CONCAVE MIRRORS

Section 10.3 (p.419 – 430)
Learning Goals

• I can draw ray diagrams for concave and convex mirrors.
CONCAVE MIRRORS

A concave mirror is a mirror where the reflecting surface curves inward.
The following are terms that you must know:

- light-ray
- reflecting surface
- principal axis
- C
- F
- V
- f
- R
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**Principle Axis** - The line that passes through the centre of curvature. It is also normal to the centre of the mirror.
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**Centre of Curvature (C)** - The point where all normals meet.
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**Centre of Curvature (C)** - The point where all normals meet.

**Vertex (V)** - The point where the principal axis cuts the centre of the mirror.
The following are terms that you must know:

**Principle Axis** - The line that passes through the centre of curvature. It is also normal to the centre of the mirror.

**Centre of Curvature (C)** - The point where all normals meet.

**Vertex (V)** - The point where the principal axis cuts the centre of the mirror.

**Focal Point (F)** - When incident rays are near and parallel to the principal axis, their reflected rays all pass through the same point on the principal axis. This point is called the focal point.

**DEMO:** [YouTube - FieryPencil.MP4](https://www.youtube.com/watch?v=FieryPencil.MP4)
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**Vertex (V)** - The point where the principal axis cuts the centre of the mirror.

**Focal Point (F)** - When incident rays are near and parallel to the principal axis, their reflected rays all pass through the same point on the principal axis. This point is called the focal point.

**Focal Length (f)** - This is the distance between the vertex and the focal point.
The following are terms that you must know:

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**Centre of Curvature (C)** - The point where all normals meet.

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**Focal Point (F)** - When incident rays are near and parallel to the principal axis, their reflected rays all pass through the same point on the principal axis. This point is called the focal point.

**Focal Length (f)** - This is the distance between the vertex and the focal point.

**Radius of Curvature (R)** - This is the distance from the vertex to the centre of curvature.
Drawing Ray Diagrams for Concave Mirrors

Points to remember when drawing ray diagrams involving concave mirrors:

1. When an incident ray travels parallel to the principal axis, it is reflected through the focal point (F).
Drawing Ray Diagrams for Concave Mirrors

2. When an incident ray passes through the focal point (F), the reflected ray is parallel to the principle axis.
3. When an incident ray passes through the centre of curvature (C), it is reflected back onto itself.

\[ \angle i = \angle r = 0 \]
Drawing Ray Diagrams for Concave Mirrors

4. When an incident ray strikes the vertex (V), the principal axis is its normal.
Characteristics of Images in Concave Mirrors

Images in concave mirrors can be very different, depending on where the object is located relative to the focal point (F).

See Lesson Worksheet: Locating images in concave mirrors
Locating Images in Concave Mirrors

Any object can be placed in one of three regions:

a) Beyond C
b) Between C and F
c) Between F and V
Instructions:
Draw ray diagrams to locate the image when the object is in each of the three locations listed above. Observe your image and identify the four characteristics of each image (Location, Orientation, Size, and Type)
Part A

Object location: beyond C
Part A

Object location: **beyond C**
Part A

Object location: **beyond C**

1. Parallel to mirror – reflect through F
Part A

Object location: **beyond C**

1. Incident ray parallel to principal axis – reflected ray goes through F
Part A

Object location: beyond C

1. Incident ray parallel to principal axis – reflected ray goes through F

2. Incident ray goes through F – reflected ray is parallel to principle axis
Part A

Object location: **beyond C**

1. Incident ray parallel to principal axis – reflected ray goes through F

2. Incident ray goes through F – reflected ray is parallel to principle axis
Part A

Object location: **beyond C**

**Conclusion:** When the object is beyond the centre of curvature, the image is:

i)  **L** – between C and F

ii) **O** – inverted

iii) **S** – smaller than object

iv) **T** – real image

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1. Incident ray parallel to principal axis – reflected ray goes through F

2. Incident ray goes through F – reflected ray is parallel to principle axis

3. Incident ray goes through C – reflected ray goes back through C
**Part B**

Object location: between C & F

**Conclusion:** When the object is between the centre of curvature and the focal point, the image is:

i) L – beyond C  
ii) O – inverted  
iii) S – larger than object  
iv) T – real image
Part C: Object location: between F and V

Conclusion: When the object is between the vertex and the focal point, the image is:

i) L – behind mirror
ii) O – upright
iii) S – larger than object
iv) T – virtual image
## Summary:

- **C**
- **F**
- **V**

<table>
<thead>
<tr>
<th>OBJECT LOCATION</th>
<th>IMAGE</th>
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<tbody>
<tr>
<td><strong>LOCATION</strong></td>
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<td>3. Between C &amp; F</td>
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#### Diagram:

- **C**: Source
- **F**: Image
- **V**: Image

1. An object is beyond C, it is in front, inverted, and smaller, and the image is real.
2. An object is exactly at C, but no information is provided for orientation, size, or type.
3. An object is between C & F, but no information is provided for location, orientation, size, or type.
4. An object is exactly at F, no information is provided for location, orientation, or size, and the type is real.
5. An object is between F & V, no information is provided for location, orientation, size, or type.

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Object at Centre of Curvature - lightbulb

Source: www.physicsclassroom.com
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CONVEX MIRRORS

A convex mirror is a mirror where the reflecting surface curves outward.
Locating Images in Convex Mirrors

In a convex mirror, the focal point and centre of curvature are on the opposite side of where the object is placed. Therefore, we have only one region to place the object and the images will all have the same characteristics.
Instructions: Complete the ray diagrams for the two object locations shown below and then characterize the image that is produced (remember it should be the same for both).
Conclusion: Any image produced by a **convex** mirror will be:

i) **L** – behind the mirror

ii) **O** – upright

iii) **S** – smaller than object

iv) **T** – virtual image
Success Criteria

• I have completed the practice questions.