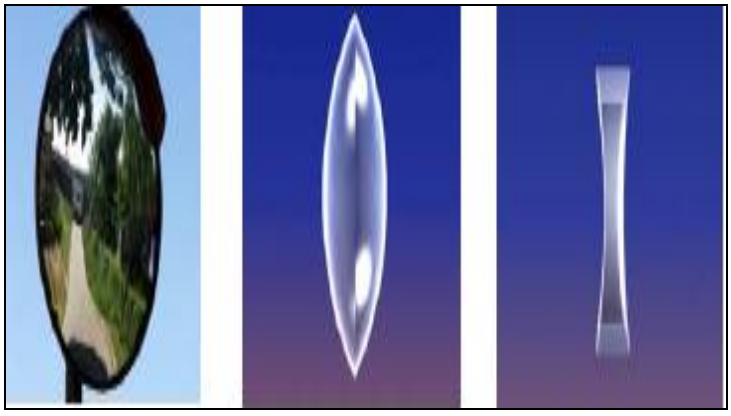
Kirkuk University

Science College

Physics Department

Lectures of GEOMETRIC OPTICS Lecture – 2 –



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Lecture 2: Spherical Mirrors - Concave Mirror-Part 1

2 - 1 The Anatomy of a Curved Mirror - Concave Mirror
2 - 2 Two Rules of Reflection - Concave Mirror
2 – 3 Image Characteristics - Concave Mirror

2 – 1 The Anatomy of a Curved Mirror – Concave Mirror

- We will turn our attention to the topic of curved mirrors, and specifically curved mirrors that have a *spherical* shape**.**
- Such mirrors are called **spherical mirrors.**
- The two types of spherical mirrors are shown in the Fig.(**2-1**) in the below**.**

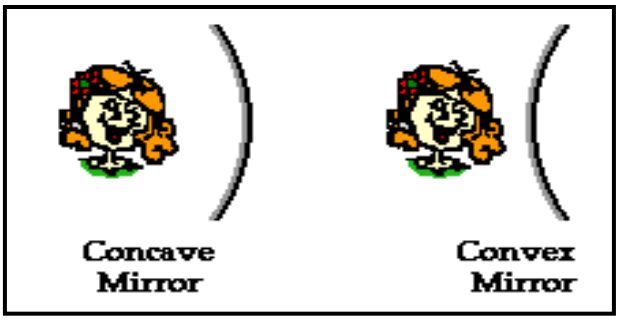


Fig.(2-1): The two types of spherical mirrors

- Spherical mirrors can be thought of as a portion of a sphere that was sliced away and then silvered on one of the sides to form a reflecting surface**.**
- **Concave mirrors** were silvered on the inside of the sphere and **convex mirrors** were silvered on the outside, as shown in Fig.(**2-1**) **.**
- Beginning a study of spherical mirrors demands that you first become acquainted with some terminology that will be periodically used**.**

Principal axis **Center of Curvature** **Vertex**

Focal Point **Radius of Curvature** **Focal Length**

- If a concave mirror were thought of as being a slice of a sphere, then there would be a line passing through the center of the sphere and attaching to the mirror in the exact center of the mirror**.**
- This line is known as the **principal axis** shown in the Fig.(**2-2**)**.**
- The point in the center of the sphere from which the mirror was sliced is known as the **center of curvature** and is denoted by the letter **C** as shown in the Fig.(**2-2**)**.**
- The point on the mirror's surface where the principal axis meets the mirror is known as the **vertex** and is denoted by the letter **A** as shown in the Fig.(**2-2**)**.**
- The vertex is the geometric center of the mirror**.**

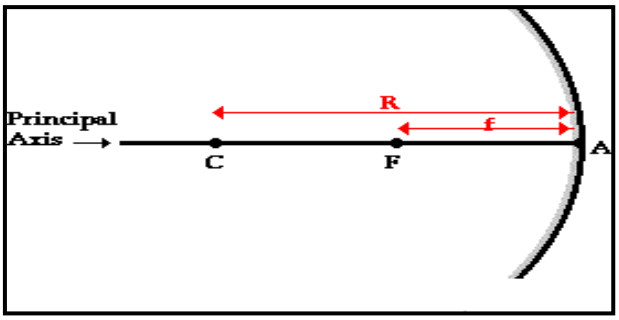


Fig.(2-2): Optical terminology of spherical mirror – concave mirror

- Midway between the vertex and the center of curvature is a point known as the **focal point**; the focal point is denoted by the letter **F** as shown in the Fig.(**2-2**)**.**

- The distance from the vertex to the center of curvature is known as the **radius of curvature** (represented by **R**) as shown in the Fig.(**2-2**)**.**
- The radius of curvature is the radius of the sphere from which the mirror was cut**.**
- Finally, the distance from the mirror to the focal point is known as the **focal length** (represented by **f**) as shown in the Fig.(**2-2**)**.**
- Since the focal point **F** is the midpoint of the line segment adjoining the vertex **A** and the center of curvature **C**, the focal length **f** would be one-half the radius of curvature **R**, as represented in Equ.(**2-1**)**.**

$$f = \frac{R}{2} \ldots (2-1)$$

- The focal point is the point at which light incident towards the mirror and traveling parallel to the principal axis will meet after reflection**.**
- Fig.(**2-3**) in the below depicts this principle**.**

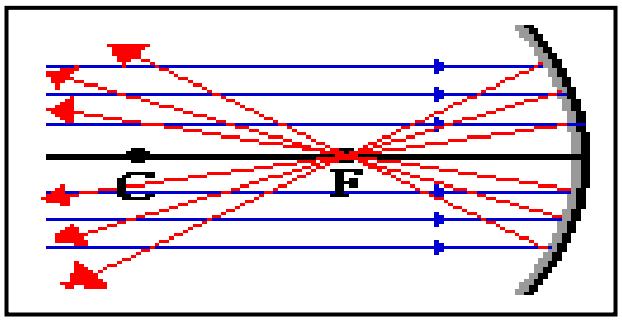


Fig.(2-3): The focal point

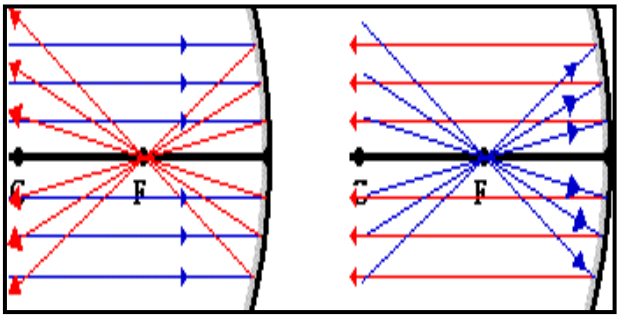
2 – 2 Two Rules of Reflection - Concave Mirror

- Light always reflects according to the **law of reflection**, regardless of whether the reflection occurs off a flat surface or a curved surface**.**
- Using reflection laws allows one to determine the image location for an object**.**
- To determine this location demands that you know how light reflects off a mirror**.**
- The image was location where all reflected rays intersected**.**
- The method of determining a reflected ray relies on two rules of reflection for concave mirrors**.**
- They are **:-**

1) Any incident ray traveling parallel to the principal axis on the way to the mirror will pass through the focal point upon reflection**.**

2) Any incident ray passing through the focal point on the way to the mirror will travel parallel to the principal axis upon reflection**.**

- These two rules of ray reflection are illustrated in the Fig.(**2-4**)**.**



(1) **(2)**

Fig.(2-4): Two rules of ray reflection for concave mirrors

- These two rules will greatly simplify the task of determining the image locations for objects placed in front of concave mirrors**.**
- These two rules will be applied to determine the location, orientation, size and type of image produced by a concave mirror**.**

2 – 3 Image Characteristics - Concave Mirror

- The purpose of this portion of the Lecture is to summarize the object-image relationships - to practice the **L•O•S•T** art of image description**.**
- We wish to describe the characteristics of the image for any given object location**.**
- The **L** of **L•O•S•T** represents the relative **location** (either in front **or** behind).
- The **O** of **L•O•S•T** represents the **orientation** (either upright **or** inverted)**.**
- The **S** of **L•O•S•T** represents the relative **size** (either magnified, reduced **or** the same size as the object)**.**
- The **T** of **L•O•S•T** represents the **type** of image (either real **or** virtual)**.**
- The best means of summarizing this relationship between object location and image characteristics is to divide the possible object locations into five general areas or points , as shown in Fig.(**2-5**)**:**

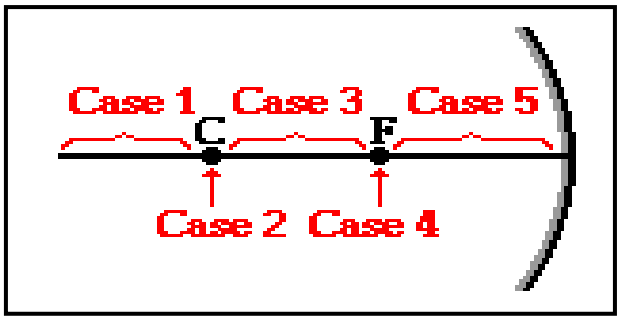


Fig. (2-5): Five general areas or points of possible object locations in front of concave mirror

- In the next lecture, ray diagrams were construct in order to determine the location, size, orientation, and type of image formed by concave mirrors**.**