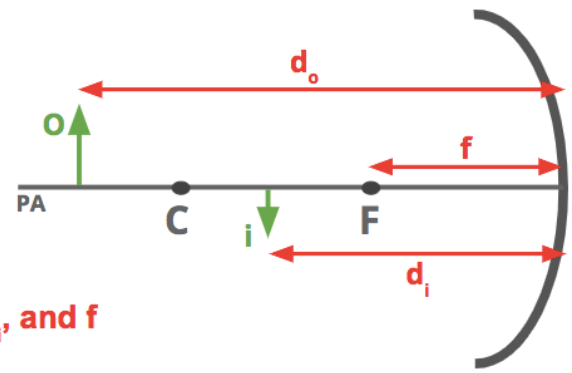
Mathematics of Curved Mirrors
Lesson Notes

Learning Outcomes
- How can the mirror equation be used to solve Physics word problems?
- What is meant by **magnification** (**M**) and how can the M ratio be used in solving Physics word problems?

The Mirror Equation

The mathematical relationship between object distance (d_o), image distance (d_i) and focal length (f) is given by the equation:

$$1/d_o + 1/d_i = 1/f$$



Sign Conventions for Variables d_o, d_i, and f

d_o is always a + value

d_i is + for real images and - for virtual images

f is + for concave mirrors and - for convex mirrors.

Effective Problem-Solving Strategy
1. Read problem carefully.
2. ID given values; relate to variable symbols.
3. ID unknown variable.
4. ID the physics formula.
5. Substitute and solve algebraically.

Magnification
The **magnification (M)** of the image refers to how many times larger that the image is than the object: $M = h_i/h_o$
where h_i = image height and h_o refers to object height.

The ratio of heights equals the ratio of distances: $h_i/h_o = - d_i/d_o$

Sign Conventions for Variables d_o, d_i, h_o, h_i, and f
d_o is always a + value
h_o is always a + value
d_i is + for real images and - for virtual images
h_i is - for inverted (real) and + for upright (virtual) images
f is + for concave mirrors and - for convex mirrors.

Example 1

Determine the image distance for a light bulb placed 45.0 cm from a concave mirror having a focal length of 15.0 cm.

Givens:
Unknown(s):
Formula(s):
Algebra/Solution:

Example 2

Determine the focal length of a convex mirror that produces an image that is 16.0 cm behind the mirror when the object is 28.5 cm from the mirror.

Givens:
Unknown(s):
Formula(s):
Algebra/Solution:

Example 3

A concave mirror with a focal length of 32.0 cm produces a 6.2-cm tall, upright image when the object is 18.8 cm from the mirror. Determine the object height and the image distance.

Givens:
Unknown(s):
Formula(s):
Algebra/Solution:

Example 4

The focal point is 22.5 cm from a convex mirror. A 5.0-cm tall light bulb is placed 48.1 cm from its surface. Determine the image distance and image height.

Givens:
Unknown(s):
Formula(s):
Algebra/Solution: