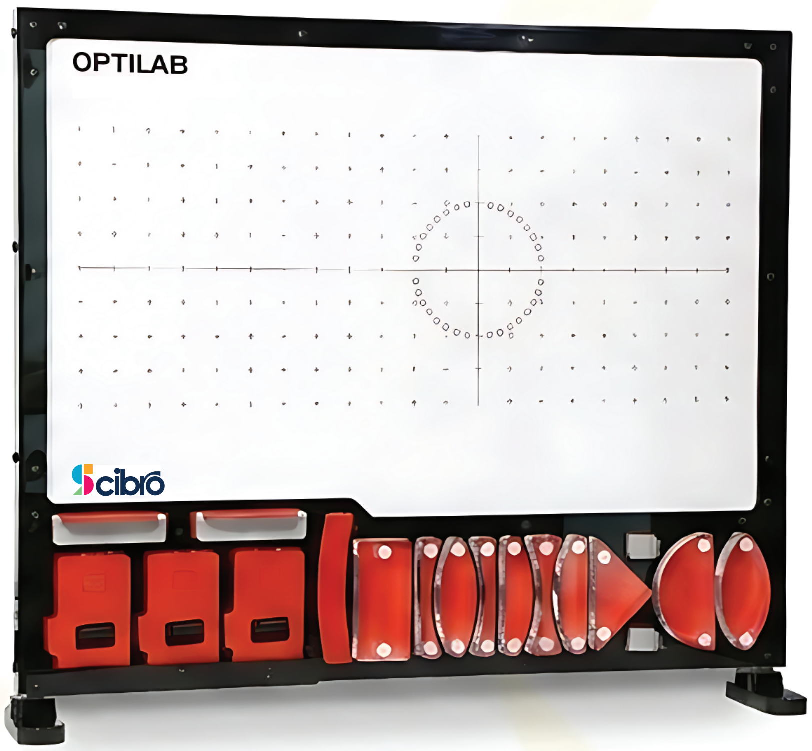
Scibro

OPTILAB
OP301

Portable Optics Laboratory



Product Manual

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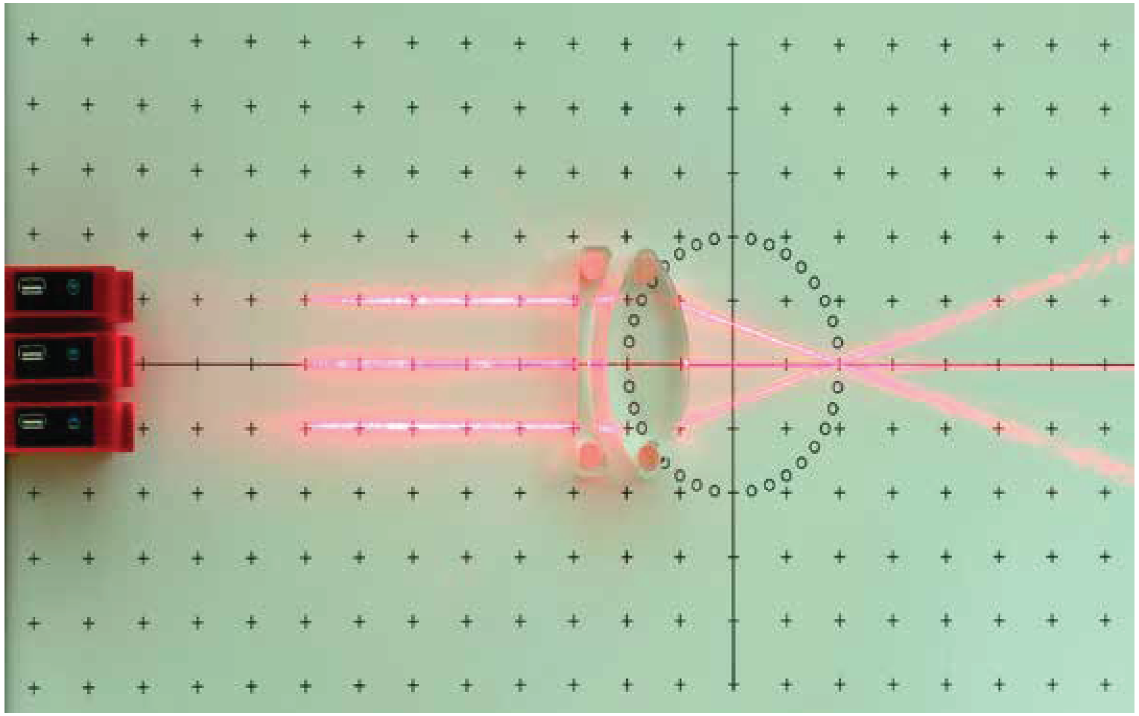
LASER OPTICS SET OP301 - Portable Optics Laboratory

LASER OPTICS SET

OP301

Portable Optics laboratory.
Easy and interesting way to studying geometrical optics based on experiments.



List of experiments (33 Experiments)

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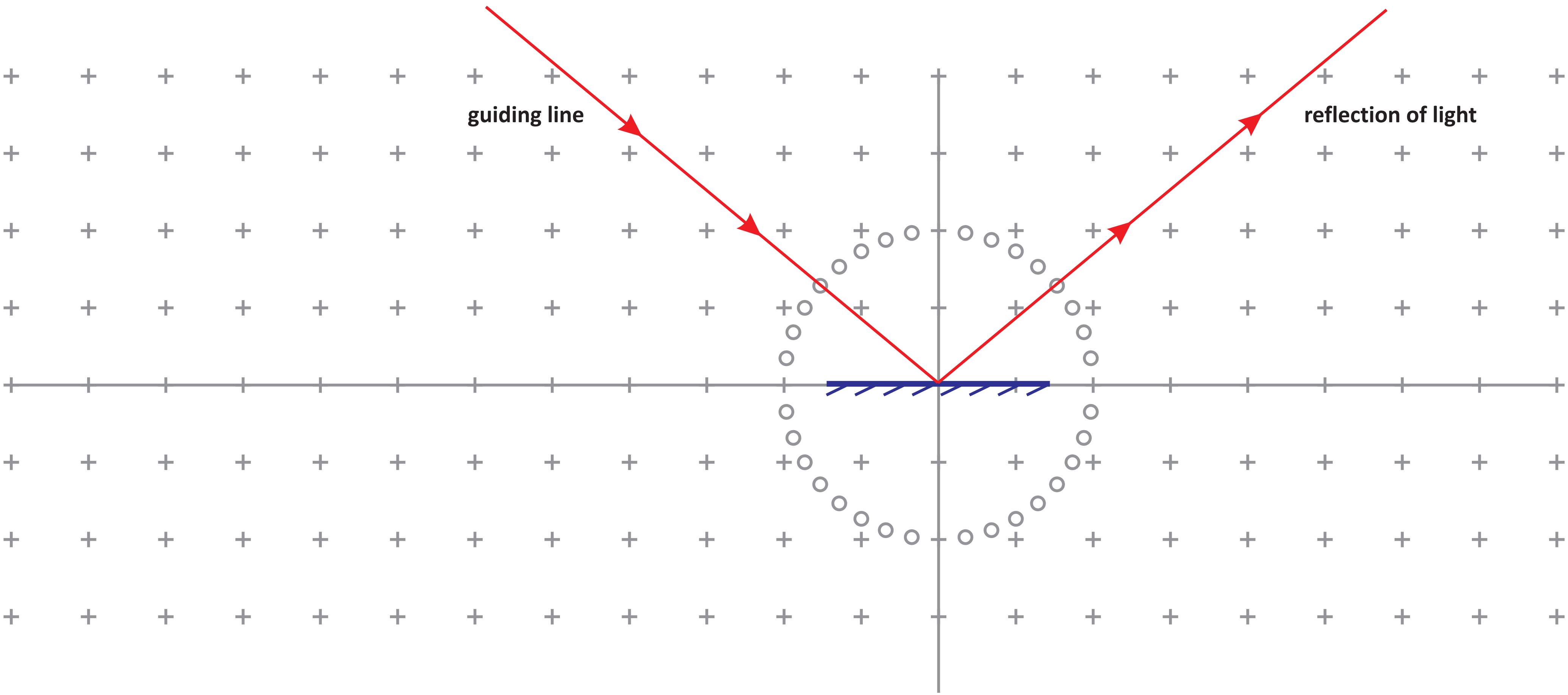
1- Plane Mirror

1- Angle of incidence

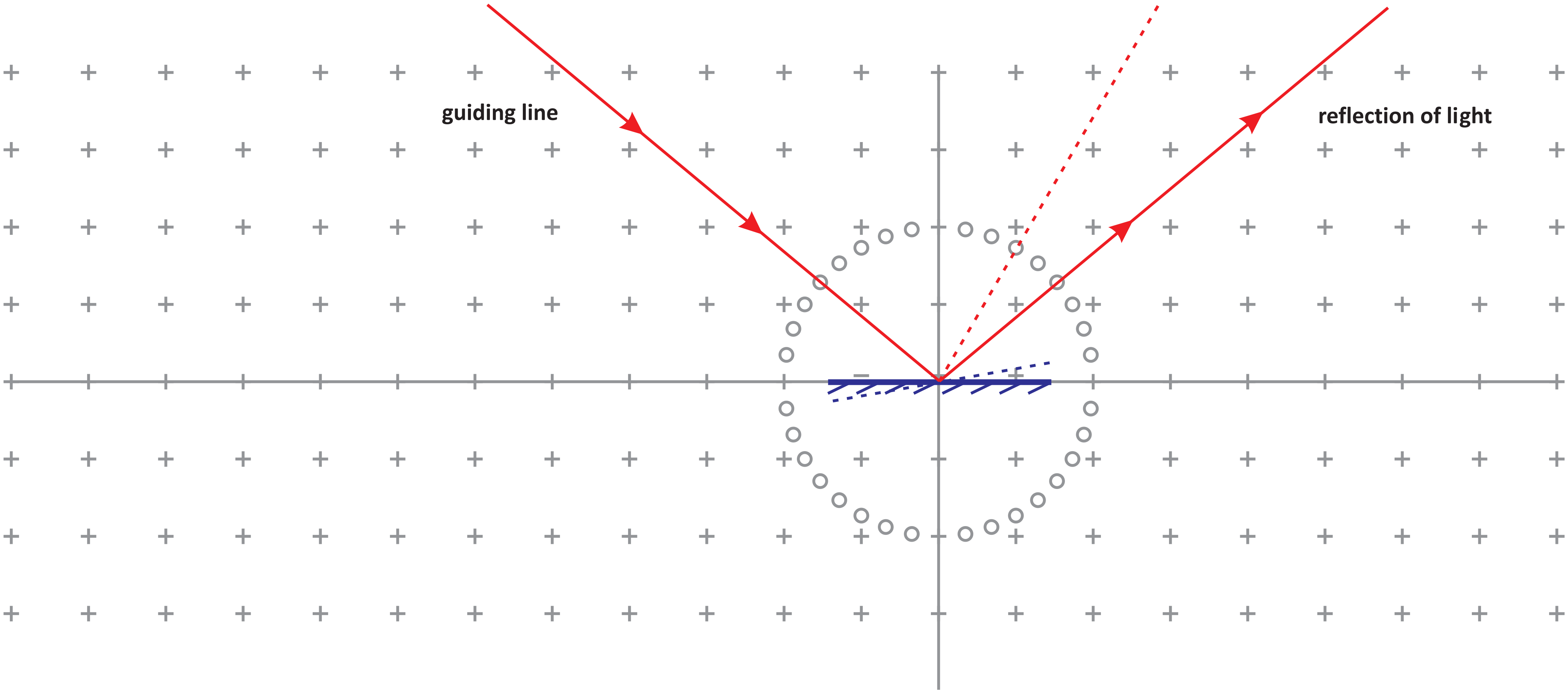
- Place the plane mirror on the determined position in the figure.
- Place the light source and illuminate the plane mirror along the guiding line.
- By varying the incidence angle, study the relation between the incidence and reflection angles in the plane mirror



1- Plane Mirror

2- Rotation of mirror and reflection angle

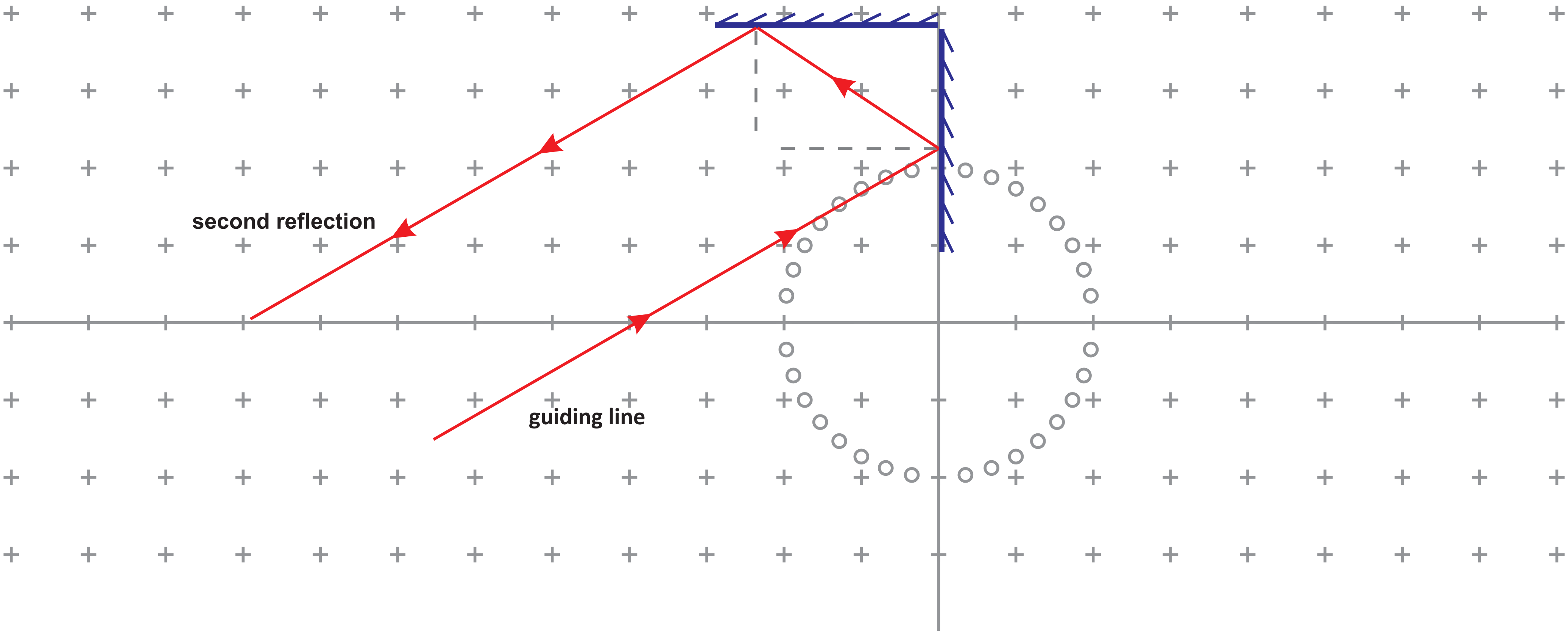
- Place the plane mirror on the determined position in the figure.
- Place the light source and illuminate the plane mirror along the guiding line. Keep the incident ray fixed.
- How much is the change in the reflection angle, when you rotate the mirror about the center of protractor (for example by 10 degrees)?



1- Plane Mirror

3- Perpendicular Mirrors

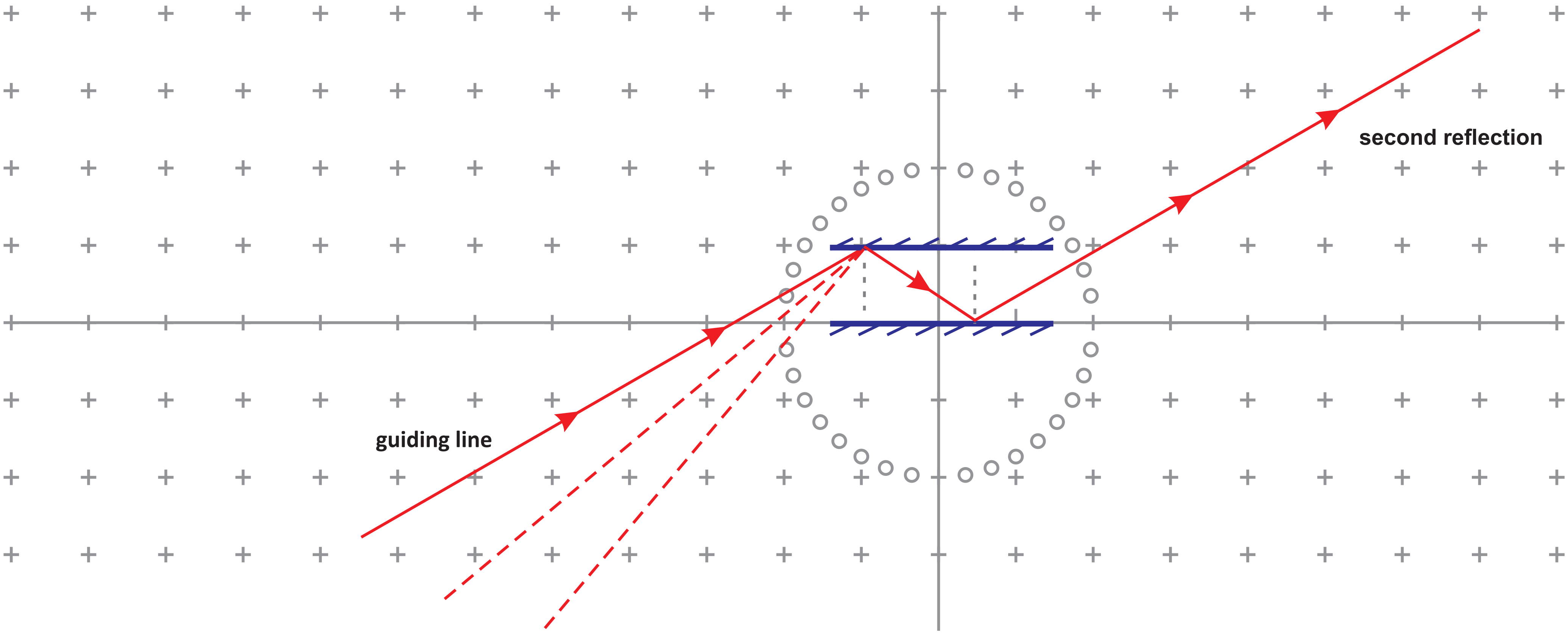
- Place two plane mirrors on the determined position in the figure.
- Illuminate the first mirror along the guiding line.
- Reflection ray from the first mirror is the incident ray for the second mirror. What is the situation of the second reflection with respect to the first incident ray?
- Examine different incident angles. Do you know an application for this experiment?



1- Plane Mirror

4- Parallel Mirrors

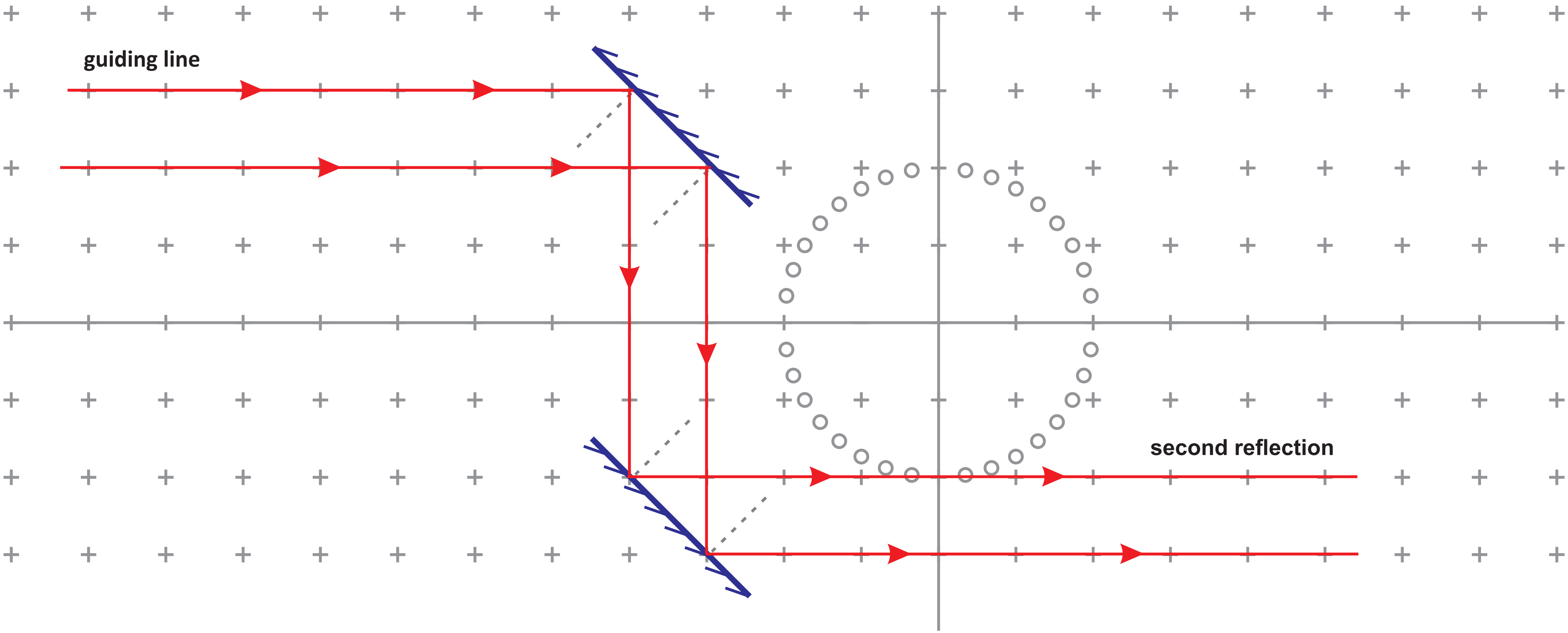
- Place two plane mirrors on the determined position in the figure.
- Throw the light ray on the first mirror along the guiding line.
- Reflection ray from the first mirror is the incident ray on the second mirror. What is the situation of the second reflection with respect to the first incident ray?
- Repeat the experiment with different incident angles. Do you know an application for this experiment?



1- Plane Mirror

5- Periscope (Submarine Eye)

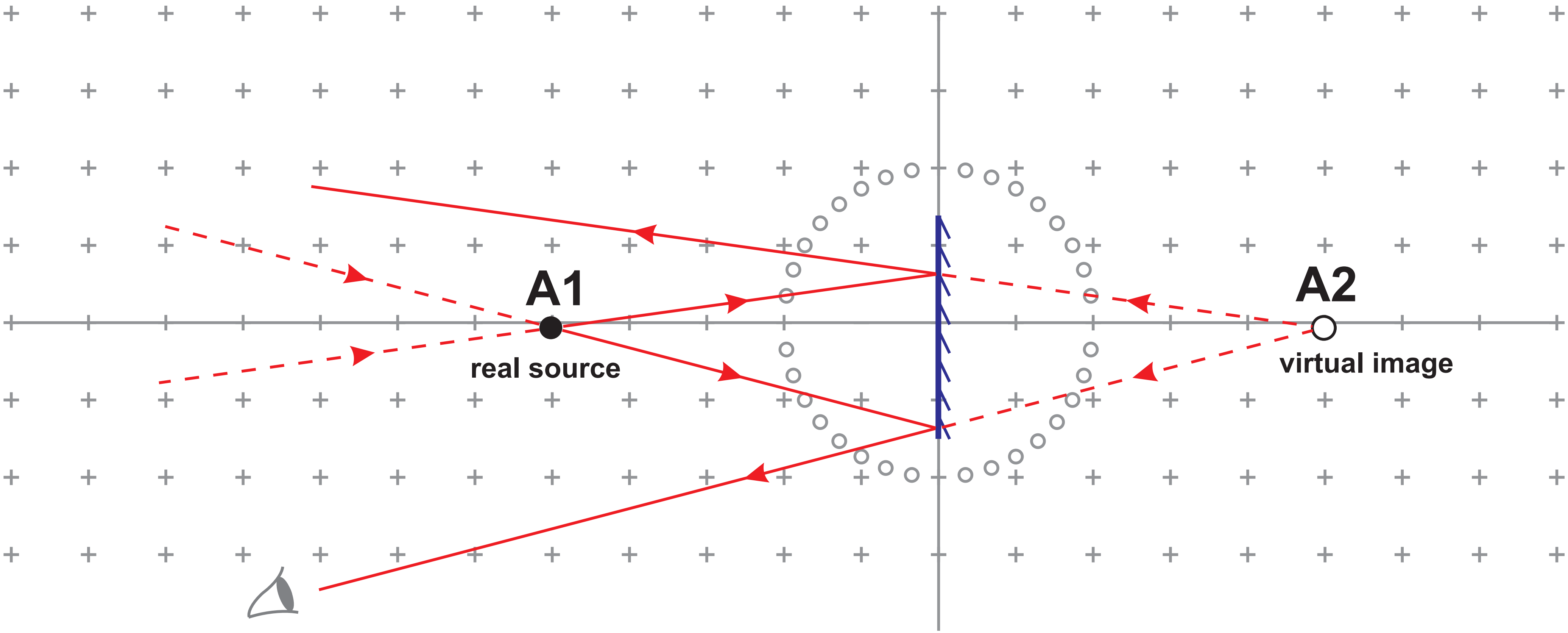
- Place two plane mirrors on the determined position in the figure.
- Throw two light rays on the first mirror along the guiding lines.
- Reflection rays from the first mirror are the incident rays on the second mirror. What is the situation of the second reflection with respect to the first incident rays?
- Can you find an application for this experiment?



1- Plane Mirror

6- Virtual Image from Real Source

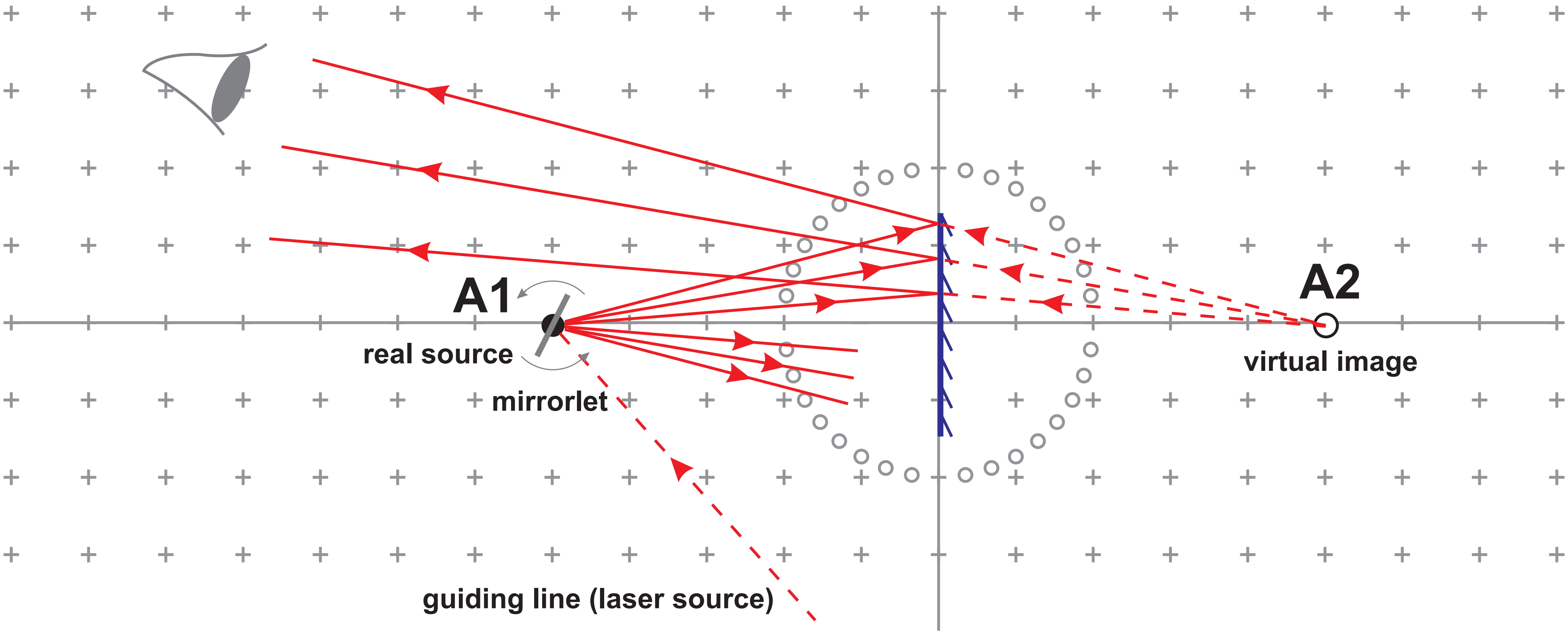
- Place a plane mirror on the determined position in the figure.
- Light rays pass through the point A1 and fall on the mirror. We assume A1 as the real source of rays.
- Reflection rays from the mirror diverge such that it seems they are emanating from the point A2.
- In this case we name A1 and A2, real source and its virtual image, respectively. Why?



1- Plane Mirror

7- Virtual Image (Hypothetical light source behind the mirror)

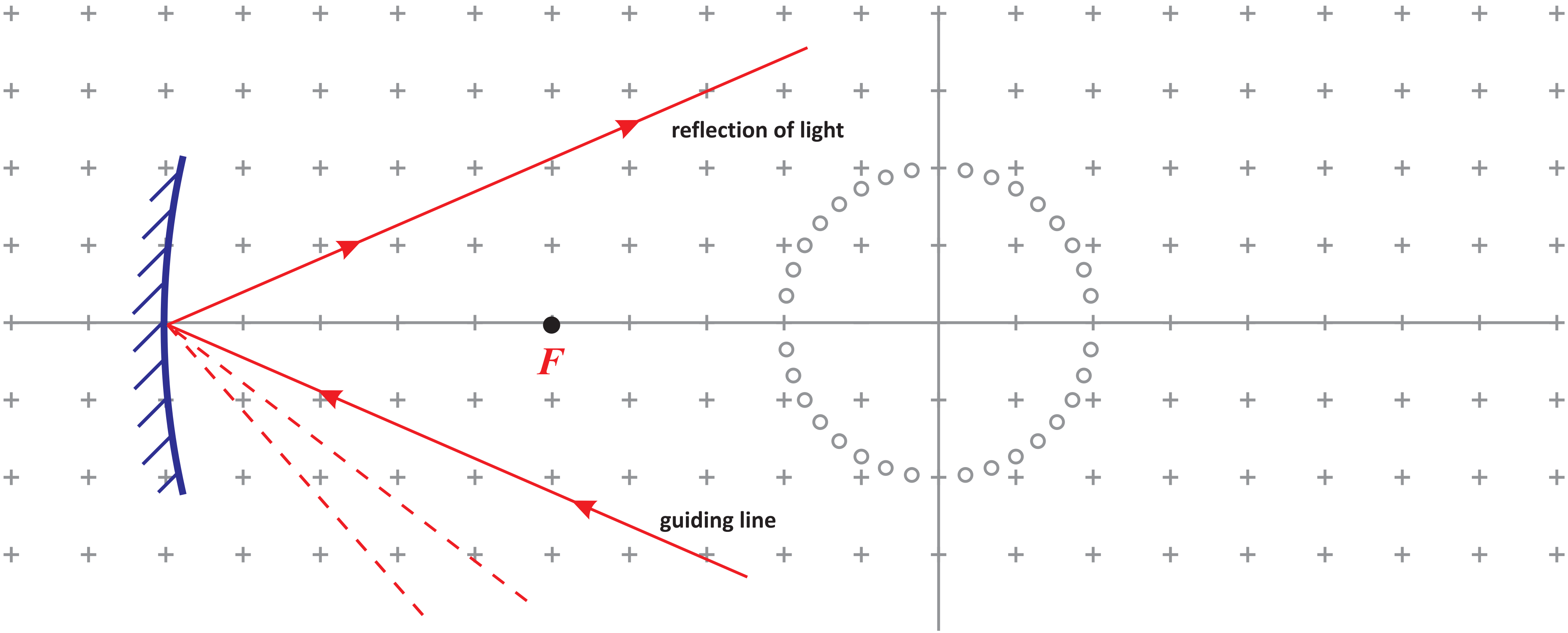
- Place the plane mirror on the determined position. Place the mirrorlet (small mirror with a handle) on the point A1.
- Light ray falls on mirrorlet at the point A1. Reflection rays from the mirrorlet illuminate the plane mirror.
- Oscillate the mirrorlet about an axis perpendicular to the board to make incident rays fall on and reflect from the mirror with different angles.
- Reflection rays from the mirror diverge such that it seems they are emanating from the point A2.



2- Concave Mirror

1- Mirror Vertex

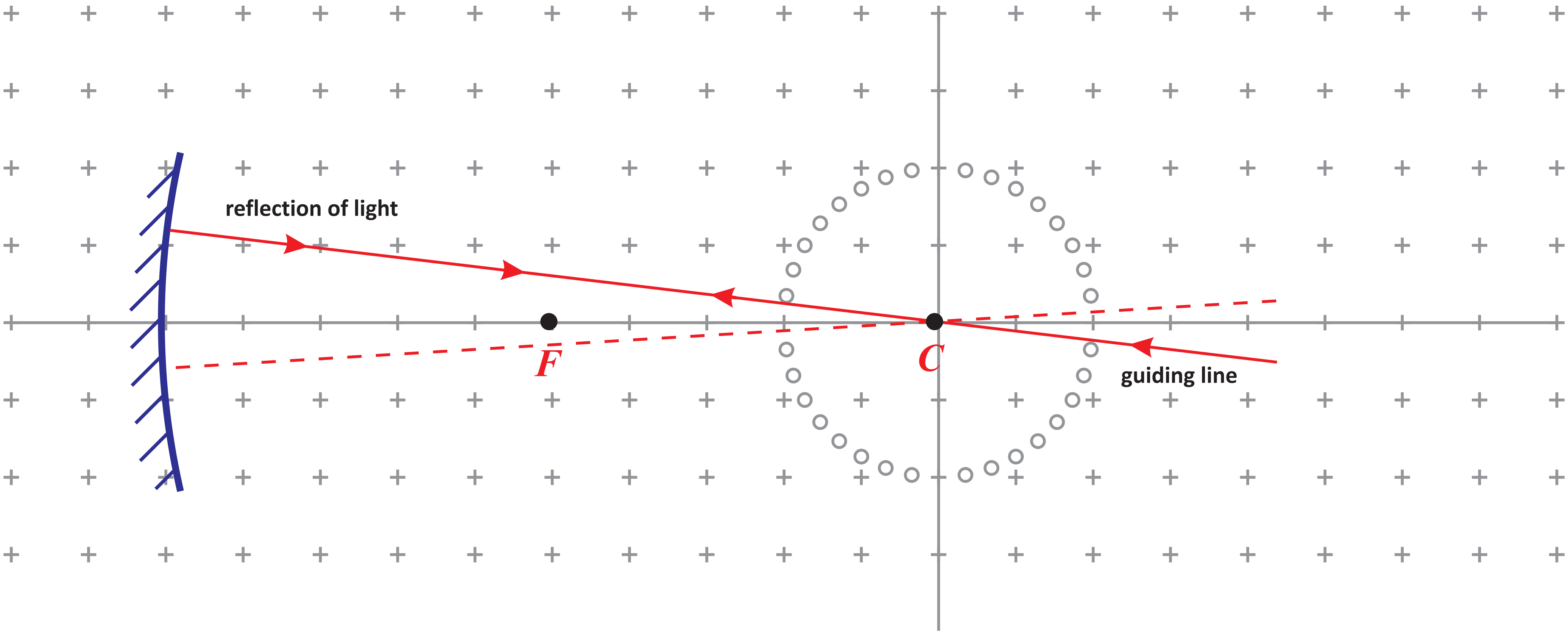
- Place the concave mirror on the determined position in the figure.
- Place a light source on the board such that the incident ray falls on the mirror vertex.
- Make sure to set the mirror position precisely and set the incident ray to fall on the vertex.
- It is seen that the incident ray falling on the vertex and its reflection, are symmetric with respect to the principal axis of concave mirror.



2- Concave Mirror

2- Mirror Center

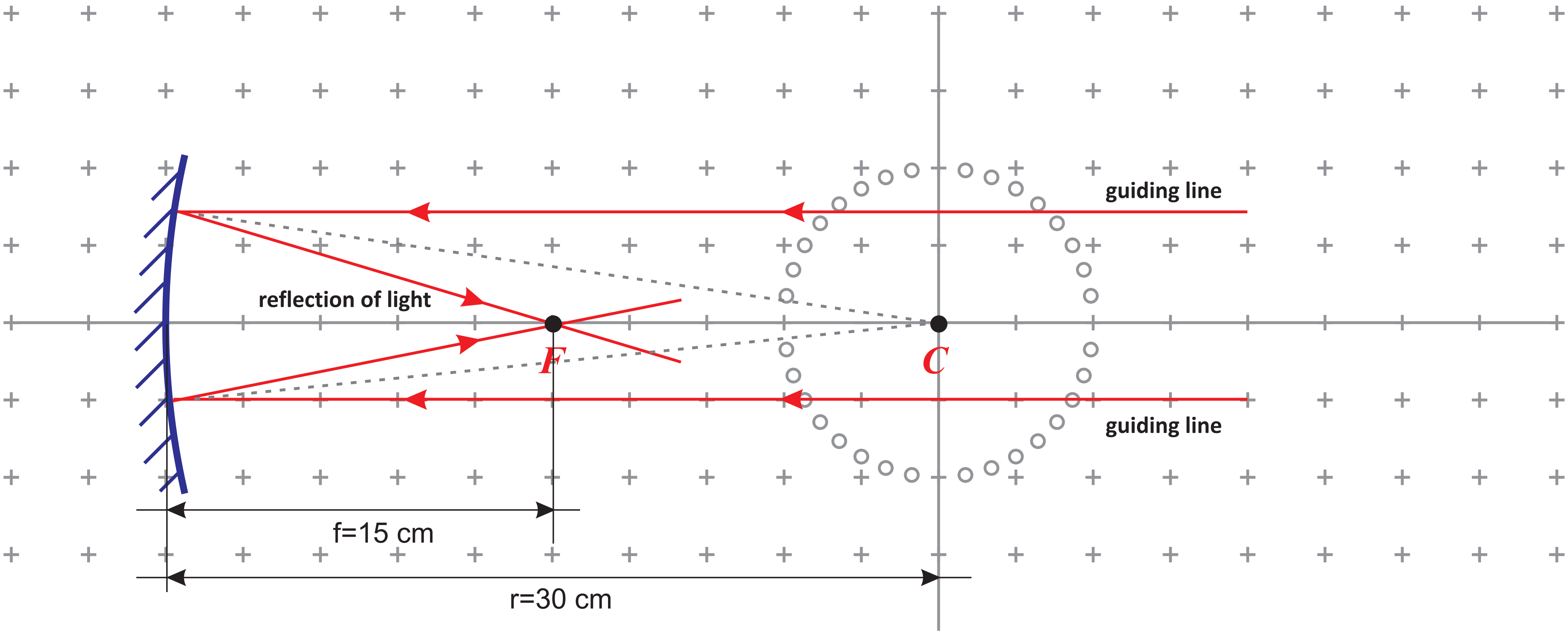
- Place the concave mirror on the determined position in the figure. Place two or three light sources on the board.
- Illuminate the mirror such that the incident rays pass the mirror center (C) before falling on mirror.
- Make sure to set the mirror position precisely, and that incident rays pass the center.
- It is seen that reflection of the incident rays passing through the center, will coincide with the incident ray.



2- Concave Mirror

3- Principal Focal point (Reflection from the incident rays parallel to the principal axis pass through this point)

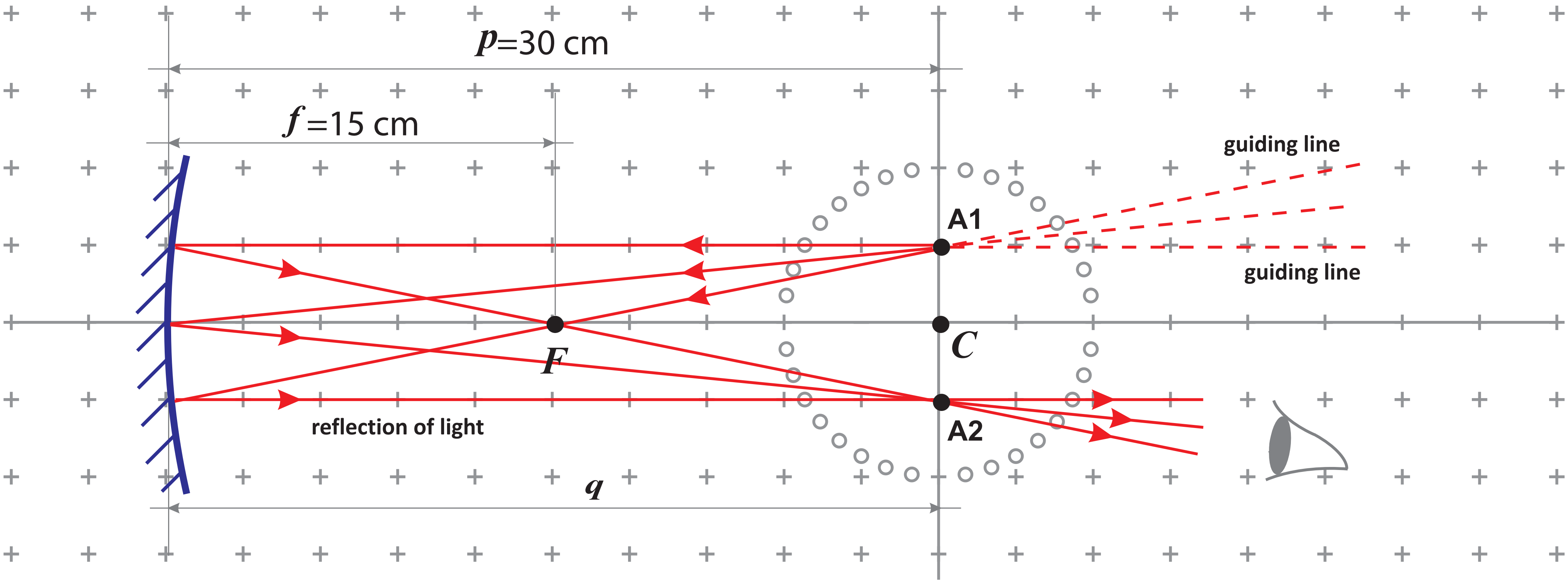
- Place the concave mirror on the determined position in the figure. Place two or three light sources on the board.
- Illuminate the mirror, by the light rays parallel to the principal axis (for example, along the guiding lines).
- Make sure to set the mirror position precisely and set the incident rays parallel to principal axis.
- Reflections of the incident rays parallel to the axis pass through a common point known as the focal point of concave mirror (F).



2- Concave Mirror

4- Real Image (Magnification equal to unity)

- Place the concave mirror on the determined position in the figure. Place two or three light sources on board.
- Incident rays pass A1 and then fall on the mirror. We assume A1 to be the real source of rays.
- Reflections converge at the point A2 and A2 becomes a new light source.
- In this case we call A1 a real source and A2 its real image. Why?

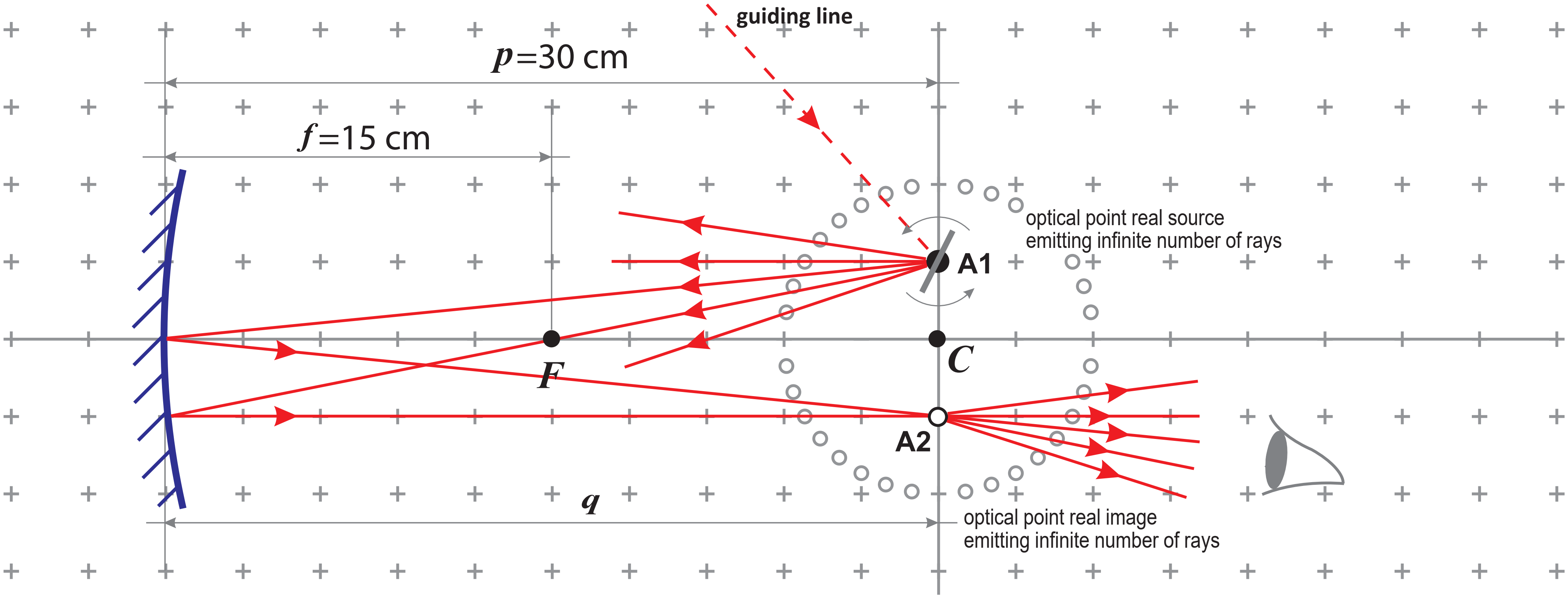


$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \Longrightarrow \frac{1}{30\text{ cm}}+\frac{1}{q}=\frac{1}{15\text{ cm}} \Longrightarrow q=30\text{ cm}$$

2- Concave Mirror

5- Real Image (Object: Infinite number of rays, Image: Infinite number of rays)

- Place a concave mirror on the determined position in the figure. Place a mirrorlet on the point A1.
- Source light ray falls on mirrorlet at the point A1. Reflection rays from the mirrorlet illuminate the concave mirror.
- Oscillate the mirrorlet about an axis perpendicular to the board to make incident rays fall on, and reflect from the mirror with different angles.
- A2 is the real image of A1. From each point of source and its image (real or virtual), infinite number of rays are emitted.

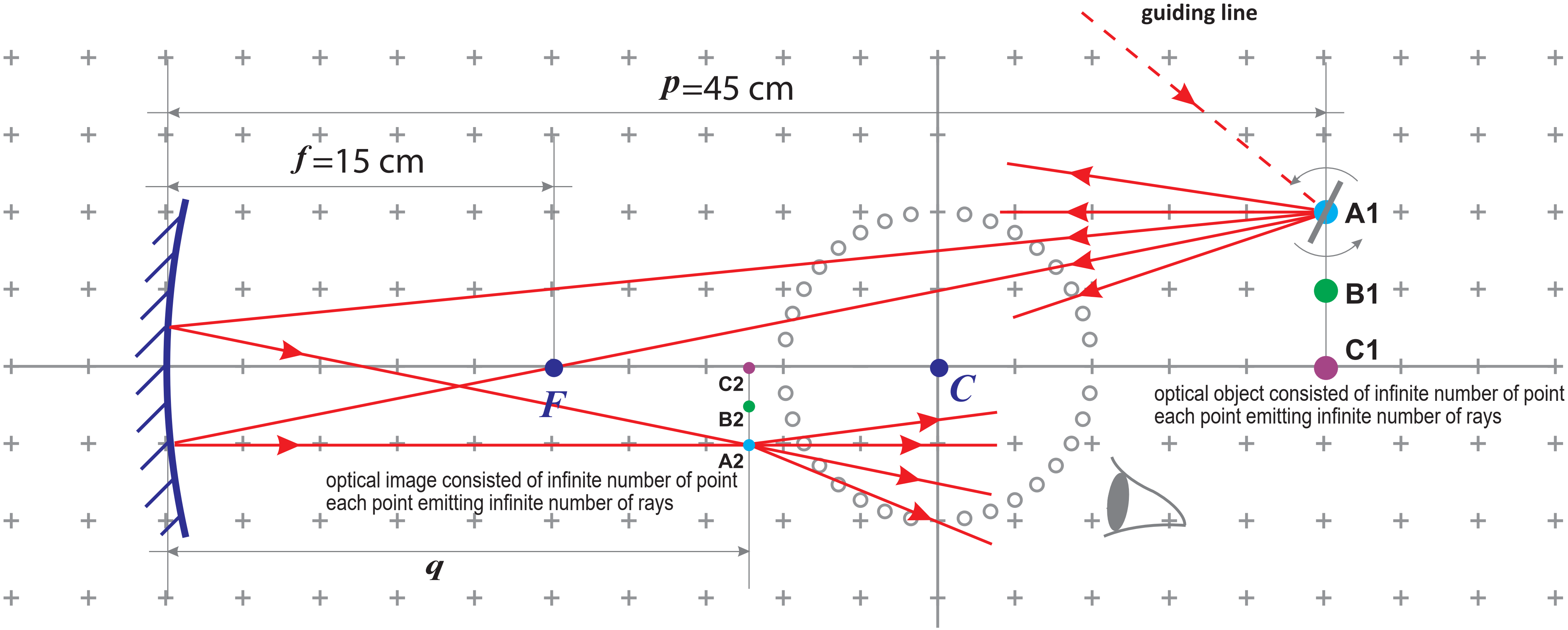


$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \Longrightarrow \frac{1}{30\text{ cm}}+\frac{1}{q}=\frac{1}{15\text{ cm}} \Longrightarrow q=30\text{ cm}$$

2- Concave Mirror

6- Real Image (Object: Infinite number of sources, Each source: Infinite number of rays)

- Place a plane mirror on the determined position in the figure. Place the mirrorlet on the point A1.
- By oscillating the mirrorlet emit light rays from A1 to the concave mirror and get their reflection.
- A2 is the real image of A1. Repeat this experiment for other points of the optical object A1B1C1D1.
- Each optical object and its image are consisted of infinite number of point sources and from each source infinite number of rays is emitted.

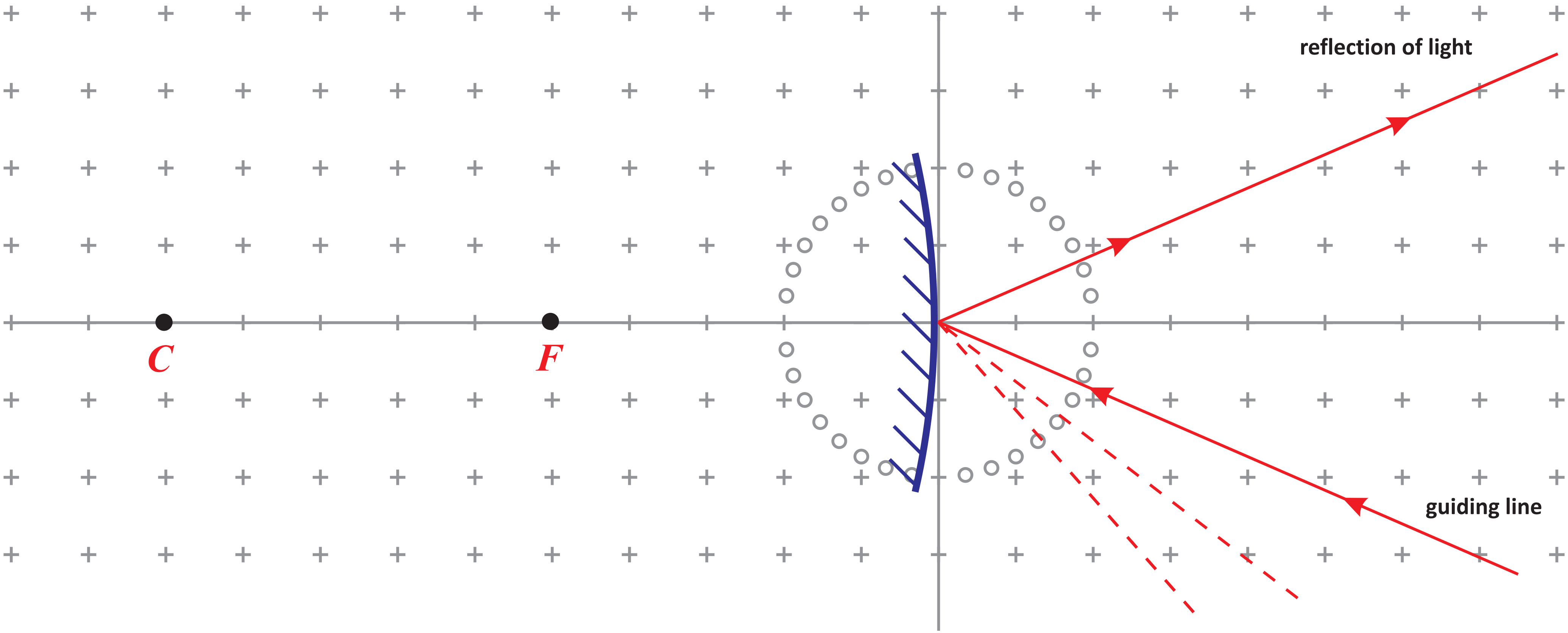


$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \Longrightarrow \frac{1}{45\text{ cm}}+\frac{1}{q}=\frac{1}{15\text{ cm}} \Longrightarrow q=22.5\text{ cm}$$

3- Convex Mirror

1- Mirror Vertex

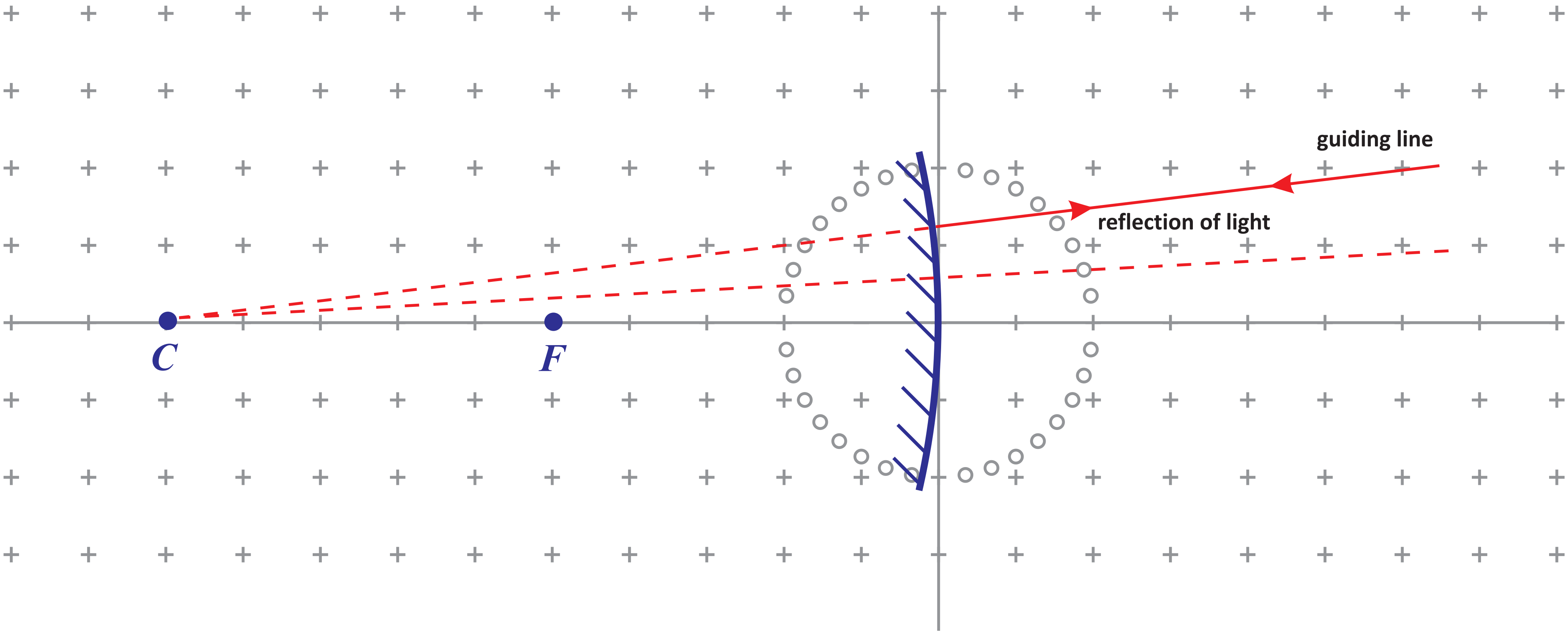
- Place the convex mirror on the determined position in the figure.
- Place a light source on the board such that the incident ray falls on the mirror vertex.
- Make sure to set the mirror position precisely and set the incident ray to fall on the vertex.
- It is seen that the incident ray falling on the vertex and its reflection, are symmetric with respect to the principal axis of convex mirror.



3- Convex Mirror

2- Mirror Center

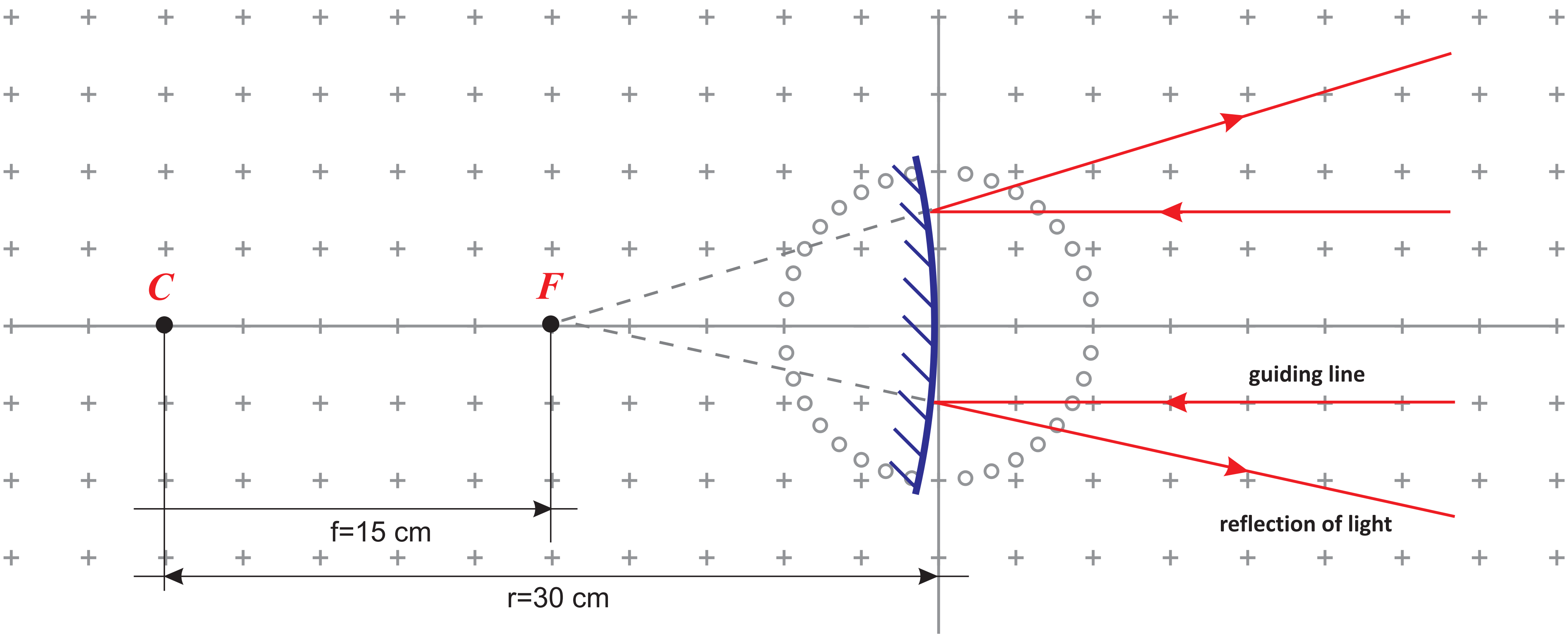
- Place the convex mirror on the determined position in the figure. Place a light sources on the board.
- With the aid of guiding lines illuminate the mirror such that the incident light rays are directed toward the center (C).
- Make sure to set the mirror position precisely, and that incident ray is directed toward the center.
- It is seen that in the convex mirror, incident ray directing toward the center, reflect on itself.



3- Convex Mirror

3- Principal Focal Point (Intersection of the direction of reflections corresponding to incident rays parallel to the principal axis)

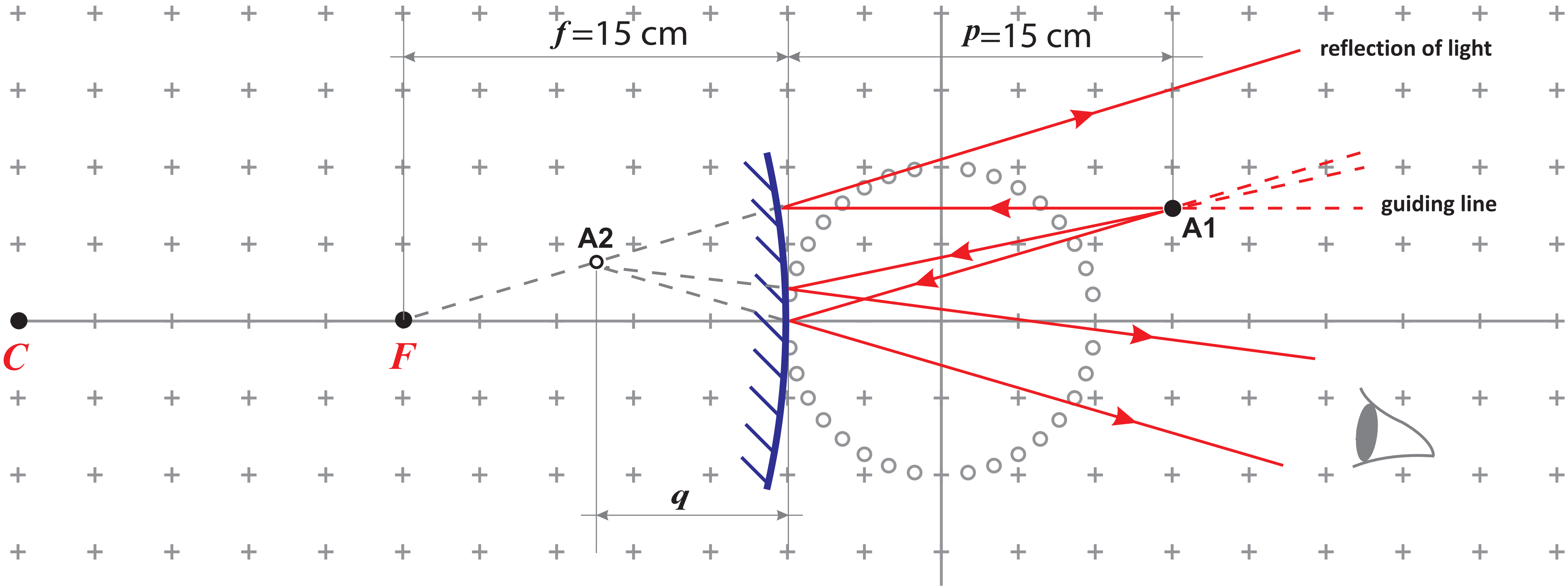
- Place the concave mirror on the determined position in the figure. Place two or three light sources on the board.
- Illuminate the mirror, by the light rays parallel to the principal axis (for example, along the guiding lines).
- If the direction of reflection of an incident ray parallel to the axis is extended, it will pass through the focal point of concave mirror (F).



3- Convex Mirror

4- Virtual Image (Magnification less than unity)

- Place the convex mirror on the determined position in the figure. Place two or three light sources on the board.
- Incident rays pass A1 and fall on the mirror. We assume A1 to be the real source of rays.
- Reflections diverge from the mirror such that it seems they are sourced from A2.
- In this case A1 is named a real source and A2 is called its virtual image. Why?

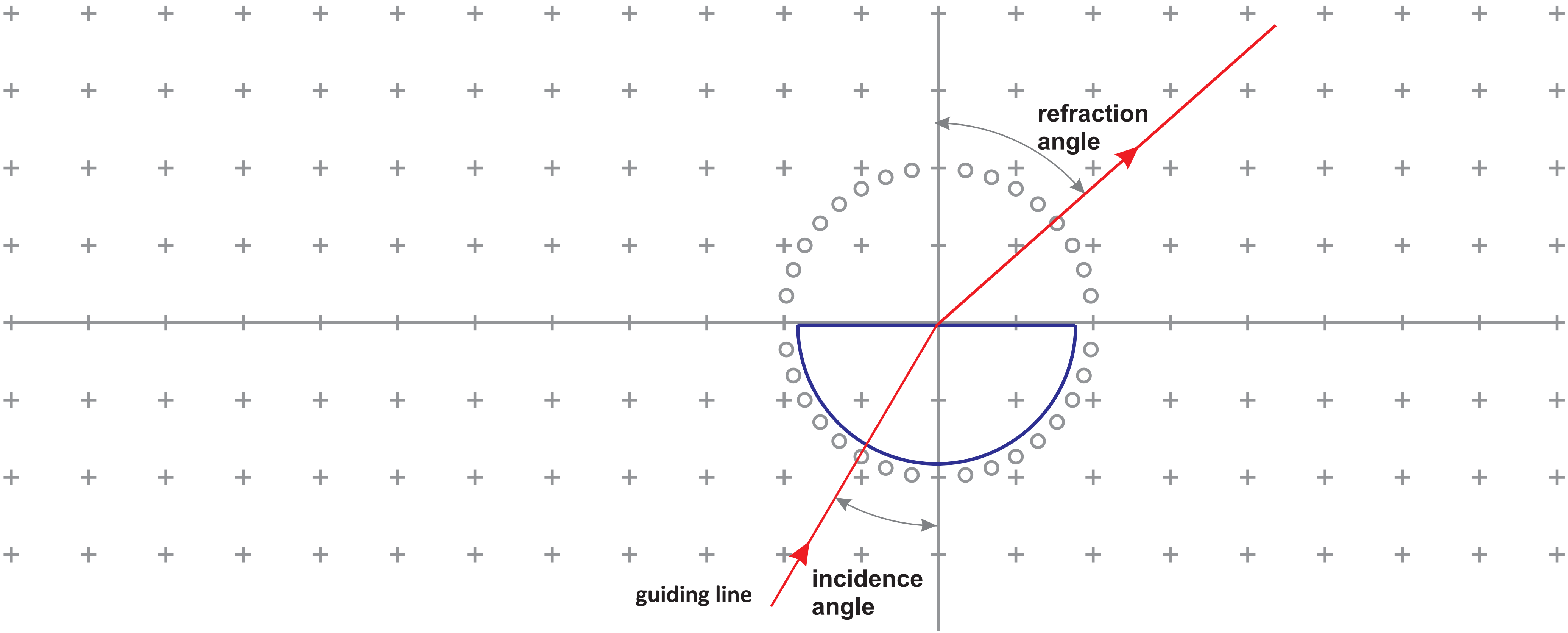


$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \Longrightarrow \frac{1}{15\text{ cm}}+\frac{1}{q}=\frac{1}{-15\text{ cm}} \Longrightarrow q=-7.5\text{ cm}$$

4- Refraction of Light

1- Transmission of light between two transparent media

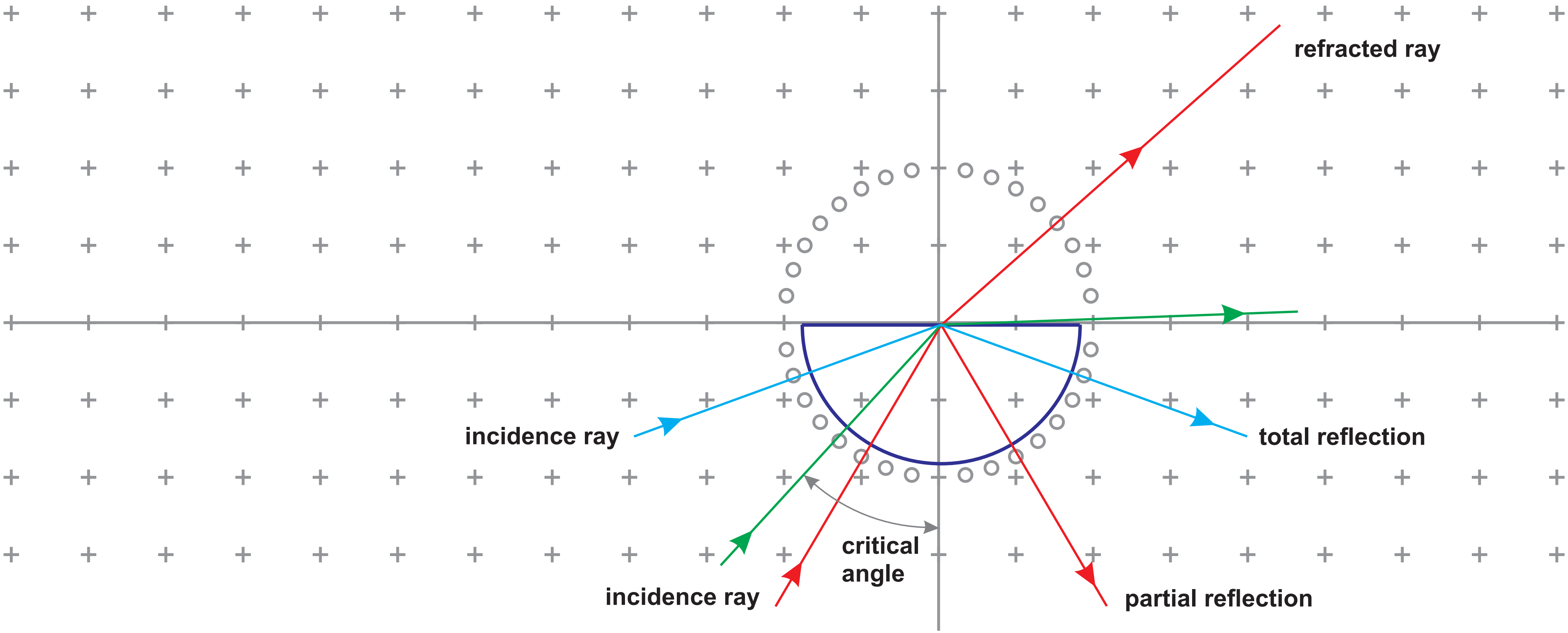
- Place the transparent half-cylinder on the determined position in the figure.
- Place a light source on the board.
- Throw the light ray on the curved surface of half-cylinder along the radius and toward the center of protractor.
- By moving the light source and changing the incidence angle, observe the refraction of light when passing from the high density medium to the low density medium (air).



4- Refraction of Light

2- Total reflection, Partial reflection and critical angle

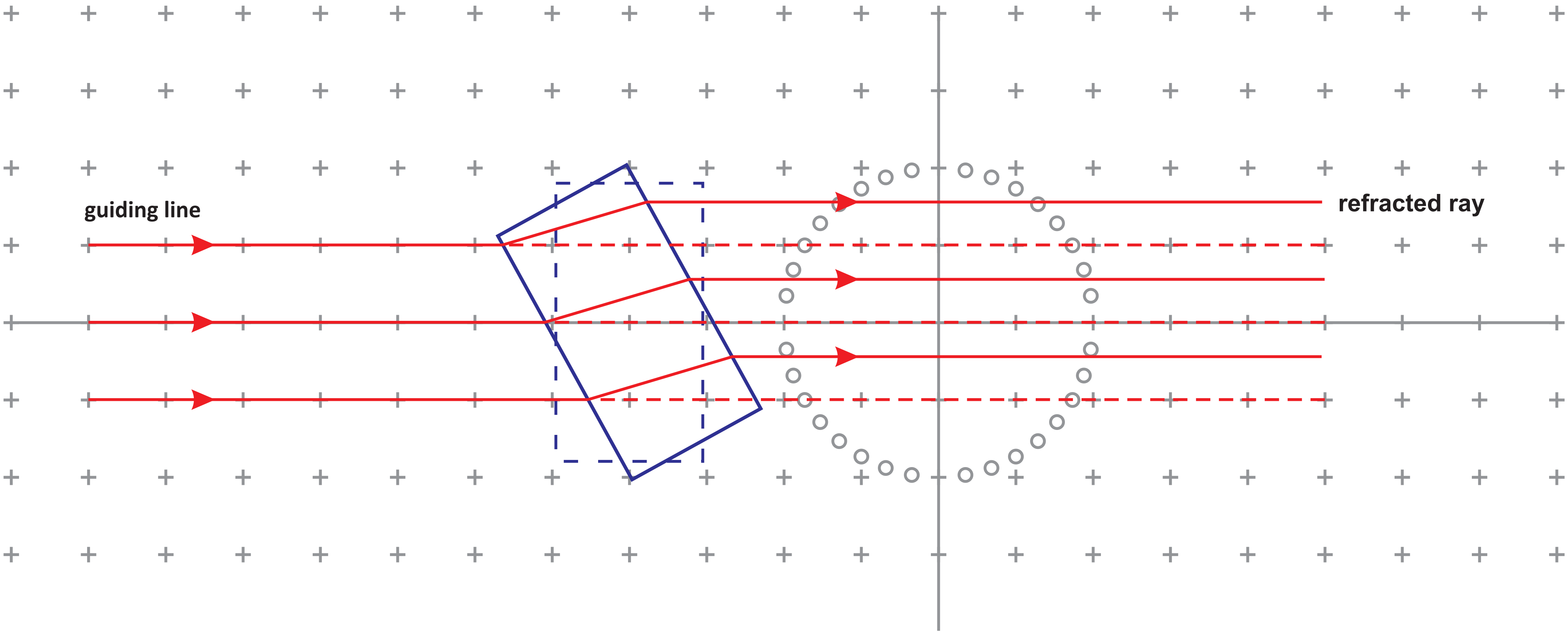
- Place the transparent half-cylinder on the determined position in the figure. Place a light source on the board.
- Throw the light ray on the curved surface of half-cylinder along the radius and toward the center of protractor.
- By changing the incidence angle,for a special incidence angle called the critical angle, reflection ray becomes tangent to the flat surface of half-cylinder and for larger incidence angles, total reflection will begin.



5- Refraction of Light

1- Transmission of light through a parallel-plane slab

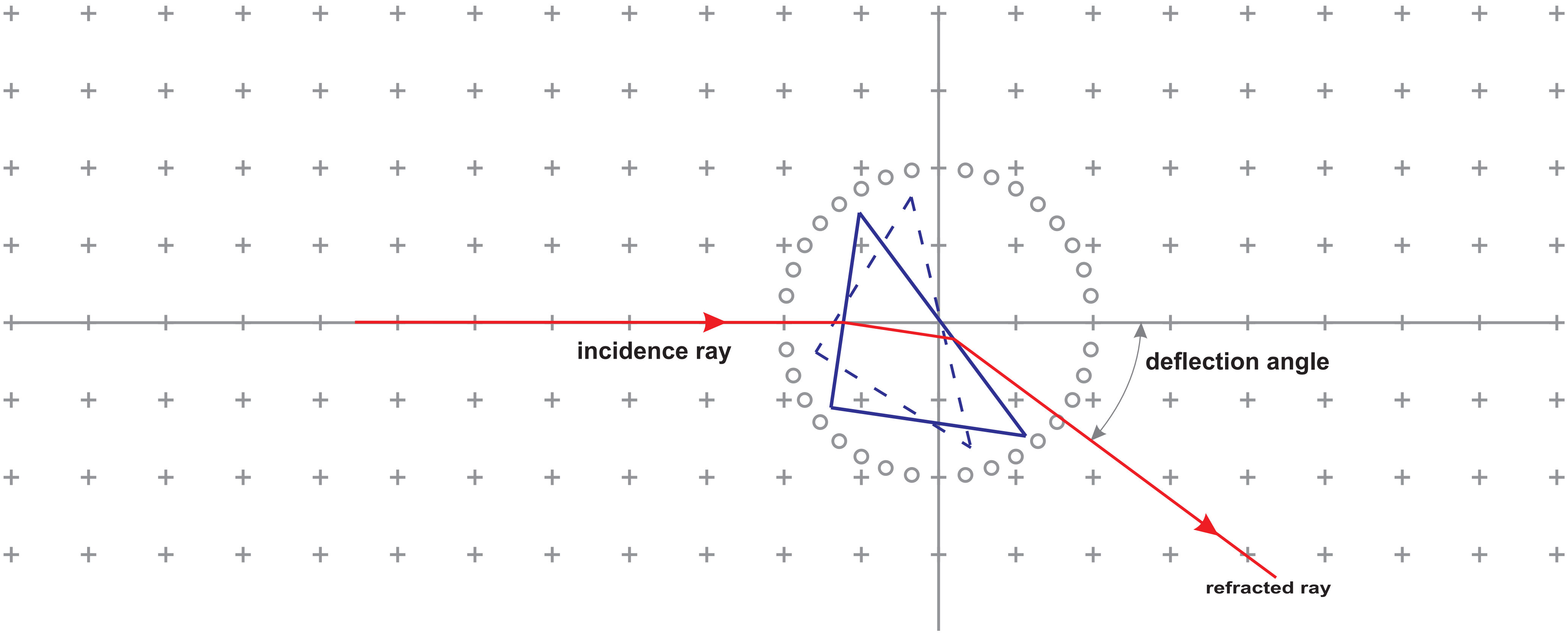
- Place the transparent parallel-plane slab on the determined position in the figure.
- Place two light sources on the left side of the board.
- With the aid of guiding lines, illuminate the surface of plane-parallel slab.
- Change the incidence angle of light by rotating the slab in its place and observe the amount of shift in the direction of light rays.



6- Prism

1- Deflection Angle (Refraction of light by prism)

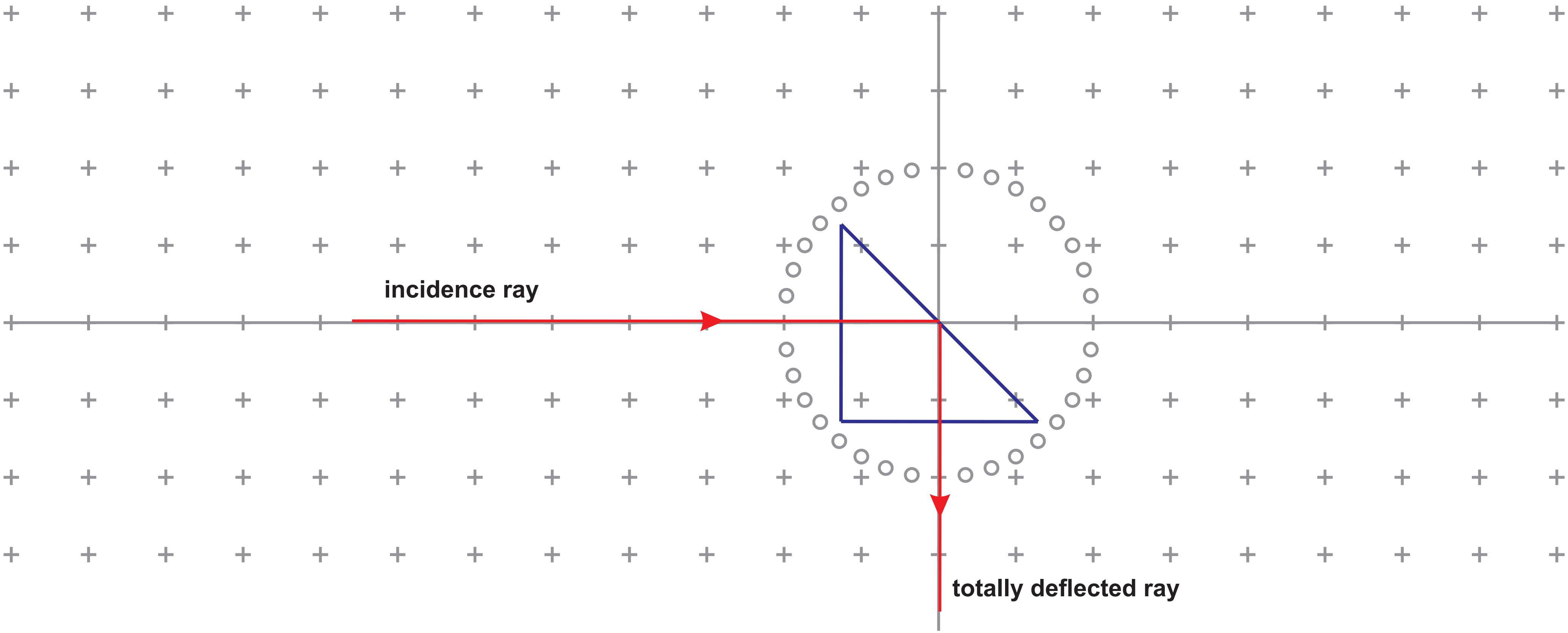
- Place the transparent prism on the determined position in the figure.
- By a light source and with the aid of guiding lines illuminate the surface of prism.
- Observe the refraction of light by prism.
- Angle between the outgoing ray and the direction of ingoing ray is called the light deflection angle.



6- Prism

2- A total Reflection (90 degrees light deflection by the prism)

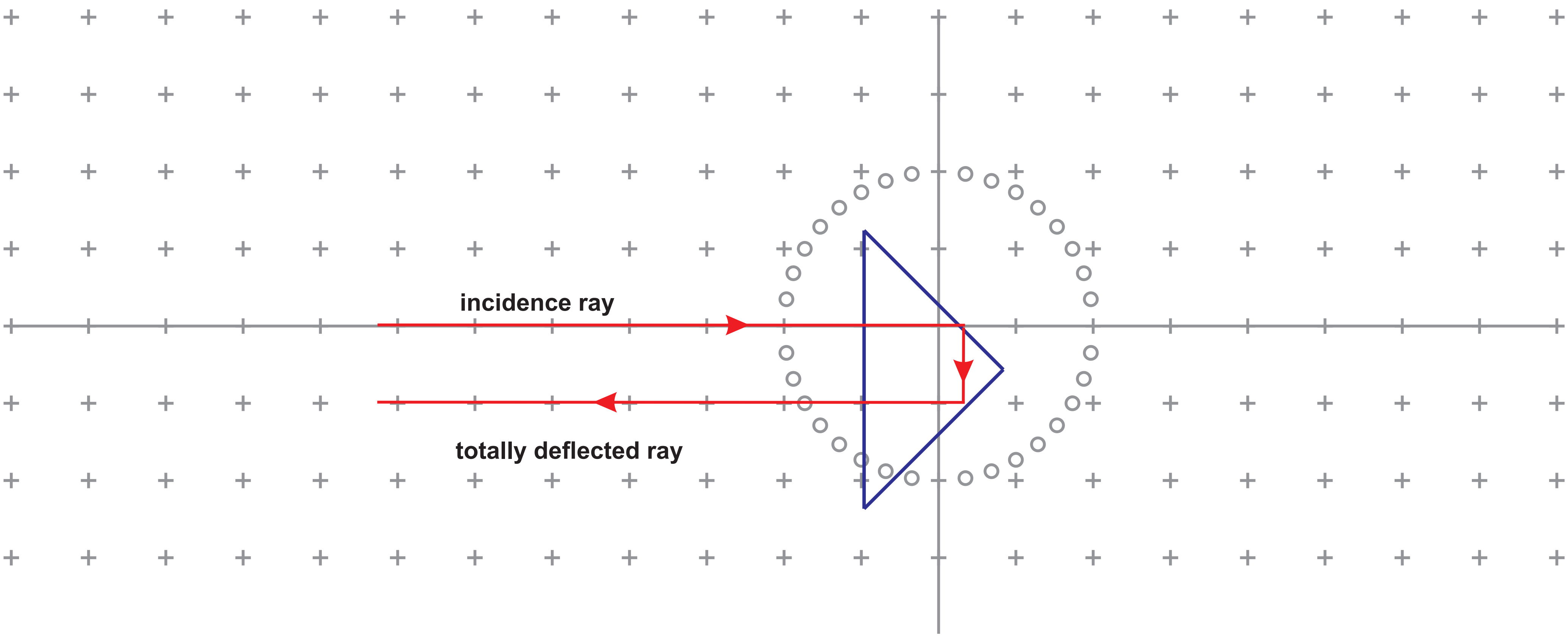
- Place the transparent prism on the determined position in the figure.
- By a light source and with the aid of guiding lines illuminate the prism and observe the result.
- In this case, a total reflection occurs instead of refraction, and light is deflected by 90 degrees.
- This phenomenon shows that the critical angle for the medium is less than the incidence angle of 45 degrees.



6- Prism

3- Two Total Reflections (180 degrees light deflection by the prism)

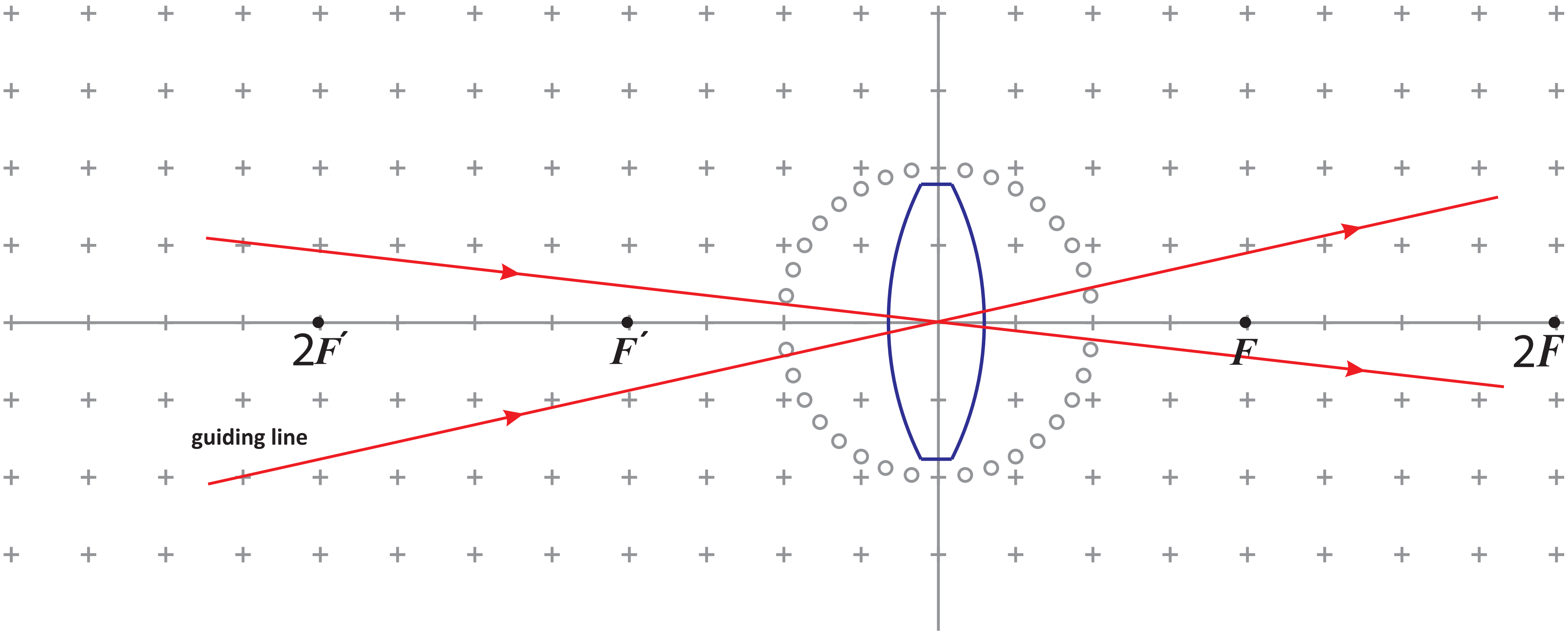
- Place the transparent prism on the determined position in the figure.
- By a light source and with the aid of guiding lines illuminate the prism and observe the result.
- In this case, two total reflections occur instead of refraction, and light is deflected by 180 degrees.
- This phenomenon shows that the critical angle for the medium is less than the incidence angle of 45 degrees.



7- Convex Lens

1- Optical Center

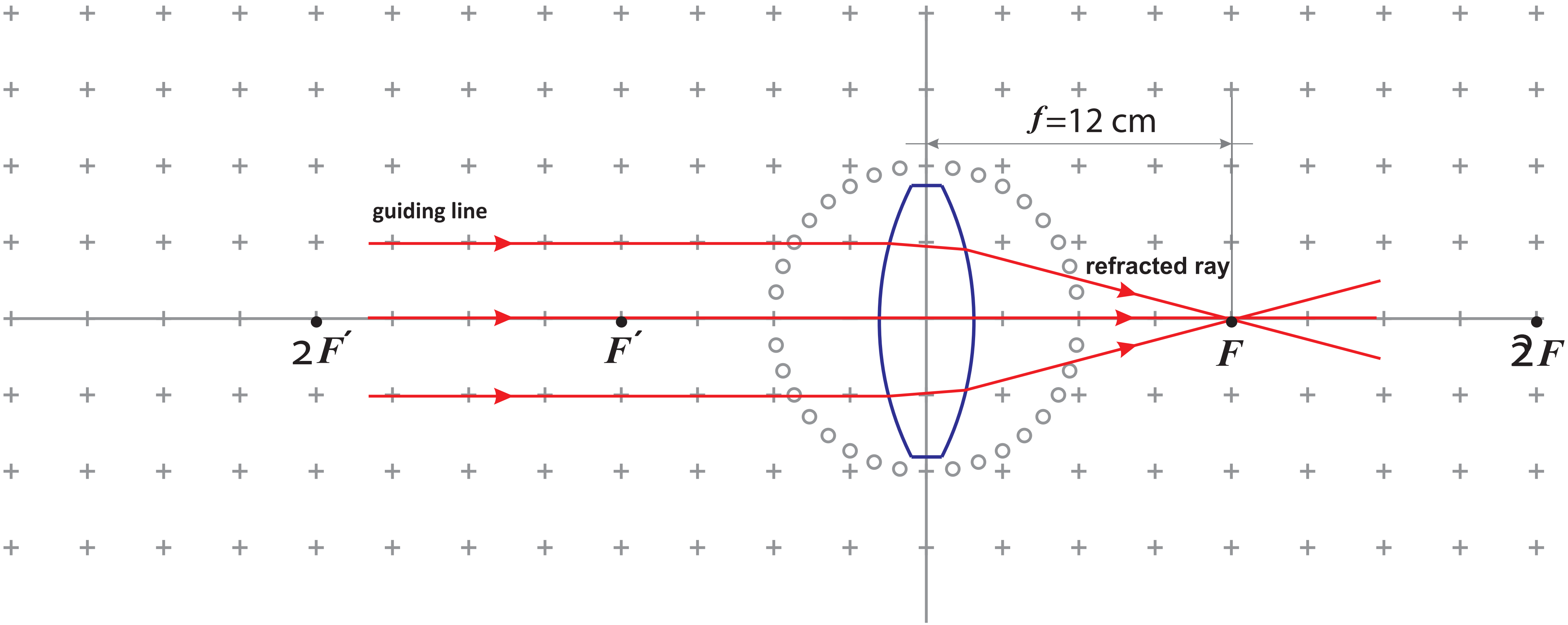
- Place a convex lens on the determined position in the figure. Place two or three light sources on the board.
- With the aid of guiding lines set the incident rays such that they fall on the optical center of lens.
- Make sure that the lens position is precise, and that the light rays pass through the optical center.
- Each incident ray falling on the optical center, will pass through the lens without refraction and deviation in its path.



7- Convex Lens

2- Principal Focal Point (Collimation point of the light rays parallel to the principal axis after refraction)

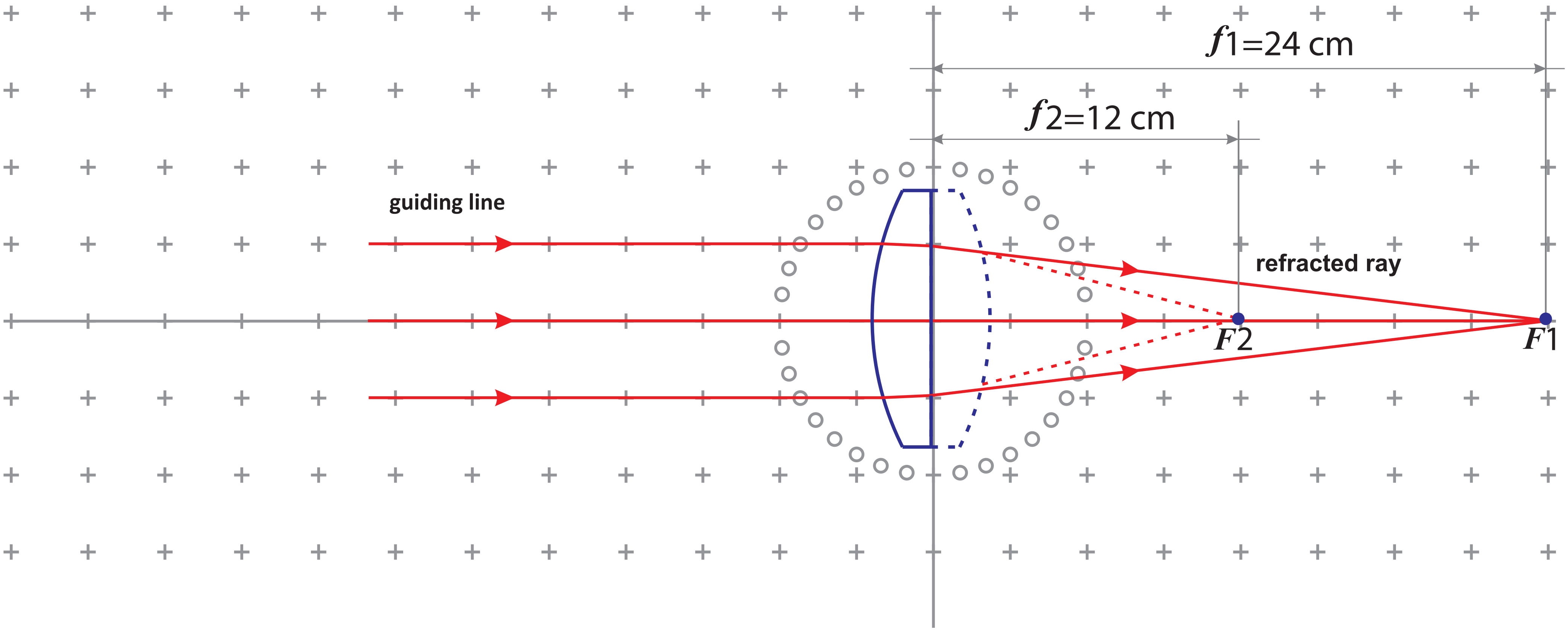
- Place the convex lens on the determined position in the figure.
- by two or three light sources, illuminate the lens with light rays parallel to the principal axis.
- Make sure that the lens position is precise, and that the light rays are parallel with the principal axis.
- Incident rays parallel to the principal axis, after refraction pass through a common point called the convex mirror focal point (F).



7- Convex Lens

3- Principal Focal Point (Effect of convexity on the position of focal point)

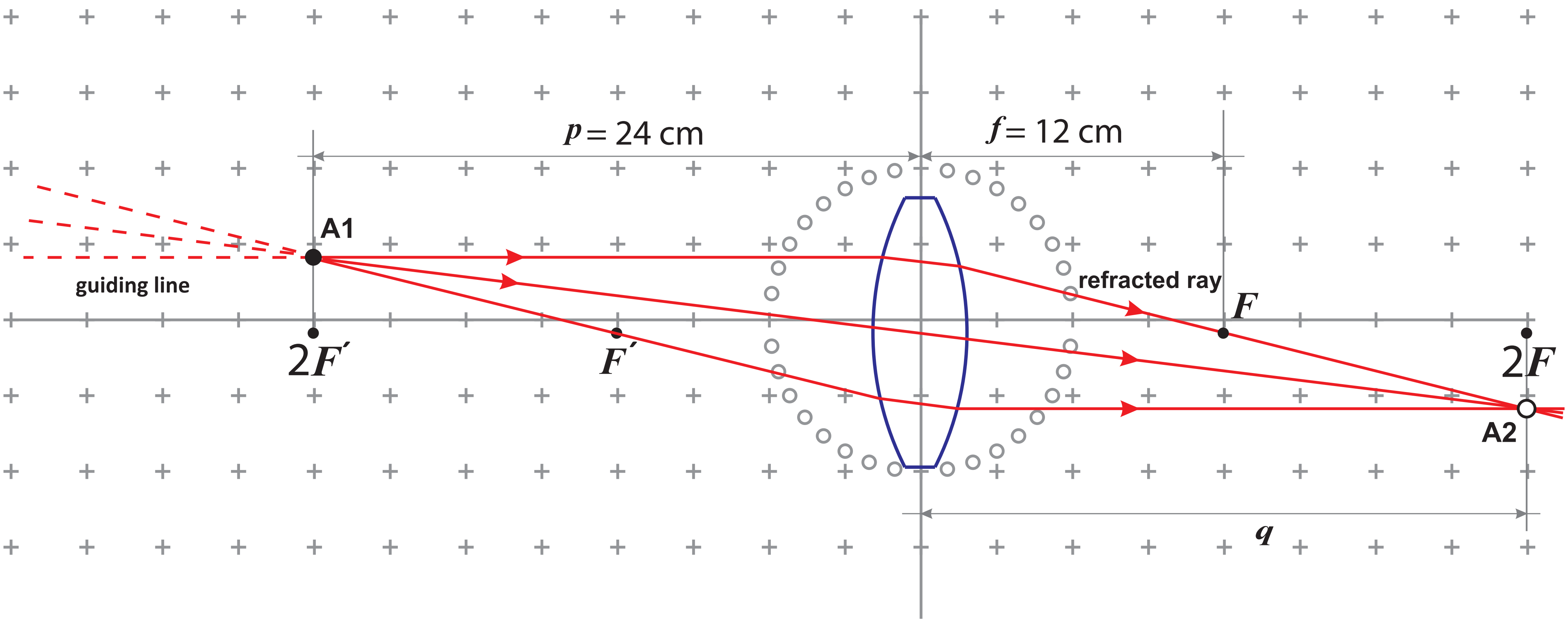
- First place a plano-convex lens and then two plano-convex lenses on the determined position in the figure. Then by two or three light sources, illuminate the lens with light rays parallel to the principal axis. (Two different experiments)
- Make sure that the lens position is precise, and that the light rays parallel with the principal axis.
- Incident rays parallel to the principal axis, pass through a common point called the convex mirror focal point (F), after refraction.



7- Convex Lens

4- Real Image (Magnification equal to unity)

- Place a convex lens on the determined position in the figure. Place two or three light sources on the board.
- Light rays pass the point A1 and fall on the lens. We assume A1 to be the real source of light rays.
- Light rays collimate at the point A2 after refraction, and A2 becomes a new light source.
- In this case, A1 is called a real source and A2 its real image. Why?

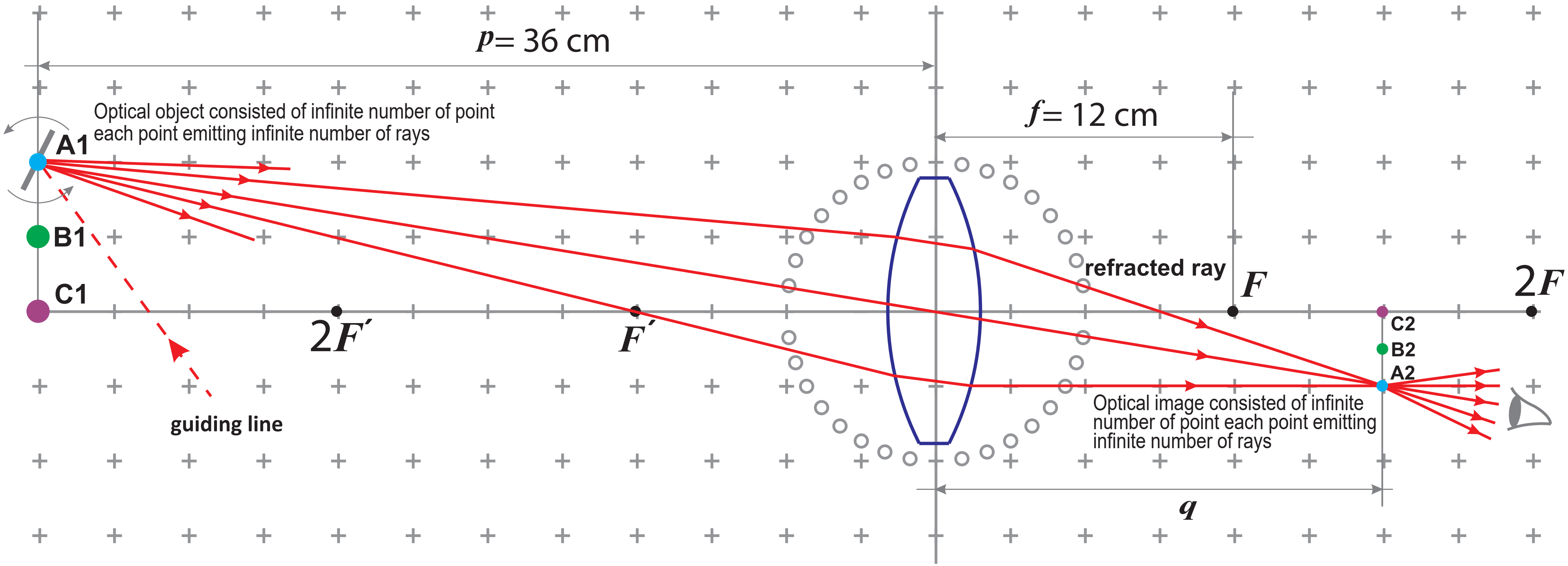


$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \Longrightarrow \frac{1}{24\text{ cm}}+\frac{1}{q}=\frac{1}{12\text{ cm}} \Longrightarrow q=24\text{ cm}$$

7- Convex Lens

5- Real Image (Object: Infinite number of rays, Image: Infinite number of rays)

- Place the convex lens on the determined position in the figure. Place the mirrorlet on the point A1.
- Light ray falls on the mirrorlet. By oscillating the mirrorlet, emit light rays from A1 to the lens and get their refractions.
- A2 is the real image of A1. Repeat this experiment for other points of the optical object A1B1C1D1.
- Each optical object and its image are consisted of infinite number of point sources and from each source infinite number of rays is emitted.

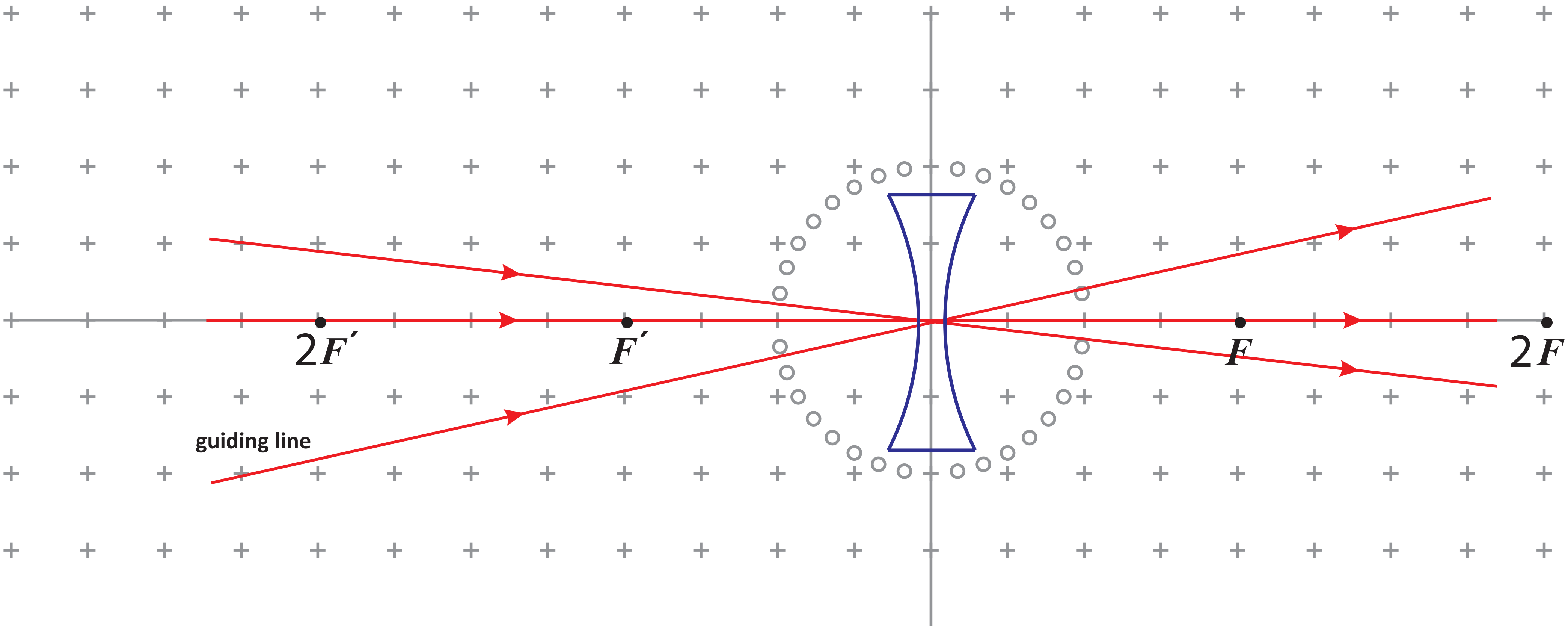


$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \Longrightarrow \frac{1}{36\text{ cm}}+\frac{1}{q}=\frac{1}{12\text{ cm}} \Longrightarrow q=18\text{ cm}$$

8- Concave Lens

1- Optical Center

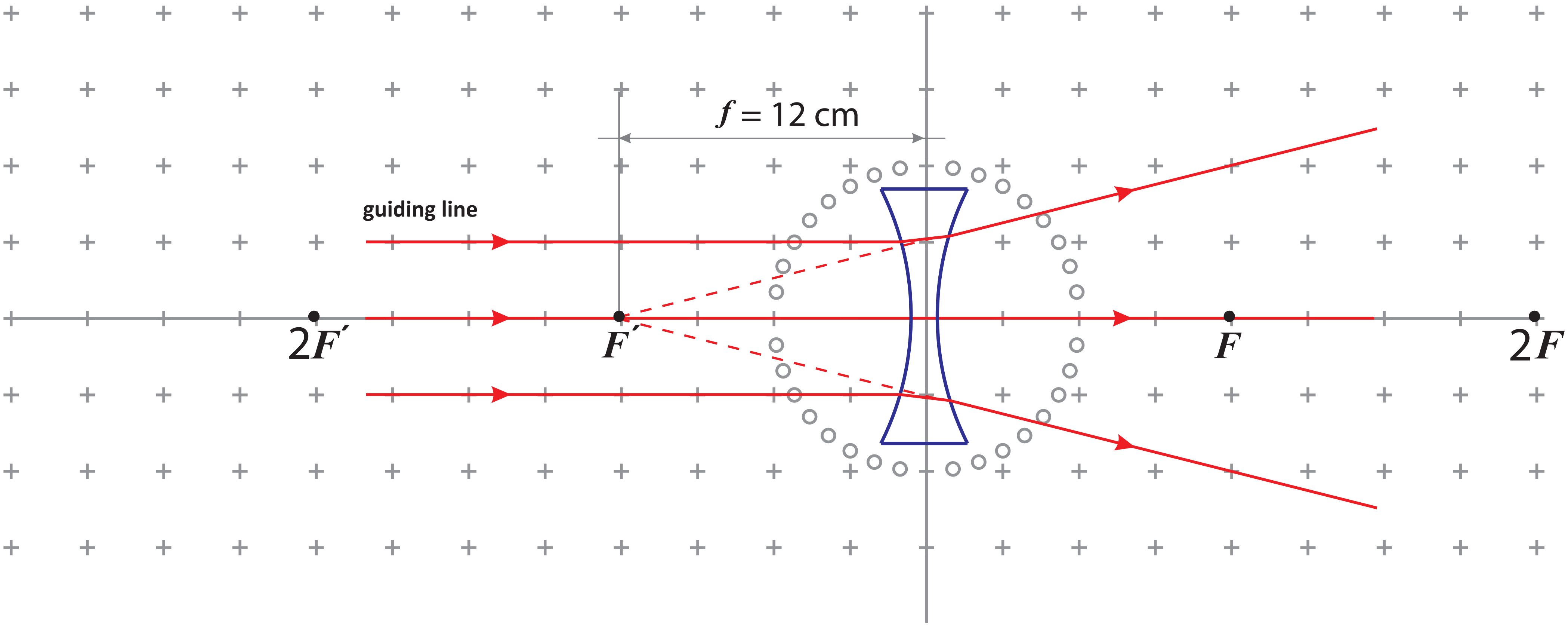
- Place a concave lens on the determined position in the figure. Place two or three light sources on the board.
- With the aid of guiding lines set the incident rays such that they fall on the optical center of lens.
- Make sure that the lens position is precise, and that the light rays pass through the optical center.
- Each incident ray falling on the optical center, will pass through the lens without refraction and deviation in its path.



8- Concave Lens

2- Virtual Focal Point (Incident rays toward the virtual focal point become parallel)

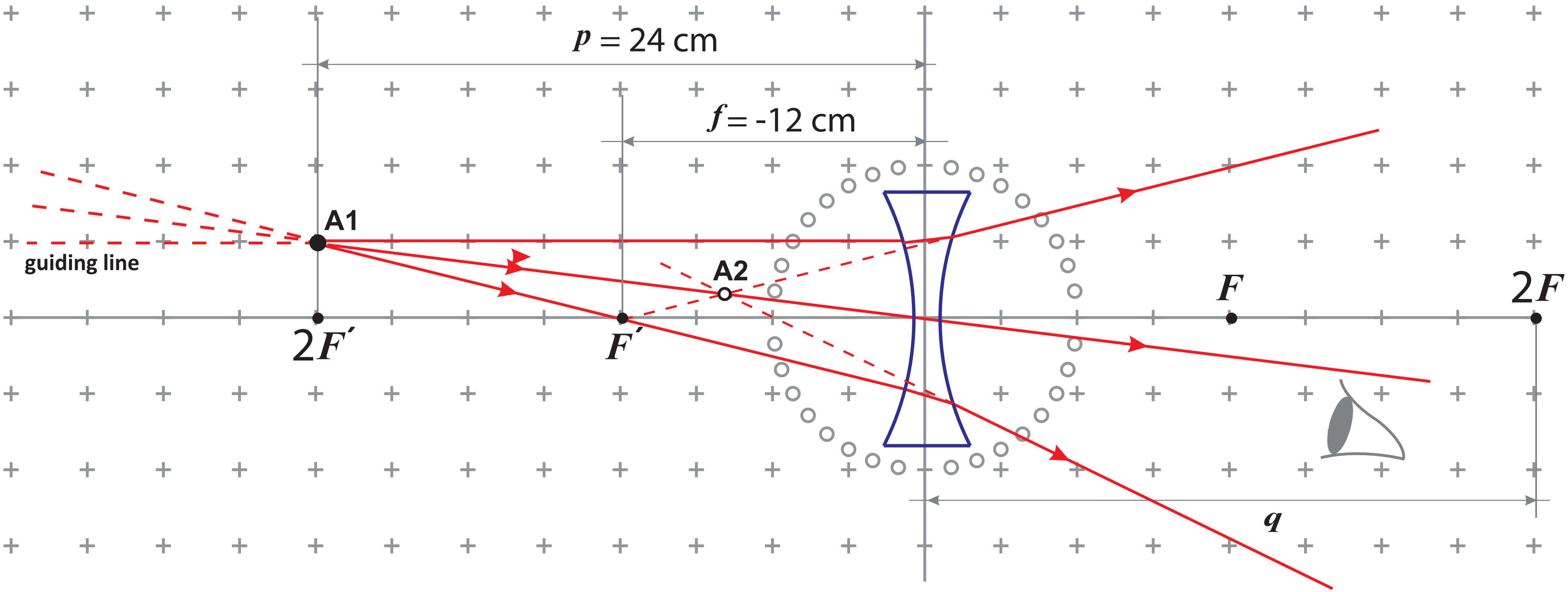
- Place a concave lens on the determined position in the figure. Place two or three light sources on the board.
- With the aid of guiding lines emit light rays toward the focal point at the other side of concave lens.
- Make sure that the lens position is precise, and that the direction of incident rays pass the focal point.
- Incident ray toward the virtual focal point of the concave lens, will become parallel to the principal axis after refraction.



8- Concave Lens

3- Virtual Image (Magnification less than unity)

- Place a concave lens on the determined position in the figure. Place two or three light sources on the board.
- Light rays pass the point A1 and fall on the lens. We assume A1 to be the real source of light rays.
- Light rays after refraction diverge such that it seems they have emerged from the point A2.
- In this case A1 is called a real source and A2 its virtual image. Why?

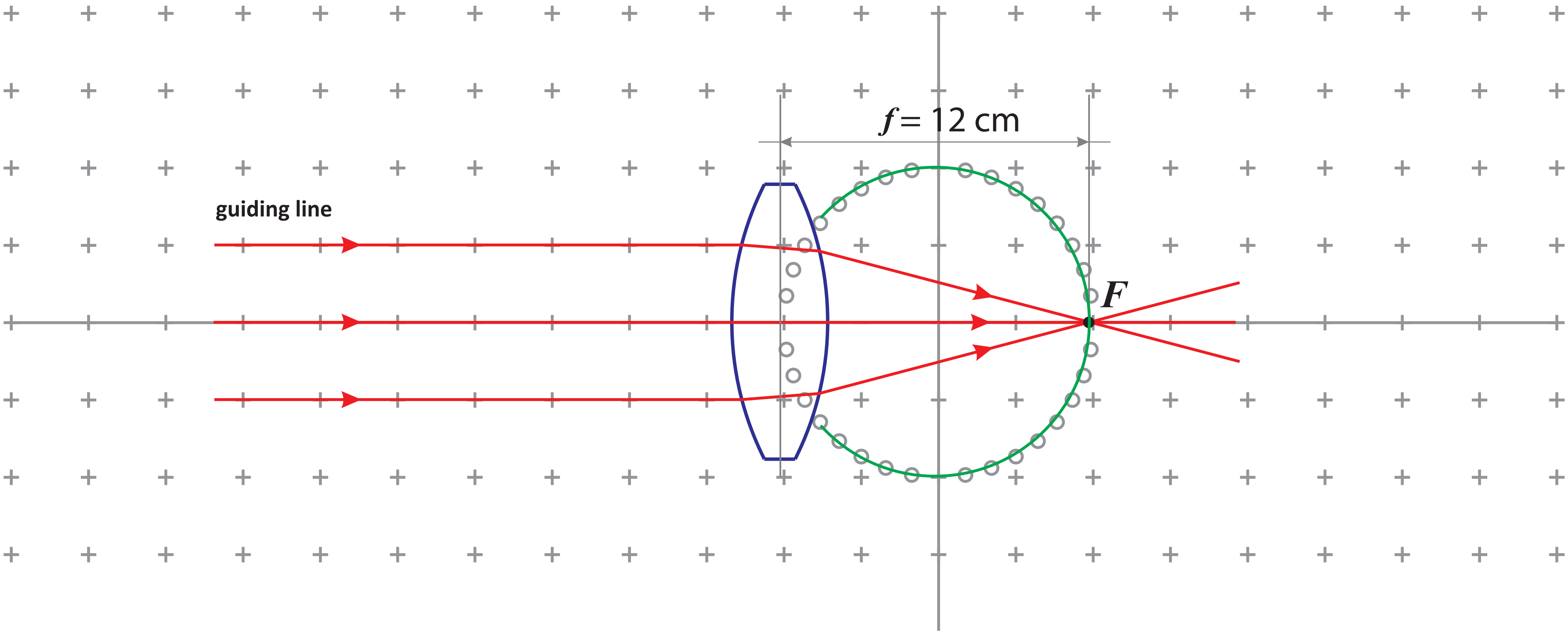


$$\frac{1}{p}+\frac{1}{q}=\frac{1}{f} \Longrightarrow \frac{1}{24\text{ cm}}+\frac{1}{q}=\frac{1}{-12\text{ cm}} \Longrightarrow q=-8\text{ cm}$$

9- Physics of the Eye

1- Healthy Lens

- The following figure is a schematic of the eye sphere. Place a convex lens suitable for the figure, as the eye lens on the determined position.
- By two or three light sources illuminate the lens with incident rays parallel to the principal axis.
- Make sure that the position of lens is precise and that light rays are parallel to the principal axis.
- Parallel rays are collimated on the eye's retina. It means that the image of a very distant point falls on the retina.



9- Physics of the Eye

2- Correction of the lens (Myopia (short-sightedness)

- The following figure is a schematic of the eye sphere. Place a convex lens suitable for the figure, as the eye lens on the determined position.
- By two or three light sources illuminate the lens with incident rays parallel to the principal axis.
- Rays are collimated in a position in front of the retina. This is a short-sighted eye.
- Solve the problem with a concave lens as an eyeglass.