PHYSICS 534

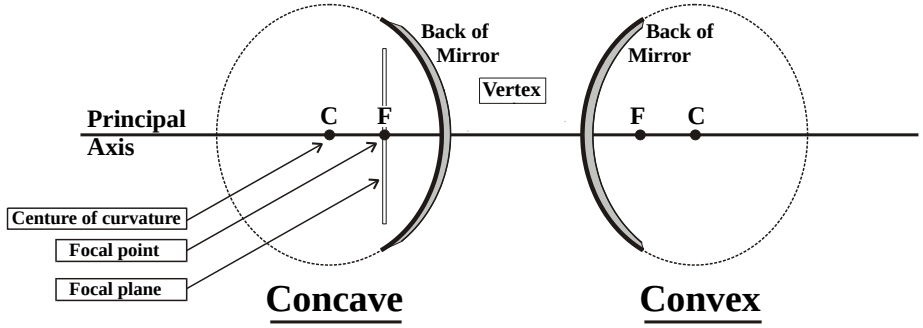
ANSWERS

EX E-48 Curved Mirrors Part-1 /2

PAULI

Wolfgang Pauli was awarded the Nobel prize for physics in 1945 for his discovery of the exclusion principle.

Parabolic Mirrors



RULES FOR DRAWING RAYS IN CURVED MIRRORS

① A ray that is parallel to the principal axis is reflected through the principal focus (F).
② A ray passing through the principal focus (F) is reflected parallel to the principal axis.
③ A ray passing through the center of curvature (C) is reflected back along its own path.

Note that images have properties called "characteristics". The characteristics include:

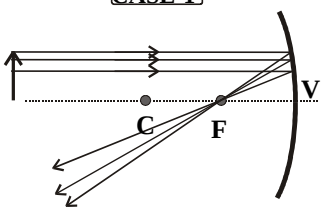
① Location of image (behind mirror or in front of mirror)
② Size of image (larger or smaller than object)
③ Inversion (whether the image is inverted or upright)
④ Reversed (whether the image is reversed left-to-right, "mirror image")

● CONCAVE MIRRORS

The characteristics of an image formed by a ***concave*** mirror depend on the location of the object. As it turns out, there are six "strategic" locations where an object may be placed. For each location, the image will be formed at a different place and with different characteristics.

We will illustrate the six different locations and label them as **CASE-1** to **CASE-6**.

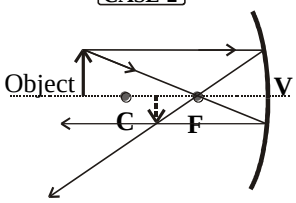
CASE-1



➲ **CASE-1** Object is at infinity.

Due to the great distance the object is from the mirror, all rays arrive at the mirror parallel to the principal axis. As a result, all rays focus at the focal point and no image is formed.

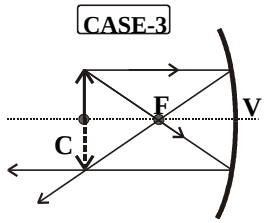
CASE-2



➲ **CASE-2** Object just beyond C.

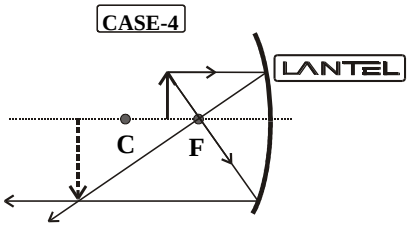
Image is between C and F, real, inverted and smaller than object.

Note: Objects that are relatively far from the mirror behave as if they were at infinity.



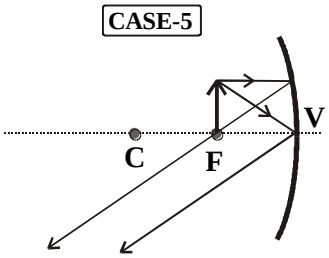
➲ **CASE-3** Object at C.

Image is at C, real, inverted and same size as object.



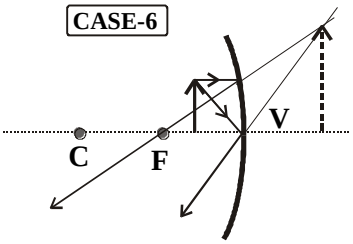
➲ **CASE-4** Object between C and F.

Image is beyond C, real, inverted and larger than object.



➲ **CASE-5** Object at F.

No image is formed. All rays reflect away parallel from the mirror.

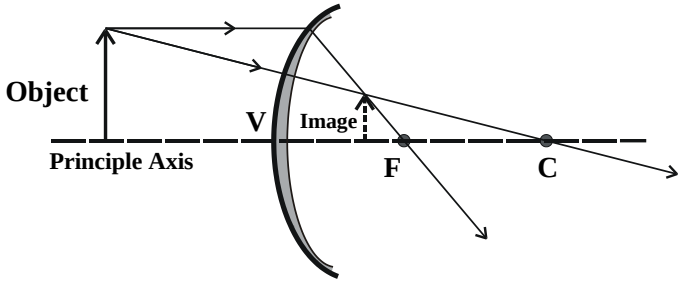


➲ **CASE-6** Object between F and V.

Image is beyond mirror, virtual, upright and larger than object.

- **CONVEX MIRRORS**

As illustrated below, convex mirrors always produce images which are ***virtual*** (formed by extended rays), **smaller** (than the object) and **upright**.



In order to find the location of an image formed by a curved mirror, select two strategic rays coming from the object. The location of the intersection of the reflected (or extended) rays is the location of the image.

Remember: A ray coming parallel to the principal axis is reflected so that it goes through the focal point.
A ray going through the focal point is reflected so that it goes parallel to the principal axis.

1. State the rules for finding the image formed by a curved mirror.

1- A ray parallel to the principle axis is reflected through the focal point (F).
2- A ray through the focal point (F) is reflected parallel to the principle axis.
3- A ray through the center of curvature (C) is reflected back along its own path.

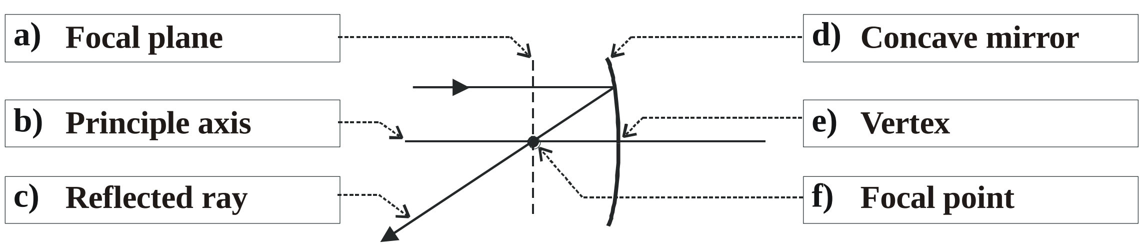
2. State four characteristics of images.

① **1- Type (real or virtual)**
② **2- Location (distance from mirror)**
③ **3- Magnification (size)**
④ **4- Attitude (upright or inverted)**

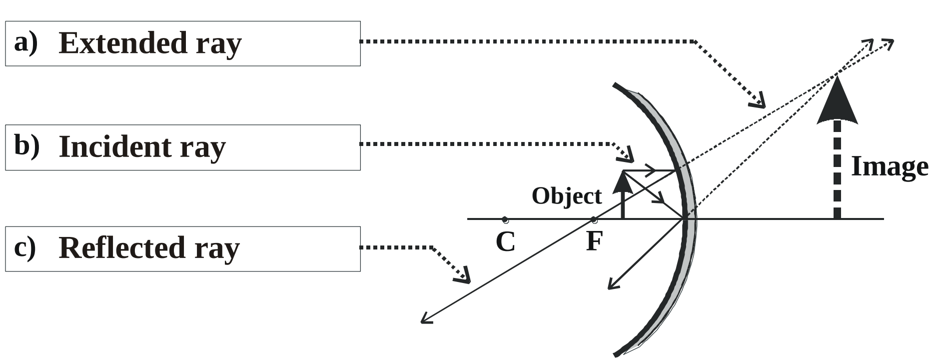
3. What is ***spherical aberration*** and how can it be eliminated?

A fuzzy image produced due to parallel rays not passing though the focal point.

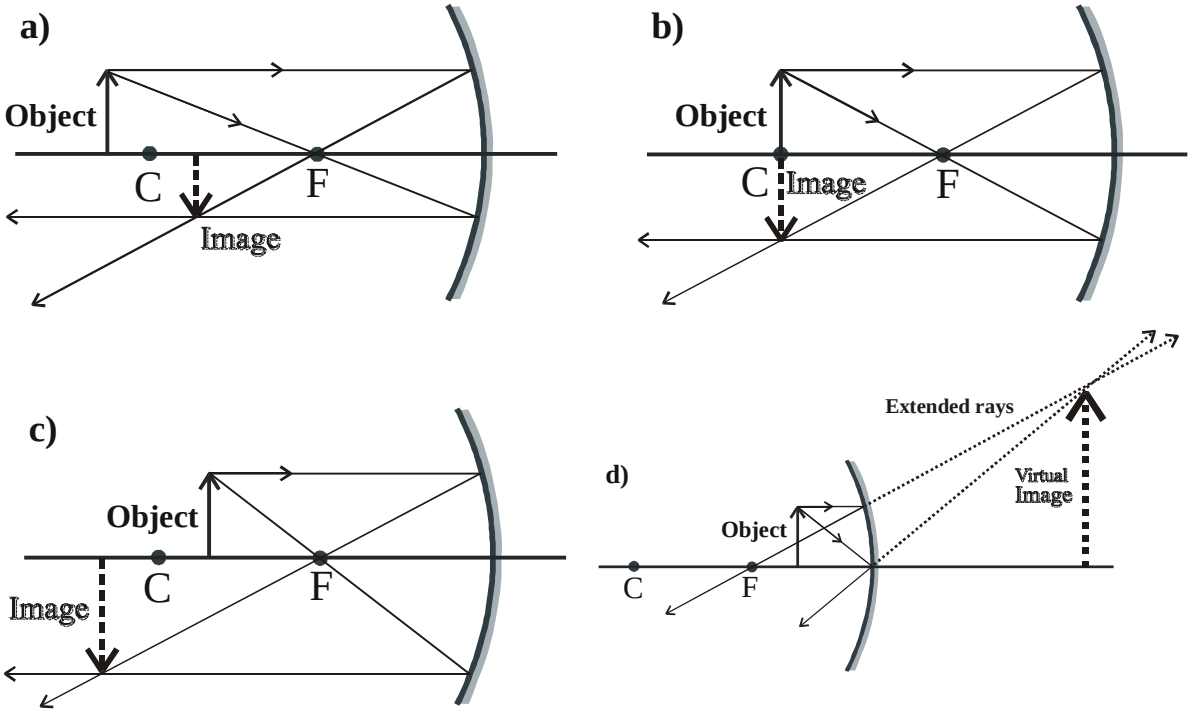
4. The diagram below displays a ***concave*** mirror. Label each part.



5. The diagram below illustrates the image of an object produced by a concave mirror. Label the incident ray, the reflected ray and the extended ray.

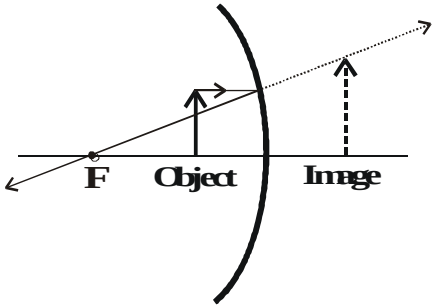


6. For each ***concave*** mirror below, draw the image.

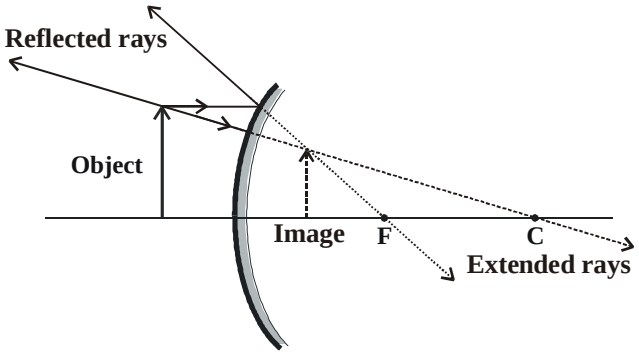


7. The diagram on the right shows an illuminated object and its virtual image in a concave parabolic mirror.

Determine the location of the ***principal focus***.



8. The diagram below shows an object in front of a ***convex*** parabolic mirror. Draw the image.



9. Where must an object be placed in front of a ***concave*** mirror so as to form an image that is:

a) Smaller than object? **Just beyond the center of curvature.**

b) Inverted? **Beyond the focal point (F).**

c) Virtual? **Within the focal length.**

d) Inverted and magnified ? **Within the center of curvature and the focal point.**

e) Same height as object? **At the center of curvature.**

10. Consider a ***convex*** mirror, where must an object be placed so as produce a ***real*** image?

11. State the properties of a virtual image.

12. In what important way does a virtual image differ from a real image?

A virtual image cannot be projected onto a screen like a real image can.

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