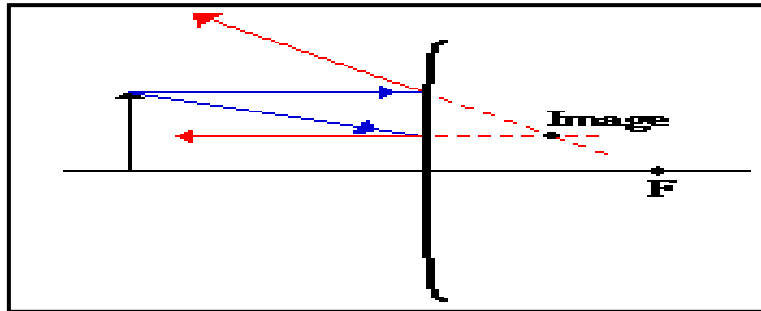


Fig.(5-6) : Third step of the method of drawing ray diagrams for convex mirrors

- The bottom of the object lies upon the principal axis, then the image of this point will also lie upon the principal axis and be the same distance from the mirror as the image of the top of the object, as shown in Fig (5-7) .
- At this point we can obtain the complete image.

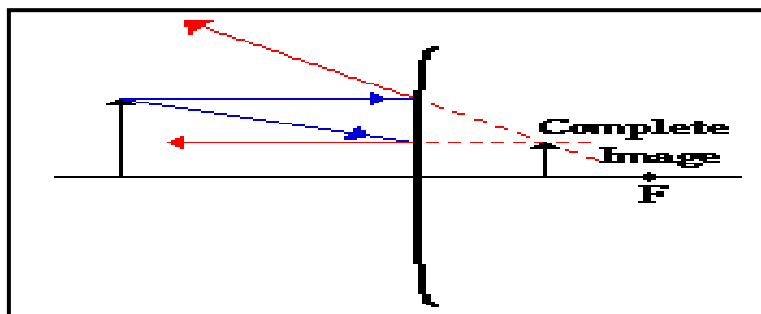


Fig.(5-7) : The complete image for convex mirrors

- The ray diagram for a convex mirror reveal that the image of the object was virtual, upright, reduced in size and located behind the mirror.