JONAHS

S.2 RECESS TERM PHYSICS NOTES: TOPIC TWO

Instructions : ***Leave three pages blank from magnetism (previous topic you copied) and continue writing theses notes.***

RFLECTION IN CURVED MIRRORS.

Curved Mirrors

Curved mirrors are mirrors whose surfaces are obtained from a hollow transparent sphere or pipe and silvering one of the side.

(a) Types of Curved Mirrors

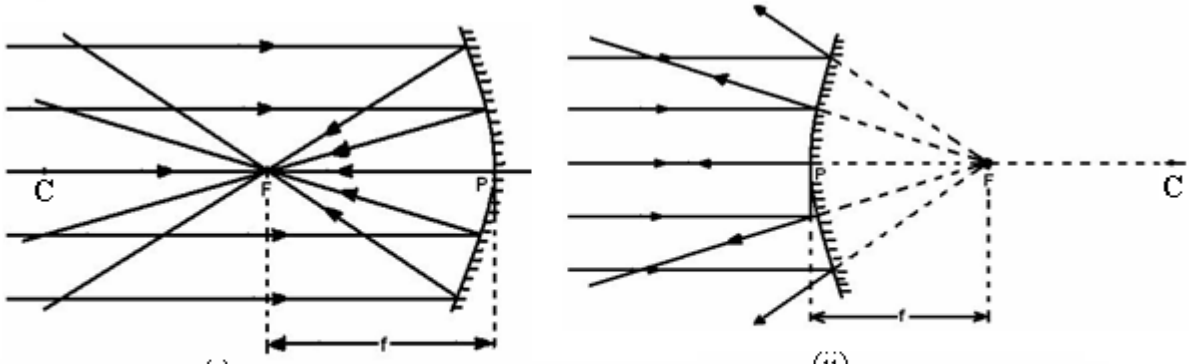
There are two types of curved mirrors, namely:

(i) Concave mirror

(ii) Convex mirror

(i) Concave mirror (ii) Convex mirror

(b) Reflection of parallel beams from curved mirrors



(i) Reflection of parallel beams from Concave mirrors

Figure 14.31

(ii) Reflection of parallel beams from Convex

(c) Terms Used

(i) *The Centre of curvature*, C, is the centre of the sphere of which the mirror is a part.

(ii) *The radius of curvature*, r, is the radius of the sphere.

(iii) *The pole, P,* of a mirror is the centre of reflecting surface.

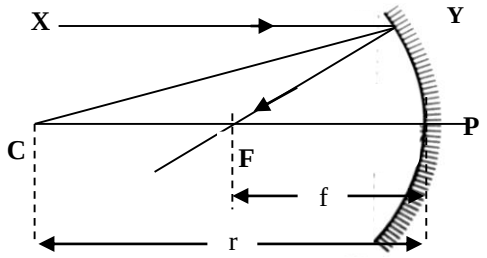
(iv) *The principal axis* is the imaginary line joining the pole and the centre of curvature produced in each case.

(v) *The principal focus, F*, is the point on the principal axis through which rays parallel and close to the principal axis pass after reflection (for the case of concave mirror) or from which the rays appear to come (for the case of convex mirror).

(vi) *The focal length, f*, is the distance between the principal focus and the pole of the mirror.

Notes: - C and f of a concave mirror - are real (i.e. are in front of the mirror).
- C and f of a convex mirror - are virtual (i.e. are behind the mirror).

(d) The Relation between f and r



From the laws of reflection
$\angle ABC = \angle CBF$
But $\angle ABC = \angle BCF$ *(alternate angles)*
$\angle CBF = \angle BCF$
$\therefore BF = FC$ *(sides of an isosceles triangle)*

Now B is very close to P
$BF = PF$
$PF = FC$
$\therefore f = \frac{r}{2}$ or $r = 2f$

(e) Mirrors of Large aperture

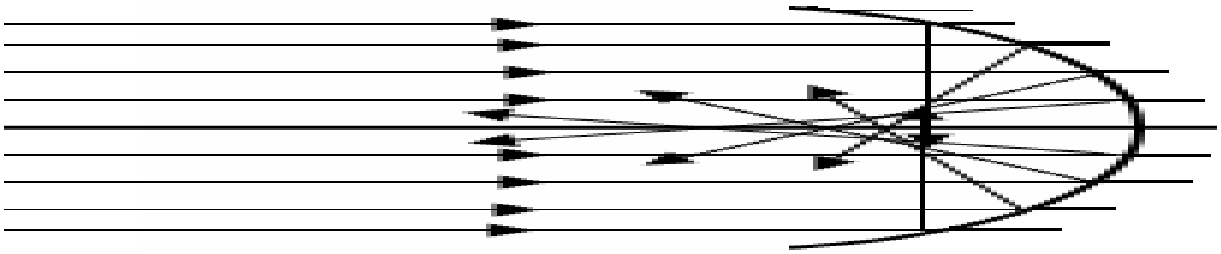
If a parallel beam parallel to the principal axis is incident on to a concave mirror, the rays which are close to the principal axis are reflected to pass through the principal focus. While those which are not close to the principal axis are refledted in such a way that they subsequently cross the axis at points which are closer to the mirror than its principal focus. The reflected rays intersect to form a surface called *caustic surface*.

Examples of bright caustic surface can be seen:

(i) on surfaces of liquids contained in vessels of circular cross section
e.g. tea surface on tea surface.

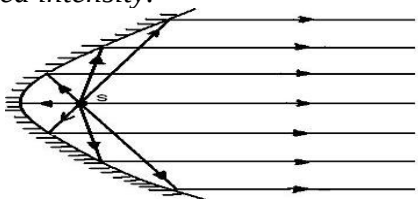
(ii) at the bottom of clean containers such as cups, source pans, basins etc.

Diagram showing formation of Caustic Surface



(i) Parabolic Mirror

A parabolic mirror has the property of reflecting the light source placed at the focal point parallel to the principal axis with undiminished intensity.



(ii) Uses of Parabolic Mirrors

Because of their property of reflecting light rays from a lamp placed at the focus parallel with An undiminishing intensity, they are used as search-light reflectors.

14.32 Construction of ray diagrams

The ray diagrams for curved mirrors are drawn by using any two of the principal rays. The images formed are described by using the technical terms.

(a) Terms used to describe images formed in Curved Mirrors

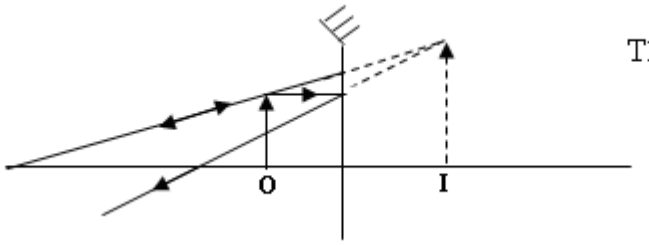
(i)	Real	- Formed by intersection of actual rays and can be obtained on screen.
(ii)	Virtual	- when not actual rays of light intersect after reflection
(iii)	Inverted	- Upside down
(iv)	Diminished	- Smaller than the object and
(ii)	Magnified	- Bigger/larger than the object.
(iii)	Erect	- Upright

(b) The principal rays for a Concave Mirror

1. A ray parallel to the principal axis is reflected through the focal point.
2. A ray passing through the focal point is reflected parallel to the principal axis.
3. A ray passing through the centre of curvature is reflected back along the same path.

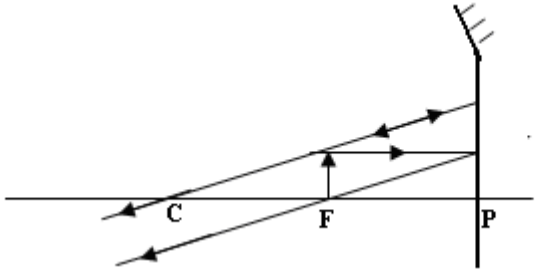
Ray diagrams for concave mirror for various positions of object

(i) Object between F and P



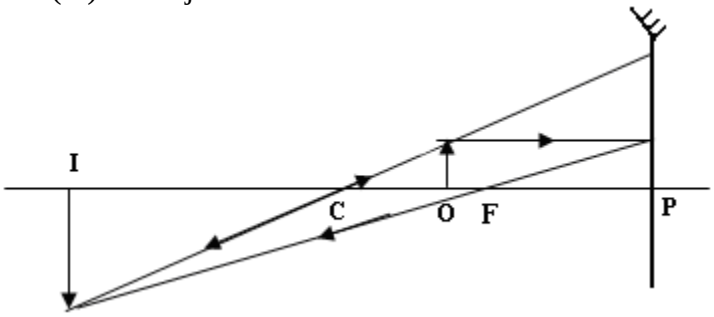
The nature of the image is
- erect
- magnified
- Virtual
- Behind the mirror

(ii) Object at F



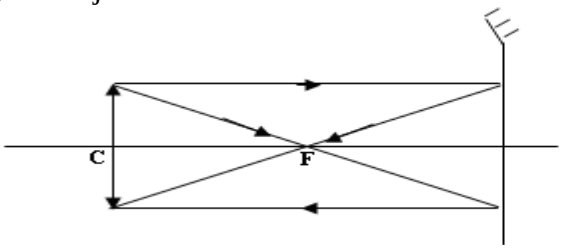
The nature of the image is
- real
- at infinite

(iii) Object between F and C



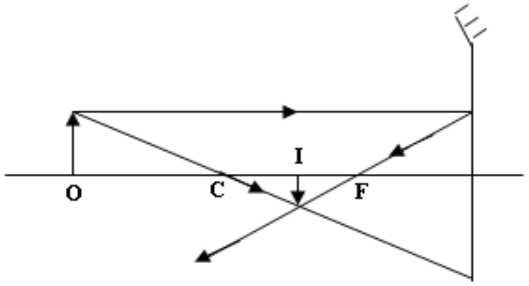
The nature of the image is
- real
- magnified
- Inverted
- Beyond C

(iv) Object at C



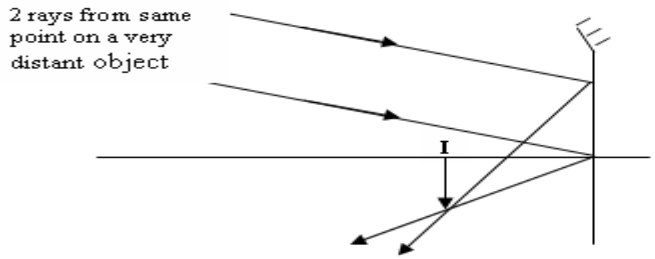
The nature of the image is
- Real
- Same size as object
- Inverted
- At C

(v) Object beyond C



The nature of the image is
- Real
- Inverted
- Diminished
- Between C and F

(vi) Object at infinite



The nature of the image is
- Real
- Inverted
- Diminished
- At F

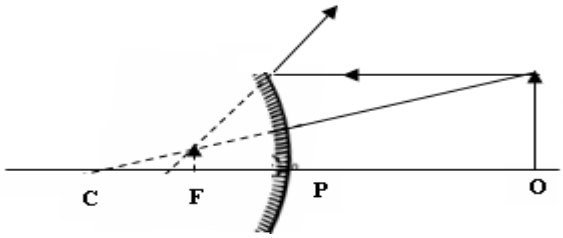
(c) The principal rays for a Convex Mirror

1. *A ray parallel to the principal axis is reflected to appear as though it passed through the focal point in other words the reflected ray, if produced, would pass through the focal point.*
2. *A ray which if produced would pass through the focal point, is reflected parallel to the principal axis.*
3. *A ray which if produced, would pass through the centre of curvature, is reflected back along the same path.*

Ray diagrams for convex mirror

For any position of object in front of the mirror, the nature of the image is:
- Erect
- Virtual
- Diminished
- Between P and F

(d) Image formed by a Convex Mirror



Applications of Curved Mirrors

Curved mirrors are applied in various fields depending on the type of the mirror.

(a) Convex Mirror

Convex mirrors are used in:

(i) locomotives as driving mirrors for seeing traffic behind.

(ii) They are used to observe the activities of customers in supper markets for.

They are preferred to plane mirrors and concave mirrors for this purpose because of the following advantages.

(i) They form erect image

(ii) They have wider field of view.

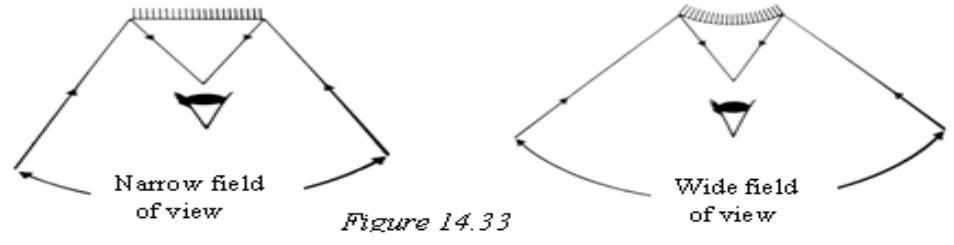


Figure 14.33

However, despite the above advantages they have one disadvantage. In that they form diminished images making them to appear as though they are farer than their actual distances from the mirror, hence, leading to accidents.

(b) Concave Mirrors

Concave mirrors are used as:

(i) dentist's mirror,

(ii) shaving mirror and

(iii) Reflectors in - telescopes for seeing far objects such as stars and planets.
- search lights, car head lights, torch light.

Advantages

For uses (i) and (ii), the image formed is:

- erect and
- magnified.

Note: *1. In uses (i) and (ii), the mirror is held so that the object distance is less than the focal length of the mirror.*

2. They are usually made of plastic or metal.

Self-Check 14.3

1. A concave mirror can be used as a shaving mirror because when an object is placed between the focus and the pole, the image formed is,

A. magnified, virtual and erect B. magnified, real and inverted

C. diminished, real and inverted and erect

D. diminished, virtual

2. Which of the following information is true about the concave and convex mirrors?

	Concave mirror	Convex mirror
A	Converges light	Diverges light
B	Diverges light	Converges light
C	Refracts light	Reflects light
D	Has a wide field of view	Has a narrow field of view

3. The focal length of a concave mirror is the
   A. distance between the pole of the mirror and the focal point
   B. distance between the center of curvature and the mirror
   C. distance between the object and the image
   D. diameter of the mirror

4. (a) With the aid of the diagram explain why a parabolic mirror is most suitable for use in car head lights.
   (b) List three uses of a concave mirror.

5. (a) Draw a ray diagram to show the formation of an image of an object O placed in front of a convex mirror shown in the figure below. F is the principal focus of the mirror.
   (b) A convex mirror whose radius of curvature is 30 cm forms an image of a real object which has been 20 cm from the mirror.
   Calculate: (i) The position of the image
   (ii) The magnification produced.
   (c) Give reasons for use of convex mirrors in vehicles.

END