Physics 262/266

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Summary for Spherical Mirrors and Thin Lens

$$\frac{1}{s}+\frac{1}{s'}=\frac{1}{f}$$ (object-image relation, spherical mirror & thin lens)

$$f=\frac{R}{2}$$ (focal length, spherical mirror)

$$\frac{1}{f}=(n-1)\left(\frac{1}{R_1}-\frac{1}{R_2}\right)$$ (lensmaker's equation)

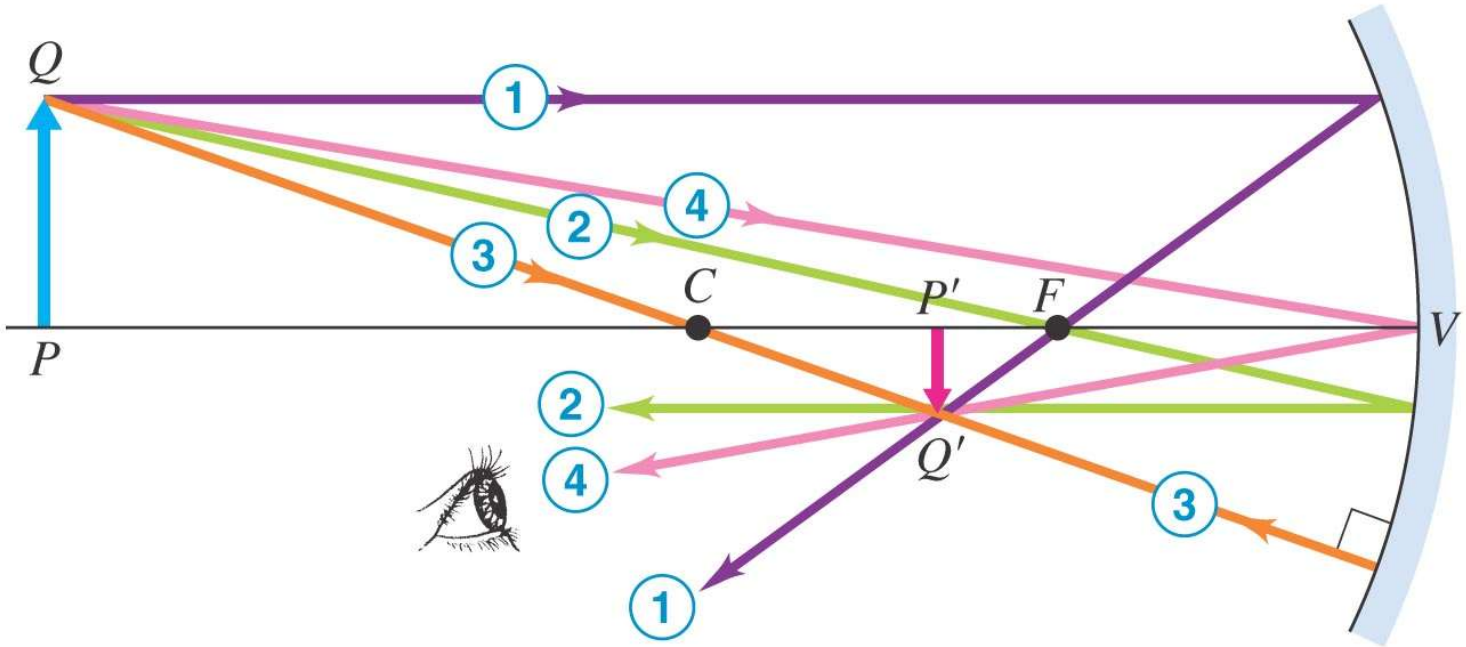
$$m=-\frac{s'}{s}$$ (lateral magnification, spherical mirror & thin lens)

Sign Rules for Mirrors & Lens

1. Object Distance:
   - s is + if the object is on the same side as the incoming light (for both reflecting and refracting surfaces) and s is – otherwise.
2. Image Distance:
   - s' is + if the image is on the same side as the outgoing light and is – otherwise.
3. Object/Image Height:
   - y (y') is + if the image (object) is erect or upright. It is – if it is inverted.
4. Radius of Curvature:
   - R is + when the center of curvature C is on the same side as the outgoing light and – otherwise.
5. Focus Length: (+ concave, - convex)
   (+ converging, - diverging)

Geometric Methods: Rays Tracing

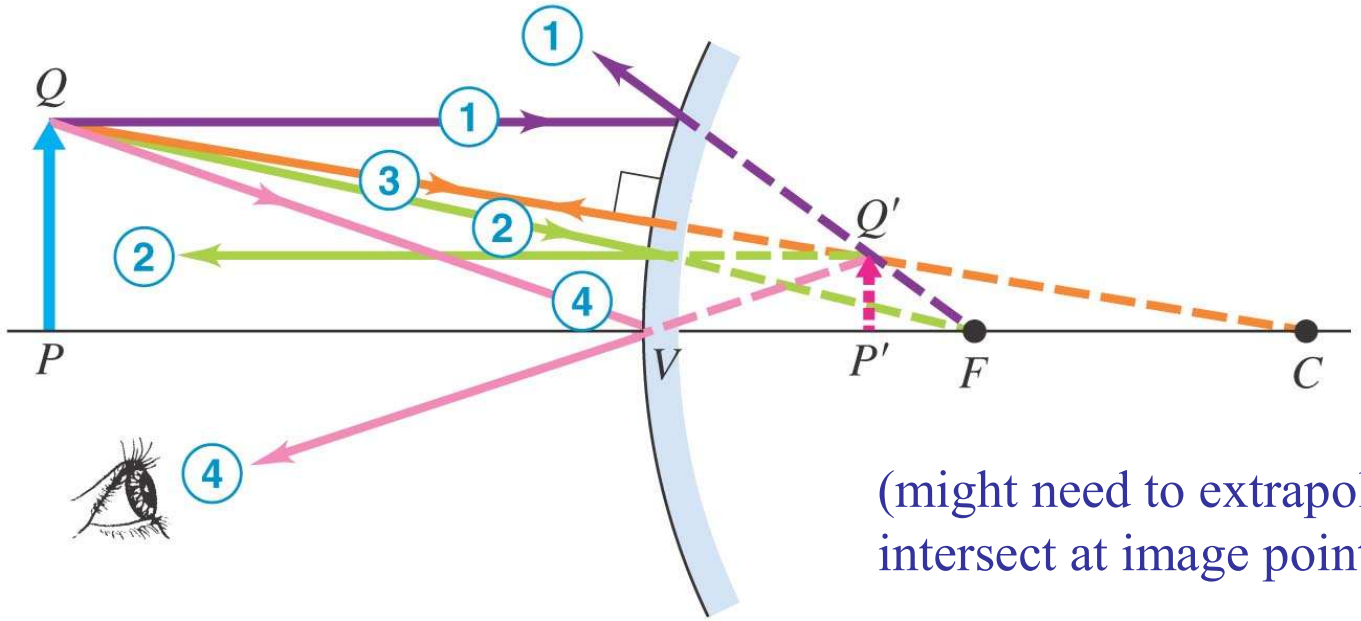
Principal rays for concave mirror



1. Ray parallel to axis reflects through focal point.
2. Ray through focal point reflects parallel to axis.
3. Ray through center of curvature intersects the surface normally and reflects along its original path.
4. Ray to vertex reflects symmetrically around optic axis.

Geometric Methods: Rays Tracing

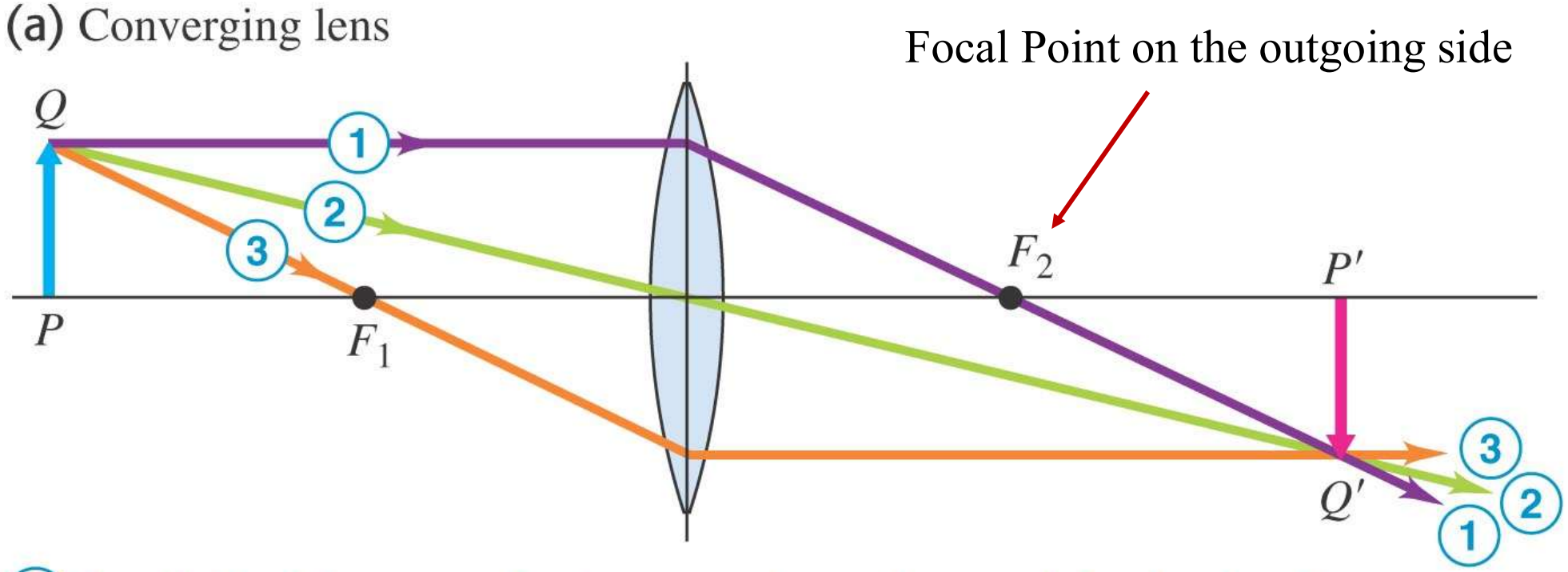
Principal rays for convex mirror



(might need to extrapolate lines to intersect at image point)

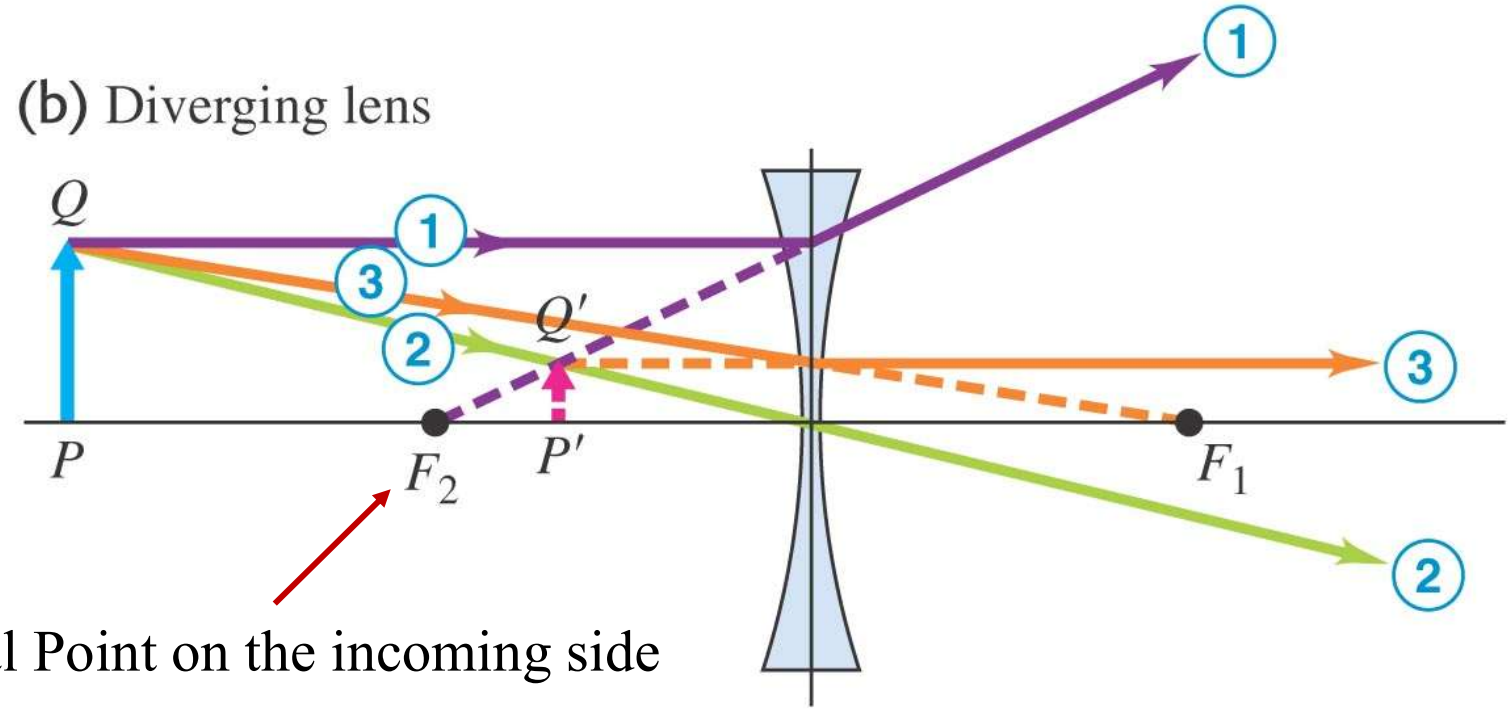
1. Reflected parallel ray appears to come from focal point.
2. Ray toward focal point reflects parallel to axis.
3. As with concave mirror: Ray radial to center of curvature intersects the surface normally and reflects along its original path.
4. As with concave mirror: Ray to vertex reflects symmetrically around optic axis.

Ray Tracing Methods for Lenses



1. Parallel incident ray refracts to pass through second focal point F_2.
2. Ray through center of lens does not deviate appreciably.
3. Ray through the first focal point F_1 emerges parallel to the axis.

Rays Tracing Methods for Lenses



Focal Point on the incoming side

1. Parallel incident ray appears after refraction to have come from the second focal point F_2.
2. Ray through center of lens does not deviate appreciably.
3. Ray aimed at the first focal point F_1 emerges parallel to the axis.

Example: Compound Lenses