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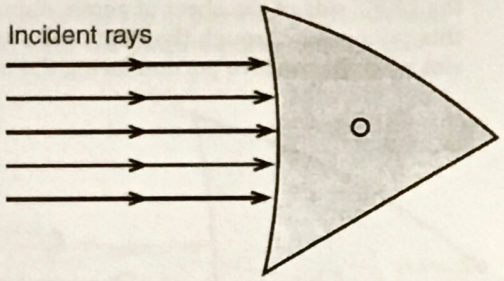
LAB 17. RAY OPTICS: SPHERICAL MIRRORS

AP PHYSICS II

Driving Question | Objective

How are cylindrical mirrors similar or different to plane mirrors? How does the focal point of a cylindrical mirror compare to the focal point of that mirror?

You are going to compare the general behavior differences and similarities between plane an spherical mirrors in the goal of determining a strategy to locate the image of an object.



Design and Conduct Your Experiment

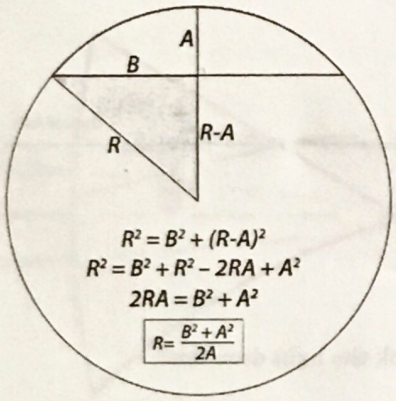
It is your group's responsibility to design and conduct an experiment whose data will support your answer to the driving question above. Use the Arc-Radius Theorem to determine the radius of curvature for each mirror before beginning.

Materials and Equipment

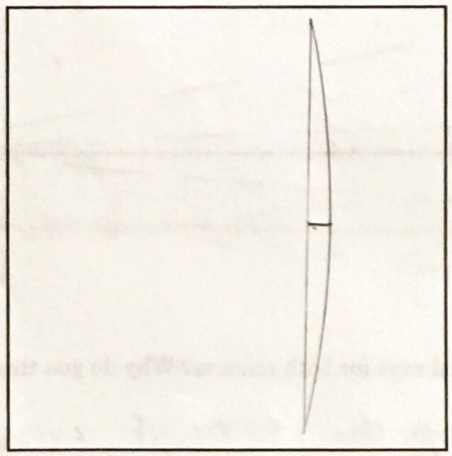
- Light Source (Ray Side)
- 3 Side Mirror
- Metric Ruler

Experimental Design Pt. 1 – Determining Radius of Curvature

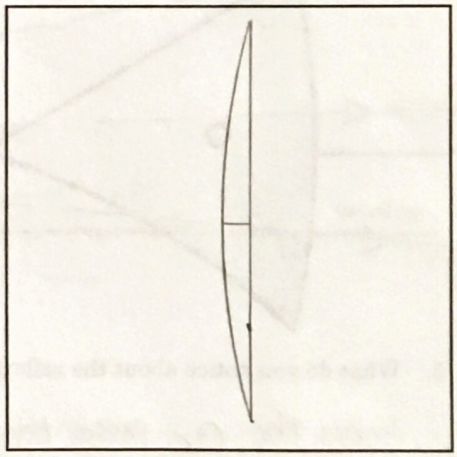
1. You will first need to determine the radius of curvature of both the concave and convex mirrors. Use the space below to trace the concave and convex portions of your mirror. Measure the A and B values with the ruler and use the Arc-Radius Theorem to determine the radius of each side of the mirror.



Convex Mirror



Concave Mirror



2. Record the radius of curvature for each mirror in the table below for future reference.

Table 1

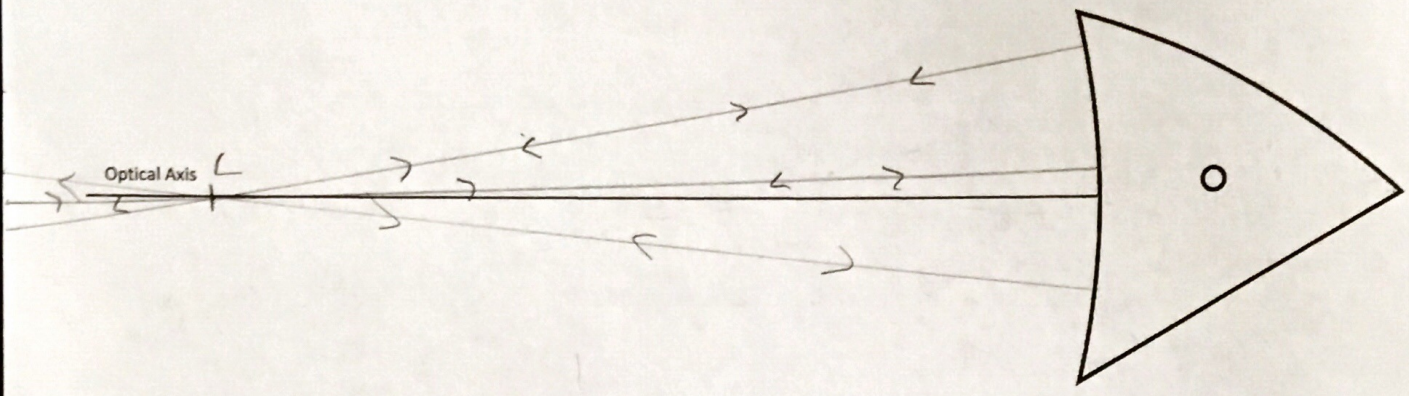
Convex Mirror Radius (cm)	130.3214
Concave Mirror Radius (cm)	130.3214

3. Just like with our lenses, we will be testing the behaviors of 3 different special incident rays to generate rules and methods to determine image locations and sizes.

Experimental Design Pt. 2 – Incident Rays Aimed at Center of Curvatures

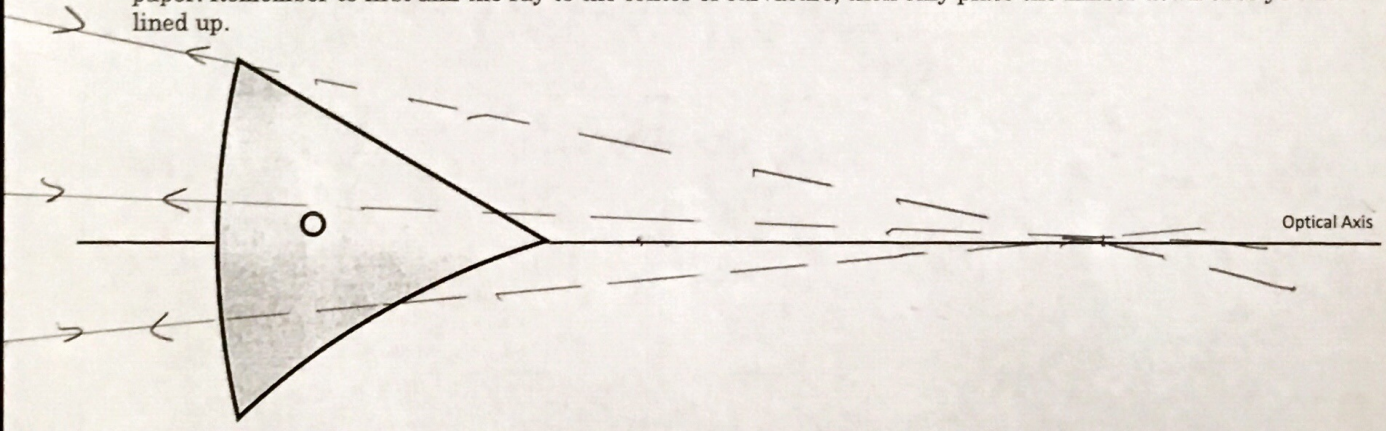
1. Before we start, first indicate, on each figure below, where the Center of Curvature is located along the Optical Axis. Label this point with a *"C"* for *"Center."*

2. Do not set your mirror on the slot yet. First, set your Light Source to display 1 ray. While the light source is on the LEFT side of the sheet of paper, shine the incident ray to the right, **not parallel** to the Optical Axis. Assure this ray passes through the Center of Curvature. Once you are lined up appropriately, place the mirror in the slot with the concave portion facing the incident rays. Observe and trace the incident and reflected rays.



3. Do this with at least 3 different rays to confirm your results.

4. Try the same thing with the Concave Mirror, assuring that the Light Source is still on the LEFT side of your paper. Remember to first aim the ray to the center of curvature, then only place the mirror down once you are lined up.



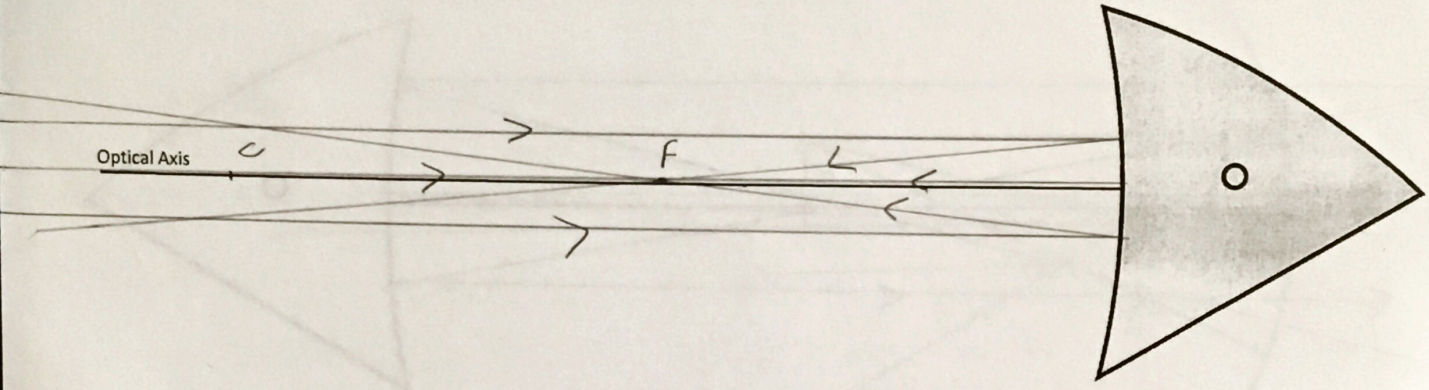
5. What do you notice about the reflected rays for both mirrors? Why do you think the light does this?

When the ray passes through the center of curvature, the ray will reflect back at 180°

Experimental Design Pt. 3 – Incident Rays Parallel to the Optical Axis

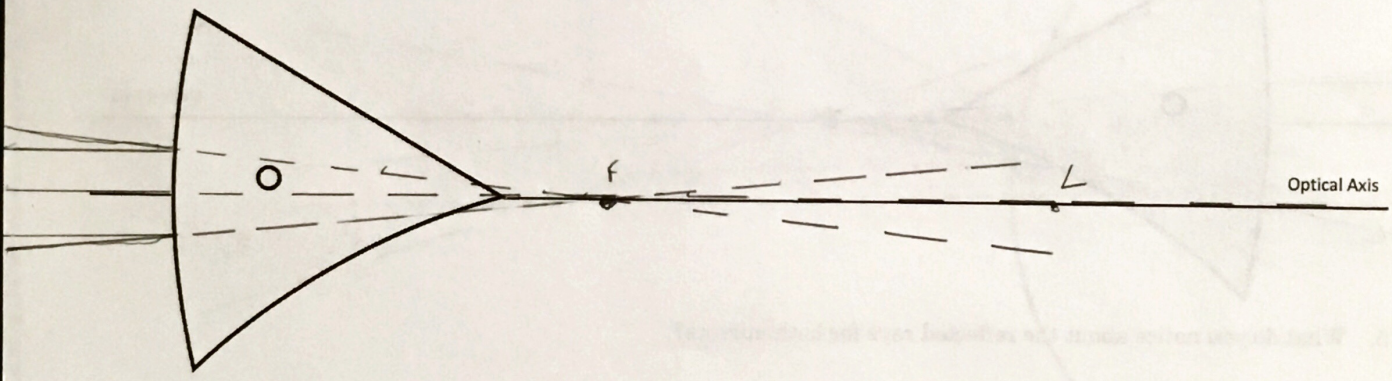
1. Before we start, first indicate, on each figure below, where the Center of Curvature is located along the Optical Axis. Label this point with a *"C"* for *"Center."*

2. Do not set your mirror on the slot yet. First, set your Light Source to display 3 parallel rays. While the light source is on the LEFT side of the sheet of paper, shine the incident rays to the right, **parallel** to the Optical Axis. Once you are lined up appropriately, place the mirror in the slot with the concave portion facing the incident rays. Trace the incident and reflected rays with solid lines.



3. Do the reflected rays (real or virtual) intersect as some point along the Optical Axis, forming a Focal Point similar to a lens? If so, mark along the Optical Axis where this point occurs.

4. Let's not try the same thing with a convex mirror. Before you place the mirror down, assure the light source is still on the LEFT side of the paper and shine 3 incident rays to the right, parallel to the Optical Axis. Once you are lined up, place the mirror in the slot and observe/trace the reflected rays.



5. Do the reflected rays (real or virtual) intersect as some point along the Optical Axis, forming a Focal Point similar to a lens? If so, mark along the Optical Axis where this point occurs.

6. Record the Focal Length of each mirror in Table 2 below.

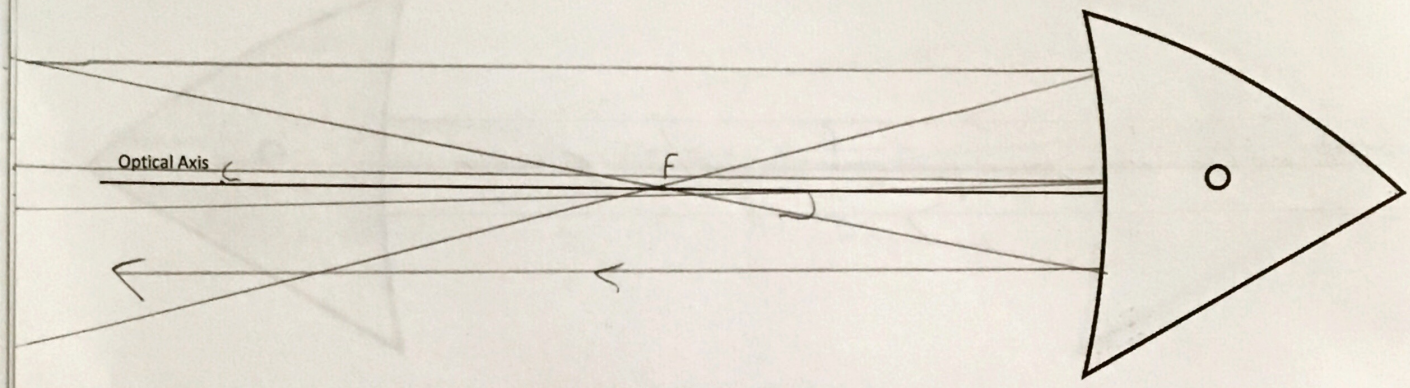
Table 2

Convex Mirror Focal Length (cm)	65.15 mm
Concave Mirror Focal Length (cm)	65.15 cm

Experimental Design Pt. 4 – Incident Rays Aimed at Focal Points

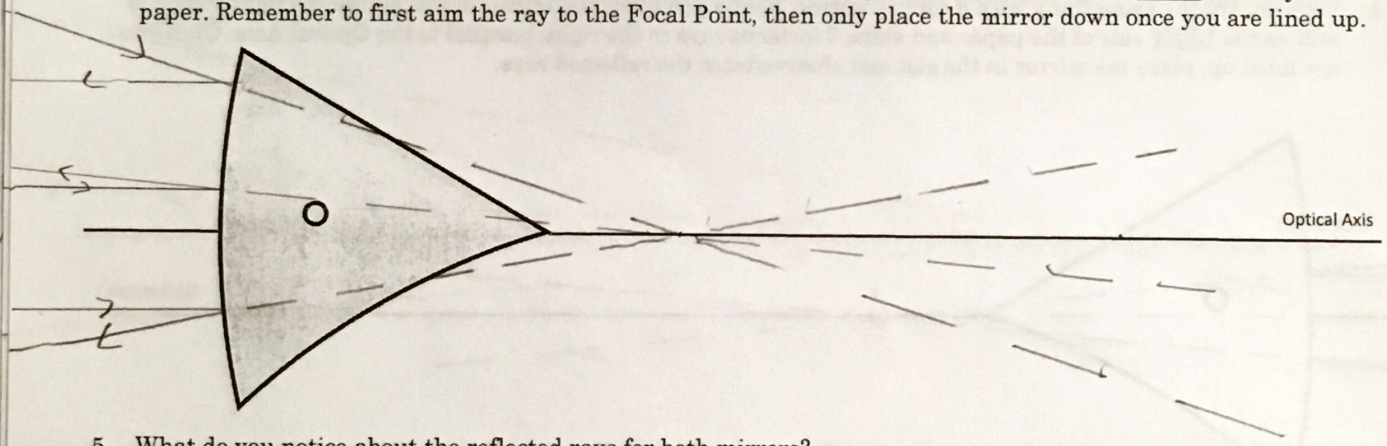
1. Before we start, first indicate, on each figure below, where the Center of Curvature is located along the Optical Axis. Label this point with a *"C"* for *"Center."* Also indicate where your Focal Point is located and label it with an *"F"* for *"Focal Point."*

2. Do not set your mirror on the slot yet. First, set your Light Source to display 1 ray. While the light source is on the LEFT side of the sheet of paper, shine the incident ray to the right, **not parallel** to the Optical Axis. Assure this ray passes through the Focal Point. Once you are lined up appropriately, place the mirror in the slot with the concave portion facing the incident rays. Observe and trace the incident and reflected rays.



3. Do this with at least 3 different rays to confirm your results.

4. Try the same thing with the Concave Mirror, assuring that the Light Source is still on the LEFT side of your paper. Remember to first aim the ray to the Focal Point, then only place the mirror down once you are lined up.



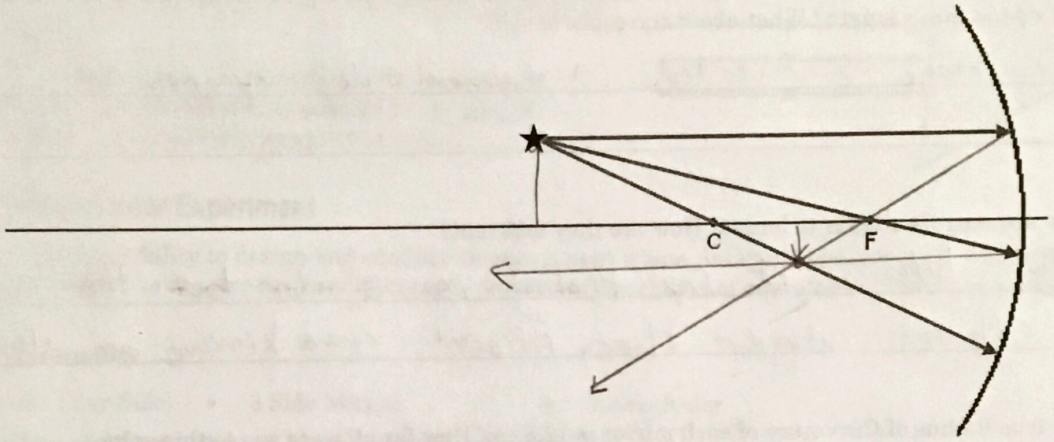
5. What do you notice about the reflected rays for both mirrors?

Putting it Together

1. It is time to apply what we have learned about the 3 special incident rays for convex mirrors.

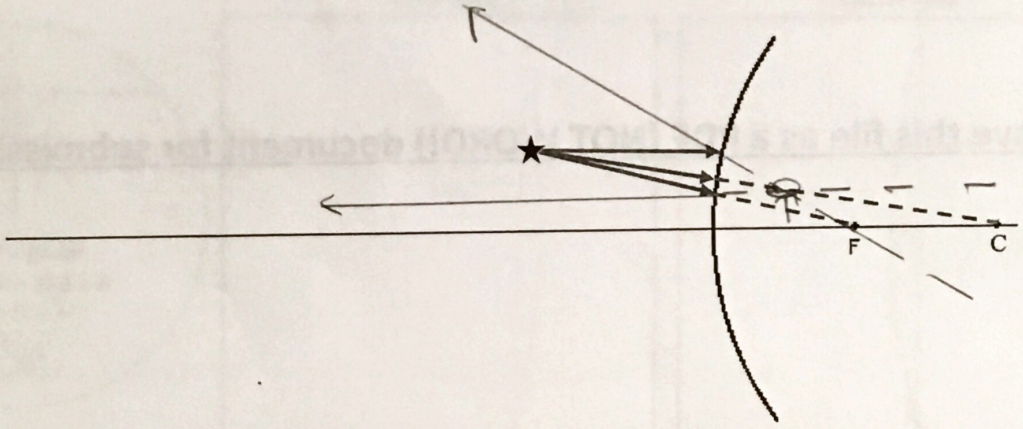
2. On the diagrams below, use what you have learned about the reflected ray of our 3 special incident rays. Attempt to locate the image formed by each mirror and mark the location with an "I" for "Image."

Concave Mirror



3. Describe this image. Real/Virtual, Upright/Inverted, Magnified/Minified?

Convex Mirror



4. Describe this image. Real/Virtual, Upright/Inverted, Magnified/Minified?

Post-Lab Questions

1. How does a Convex/Concave mirror's Focal Length compare to its Radius of Curvature?

Focal length is 1/2 of center of curvature

2. Whenever you look into a metal spoon, what do you notice happens to your image when you are looking at the convex side at arm's length? What about the concave side?

the image is inverted in Convex side, upright on Concave

3. How are mirrors similar to lenses? How are they different?

the behavior of ray tracing is similar, but the rays are reflected rather than refracted. Convex & Concave are also swapped

4. The true Radius of Curvature of each mirror is 12.5 cm. How far off were you to this value?

0.5 cm

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