Next Toppers

आरंभ BATCH

ACP

AARAMBH CHAPTERWISE PROBLEMS

Class-10th



Light

PRASHANT KIRAD



(Options acche se padhna)

VERY SHORT QUESTIONS (1 Mark)

(A) Multiple Choice Questions (MCQ's)

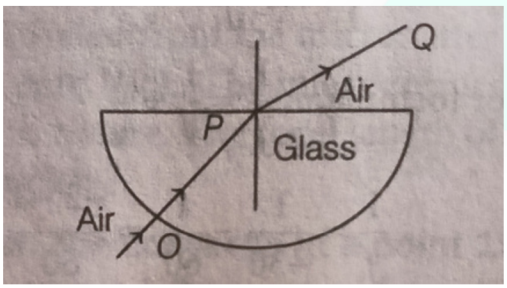
1. To obtain a magnification of + 2 with a concave mirror of radius of curvature 60 cm the object distance must be. [2023]

(a) - 90cm
(b) - 45cm
(c) -30cm
(d) - 15 cm

2. Which of the following mirror is used by a dentist to examine a small cavity in a patient's teeth ? [2021]

(a) Convex mirror
(b)Plane mirror
(c)Concave mirror
(d)Any spherical mirror

3. The angle of incidence from air glass at the point O on the hemispherical glass slab is. [2021]



(a) 45°
(b) 0°
(c) 90°
(d) 180°



4. When light is incident on a glass slab , the incident ray , refracted ray and the emergent ray are in three media A , B and C . if n_1 , n_2 and n_3 are the refractive indices of A , B and C respectively and the emergent ray is parallel to the incident ray , Which of the following is true ? [2021]

(a) $n_1 < n_2 < n_3$

(b) $n_1 > n_2 > n_3$

(c) $n_1 < n_2 = n_3$

(d) $n_1 = n_3 < n_2$

5. If the real image of a candle flame formed by a lens is three times the size of the flame and the distance between lens and image is 80 cm , at what distance should the candle be placed from the lens ? [2021]

(a) - 80 cm

(b) - 40 cm

(c) - 40/3 cm

(d) - 80/3 cm

6. An object of height 3.0 cm is placed vertically on the principal axis of a convex lens. When the object distance is - 37.5 cm , an image of height - 2.0 cm is formed at a distance of 25.0 cm from the lens. Next , the same object is placed vertically at 25.0 cm from the lens. In this situation , the image distance v and height h of the image is (according to the new cartesian sign convention). [2021]

(a) v = + 37.5 cm ; h = + 4.5 cm

(b) v = - 37.5 cm ; h = + 4.5 cm

(c) v = + 37.5 cm ; h = - 4.5 cm

(d) v = - 37.5 cm ; h = - 4.5 cm

7. The refractive index of flint glass is 1.65 and that for alcohol is 1.36 with respect to air. What is the refractive index of the flint glass with respect to alcohol ? [2022]

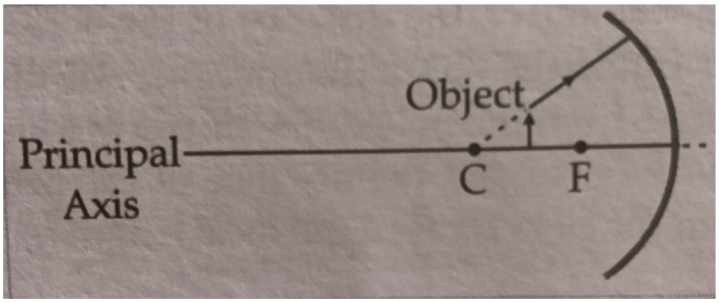
(a) 0.82

(b) 1.21

(c) 1.11

(d) 1.01

8.



While looking at the above diagram , Nalini concluded the following:

(a) the image of the object will be a virtual one.
(b) the reflected ray will travel along the same path as the incident ray but in opposite direction.
(c) the image of the object will be inverted.
(d) this is a concave mirror and hence the focal length will be negative.
Which one of the above statements are correct? [2022]
(a) 1 and 2
(b) 1 and 3
(c) 2 , 3 and 4
(d) 1 , 2 , 3 and 4

9. Three students A , B and C focused a distant building on a screen with the help of a concave mirror. To determine focal length of the concave mirror they measured the distance as give below: [Delhi 2017]
Student A : From mirror to the screen
Student B : From building to the screen
Student C : From building to the mirror
Who measured the focal length correctly ?
(a) Only A
(b) Only B
(c) A and B
(d) B and C

10. Consider these indices of refraction: glass: 1.52; air: 1.0003; water: 1.333. Based on the refractive indices of three materials , arrange the speed of light through them in decreasing order. [2022]
(a) The speed of light in water > the speed of light in air > the speed of light in glass.
(b) The speed of light in glass > the speed of light in water > the speed of light in air.
(c) The speed of light in air > the speed of light in water > the speed of light in glass.
(d) The speed of light in glass > the speed of light in air > the speed of light in water.

11.[i] A spherical mirror and a thin spherical lens have a focal length of (-) 15 cm. What type of mirror and lens are these? [SQP 2021]
[ii] The refractive index of flint glass is 1.65 and that for alcohol is 1.36 with respect to air. In which medium speed of light will be more? [SQP 2022]

12. [i] Where is the image formed when an object is at large distance from a concave mirror?
[ii] The image formed by a concave mirror is observed to be real , inverted and larger than the object. Where is the object placed? [2020-21]

13. Name the part of a lens through which a ray of light passes without suffering any deviation. [2020-21]

14. Both a spherical mirror and a thin spherical lens have a focal length of [-15] cm. What type of mirror and lens are these? [2020-21]

(yaha Marks katate h)

Assertion and Reason type of Questions

In the following questions a statement of Assertion is followed by a statement of Reason.
Mark the correct choice as two statements are given one labeled Assertion (A) and the other labeled Reason (R). Select the correct answer to these questions from the codes (a), (b), (c) and (d) as given below:
(a) Both A and R are true, and R is correct explanation of the assertion.
(b) Both A and R are true, but R is not the correct explanation of the assertion.
(c) A is true, but R is false.
(d) A is false, but R is true.

15. Assertion (A): A real image can be obtained on a screen.

Reason (R): A convex lens always forms real images. [2021]

16. Assertion (A): The refractive index of water is greater than that of glass.

Reason (R): Light travels faster in water than in glass. [2022]

17. Assertion (A): A concave mirror is used by ENT specialists.

Reason (R): Concave mirrors form diminished and virtual images. [2023]

18. Assertion (A): The image formed by a convex lens is always real and inverted.

Reason (R): A convex lens converges light rays to a point. [2019]

19. Assertion (A): A ray of light passing through the optical centre of a lens emerges undeviated.

Reason (R): At the optical centre, the angle of incidence is 90°. [2022]

(ho jaayenge aaram se)
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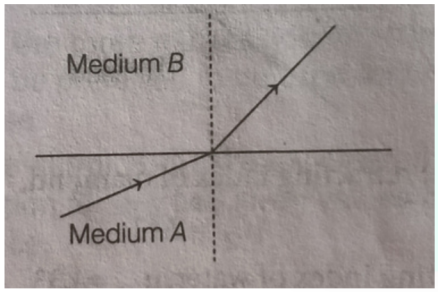
SHORT ANSWER TYPE QUESTIONS (2 and 3 Marks)

20. Draw a ray diagram in each of the following cases to show what happens after reflection to the incident ray when.
(i) It is parallel to the principal axis and falling on a convex mirror.
(ii) It is falling on a concave mirror while passing through its principal focus. (iii) It is coming oblique to the principal axis and falling on the pole of a convex mirror. [2020]

21. Rohit wants to have an erect image of an object using a converging mirror of focal length 40 cm.
(i) Specify the range of distance where the object can be placed in front of the mirror. Give reason for you answer.
(ii) Will the image be bigger or smaller than the object?
(iii) Draw a ray diagram to show the image formation in this case. [2022]

22. [i] Water has refractive index 1.33 and alcohol has refractive index 1.36. Which of the two medium is optically denser? give reason for your answer.
[ii] Draw a ray diagram to show the path of a ray of light passing obliquely from water to alcohol.
[iii] State the relationship between angle of incidence and angle of refraction in the above case. [CBSE 2020]

23. A light ray enters from medium A to medium B as shown in the figure. [2023]



[i] Which one of the two medium is denser w.r.t. other medium? Justify your answer.
[ii] A ray of light starting from diamond is incident on the interface separating diamond and water. Draw a labelled ray diagram to show the refraction of light in this case.
[iii] Absolute refractive indices of diamond and water are 2.42 and 1.33 , respectively. Find the value of refractive index of water w.r.t. diamond.

24. [i] An object is kept at a distance of 1m from a lens of power + 2 D.
[a] Identify the type of lens.
[b] Calculate its focal length and distance of the image formed.

25. It is desired to obtain an erect image of an object , using concave mirror of focal length of 12 cm.
[i] What should be the range of the object distance in the above case?
[ii] Will the image be smaller or larger than the object? Draw a ray diagram to show the formation of image in this case.
[iii] Where will the image of this object be , if it is placed 24 cm in front of the mirror? [2020]

26. An object of height 1.2 cm is placed before a concave mirror of focal length 20 cm so that a real image is formed at a distance of 60 cm from it. Find the position of the object. What will be the height of the image formed? [2018]

27. Rohit wants to have an erect image of an object using a converging mirror of focal length 40 cm.
[i] Specify the range of distance where the object can be placed in front of the mirror. Justify.
[ii] Draw a ray diagram to show image formation in this case.
[iii] State one use of the mirror based on the above kind of image formation [2023]

28. [i] A ray of light enters into benzene from air. If the refractive index of benzene is 1.50, by what percentage does the speed of light reduce when entering benzene?
[ii] For the same angle of incidence in media A , B and C , the angle of refraction are 20 degree , 30 degree and 40 degree respectively. In which medium will the velocity of light be maximum? Give reason in support of your answer.
[iii] The image of an object formed by a mirror is real , inverted and is of magnification -1. If the image is at the distance of 30 cm from the mirror , where is the object placed ? Find the position of the image if the object is now moved 20 cm towards the mirror. what is the nature of the image obtained?
[iv] What is meant by power of lens? You have three lenses L_1, L_2 and L_3 of powers +10 D , +5 D and -10 D respectively. State the nature and focal length of each lens. Explain which of the three lenses will from a virtual and magnified image of an object placed at 15 cm from the lens. Draw the ray diagram in support of your answer. [2019]

29. Rohit focused the image of a candle flame on a white screen using a convex lens. He noted down the position of the candle , screen and lens as under :
Position of candle = 26.0 cm
Position of convex lens = 50.0 cm
[i] What is the focal length of the convex lens?
[ii] Where will the image be formed if he shifts the candle towards the lens at a position of 38 cm?
[iii] Draw a ray diagram to show the formation of the image in case [ii] as said above? [2018]

(pahle points socho firr likho)

LONG ANSWER TYPE QUESTIONS (5 Marks)

30. [i] A lens produce a magnification of -0.5. Is this a converging or diverging lens? If the focal length of the lens is 6 cm, draw a ray diagram showing the image formation in this case.
[ii] A girl was playing with a thin beam of light from a laser torch by directing it form different directions on a convex lens held vertically. She was surprised to see that in a particular direction, the beam of light continues to move along the same direction after passing through the lens. State the reason for her observation. Draw a ray diagram to support your answer. [2020]

31. An object 6 cm in size is placed at 50 cm in front of a convex lens of focal length 30 cm. At what distance from the lens should a screen be placed in order to obtain a sharp image of the object? Find the nature and size of the image. Also, draw labelled ray diagram to show the image formation in this case. [Set-III, 2019, Outside Delhi]

32. A 6 cm tall object is placed perpendicular to the principal axis of a concave mirror of focal length 30 cm. The distance of the object from the mirror is 45 cm. Use mirror formula to determine the position, nature and size of the image formed. Also, draw labelled ray diagram to show the image formation in this case. [Outside Delhi, Set-III, 2019]

33. An object is placed at a distance of 30 cm from a concave lens of focal length 30 cm.
(i) Use lens formula to determine the distance of the image from the lens.
(ii) List four characteristics of the image (nature, position, size, erect/inverted) in this case.
(iii) Draw a labelled diagram to justify your answer of part (ii). [Delhi, Set-II, 2019]

34. An object is placed at a distance of 60 cm from a concave lens of focal length 30 cm.
(i) Use lens formula to find the distance of the image from the lens.
(ii) List four characteristics of the image (nature, position, size, erect/inverted) formed by the lens in this case.
(iii) Draw ray diagram to justify your answer of part (ii). [Outside Delhi, Set-III, 2019]

(pahle points socho firr likho)

Case Study/Source Based Question

35. Ananya was performing an experiment in her school lab using a rectangular glass slab. She allowed a ray of light to fall on the slab at an angle. She observed that the ray bent towards the normal as it entered the glass and then bent away from the normal as it emerged back into air. She marked the incident ray, refracted ray, emergent ray, and the normals. Interestingly, she noticed that the emergent ray was parallel to the incident ray, but slightly displaced sideways. This sideways shift increased when the angle of incidence increased. She also repeated the activity using liquids like water and glycerin, and observed different degrees of bending.

[i] What phenomenon is observed when the ray bends while entering the glass slab?
(a) Reflection
(b) Refraction
(c) Dispersion
(d) Diffraction

[ii] The ray bends towards the normal inside the glass slab because:
(a) Light speeds up
(b) Light slows down
(c) Light gets absorbed
(d) Light reflects back

[iii] The parallel but shifted ray after emerging from the slab is due to:
(a) Diffusion
(b) Lateral Displacement
(c) Total Internal Reflection
(d) Optical Rotation

PK Special [KBC]



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36. A convex lens forms a real, three times magnified image on a screen. If the focal length of the lens is 30 cm, calculate:
(a) the object distance
(b) image distance
(c) draw the ray diagram.

37. An object is placed 20 cm from a concave mirror. The image formed is twice the size of the object and real. Find:
(a) the focal length of the mirror
(b) position of the image
(c) draw the ray diagram.

38. The image of a candle formed by a convex lens is inverted and on a screen.
(a) What is the nature of the image?
(b) What would happen if the object is moved closer to the lens?

39. One half of a convex lens is covered with a black paper. (2016)
(a) Show the formation of image of an object placed at 2F in front of such a covered lens using a ray diagram. Mention the position and nature of image.
(b) Draw the ray diagram for the same object at the same position in front of the same lens, but now uncovered. Will there be any difference in the image obtained in the two cases? Give reason.

40. An object is placed between F and 2F in front of a convex lens. Draw a ray diagram and describe the nature, size, and position of the image formed.

41. Why does a convex mirror always form a virtual and diminished image, no matter where the object is placed? Explain with a ray diagram.

42. 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 focussed image can be obtained? Find the size and the nature of the image.

43. Many optical instruments consist of a number of lenses. They are combined to increase the magnification and sharpness of the image. The net power (P) of the lenses placed in contact is given by the algebraic sum of the powers of the individual lenses:

$P_1, P_2, P_3,...$ as

$P = P_1 + P_2 + P_3 + ...$

This is also termed as the simple additive property of the power of lens, widely used to design lens systems of cameras, microscopes, and telescopes. These lens systems can have a combination of convex lenses and also concave lenses. (2023)

(a) What is the nature (convergent/divergent) of the combination of a convex lens of power +4 D and a concave lens of power -2 D?

(b) Calculate the focal length of a lens of power -2.5 D.

44. Find out from the following table the medium having the highest optical density. Also find the medium with the lowest optical density.

Material medium	Refractive index	Material medium	Refractive index
Air	1.0003	Canada Balsam	1.53
Ice	1.31		
Water	1.33	Rock said	1.54
Alcohol	1.36		
Kerosene	1.44	Carbon disulphide	1.63
Fused quartz	1.46	Dense flint glass	1.65
Turpentine oil	1.47	Ruby	1.71
Benzene	1.50	Sapphire	1.477
Crown glass	1.52	Diamond	2.42

45. Study the data given below showing the focal length of three concave mirrors A, B, and C and the respective distances of objects placed in front of the mirrors:

(i) In which one of the above cases the mirror will form a diminished image of the object? Justify your answer.

(ii) List two properties of the image formed in case 2.

(iii) (A) What is the nature and size of the image formed by mirror C?

Draw ray diagram to justify your answer.

Case	Mirror	Focal Length (cm)	Object Distance (cm)
1	A	20	45
2	B	15	30
3	C	30	20

Kitne Questions kar paaye?

SOLUTIONS



SOLUTIONS

VERY SHORT ANSWER TYPE QUESTIONS:

1. (d)

2. (c)

3. (b)

4. (d)

5. (d)

6. (c)

7. (b)

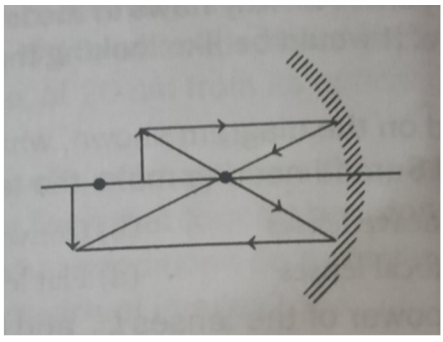
8. (c)

9. (a)

10. (c)

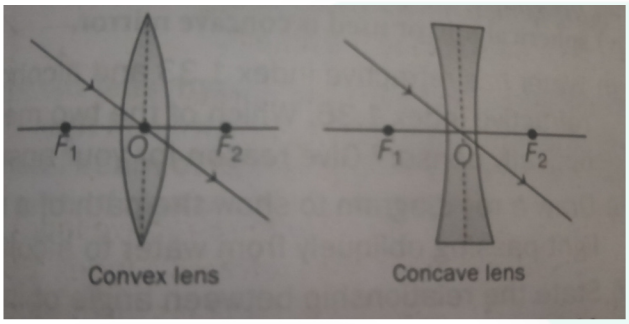
11. [i] Both are concave. As for concave mirror and concave lens, focal length is negative.
[ii] The speed of light is more in alcohol than in flint glass, as refractive index for flint glass is more than alcohol.

12. [i] The image formed is at the focus of the mirror.
[ii] When the object is placed between the principal focus and the centre of curvature of concave mirror, the image formed will be real, inverted and larger than the object (as shown in figure).
AB → object, A'B' → image



SOLUTIONS

13. When a ray of light passes through optical centre of the lens (both concave and convex), it will emerge out undeviated (as shown in figure).



14. Here, focal, length = (-5) cm = negative
According to new Cartesian sign conventions, the focal length of concave mirror and the convex lens are negative. So, both spherical mirror and thin spherical lens will be concave in nature.

ASSERTION AND REASON TYPE QUESTIONS:

15. [c]

16. [d]

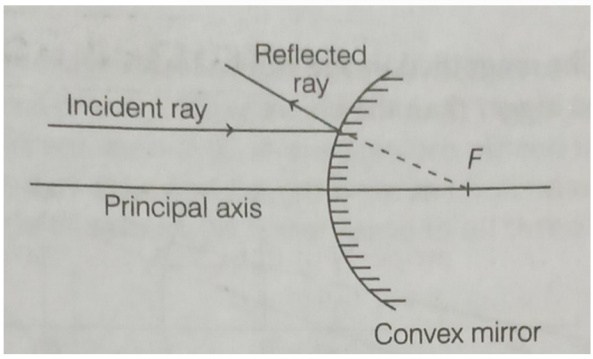
17. [c]

18. [d]

19. [c]

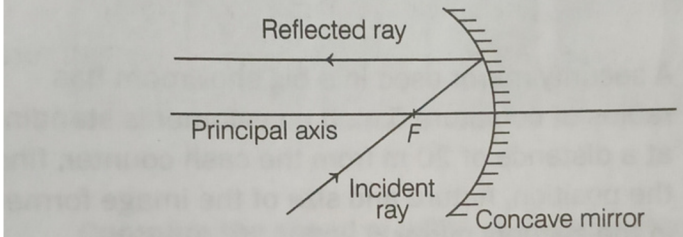
SHORT ANSWER TYPE QUESTIONS:

20. [i] Appears to pass through focus of mirror after reflection.

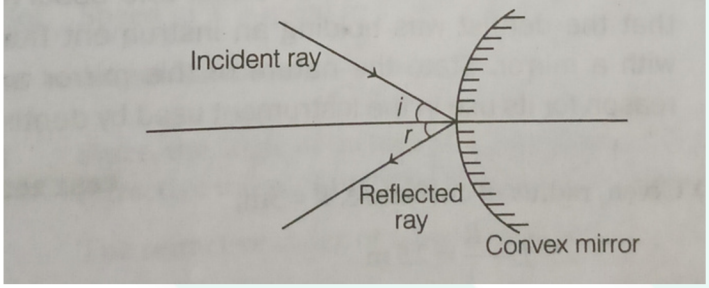


SOLUTIONS

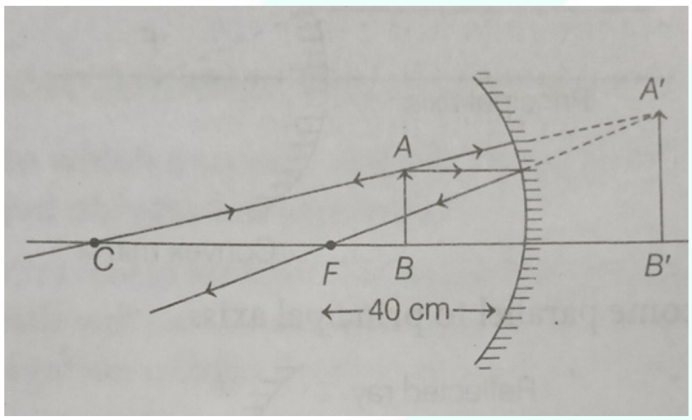
(ii) Become parallel to principal axis.



(iii) Passes with $\angle i = \angle r$

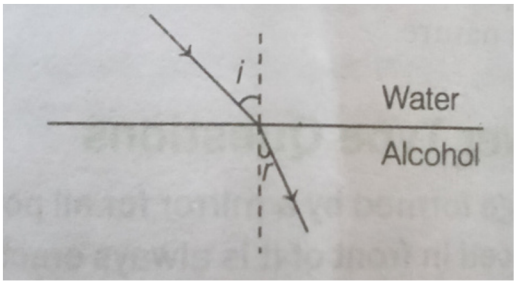


21. [i] To have an erect image of an object, the position of object should be between pole of the concave mirror and it's focus, i.e. between 0 to 40 cm.
[ii] The magnified image will be formed, i.e. image will be bigger than the object.
[iii]



22. [i] Given, refractive index of water, μ = 1.33
and refractive index of alcohol, μ = 1.36
∴ μ water < μ alcohol
Hence, alcohol is denser than water.

[ii] Ray diagram is given below

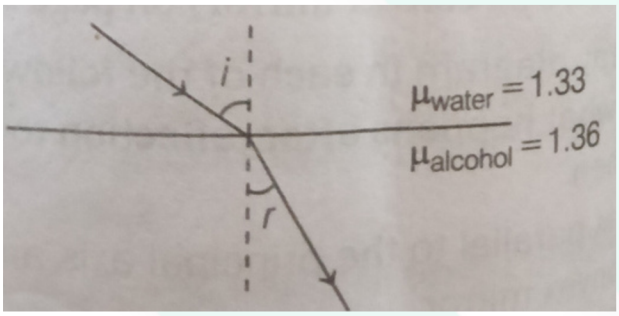


SOLUTIONS

[iii] Here, relation between angle of incidence and angle of refraction is:

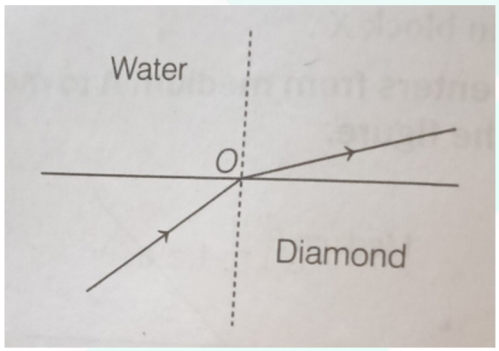
$$\frac{\sin i}{\sin r} = \frac{\mu \text{ alcohol}}{\mu \text{ water}} = \frac{1.36}{1.33}$$

⇒ 1.33 sin i = 1.36 sin r



23. [i] When a light ray travel from a rarer medium to a denser medium it bends towards normal so, medium B is denser w.r.t. medium A.

[ii]



[iii] Given, refracting index of diamond,

$$\mu_d = 2.42$$

Refracting index of water, $\mu_w = 1.33$

$$\therefore \quad {}_d\mu_w = \frac{\mu_w}{\mu_d} = \frac{1.33}{2.42} = 0.549$$

24. [i] (a) The power of the lens is positive, so this lens is convex lens.

(b) Given, u = -1m = -100cm

Power, P = +2D

Focal lenght , $f = \frac{1}{P} = \frac{1}{2}$ m = 0.5m

f = 50 cm

Using lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u} \rightarrow \frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$

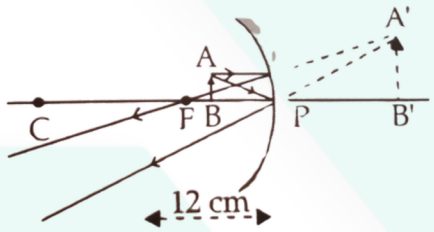
SOLUTIONS

$= \frac{1}{50} - \frac{1}{100} = \frac{2-1}{100}$

$= \frac{1}{v} = \frac{1}{100} \rightarrow v = 100$ cm

25. [i] Range of distance should be from 0 cm to 12 cm i.e., from pole to principal focus.

[ii]



[iii] Image will be at 24 cm in front of the mirror or the image will be at the centre of curvature.

26.

$h_0 = 1.2$ cm, $f = -20$ cm, $v = -60$ cm, $\frac{1}{u} = \frac{1}{f} - \frac{1}{v}$

$$\frac{1}{u} = \frac{1}{-20} - \frac{1}{-60} = \frac{1}{60} - \frac{1}{20} = \frac{1-3}{60} = \frac{-2}{60}$$

$\Rightarrow u = -30$ cm

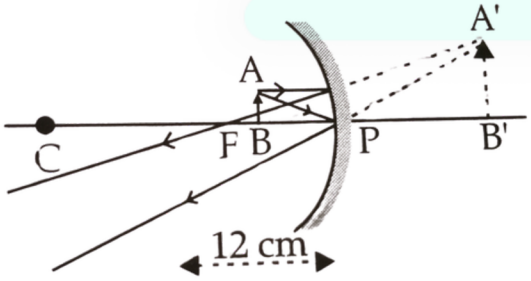
$$\frac{h_i}{h_0} = \frac{-v}{u}$$

$$h_i = -\frac{-60}{-30} \times 1.2 = -2.4 \text{ cm}$$

The object is placed at 30 cm in front of the mirror and a real and inverted image of size 2.4 cm is formed. [Marking Scheme, 2018]

27. [i] The object has to be placed at a distance between 0 - 40 cm. This is because image is virtual, erect and magnified when the object is placed between F and P.

[ii]



[iii] Used as shaving mirror or used by dentists to get enlarged image of teeth (any one usse)

SOLUTIONS

28. [i]Given:
Refractive index of benzene, n = 1.50
Percentage reduction in speed =
(1 - 1/n) × 100%
= (1 - 1/1.50) × 100%
= (1 - 0.6667) × 100%
= 0.3333 × 100%
= 33.33%
Answer: The speed of light reduces by 33.33% when entering benzene.

[ii]According to Snell's Law:
$n = \frac{\sin i}{\sin r}$
since, c and sin i are constant therefore sin r ∝ v. Therefore, velocity of light is maximum in medium C.

[iii] Magnification, m = -v/u = -1
⇒ v = u
Given: v = -30 cm (real image is in front of mirror)
∴ u = -30 cm
New object distance: u = -30 + 20 = -10 cm
From earlier, focal length f = -15 cm (using mirror formula)
Now using mirror formula:
1/f = 1/v + 1/u
1/(-15) = 1/v + 1/(-10)
⇒ 1/v = 1/(-15) + 1/10 = (-2 + 3)/30 = 1/30
⇒ v = +30 cm
Answer: Image is formed 30 cm behind the mirror
→ Virtual, erect, and magnified

[iv]Power of a lens is the ability of a lens to converge or diverge light rays.
It is given by:
P = 100 / f (in cm)
L_1 = +10 D
- Convex lens
- Focal length = 100 / 10 = 10 cm

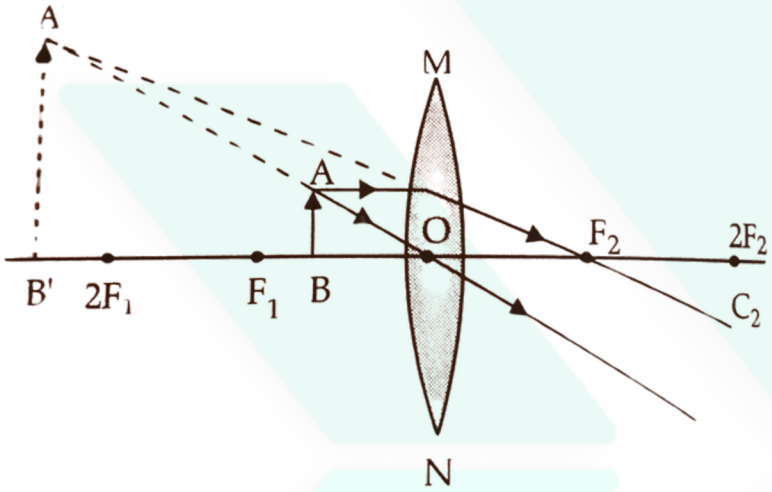
L_2 = +5 D
- Convex lens
- Focal length = 100 / 5 = 20 cm

SOLUTIONS

L_3 = -10 D

- Concave lens
- Focal length = 100 / -10 = -10 cm
- Object is placed at 15 cm
- L_2 has focal length 20 cm → object is between pole and focus
- → Forms virtual and magnified image

Answer: Lens L_2 which is convex lens will form a virtual and magnified image.



29. [i] u = 50 - 26 = 24 cm

v = 74 - 50 = 20 cm

The image is at centre of curvature (2f).

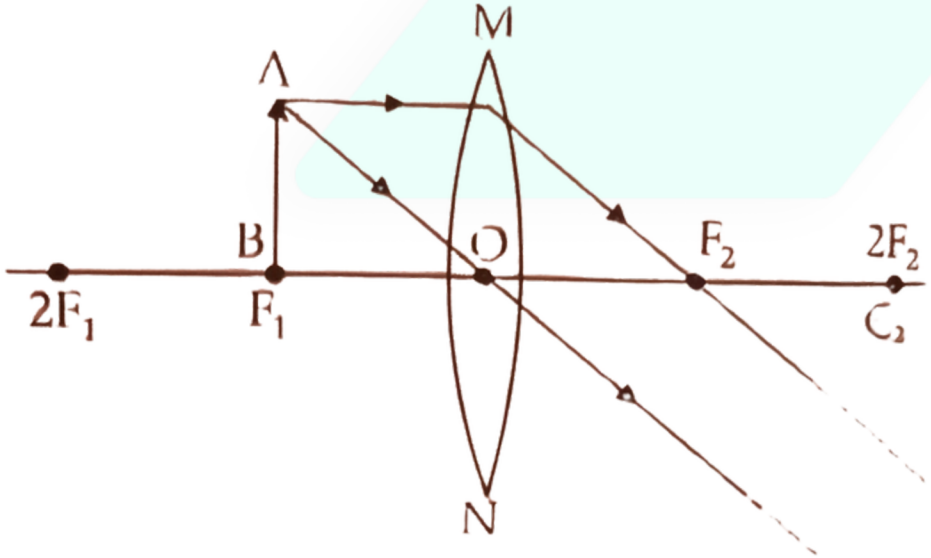
2f = 24 cm

f = 24/2 = 12 cm

[ii] u = 50 - 38 = 12 cm

i.e., Candle is at f

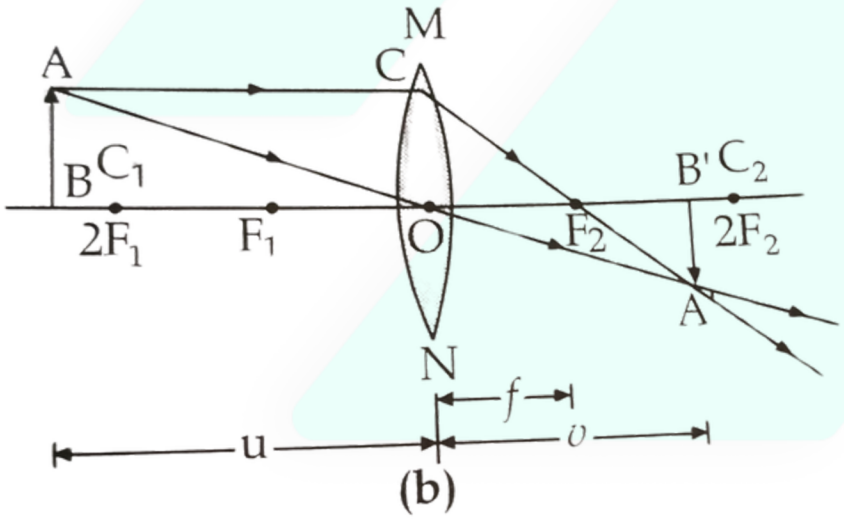
Image is formed ai infinity



SOLUTIONS

LONG ANSWER TYPE QUESTIONS:

30. [i] The image will be real and inverted, since the magnification has negative value.
The lens that can produce a real and inverted image is a converging / convex lens.
we are given in the problem
f = +6 cm
m = 0.5
we know that,
m = v / (-u) = 0.5
v = +0.5u
we known by the lens formula
1/f = 1/v - 1/u
1/6 = 1/0.5u - 1/(-u)
1/6 = 1/0.5u + 1/(-u)
Now we take LCM
1/6 = 1+0.5/0.5u
1/6 = 3/u
u = 18 cm
v = 0.5u = 9cm
Here is the ray diagram showing the image formation:



In the figure, OF1 = OF2 = 6cm ,
u = 18 cm and v = 9 cm
[ii] The girl must have directed the ray of light along the direction of the optical centre of the lens because the ray of light passes straight through the optical centre of the lens.

SOLUTIONS

31.

Given:

$f = +30 \text{ cm}, u = -50 \text{ cm}, h = -6.0 \text{ cm}$

Using lens formula,

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$

$$= \frac{1}{30} - \frac{1}{50}$$

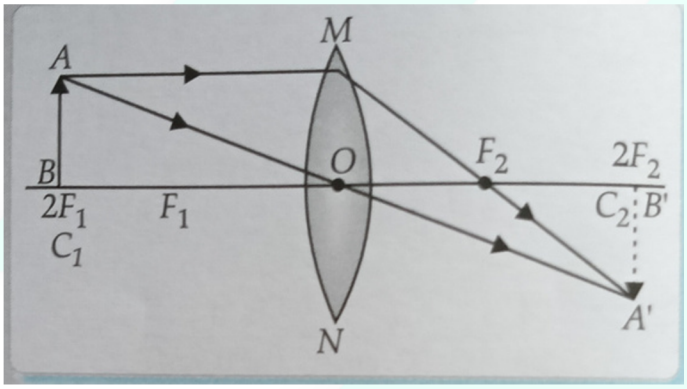
$$= \frac{5-3}{150} = \frac{2}{150}$$

$$= \frac{1}{75}$$

$$v = +75 \text{ cm}$$

$$m = \frac{v}{u} = \frac{h_1}{h_2}$$

$$= \frac{75}{-50} = \frac{h_1}{6}$$



32.

Given,

$h = 6 \text{ cm}$

$f = -30 \text{ cm}$

$v = -45 \text{ cm}$

Using mirror formula,

$$\frac{1}{f} = \frac{1}{v} + \frac{1}{u}$$

$$\frac{1}{v} = \frac{1}{f} - \frac{1}{u}$$

$$= -\frac{1}{30} - \frac{1}{(-45)}$$

SOLUTIONS

$$= -\frac{1}{30} + \frac{1}{45} = -\frac{1}{90}$$

$v = -90$ cm

Image is formed at 90 cm in front of the mirror.

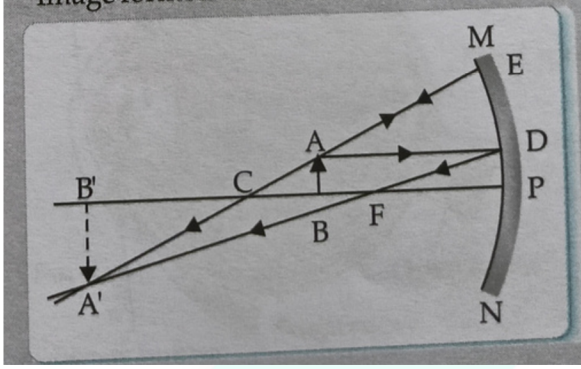
$$m = \frac{-v}{u} = \frac{h_1}{h_2}$$

$$m = -\frac{90}{45} = -2$$

$$\Rightarrow h_1 = -2 \times 6 \text{ cm}$$

$= -12$ cm

Image formed will be real, inverted and enlarged.



33. (i) $u = -30$ cm, $f = -30$ cm, $v = ?$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\therefore \frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$

$$\frac{1}{v} = \frac{1}{(-30 \text{ cm})} + \frac{1}{(-30 \text{ cm})}$$

$$= \frac{-2}{30} \text{ cm}$$

$v = -15$ cm

$$m = \frac{v}{u}$$

$$m = \frac{(-15 \text{ cm})}{(-30 \text{ cm})} = \frac{1}{2}$$

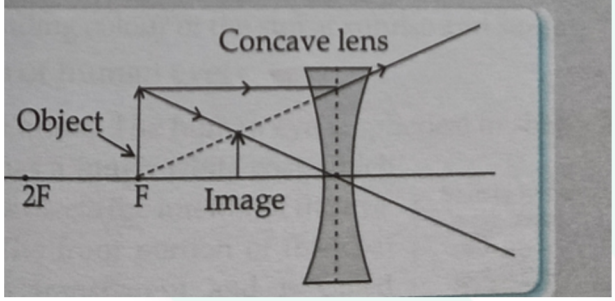
SOLUTIONS

ii) Nature: Virtual

Position: 15 cm away from the lens, on the same side as the object

Size: Diminished

Erect/inverted: Erect



34.

(i) $u = -60$ cm, $f = -30$ cm, $v = ?$

$$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$$

$$\frac{1}{v} = \frac{1}{f} + \frac{1}{u}$$

$$= \frac{1}{(-30\ \text{cm})} + \frac{1}{(-60\ \text{cm})} = \frac{-3}{60}$$

$$\therefore v = -20\ \text{cm}$$

$$m = \frac{v}{u} = \frac{-20\ \text{cm}}{-60\ \text{cm}} = \frac{1}{3}$$

Distance of the image will be 20 cm in front of lens.

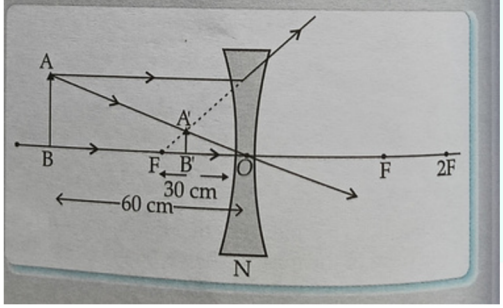
(ii) Nature: Virtual

Position: 20 cm from lens on the same as the object

Size: Diminished

Erect/inverted: Erect

(iii)



CASE STUDY/SOURCE BASED QUESTION:

35. [i]. (b)

[ii]. (b)

[iii]. (b)

SOLUTIONS

PK SPECIAL [KBC] :

36. Given:

- **Magnification, M = -3 (real image ⇒ negative)**
- **Focal length, f = +30 cm (convex lens)**

Formulas:

1. **Lens formula:**
2. **1/f = 1/v - 1/u**
3. **Magnification:**
4. **M = v/u ⇒ v = Mu = -3u**

Step 1: Substitute in lens formula

1/30 = 1/(-3u) - 1/u

⇒ 1/30 = (-1 - 3)/3u = -4/3u

⇒ 3u = -120

⇒ u = -40 cm

Step 2: Find image distance

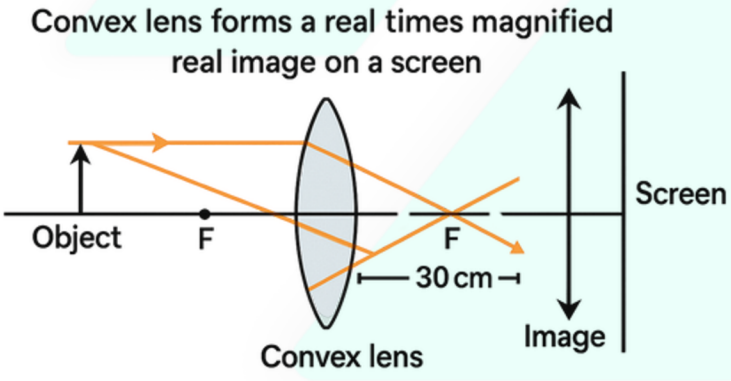
v = -3u = -3 × (-40) = +120 cm

Final Answers:

(a) Object distance (u) = -40 cm

(b) Image distance (v) = +120 cm

(c) Ray Diagram:



37.Given:

- ***Object distance, u = −20 cm (object in front of mirror)***
- ***Magnification, M = −2 (real image ⇒ negative magnification)***

Step 1: Use magnification to find image distance

M = v/u

−2 = v/−20

v = +40 cm

SOLUTIONS

Step 2: Use mirror formula to find focal length

Mirror formula:

$1/f = 1/v + 1/u$

$= 1/40 + 1/(-20)$

$= (1 - 2)/40 = -1/40$

So, $f = -40$ cm

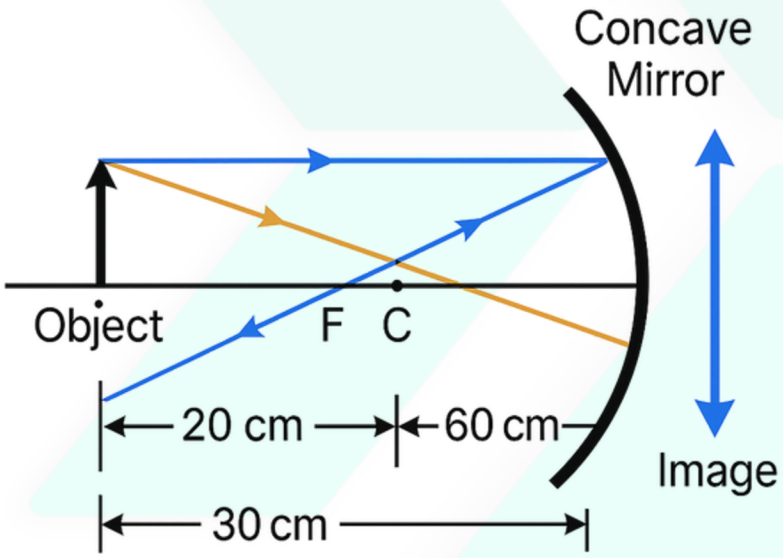
Final Answers:

(a) Focal length = −40 cm

(b) Image distance = +40 cm

(c) Ray diagram:

- **Object placed 20 cm in front of the concave mirror**
- **Real, inverted, magnified image formed 40 cm in front of the mirror**
- **The image is twice the size of the object**



38.(a) Since the image is inverted and formed on a screen, it must be a real and inverted image.

Nature of image: Real, inverted, and formed on the opposite side of the lens.

(b) If the object (candle) is moved closer to the lens, the following changes occur:

- **The image moves farther from the lens.**
- **The image becomes larger (more magnified).**
- **If the object is brought very close to the lens (closer than the focal length), the image will:**
  - **Become virtual**
  - **Erect**
  - **Magnified**
  - **Appear on the same side as the object and cannot be captured on a screen.**

SOLUTIONS

39. (a) Lens half-covered with black paper, object at 2F

- The object is placed at 2F in front of the convex lens.
- Even if half the lens is covered, the entire image is still formed, because every part of the lens can form a complete image.
- However, since only half the lens allows light to pass:
  - The image will be identical in size and position as in the uncovered case.
  - But the image will be less bright or less intense.

Nature of image:

- Real, inverted, and of the same size as the object
- Formed at 2F on the opposite side of the lens

(b) Lens fully uncovered, same object at 2F

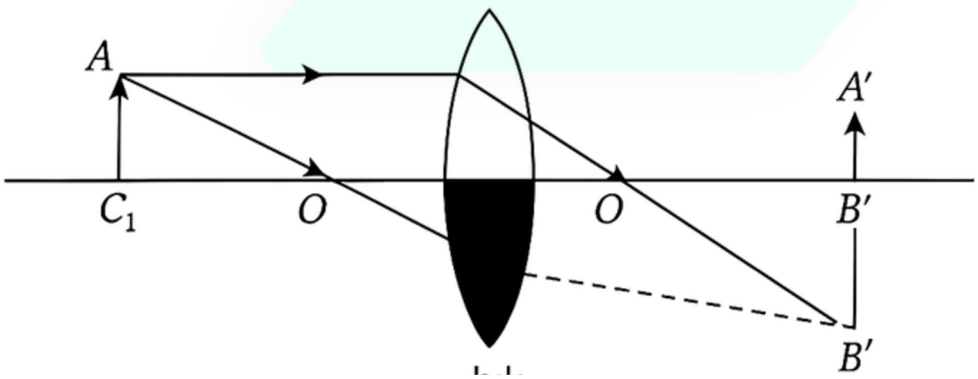
- When the lens is uncovered, the rays from the entire object pass through the whole lens.
- The image formed is:
  - Real
  - Inverted
  - Same size as the object
  - Formed at 2F on the opposite side

Conclusion / Difference:

- No difference in the position or size of the image in both cases.
- The only difference is that the image in case (a) will be less bright because fewer rays contribute to its formation.

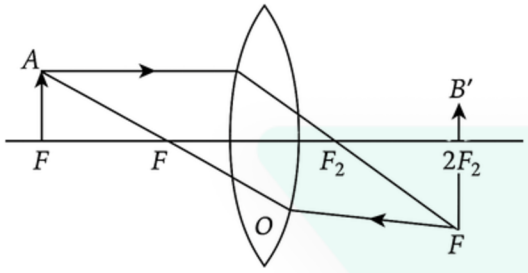
40. a. If the lower half of the lens is covered, even then it will form a complete real, inverted image of same size at
C_2 ($2F_2$) with reduced intensity of image.

b. There will be no change in the nature and position of the object except in later case the image will be brighter.



SOLUTIONS

41.



An object is placed between F and $2F$ in front af a convex lens. Real, inverted, and enlarged image is formed beyond $2F_2$

42. Ans. Concave minor u = −27 cm, f = −18 cm, h = 7.0 cm

Mirror formula $\frac{1}{v}+\frac{1}{u}=\frac{1}{f}$

$$\therefore \frac{1}{v}+\frac{1}{(-27)}=\frac{1}{(-18)}$$

$$\therefore \frac{1}{v}=\frac{-1}{18}+\frac{1}{27}=\frac{-3+2}{54}=\frac{-1}{54}$$

v = –54 cm.

$$\frac{h_i}{h_0}=\frac{v}{u}$$

$$\therefore h_i=\frac{v\times h_0}{u}$$

$$=\frac{54\times 7}{27}=14 \text{ cm}$$

The image is real, inverted and enlarged.

43. (a) Given:
Power of convex lens = +4 D
Power of concave lens = -2 D
Net power,
P = +4 D + (-2 D) = +2 D
Since the total power is positive, the combination is converging.
= Convergent
(b) Focal length of a lens with power -2.5 D:
Formula:
f (in cm) = 100 / P
So,
f = 100 / (-2.5) = -40 cm
Or in meters:
f = 1 / (-2.5) = -0.4 m
= -40 cm (or -0.4 m)

SOLUTIONS

44. Diamond has highest optical density i.e., 2.42 and air has the lowest optical density i.e., 1.0003."

45. (i) Case 1 (Mirror A) will form a diminished image.
Justification: For Mirror A, the object is placed at a distance of 45 cm, and the focal length is 20 cm.
So, the object is beyond 2F (2 × 20 = 40 cm).
In a concave mirror, when the object is placed beyond 2F, the image formed is real, inverted, and diminished.
(ii) For Mirror B:
Focal length = 15 cm → 2F = 30 cm
Object distance = 30 cm → object is at 2F
So, the image will be:
1. Real and inverted
2. Same size as the object and formed at 2F
(iii) (A) Mirror C:
Focal length = 30 cm
Object distance = 20 cm
So, the object lies between F (30 cm) and the mirror.
In this case, a concave mirror forms a virtual, erect, and enlarged image behind the mirror.