CLASS 10 SCIENCE
CHAPTER: LIGHT - REFLECTION AND REFRACTION
NCERT EXERCISE SOLUTIONS

QUESTION 1,.
Which of the following materials cannot be used to make a lens?
(a) Water
(b) Glass
(c) Plastic
(d) Clay

ANSWER 1:
(d) Clay

Reason:
Clay is an opaque material. Light cannot pass through it. A lens must be made of a transparent material to allow light rays to refract (bend) through it.

QUESTION 2
The image formed by a concave mirror is observed to be virtual, erect and larger than the object. Where should be the position of the object?
(a) Between the principal focus and the centre of curvature
(b) At the centre of curvature
(c) Beyond the centre of curvature
(d) Between the pole of the mirror and its principal focus

ANSWER 2:
(d) Between the pole of the mirror and its principal focus

Reason:
When an object is placed very close to a concave mirror (between Pole P and Focus F), the reflected rays diverge. When produced backward, they meet behind the mirror to form a virtual, erect, and magnified image.

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QUESTION 3

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Where should an object be placed in front of a convex lens to get a real image of the size of the object?
(a) At the principal focus of the lens
(b) At twice the focal length
(c) At infinity

(d) Between the optical centre of the lens and its principal focus

ANSWER 3:
(b) At twice the focal length

Reason:
When an object is placed at a distance of 2f (twice the focal length) in front of a convex lens, its real and inverted image is formed at 2f on the other side. The size of the image is equal to the size of the object.

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QUESTION 4
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A spherical mirror and a thin spherical lens have each a focal length of -15 cm. The mirror and the lens are likely to be:
(a) Both concave
(b) Both convex
(c) The mirror is concave and the lens is convex
(d) The mirror is convex and the lens is concave

ANSWER 4:
(a) Both concave

Reason:
By New Cartesian Sign Convention, the focal length of both a concave mirror and a concave lens is taken as negative.

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QUESTION 5
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No matter how far you stand from a mirror, your image appears erect. The mirror is likely to be:
(a) Plane
(b) Concave
(c) Convex
(d) Either plane or convex

ANSWER 5:
(d) Either plane or convex

Reason:
A plane mirror always forms a virtual and erect image of the same size. A convex mirror always forms a virtual, erect, and diminished image for all positions of the object.

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QUESTION 6
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Which of the following lenses would you prefer to use while reading small letters found in a dictionary?
(a) A convex lens of focal length 50 cm
(b) A concave lens of focal length 50 cm
(c) A convex lens of focal length 5 cm
(d) A concave lens of focal length 5 cm

ANSWER 6:
(c) A convex lens of focal length 5 cm

Reason:
A convex lens acts as a magnifying glass when an object is placed within its focus. Magnifying power is inversely proportional to the focal length (P = 1/f). Therefore, a convex lens with a shorter focal length (5 cm) gives higher magnification than one with a 50 cm focal length.

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QUESTION 7
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We wish to obtain an erect image of an object, using a concave mirror of focal length 15 cm. What should be the range of distance of the object from the mirror? What is the nature of the image? Is the image larger or smaller than the object? Draw a ray diagram to show the image formation in this case.

ANSWER 7:
- Range of object distance:
The object must be placed at a distance less than its focal length, which means between 0 cm and 15 cm from the pole of the mirror.

- Nature of the image:
The image will be virtual and erect.

- Size of the image:
The image will be larger than the object (magnified).

[Note for Word Document: Leave space here to insert or draw the ray diagram showing the object between P and F, with divergent rays meeting behind the mirror.]

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QUESTION 8
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Name the type of mirror used in the following situations:
(a) Headlights of a car.
(b) Side/rear-view mirror of a vehicle.
(c) Solar furnace.
Support your answer with reason.

ANSWER 8:
(a) Headlights of a car: Concave mirror.
Reason: The light source (bulb) is placed at the principal focus of the mirror. The reflected rays emerge as a powerful, parallel beam of light that illuminates the road ahead over a long distance.

(b) Side/rear-view mirror of a vehicle: Convex mirror.
Reason: It always forms an erect and diminished image, which gives the driver a much wider field of view of the traffic behind them compared to a plane mirror.

(c) Solar furnace: Concave mirror.
Reason: It is a converging mirror. Large concave mirrors capture parallel sun rays and converge them to a single point (focus), generating an extremely high temperature at that spot.

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QUESTION 9
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One-half of a convex lens is covered with a black paper. Will this lens produce a complete image of the object? Verify your answer experimentally. Explain your observations.

ANSWER 9:

Yes, the convex lens will still produce a complete image of the object.

Explanation and Observation:
1. Every part of a lens forms a complete image of the object.
2. When the lower half of the lens is covered with black paper, light rays coming from the object can still pass through the top uncovered half.
3. These rays refract normally and converge on the other side to form the complete image.
4. However, because the total area available for light transmission is reduced by half, fewer light rays contribute to the image formation.
5. As a result, the intensity (brightness) of the image will be less compared to the image formed by an completely uncovered lens.

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QUESTION 10
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An object 5 cm in length is held 25 cm away from a converging lens of focal length 10 cm. Draw the ray diagram and find the position, size and the nature of the image formed.

ANSWER 10:
Given data:
Height of object (h) = +5 cm
Object distance (u) = -25 cm (By sign convention)
Focal length of converging/convex lens (f) = +10 cm

Using the Lens Formula:
$1/f = 1/v - 1/u$

Substitute the values:
$1/10 = 1/v - 1/(-25)$
$1/10 = 1/v + 1/25$
$1/v = 1/10 - 1/25$

Taking LCM of 10 and 25, which is 50:
$1/v = (5 - 2) / 50$
$1/v = 3 / 50$
$v = 50 / 3$
$v = +16.67$ cm

Image Position:
The image is formed at a distance of 16.67 cm on the other side of the lens.

Using the Magnification Formula:
m = v / u = h' / h

Substitute values to find image height (h'):
(50 / 3) / (-25) = h' / 5
-2 / 3 = h' / 5
h' = (-2 * 5) / 3
h' = -10 / 3
h' = -3.33 cm

Image Size and Nature:
- The negative sign of h' indicates that the image is inverted.
- Since the image is inverted, its nature is real.
- The height of the image (3.33 cm) is less than the object height (5 cm), so it is diminished.

Conclusion:
The image is real, inverted, diminished, and formed 16.67 cm behind the lens.

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QUESTION 11
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A concave lens of focal length 15 cm forms an image 10 cm from the lens. How far is the object placed from the lens? Draw the ray diagram.

ANSWER 11:
Given data:
Focal length of concave lens (f) = -15 cm (By sign convention)
Image distance (v) = -10 cm (Concave lens always forms a virtual image on the same side as the object)

Using the Lens Formula:
1/f = 1/v - 1/u

Substitute the values:
1/(-15) = 1/(-10) - 1/u
-1/15 = -1/10 - 1/u

Rearranging for 1/u:
1/u = -1/10 + 1/15

Taking LCM of 10 and 15, which is 30:
1/u = (-3 + 2) / 30
1/u = -1 / 30
u = -30 cm

Conclusion:
The object is placed at a distance of 30 cm in front of the concave lens.

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QUESTION 12
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An object of size 7.0 cm is placed at 27 cm in front of a concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed, so that a sharp focused image can be obtained? Find the size and the nature of the image.

ANSWER 12:
Given data:
Height of object (h) = +7.0 cm
Object distance (u) = -27 cm (By sign convention)
Focal length of concave mirror (f) = -18 cm (By sign convention)

Using the Mirror Formula:
1/f = 1/v + 1/u

Substitute the values:
1/(-18) = 1/v + 1/(-27)
-1/18 = 1/v - 1/27

Rearranging for 1/v:
1/v = 1/27 - 1/18

Taking LCM of 27 and 18, which is 54:
1/v = (2 - 3) / 54
1/v = -1 / 54
v = -54 cm

Screen Distance:
The screen should be placed at a distance of 54 cm in front of the mirror on the same side as the object.

Using the Magnification Formula for mirrors:
m = -v / u = h' / h

Substitute values to find image height (h'):
-[(-54) / (-27)] = h' / 7.0
-(2) = h' / 7.0
h' = -2 * 7.0
h' = -14.0 cm

Image Size and Nature:
- The negative sign of h' shows that the image is inverted.
- An inverted image formed on a screen is always real.
- The height of the image (14 cm) is double the height of the object (7 cm), so it is magnified.

Conclusion:
The screen should be placed 54 cm in front of the mirror. The image is real, inverted, and magnified (14 cm tall).

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QUESTION 13
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Find the focal length of a lens of power -2.0 D. What type of lens is this?

ANSWER 13:
Given data:
Power of the lens (P) = -2.0 D

Formula for Power of a lens:
P = 1 / f (where f is in metres)
Rearranging the formula:
f = 1 / P
f = 1 / (-2.0)
f = -0.5 m

Converting to centimetres:
f = -0.5 * 100 = -50 cm
Type of Lens:
Since the focal length and power are negative, it is a concave lens (diverging lens).
QUESTION 14
A doctor has prescribed a corrective lens of power +1.5 D. Find the focal length of the lens. Is the prescribed lens diverging or converging?
ANSWER 14:
Given data:
Power of the lens (P) = +1.5 D
Formula for Power of a lens:
P = 1 / f (where f is in metres)
Rearranging the formula:
f = 1 / P
f = 1 / (+1.5)
f = 10 / 15 m
f = 2 / 3 m
f = +0.67 m
Converting to centimetres:
f = (2 / 3) * 100 = +66.67 cm
Type of Lens:
Since the focal length and power are positive, the prescribed lens is a convex lens, which is a converging lens.