PREVIOUS YEAR QUESTIONS
(Chapterwise)

CHAPTER NAME: REFRACTION THROUGH LENS

SUMMARY POINTS

Concept	Key Points	Formula	SI Units
Types of Lenses	- **Concave lens**: Diverging lens, forms virtual, diminished, upright images. - **Convex lens**: Converging lens, forms real or virtual images depending on object distance.		
Linear Magnification (m)	- Magnification is the ratio of the height of the image to the height of the object. - For concave lenses, $m < 1$ for real images.	$m = \frac{\text{Height of image}}{\text{Height of object}}$	Unitless (ratio)
Lens Formula	Relates object distance (u), image distance (v), and focal length (f).	$\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$	m (meters)
Power of a Lens (P)	- Power is the reciprocal of focal length. - Positive for convex lenses and negative for concave lenses.	$P = \frac{100}{f(\mathrm{cm})}$	Diopter (D)
Magnification (m) (Distances)	Magnification also relates image distance and object distance.	$m = \frac{v}{u}$	Unitless (ratio)
Image Formation by Convex Lens	- **Beyond 2F**: Real, diminished, inverted. - **At 2F**: Real, same size, inverted. - **Between F and 2F**: Real, magnified, inverted. - **Within F**: Virtual, magnified, upright.		
Effect of Water on Lens	Focal length increases when placed in water due to reduced refractive index difference.		
Types of Images	- **Real Image**: Inverted, can be projected on a screen. - **Virtual Image**: Upright, cannot be projected on a screen.		
Position of Object	- **Real and same size image**: Object at $2F$ in front of convex lens. - **Magnified virtual image**: Object within focal length of convex lens.		
Ray Diagrams	Use three standard rays: - One parallel to the principal axis. - One through the focal point. - One passing through the optical center.		
Focal Length and Object Distance	- Measure object distance from the lens's optical center. - Focal length determines image characteristics.		m (meters)

	Key Formulas: 1. **Lens Formula:** $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ 2. **Magnification:** $m = \frac{v}{u}$ 3. **Power of a Lens:** $P = \frac{100}{f}$ (f in cm)

Q.NO.: 1	**Linear magnification(m) produced by a concave lens is:** **(a) m <1** **(b) m > 1** **(c) m = 1** **(d) m = 2**	**YEAR** **[2024]**
ANS.:	The correct answer is **(a) m < 1**. Here's why, based on the information in the sources: • Concave lenses always produce **diminished images**1.... • A diminished image means the image is smaller than the object. • **Linear magnification (m) is the ratio of the image height to the object height** (or image distance to object distance). • If the image is smaller than the object, the magnification (m) will be less than 13. Therefore, for a concave lens, the linear magnification (m) is always less than 1 (m < 1).	
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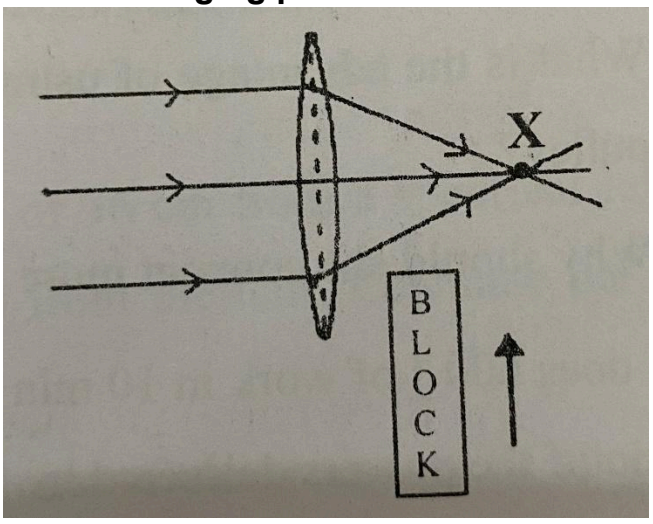
Q.NO.: 2	**A block of glass is pushed into the path of the light as shown below. Then the converging point X will:** 	**YEAR** **[2024]**

	(a) Move away from the slab **(b) Move towards the slab** **(c) Not shift** **(d) Move towards the left side of the lens**	
ANS.:		
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Q.NO.: 3	**(a) In a reading glass what is the position of the object with respect to the convex lens used?** **(b) Why can we not use concave lens for the same purpose?**	**YEAR** **[2024]**
ANS.:	**(a) 25 cm :** • A reading glass uses a **convex lens**1.... • For a convex lens to act as a magnifying glass, the object must be placed **between the lens and its focal point (f)**, also described as between the focus and the optical center2.... This is the position that produces a magnified, virtual, and upright image2.... **(b) Why a concave lens cannot be used as a reading glass:** • Concave lenses always produce **virtual and diminished images**4.... This means that the image formed by a concave lens is always smaller than the object, which is not helpful for reading. • A concave lens can never produce a magnified image7, except in some specific cases, but a reading glass has to magnify to be useful. • A concave lens is a **diverging lens**1..., which is not suitable for a reading glass. A converging lens is needed for magnification1.... • Concave lenses are used to correct myopia1 not hypermetropia.	
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Q.NO.: 4	**The image of a candle flame placed at a distance of 36 cm from a spherical lens, is formed on a screen placed at a distance of 72 cm from the lens. Calculate the focal length of the lens and its power.**	**YEAR** **[2024]**
ANS.:	**1. Identify the given values and sign conventions:** • **Object distance (u) = -36 cm**. The object distance is always considered negative because the object is placed on the left side of the lens in the sign convention1....	

	• **Image distance (v) = +72 cm**. The image distance is positive because the image is formed on the screen, which is on the right side of the lens[1]. This indicates a real image as well. **2. Use the lens formula to find the focal length (f):** The lens formula is: 1/v - 1/u = 1/f[1]... • Substitute the given values: 1/72 - 1/(-36) = 1/f • Simplify: 1/72 + 1/36 = 1/f • Find a common denominator: 1/72 + 2/72 = 1/f • Add the fractions: 3/72 = 1/f • Simplify: 1/24 = 1/f • Therefore, the focal length (f) = 24 cm **3. Convert the focal length to meters:** • To calculate the power of the lens, we need the focal length in meters. • f = 24 cm = 24/100 = 0.24 meters. **4. Calculate the power of the lens (P):** • The formula for the power of a lens is: P = 1/f (where f is in meters)[6]... • Substitute the focal length in meters: P = 1 / 0.24 • Calculate the power: P = 4.1666... • Therefore, the power of the lens is approximately **4.17 Diopters (D)**. **5. Determine if the lens is converging (convex) or diverging (concave):** • Since the image formed is real and the power is positive, the lens is a **convex lens**[1]. • The sources note that positive power corresponds to a convex lens[11]. **Therefore:** • The focal length of the lens is **24 cm**. • The power of the lens is approximately **+4.17 D**. • The lens is a **convex (converging) lens**.	
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Q.NO.: 5	**A concave lens produces only image.** **a. real, enlarged** **b. virtual, enlarged** **c. virtual, diminished** **d. real, diminished**	**YEAR** **[2023]**
ANS.:	The correct answer is (C) Virtual and diminished. Concave lenses always form virtual and diminished images.	
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Q.NO.: 6	**(a) Is it possible for a concave lens to form an image of size two times that of the object? Write Yes or No. (b) What will happen to the focal length of the lens if a part of the lens is covered with an opaque paper?**	**YEAR [2023]**
ANS.:	(a) No, it is not possible. A concave lens always produces a diminished image. (b) The focal length of the lens will not change. However, the intensity or brightness of the image will decrease. The remaining part of the lens still allows rays to pass through and form an image.	
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Q.NO.: 7	**An object of height 10 cm is placed in front of a concave lens of focal length 20 cm at a distance 25 cm from the lens. Is it possible to capture this image on a screen? Select a correct option from the following: (a) Yes, as the image formed will be real. (b) Yes, as the image formed will be erect. (c) No, as the image formed will be virtual. (d) No, as the image formed will be inverted.**	**YEAR [2021]**
ANS.:	The correct answer is (C) No, as the image formed will be virtual. Concave lenses always form virtual images, which cannot be captured on a screen.	
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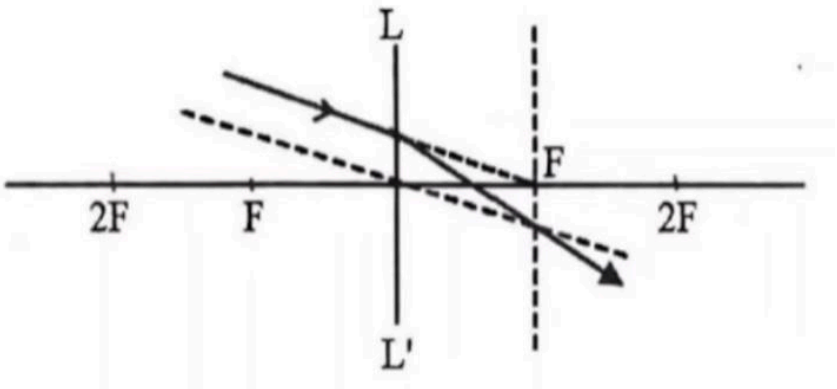
Q.NO.: 8	**Observe the diagram which shows the path of an incident ray through an optical plane LL" of a lens. The focal length of the lens is 20 cm.**  	**YEAR [2021]**

	(i) If an object is placed at a distance of 30 cm in front of this lens, then: **(a) the image will be virtual** **(b) the image will be diminished and inverted.** **(c) the image will be diminished.** **(d) the image will be real and magnified.** **(ii) This type of lens can be used:** **(a) to correct hypermetropia.** **(b) to correct myopia.** **(c) to diverge light.** **(d) in the front door peepholes.** **(iii) An object is placed in front of this lens at a distance of 60 cm. Then the image distance from the lens with proper sign convention is:** **(a) +60 cm** **(b) +30 cm** **(c) -30 cm** **(d) +15 cm** **(iv) An object is placed in front of this lens at a distance of 60 cm. Then the magnification of the image is:** **(a) 0.25** **(b) 1.25** **(c) -0.5** **(d) 1**	
ANS.:	(i) The correct answer is (D) The image will be real and magnified. Since the object is placed between f and 2f of a convex lens, the image formed is real and magnified. (ii) The correct answer is (A) To correct hypermetropia. Convex lenses are used to correct hypermetropia. (iii) Using the lens formula (1/v - 1/u = 1/f), with u = -60 cm and f = +20 cm, the image distance (v) is calculated to be +30 cm. (iv) Using the magnification formula (m = v/u), with v = 30 cm and u = -60 cm, the magnification (m) is calculated to be -0.5.	
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Q.NO.: 9	**Where should an object be placed in front of a convex lens in order to get:** **(i) an enlarged real image ? (ii) enlarged virtual image?**	**YEAR** **[2020]**
ANS.:	(i) The object should be placed between f and 2f. (ii) The object should be placed between the focus (f) and the optical center (pole) of the lens.	
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Q.NO.: 10	**A lens of focal length 20 cm forms an inverted image at a distance 60 cm from the lens.** **(i) Identify the lens.** **(ii) How far is the lens present in front of the object?** **(iii) Calculate the magnification of the image.**	**YEAR** **[2020]**
ANS.:	(i) The lens is a convex lens. Using the lens formula, with f = +20 cm and v = +60 cm, the object distance (u) is calculated to be -30 cm. Using the magnification formula (m = v/u), with v = 60 cm and u = -30 cm, the magnification is calculated to be -2.	
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Q.NO.: 11	**If the lens is placed in water instead of air, how does its focal length change?** **(i) Which lens, thick or thin has greater focal length?** **(ii) A thin lens has greater focal length as compared to a thick lens**	**YEAR** **[2019]**
ANS.:	The focal length increases11. This is because the refractive index of the surrounding medium changes from air to water, decreasing the relative refractive index of the lens material and thus increasing the focal length. A thin lens has a greater focal length.	
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Q.NO.: 12	**A virtual, diminished image is formed when an object is placed between the optical centre and the principal focus of a lens.** **(i) Name the type of lens which forms the above image.** **(ii) Draw a ray diagram to show the formation of the image with the above stated characteristics.**	**YEAR** **[2019]**
ANS.:	The lens is a concave lens. The ray diagram should show a concave lens with the object placed between the optical center and the focus. The image formed will be virtual, diminished, and on the same side of the lens as the object.	
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Q.NO.: 13	**An object is placed at a distance 24 cm in front of a convex lens of focal length 8 cm.** **(i) What is the nature of the image so formed?** **(ii) Calculate the distance of the image from the lens.** **(iii) Calculate the magnification of the image.**	**YEAR** **[2019]**
ANS.:	The image is real, inverted, and diminished. Using the lens formula, with u = -24 cm and f = +8 cm, the image distance (v) is calculated to be +12 cm. Using the magnification formula, with v = 12 cm and u = -24 cm, the magnification (m) is calculated to be -0.5.	
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Q.NO.: 14	**The power of a lens is —5D.** **(i) Find its focal length.** **(ii) Name the type of lens.**	**YEAR** **[2018]**
ANS.:	The focal length is calculated as 1/power = 1/-5 = -0.2 meters or -20 cm. The lens is a concave lens.	
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Q.NO.: 15	**State the position of the object in front of a converging lens if:**	**YEAR**

	(i) It produces a real and same size image of the object. **(ii) It is used as a magnifying lens.**	**[2018]**
ANS.:	The object should be placed at 2f (twice the focal length). The object must be placed between the lens and its focus (f).	
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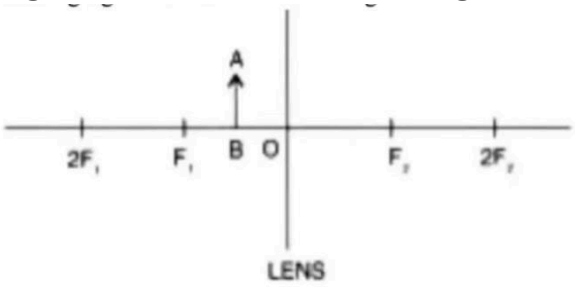
Q.NO.: 16	**An object AB is placed between O and F; on the principal axis of a converging lens as shown in the diagram.**  **Copy the diagram and by using three standard rays starting from point A, obtain an image of the object AB**	**YEAR** **[2018]**
ANS.:	A ray diagram should be drawn showing three rays: one parallel to the principal axis, one through the optical center, and one through the focus. The image will be virtual, erect, and magnified, formed on the same side as the object.	
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Q.NO.: 17	**An object is placed at a distance of 12 cm from a convex lens of focal length 8 cm. Find:** **(i) the position of the image (ii) nature of the image**	**YEAR** **[2018]**
ANS.:	Using the lens formula, with u = -12 cm and f = +8 cm, the image distance (v) is calculated to be +24 cm. The image is real, inverted, and magnified.	
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Q.NO.: 18	**A Lens forms an upright and diminished image of an object when the object is placed at the focal point of the given lens.**	**YEAR**

	(i) Name the lens. **(ii) Draw a ray diagram to show the image formation.**	**[2018]**
ANS.:	The lens is a concave lens. A ray diagram should be drawn for a concave lens with the object at the focal point. The image formed will be virtual, diminished, and on the same side of the lens as the object.	
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Q.NO.: 19	**A lens produces a virtual image between the object and the lens.** **(i) Name the lens.** **(ii) Draw a ray diagram to show the formation of this image.**	**YEAR** **[2016]**
ANS.:	The lens is a concave lens. A ray diagram should be drawn with a concave lens and the object placed in front of the lens. The image will be virtual, diminished, and formed between the object and the lens.	
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Q.NO.: 20	**(i) Where should an object be placed so that a real and inverted image of the same size as the object is obtained using a convex lens?** **(ii) Draw a ray diagram to show the formation of the image as specified in the part a (1).**	**YEAR** **[2015]**
ANS.:	The object should be placed at the center of curvature or 2f. A ray diagram should show a convex lens with the object at 2f. The image formed will be real, inverted, and of the same size as the object, also at 2f on the other side of the lens.	
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Q.NO.: 21	**Ranbir claims to have obtained an image twice the size of the object with a concave lens. Is he correct? Give a reason for your answer.**	**YEAR** **[2014]**

ANS.:	No, Ranbir is incorrect. A concave lens always produces a diminished image.	
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Q.NO.: 22	**(a) A lens forms an erect, magnified and virtual image of an object.** **(i) Name the lens.** **(ii) Draw a labelled ray diagram to show the image formation.** **(b) (i) Define the power of a lens.** **(ii) The lens mentioned in 6(b) above is of focal length 25 cm. Calculate the power of the lens.**	**YEAR** **[2014]**
ANS.:	The lens is a convex lens. A ray diagram should be drawn showing a convex lens with the object between the focus and the optical center. The image formed will be virtual, erect, and magnified, on the same side as the object. The power of a lens is its ability to converge or diverge rays of light falling on it. The power of the lens is calculated as 1/focal length (in meters) = 1 / 0.25 = +4 diopters.	
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