Light and Convex Mirrors

by

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P4.8 Wave Behavior — Reflection and Refraction

The laws of reflection and refraction describe the relationships between incident and reflected/refracted waves.

P4.8A Draw ray diagrams to indicate how light reflects off objects or refracts into transparent media.

P4.8B Predict the path of reflected light from flat, curved, or rough surfaces (e.g., flat and curved mirrors, painted walls, paper).

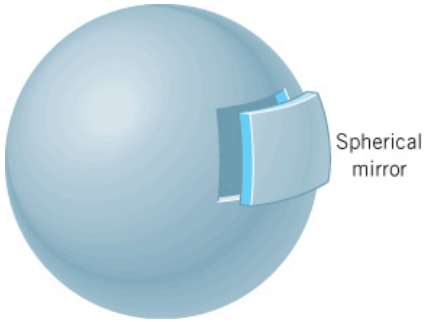
P4.9B Explain how various materials reflect, absorb, or transmit light in different ways.

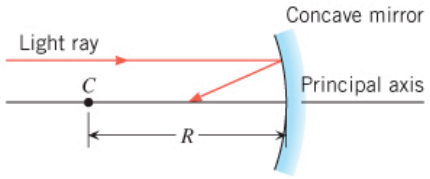
Items;

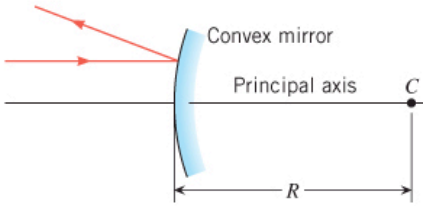
1- Convex Mirror

2- Ray Tracing and Images in Convex Mirror

A curved mirror may be thought of as a section of a hollow sphere.







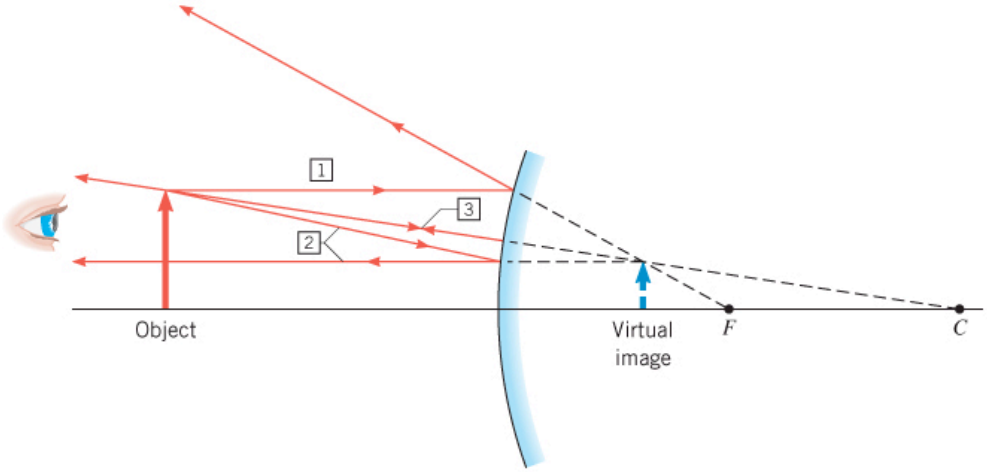
If the outside of the sphere is polished to reflect light, the resulting mirror has a convex shape and makes parallel light rays diverge. Hence the term convex (diverging) mirror (first picture on the right).

In a convex mirror, the center of curvature (C) and the principal focus (F) are virtual because they are located behind the mirror.

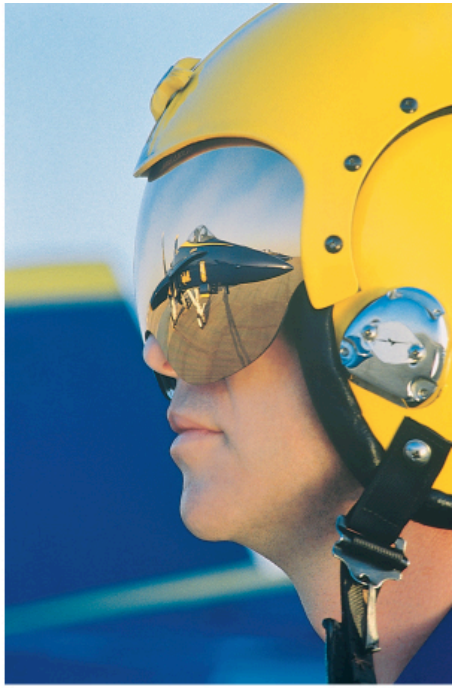
R is the radius of curvature of the mirror. The principal axis of the mirror is a straight line drawn through the center of curvature C and the midpoint of the mirror.

The rules for rays in diverging mirrors are similar to the rules for rays in converging mirrors.

For convex mirrors the image of an object is always virtual, upright, and reduced in size.

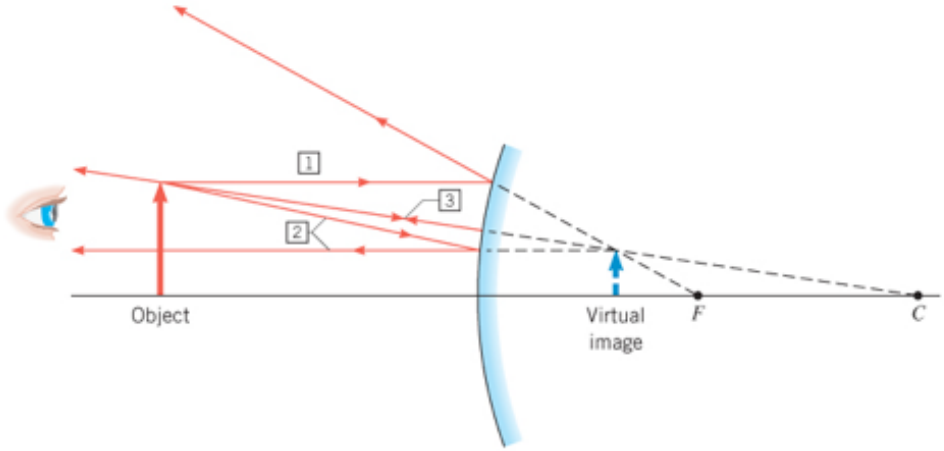


(a)



(b)

RAY TRACING AND IMAGES IN A CONVEX MIRROR



The top point on the object (red up arrow) emits the following rays:

Ray 1 is initially parallel to the principal axis and reflects from the mirror. The reflected ray appears to originate from the focal point (F), as shown when tracing its path with a dotted line behind the mirror.

Ray 2 heads towards the focal point (F), emerging parallel to the principal axis after reflection. Its path is traced with a dotted line behind the mirror.

Ray 3 travels toward the center of curvature (C) and reflects back on itself. Its path is also traced with a dotted line behind the mirror.

All three rays intersect behind the mirror to form the top point of a virtual image (blue up arrow).

Summary;

The reflected rays that enter the eye do not intersect in front of the mirror, but appear to originate at a point behind the mirror. The image can be located behind the mirror by extending the reflected ray backward as dotted lines. The extended rays intersect at the image. Therefore, the image formed is virtual. This virtual image can not be projected onto a screen.

For convex mirrors the image of an object is always virtual, upright, and reduced in size.

By forming smaller images, convex mirrors make images seem farther away and produce a wide field of view.

Example 1: *Passenger-side rearview mirrors: Convex Mirrors Application;*

Convex mirrors often are used in cars as passenger-side rearview mirrors. The outside rearview mirrors of cars often carry the warning “Objects in the mirror are closer than they appear.”

By forming smaller images, convex mirrors make images seem farther away. Therefore, they produce a wide field of view that an observer can sees from a wide perspective.

Example 2: *Security Purposes: Convex Mirrors Application;*

Convex mirrors are also used for security purposes. A convex mirror is commonly used in stores to monitor customers and discourage shoplifting.

References:

1) Humanic. (2013). www.physics.ohio-state.edu/~humanic/. In Thomas Humanic Brochure Page.

Physics 1200 Lecture Slides: Dr. Thomas Humanic, Professor of Physics, Ohio State University, *2013-2014 and Current.* *www.physics.ohio-state.edu/~humanic/*

2) Cutnell, J. D. & Johnson, K. W. (1998). *Cutnell & Johnson Physics, Fourth Edition*. New York: John Wiley & Sons, Inc.

The edition was dedicated to the memory of Stella Kupferberg, Director of the Photo Department:"We miss you, Stella, and shall always remember that a well-chosen photograph should speak for itself, without the need for a lengthy explanation"

3) Martindale, D. G. & Heath, R. W. & Konrad, W. W. & Macnaughton, R. R. & Carle, M. A. (1992). *Heath Physics.* Lexington: D.C. Heath and Company

4) Zitzewitz, P. W. (1999). *Glencoe Physics Principles and Problems*. New York: McGraw-Hill Companies, Inc.

5) Schnick, W.J. (n.d.). *Calculus-based physics, A Free Physics Textbook*. Retrieved from http://www.anselm.edu/internet/physics/cbphysics/index.html

6) Nada H. Saab (Saab-Ismail), (2009- 2014) Wayne RESA, Bilingual Department, Detroit, Michigan, U.S.A.