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CBSE Coaching Classes | Classes VIII - XII

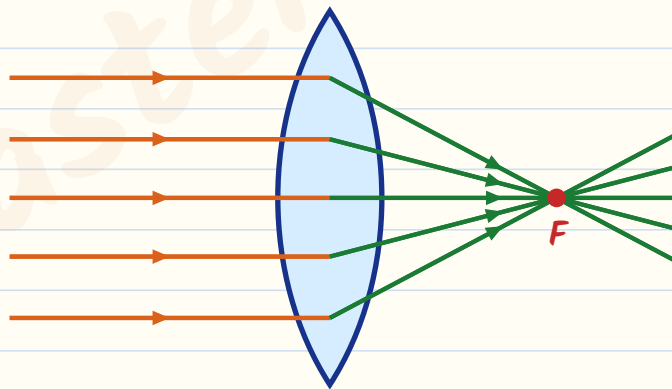
CLASS 8 | SCIENCE | CURIOSITY (NCERT)

Chapter 10

Light: Mirrors and Lenses

Detailed Handwritten-Style Notes

with activities, diagrams, tables, fun Q&A & solved NCERT exercise



Inside:

- * Spherical mirrors: concave & convex, images and uses
- * Laws of reflection (with all activities)
- * Concave mirror converges, convex diverges; solar concentrators
- * Lenses: convex & concave, converging & diverging
- * Fun Q&A after every topic + full NCERT exercise solutions
- * Revision sheet, extra practice and answer key

Chapter at a Glance

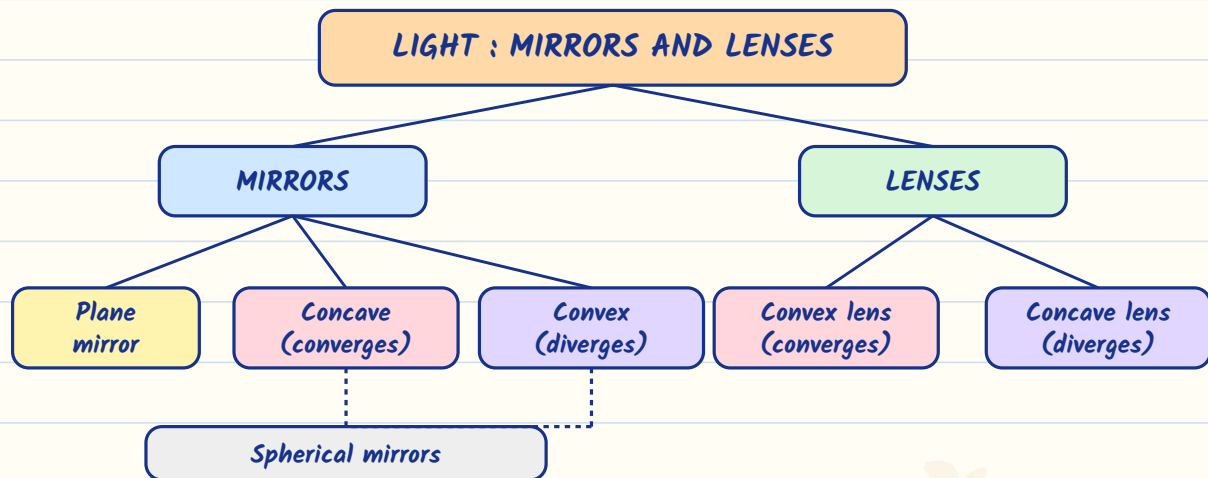


Fig. 1: Concept map of the chapter

Quick intro

In Grade 7 we learnt that a **plane mirror** always forms an **erect** image of the **same size** as the object (and the image is laterally inverted). In this chapter we find out what happens when the mirror or the transparent material is **curved**.

Meena at the science centre saw her face **very large** in one mirror, her brother **upside down** in another and a **tiny** version of herself in a third. Those were **spherical mirrors**!

Probe and Ponder - quick answers

- **Can we make mirrors giving enlarged or diminished images?** Yes. A **concave mirror** (object close) gives an enlarged image; a **convex mirror** always gives a diminished image.
- **"Objects in mirror are closer than they appear" - why?** Side-view mirrors are **convex**. They form **diminished** images, so vehicles look smaller and hence farther than they really are. In return the mirror gives a **much wider field of view** of the road behind.
- **Why a curved line on some reading glasses?** Such glasses combine **two lenses** of different curvature in one frame (one part for distant objects, the other for reading), so the curved line is the boundary between the two lenses.

10.1 What Are Spherical Mirrors?

Activity 10.1 - the shiny metallic spoon

Let us explore

- Hold the **inner (hollow)** side of a shiny spoon near your face: you see an **inverted** image.
- Hold the **outer (bulging)** side: you see an **erect** but **smaller** image.
- Move the spoon away slowly and observe how the image changes.

Conclusion: a curved shiny surface acts like a mirror, but the image is different from a plane mirror.

Spherical mirror - definition

A mirror whose reflecting surface is **spherical** (like a part of a hollow glass sphere) is called a **spherical mirror**.

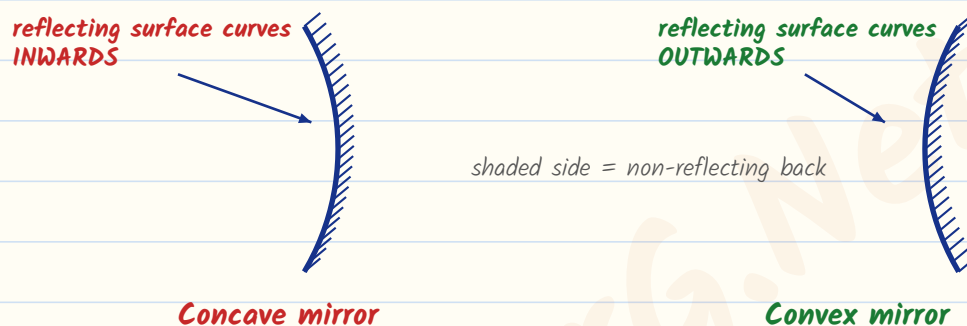


Fig. 2: Schematic representation of concave and convex mirrors

Point	Concave mirror	Convex mirror
Reflecting surface	Curves inwards (like the inside of a bowl)	Curves outwards (bulges towards you)
Shape of back	Back is bulging out	Back is hollow (caved in)
In diagrams	Shaded (non-reflecting) side is the outer bulge	Shaded (non-reflecting) side is the inner hollow
Light beam	Converging mirror	Diverging mirror
Outline of the surface	Circular	Circular

A step further - how are spherical mirrors made?

- They are **not** made by slicing a hollow glass sphere. A flat piece of glass is **ground and polished** into a curved surface.
- A thin reflective coating (e.g. **aluminium**) on the **outer** curved surface gives a **concave** mirror.
- The same coating on the **inner** curved surface gives a **convex** mirror.

Activity 10.2 - how to distinguish concave and convex mirrors

- Place both mirrors on a table with the reflecting surfaces **facing up**. Keep your eye at the table level and look from the side.
- The mirror whose reflecting surface is **sunken inwards** is **concave**; the one that is **raised outwards** is **convex**.

Kuch Mazedaar Questions - Spherical mirrors

Q1. Define a spherical mirror. Name its two types. (2 marks)

Ans. A mirror whose reflecting surface is a part of a hollow sphere is a spherical mirror. Its two types are the **concave mirror** (reflecting surface curves inwards) and the **convex mirror** (reflecting surface curves outwards).

Q2. How will you identify a concave and a convex mirror without using any light? (2 marks)

Ans. Place them on a table, reflecting surface up, and view from the side at eye level. The surface that curves **inwards** is concave; the surface that curves **outwards** is convex.

Q3. The inner side of a shiny spoon shows an inverted image while its outer side shows a small erect image. Why? (2 marks)

Ans. The inner side is curved inwards and acts like a **concave mirror** (can give inverted images); the outer side bulges outwards and acts like a **convex mirror** (always erect and diminished).

Q4. On which surface is the reflective coating applied to make a convex mirror? (1 mark)

Ans. On the **inner** curved surface of the polished glass piece.

10.2 Characteristics of Images by Spherical Mirrors

Activity 10.3 - object in front of the two mirrors

Place a concave and a convex mirror side by side and an object (toy) 3-4 cm in front. Then move the object slowly away. Observations are collected below.

Mirror	Object close to mirror	Object moved farther away
Concave	Image is erect and enlarged	Image becomes inverted . First it is enlarged, then it keeps getting smaller
Convex	Image is erect and diminished	Always erect and diminished. Size decreases only slightly as object moves away
Plane (for comparison)	Erect, same size	Always erect and same size

Remember

- **Plane mirror:** image is always erect and of the same size, whatever the distance.
- **Concave mirror:** size and nature (erect/inverted) of image **change** with the object distance.
- **Convex mirror:** image is **always erect and diminished**.
- **Lateral inversion** (left-right reversal) is seen in **all three** types of mirrors.
- We can **identify** an unknown mirror (plane / concave / convex) just by looking at the image of an object in it.

Uses of spherical mirrors

Mirror	Where it is used	Why
Concave	Reflectors of torches, headlights of cars and scooters	Concave shape sends light out as a strong beam
Concave	Dentist's mirror	Gives an enlarged view of teeth when held close
Concave	Main mirror of modern reflecting telescopes	A large concave mirror collects and converges light
Concave	Solar cookers / solar furnaces	Converges sunlight to a small area → heat
Convex	Side-view mirrors of vehicles	Erect image of traffic, wider area of road visible
Convex	Road safety mirrors at sharp bends & intersections	Drivers on both sides see each other → avoids collisions
Convex	Surveillance mirrors in big stores	Large area can be monitored to deter theft

Why convex for side-view mirrors?

- Image is always **erect** (so the driver sees the traffic the right way up).
- Image is **diminished**, so a **wider area** fits in the mirror.
- Caution: diminished image makes vehicles appear farther than they are, hence the warning **Objects in mirror are closer than they appear**.

Dekhe Kya Seekha Tumne? - Images and uses

Q1. Which mirror always forms an erect and diminished image? Give two uses. (2 marks)

Ans. Convex mirror. Uses: side-view mirrors in vehicles; road safety mirrors at sharp bends; surveillance mirrors in shops (any two).

Q2. Why does a dentist use a concave mirror? (1 mark)

Ans. When held close to the teeth, a concave mirror forms an **erect and enlarged** image, giving a magnified view of the teeth.

Q3. How does the image formed by a concave mirror change as the object is moved away from it? (2 marks)

Ans. Near the mirror the image is erect and enlarged. As the object moves away, the image becomes **inverted**; it is first enlarged and then keeps becoming smaller.

Q4. Why are convex mirrors preferred as rear-view mirrors? (2 marks)

Ans. They always give an **erect** image and cover a **much larger field of view** than a plane mirror, so the driver can see more of the traffic behind.

Q5. Differentiate between a plane mirror and a spherical mirror on the basis of images. (2 marks)

Ans. A plane mirror always forms an erect image of the same size as the object. In spherical mirrors the size of the image changes with object distance (concave: enlarged/diminished, erect/inverted; convex: always diminished and erect).

Extra - for Olympiad / foundation (beyond NCERT Grade 8)

Standard terms: Pole (**P**) = centre of the mirror surface; Centre of curvature (**C**) = centre of the sphere of which the mirror is a part; Principal axis = line through P and C; Principal focus (**F**) = point where parallel rays meet (concave) or appear to come from (convex); Focal length $f = PF$; Radius of curvature $R = PC = 2f$.

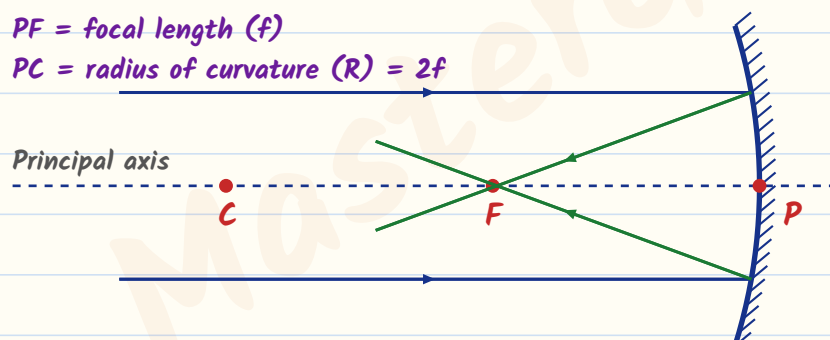


Fig. 3: Terms related to a concave mirror

Object position (concave mirror)	Image position	Nature and size
At infinity	At F	Real, inverted, highly diminished
Beyond C	Between F and C	Real, inverted, diminished
At C	At C	Real, inverted, same size
Between C and F	Beyond C	Real, inverted, enlarged
At F	At infinity	Real, inverted, highly enlarged
Between P and F	Behind the mirror	Virtual, erect, enlarged
Any position (convex mirror)	Behind mirror, between P and F	Virtual, erect, diminished

10.3 What Are the Laws of Reflection?

Activity 10.4 - beam of light on a plane mirror

- Make a **thin slit** by covering all openings of a comb with black paper except the middle one. Using a torch, send a thin beam along a white paper to a plane mirror.
- Change the angle at which the beam falls; the reflected beam **also shifts**. Reflection obeys a rule!

Representing light and important terms

Light is represented by straight lines with arrows called **rays** (light travels along a straight line).

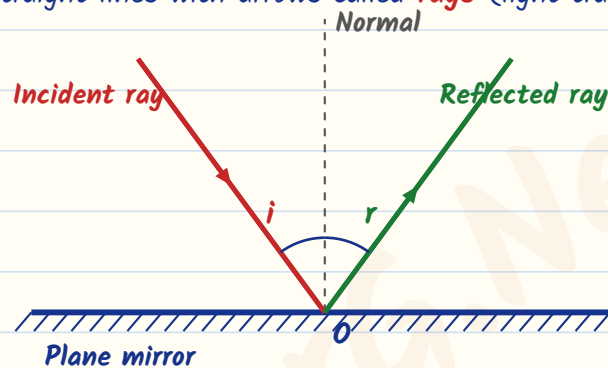


Fig. 4: Reflection of light from a plane mirror

Term	Meaning
Incident ray	The ray of light that falls on the mirror
Reflected ray	The ray that comes back from the mirror
Point of incidence (O)	The point where the incident ray strikes the mirror
Normal	A line drawn at 90° to the mirror surface at the point of incidence
Angle of incidence (i)	Angle between the incident ray and the normal
Angle of reflection (r)	Angle between the reflected ray and the normal

Measuring i and r (Table 10.1 idea)

- Draw the mirror line, the incident ray and the reflected ray. Remove the mirror, draw the normal at O (90° to the mirror line).
- Measure i and r with a protractor. Repeat for several angles of incidence. They come out **nearly equal**.
- If the beam falls **along the normal**, it returns along the same path: **$i = 0^\circ$ and $r = 0^\circ$** .

FIRST LAW OF REFLECTION

Angle of incidence (i) = Angle of reflection (r)

Activity 10.5 - bending the paper

- Use the same set-up on a stiff chart paper that extends beyond the edge of the table. The reflected beam is visible on the extended part.
- **Bend** the extended part along the table edge; the reflected beam **disappears**. **Flatten** it again; the beam **reappears**.
- So the reflected beam lies in the **same plane** as the incident beam; bending the sheet creates a new plane and breaks the alignment.

SECOND LAW OF REFLECTION

The incident ray, the normal at the point of incidence and the reflected ray all lie in the **SAME PLANE**.

Points to remember

- Both laws are valid for **all kinds of mirrors** - plane, concave and convex.
- If the incident ray makes an angle **x** with the **mirror surface** (not with the normal), then $i = 90^\circ - x$. Angle between incident and reflected ray = $2i$.
- Angle between the **reflected ray and the mirror** = $90^\circ - r$.

Solved numericals

Ex 1. A ray is incident at 40° to the normal. Find r and the angle the reflected ray makes with the mirror.

Sol. $r = i = 40^\circ$. Angle with mirror = $90^\circ - 40^\circ = 50^\circ$.

Ex 2. A ray makes an angle of 30° with a plane mirror. Find i , r and the angle between incident and reflected rays.

Sol. $i = 90^\circ - 30^\circ = 60^\circ$; $r = 60^\circ$; angle between rays = $60^\circ + 60^\circ = 120^\circ$.

Ex 3. A ray strikes along the normal. What are i and r ?

Sol. The ray falls at 90° to the mirror so $i = 0^\circ$ and $r = 0^\circ$; it retraces its path.

Kuch Mazedaar Questions - Laws of reflection

Q1. State the two laws of reflection. (2 marks)

Ans. (1) The angle of incidence is equal to the angle of reflection. (2) The incident ray, the normal to the mirror at the point of incidence and the reflected ray all lie in the same plane.

Q2. Define the normal, angle of incidence and angle of reflection. (3 marks)

Ans. **Normal:** line at 90° to the mirror at the point of incidence. **Angle of incidence:** angle between incident ray and normal. **Angle of reflection:** angle between reflected ray and normal.

Q3. Describe an activity to show that incident ray, normal and reflected ray lie in the same plane. (3 marks)

Ans. Place a plane mirror on a flat chart paper that extends beyond a table edge and send a thin beam on it. The reflected beam is seen on the extended part. On bending the extended part the beam disappears; on flattening it reappears. Hence all rays lie in one plane.

Q4. What are i and r when light falls along the normal? (1 mark)

Ans. Both are 0° .

Q5. Do laws of reflection hold for curved mirrors? (1 mark)

Ans. Yes, they are valid for **all** kinds of mirrors - plane, concave and convex.

Parallel Beams on Spherical Mirrors

Activity 10.6 - multiple parallel beams

Leave **many openings** of the comb uncovered to get several parallel beams and let them fall on the three mirrors one by one.

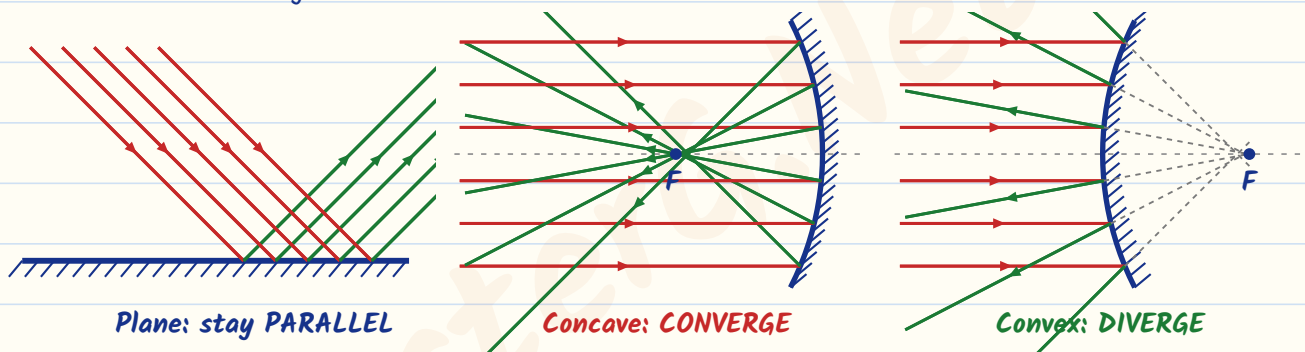


Fig. 5: Parallel rays reflected by plane, concave and convex mirrors

Mirror	Parallel beams falling on it	Reflected beams
Plane	Parallel	Remain parallel
Concave	Parallel	Get closer - they converge
Convex	Parallel	Spread out - they diverge

Why do they converge/diverge?

Each ray still obeys the laws of reflection, but the **curved surface** has a different normal at every point. So a parallel beam converges on a concave mirror and diverges on a convex mirror.

Activity 10.7 - burning paper with a concave mirror

Safety first!

Do it under **teacher/adult supervision**. **Never** look at the Sun or at the mirror reflecting the Sun. Focus the light only on a **paper**, never towards anyone's face or eyes.

- Hold the concave mirror facing the Sun and direct the reflected light on a sheet of thin paper.
- Adjust the paper's distance until a **sharp bright spot** is formed. Hold steady for some minutes: the paper may start to **burn and smoke**.

- Reason: reflected sunlight gets **concentrated** at one point, giving enough heat to ignite the paper.

A step further - solar concentrators

- Devices that **concentrate sunlight into a small area** using mirrors and lenses are called **solar concentrators**.
- The heat produces **steam** from a liquid, which is used to generate electricity, for large-scale cooking, and in **solar furnaces** (even for melting steel!).
- Solar cookers** use mirrors to converge sunlight; in Indian villages they save electricity and reduce fossil fuel use.

Dekhe Kya Seekha Tumne? - Mirrors and light beams

Q1. What happens to a parallel beam of light after reflection from (a) plane, (b) concave, (c) convex mirror? (3 marks)

Ans. (a) remains parallel; (b) converges; (c) diverges.

Q2. Explain how a concave mirror can set paper on fire. (2 marks)

Ans. The concave mirror converges the parallel rays of sunlight to a small bright spot. The concentrated light produces enough heat to ignite the paper kept there.

Q3. Why is it said that a convex mirror is a diverging mirror even though each ray obeys the laws of reflection? (2 marks)

Ans. Because of the outward-curved surface, the normals at different points point in different directions. Each ray still has $i = r$, but the reflected rays spread out (diverge).

Q4. What are solar concentrators? Give one use. (2 marks)

Ans. Devices using mirrors and lenses to concentrate sunlight in a small area. Use: heating a liquid to make steam for electricity generation / solar cooking / solar furnaces.

Q5. State the safety rules while doing Activity 10.7. (2 marks)

Ans. Do it under adult supervision; never look at the Sun or into the mirror reflecting it; focus the reflected light only on paper, not on anybody's face or eyes.

10.4 What Is a Lens?

Activity 10.8 - a water drop as a lens

- Rub a thin coat of oil/wax on a flat strip of glass or clear plastic. Put a small **drop of water** on it (oil helps form a round drop).
- The surface of the drop is **curved outwards**. Keep printed text under it: the letters under the drop look **larger** than the nearby letters.
- So the water drop acts like a **simple lens**; a **magnifying glass** is also a lens that makes letters look bigger.

Lens - definition

A **lens** is a piece of **transparent material** (usually glass or plastic) which has **curved surfaces**. Like mirrors, lenses can be convex or concave.

Point	Convex lens	Concave lens
Shape	Thicker at the middle than at the edges	Thicker at the edges than at the middle
Effect on parallel beam	Converges it	Diverges it
Other name	Converging lens	Diverging lens
Image (at any distance)	Enlarged / diminished, erect / inverted - depends on distance	Always erect and diminished
Examples	Magnifying glass, camera, microscope, telescope, spectacles for far-sightedness	Spectacles for short-sightedness, door peepholes

Mirror vs lens - a vital difference

Mirrors reflect light - we see the image **in** a mirror. **Lenses** let light pass through - we see things **through** a lens.

Activity 10.9 - object seen through a lens

Lens	Object at small distance	Object moved farther
Convex lens	Erect and enlarged	Appears inverted ; first enlarged, then diminishes in size
Concave lens	Always erect and diminished	Still erect and diminished; size changes (reduces) as distance increases
Flat glass piece	Same size, same shape	Same size, same shape

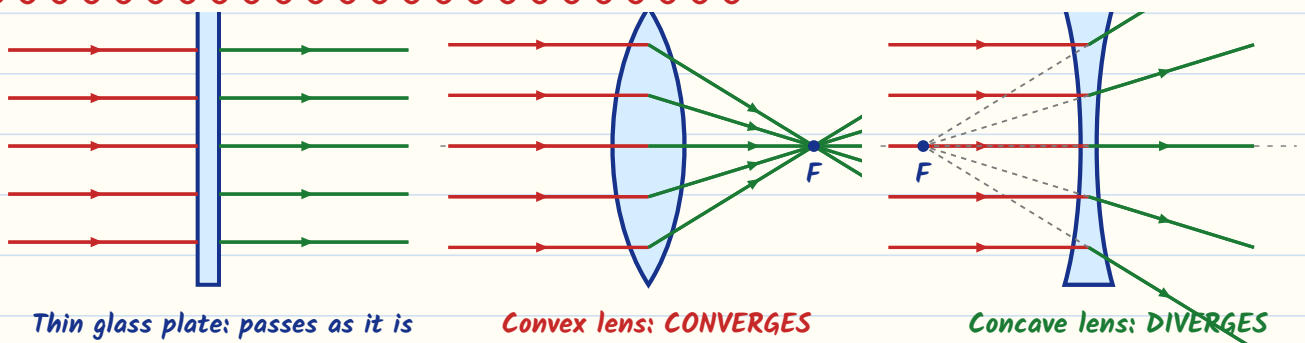
Activity 10.10 - parallel beams through lenses

Fig. 6: Parallel beams through a glass plate, a convex lens and a concave lens

- Thin transparent **glass plate**: the beam passes **as it is**.

- **Convex lens** converges the beam - called a **converging lens**.
- **Concave lens** diverges the beam - called a **diverging lens**.

Activity 10.11 - burning paper with a convex lens

Safety first!

Do **not** look at the Sun directly or through the lens - it can **damage your eyes**.

- Hold a convex lens in the path of sunrays and focus the light on a paper. A **bright spot** forms and the paper can **burn**, because a convex lens converges light.
- **Concave lens cannot burn paper** - it spreads the light.

Where all are lenses used?

- **Eyeglasses** help people see clearly; **cameras** (including smartphones), **telescopes**, **microscopes** and **magnifying glasses** use lenses.
- **Our eye** has a **convex lens** inside it. It can **change its shape**, which lets us read a book or see something far away.

Kuch Mazedaar Questions - Lenses

Q1. Define a lens. Name the two types. (2 marks)

Ans. A lens is a piece of transparent glass/plastic having curved surfaces. Types: convex lens (thicker at the middle) and concave lens (thinner at the middle).

Q2. How does a drop of water act as a lens? (2 marks)

Ans. The drop has a surface curved outwards (thicker in the middle), like a convex lens, so it makes the letters beneath it look larger.

Q3. Why is a convex lens called a converging lens and a concave lens a diverging lens? (2 marks)

Ans. A convex lens brings parallel light rays closer (converges them), whereas a concave lens spreads them out (diverges them).

Q4. How do images formed by a convex lens differ from those by a concave lens? (2 marks)

Ans. Convex lens: image may be enlarged, diminished or same size, erect or inverted depending on the distance. Concave lens: image is always erect and diminished.

Q5. Can a concave lens burn paper? Give reason. (1 mark)

Ans. No, it diverges sunlight and does not concentrate it at a point.

Q6. Differentiate between a mirror and a lens. (2 marks)

Ans. A mirror reflects light and we see the image in it; a lens allows light to pass through and we see through it.

Extra - for Olympiad / foundation (beyond NCERT Grade 8)

Lens terms: **Optical centre (O)** = centre of the lens; **Principal axis** = line through the optical centre joining the centres of curvature; **Principal focus (F)** = point where parallel rays meet after refraction (convex) or appear to come from (concave); **Focal length $f = OF$.**

Object position (convex lens)	Image position	Nature and size
At infinity	At F (other side)	Real, inverted, highly diminished
Beyond $2F$	Between F and $2F$	Real, inverted, diminished
At $2F$	At $2F$ (other side)	Real, inverted, same size
Between F and $2F$	Beyond $2F$	Real, inverted, enlarged
At F	At infinity	Real, inverted, highly enlarged
Between O and F	Same side as object, farther away	Virtual, erect, enlarged
Concave lens: any position	Same side, between O and F	Virtual, erect, diminished

Discover, Design and Debate + Our Scientific Heritage

- **Hospital visit:** doctors use small **concave** mirrors (head mirror/dental mirror) for examining ear, nose, throat and teeth - they give an enlarged, erect view.
- **Solar cooker proposal:** design with a large **concave reflector** (or several mirrors) converging sunlight on a vessel; include a budget for mirror/foil, frame, stand and vessel.
- **Virtual experiments:** use online simulations to move an object in front of spherical mirrors and lenses and watch the image change.

Our scientific heritage

More than **800 years ago**, in the time of the Indian mathematician **Bhāskara II**, astronomers used **shallow bowls of water** to observe stars and planets. By looking at reflected images through tubes at suitable angles, they measured positions of stars and planets. Although the laws of reflection are not mentioned in the literature, their methods suggest that they understood the idea in practice.

Snapshots - Quick Revision Sheet

Learn these by heart!

- Image by **concave mirror**: enlarged, diminished or same size; erect or inverted - depends on object distance.
- Image by **convex mirror**: always erect and diminished.
- **Two laws of reflection**: (1) $i = r$; (2) incident ray, normal and reflected ray lie in the **same plane**.
- Laws of reflection hold for **plane, concave and convex mirrors**.
- **Concave mirror converges** light beams; **convex mirror diverges** them.
- Image by **convex lens**: enlarged, diminished or same size; erect or inverted - depends on distance.
- Image by **concave lens**: always erect and diminished.
- **Convex lens converges** light; **concave lens diverges** it.

Device	Image	Light beam	Typical use
Plane mirror	Erect, same size, laterally inverted	Stays parallel	Daily mirrors
Concave mirror	Depends on distance	Converges	Torch, headlight, dentist, telescope, solar cooker
Convex mirror	Always erect, diminished	Diverges	Side-view, road & shop mirrors
Convex lens	Depends on distance	Converges	Magnifier, camera, microscope, spectacles
Concave lens	Always erect, diminished	Diverges	Spectacles, peepholes

Memory tricks

- **CAVE** → concave = caved in = **C**onverging mirror (it converges).
- **Convex = bulge**: convex mirror bulges, spreads light (diverges); convex **lens** is fat in the middle and converges.
- Mirror = image **in** it; lens = look **through** it.

NCERT Exercise - Keep the Curiosity Alive (Solved)

Q1. A ray is incident at 40° to the normal. What is the angle made by the reflected ray with the mirror? (i) 40° (ii) 50° (iii) 45° (iv) 60°

Ans. (ii) 50° . $r = i = 40^\circ$, so the reflected ray makes $90^\circ - 40^\circ = 50^\circ$ with the mirror surface.

Q2. Draw the reflected ray in each case of Fig. 10.22 and find the angle of reflection.

Ans. (a) Ray along the normal: $i = 0^\circ$, so $r = 0^\circ$ (ray returns along itself). (b) Mirror tilted, ray still along the normal of the tilted surface: $i = 0^\circ$, so $r = 0^\circ$. (c) Ray makes 20° with the normal: $r = 20^\circ$, reflected ray on the other side of the normal in the same plane.

Q3. Match each image of the sketch-pen cap (Fig. 10.23) with the correct mirror.

Ans. Image (i) is small and erect: **convex mirror**. Image (ii) is large (enlarged): **concave mirror**. Image (iii) is same size: **plane mirror**.

Q4. Match each image in Fig. 10.24 with convex lens, concave lens or flat glass.

Ans. Image (i) is enlarged: **convex lens**. Image (ii) is small: **concave lens**. Image (iii) is of the same size: **flat transparent glass piece**.

Q5. When light is incident along the normal on a mirror, which statement is true?

Ans. (ii) Angle of incidence is 0° . (The angle is measured from the normal, and the ray lies along the normal; reflection does take place and $r = 0^\circ$.)

Q6. Identify the plane, concave and convex mirrors in Fig. 10.25 from the images of the graph sheet.

Ans. Method: the mirror in which the graph squares look **the same size** as the real sheet is **plane**; where they look **larger/enlarged** it is **concave**; where the graph looks **smaller with a wider area visible** it is **convex**. Write the names above the mirrors accordingly.

Q7. A woman walks towards a large concave mirror. She will see that:

Ans. (iii) her inverted image keeps increasing in size and eventually becomes erect and magnified (when she is close to the mirror).

Q8. Hold a magnifying glass over text. What do you notice when you move it away? Which lens is it?

Ans. Close to the text, the letters look **bigger and erect**. As the lens is moved away, the letters become more enlarged, then blurred and finally appear **inverted and smaller**. A magnifying glass is a **convex lens**.

Q9. Match Column I with Column II.

Ans. (i) Concave mirror - **(a)**; (ii) Convex mirror - **(b)**; (iii) Convex lens - **(c)**; (iv) Concave lens - **(d)**.

Q10. Assertion: Convex mirrors are preferred for observing the traffic behind us. Reason: Convex mirrors provide a significantly larger view area than plane mirrors.

Ans. (i) Both are correct and the Reason explains the Assertion.

Q11. In Fig. 10.27, O = object, M = mirror, I = image. Which statement is true?

Ans. (i) Figure (a) shows a plane mirror (image same size as object, same distance behind M) and Figure (b) shows a concave mirror (image erect and enlarged, behind the mirror).

Q12. A pencil is placed behind a glass tumbler; now fill it halfway with water. How does the pencil look? Why?

Ans. Seen through the water-filled part, the pencil looks **thicker/enlarged and shifted or broken** compared to the part seen through air. The water-filled curved tumbler acts like a **convex lens** (thicker in the middle), and light also changes direction while passing between water, glass and air, so the shape appears changed.

Extra Practice (Test Yourself)**A. Multiple choice questions (1 mark each)**

1. A mirror whose reflecting surface curves inwards is a: (a) plane mirror (b) convex mirror (c) concave mirror (d) none of these
2. Side-view mirrors of vehicles are: (a) plane (b) concave (c) convex (d) either concave or plane
3. The image formed by a convex mirror is always: (a) erect and enlarged (b) erect and diminished (c) inverted and diminished (d) inverted and enlarged
4. A ray falls on a plane mirror making 35° with the normal. The angle between the reflected ray and the mirror is: (a) 35° (b) 55° (c) 70° (d) 90°
5. Lateral inversion is seen in: (a) plane mirror only (b) concave mirror only (c) convex mirror only (d) all three types of mirrors
6. Which of these can burn a paper using sunlight? (a) convex lens (b) concave mirror (c) both (a) and (b) (d) concave lens
7. A lens thicker at the edges than at the middle is: (a) convex (b) concave (c) converging (d) plane
8. The mirror used in surveillance of big stores is: (a) plane (b) concave (c) convex (d) cylindrical
9. A dentist uses which mirror to see an enlarged view of a tooth? (a) plane (b) convex (c) concave (d) none
10. The image formed by a concave lens is always: (a) real (b) erect and diminished (c) inverted (d) enlarged
11. Which of the following always gives an erect image? (a) concave mirror (b) convex lens (c) convex mirror (d) both (a) and (b)
12. When parallel rays fall on a convex mirror, the reflected rays: (a) converge (b) stay parallel (c) diverge (d) vanish

B. Fill in the blanks

1. A concave mirror is a _____ mirror while a convex mirror is a _____ mirror.
2. The angle between the normal and the reflected ray is called the angle of _____.
3. A convex lens is also called a _____ lens.
4. Our eye has a _____ lens inside it.
5. The normal makes an angle of _____ with the mirror surface.
6. Mirrors form images _____ them while lenses are used to see things _____ them.

C. True or False

1. Laws of reflection are valid only for plane mirrors.
2. A concave lens can burn a paper when kept in sunlight.
3. A plane mirror always forms an erect image of the same size.
4. In a convex mirror the size of the image decreases slightly as the object moves away.
5. A convex mirror converges a beam of parallel light.

D. Assertion - Reason

Options: (A) both true, R explains A; (B) both true, R does not explain A; (C) A true, R false; (D) A false, R true.

1. **A:** A concave mirror can set a paper on fire. **R:** It converges sunlight to a small bright spot.
2. **A:** Laws of reflection do not hold for convex mirrors. **R:** Convex mirrors diverge a parallel beam.
3. **A:** A concave lens is called a diverging lens. **R:** It makes parallel rays spread out.

E. Short and long answer questions

1. Distinguish between concave and convex mirrors (any three points). (3)
2. Explain with an activity how you can find out whether an unknown mirror is plane, concave or convex. (3)
3. Why is the warning "Objects in mirror are closer than they appear" written on side-view mirrors? (2)
4. State and explain the second law of reflection with the paper-bending activity. (3)
5. How does a water drop act as a lens? Which type of lens is it like? (2)
6. A ray makes 30° with a plane mirror. Find the angle of incidence, the angle of reflection and the angle between the incident and reflected rays. (3)
7. Write any three uses each of concave and convex mirrors. (3)

F. HOTS / case based

1. Priya sees her face enlarged and erect when she is very close to a mirror in a science centre; when she steps back, her face becomes inverted. Which mirror is it? What would she see if the mirror were convex?
2. A solar cooker uses mirrors to heat food. Which type of mirror is suitable and why? Why should the reflected light never be directed to a person's face?
3. A convex mirror and a concave lens both form erect diminished images. How do you tell them apart in a lab, without light beams?

Answer Key - Extra Practice

Section	Answers
A. MCQ	1-(c); 2-(c); 3-(b); 4-(b) [$i = r = 35^\circ$, so $90^\circ - 35^\circ = 55^\circ$]; 5-(d); 6-(c); 7-(b); 8-(c); 9-(c); 10-(b); 11-(c); 12-(c)
B. Blanks	1. converging, diverging; 2. reflection; 3. converging; 4. convex; 5. 90° ; 6. in, through
C. True/False	1-False; 2-False (it diverges light); 3-True; 4-True; 5-False (it diverges)
D. Assertion-Reason	1-(A); 2-(D); 3-(A)

Hints for Sections E and F

- **E3:** Convex mirror - wider view, erect, diminished image. **E4:** bending the extended paper makes the reflected beam vanish → all three rays are in one plane.
- **E6:** $i = 90^\circ - 30^\circ = 60^\circ$, $r = 60^\circ$, angle between rays = 120° .
- **F1:** Concave mirror. In a convex mirror she would always see an erect, smaller (diminished) face.
- **F2:** A **concave** mirror - it converges sunlight onto the vessel. Concentrated light can injure/burn eyes and skin, so it must never be pointed at anyone's face.
- **F3:** The concave lens is seen through (light passes through; the object must be behind it) whereas the convex mirror is seen in (silvered surface, image behind the mirror, opaque back).

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