

Chapter 10

I will Win

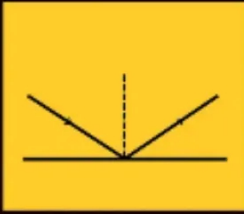
Light Reflection & Refraction

Class 10

100% Paper yahi se banega



Topics Covered



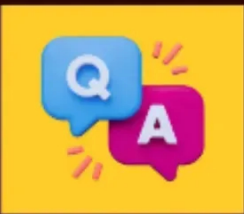
Reflection- Concave & Convex Mirror



Concave and Convex Lens



Refraction- Refractive Index & Snell's Law



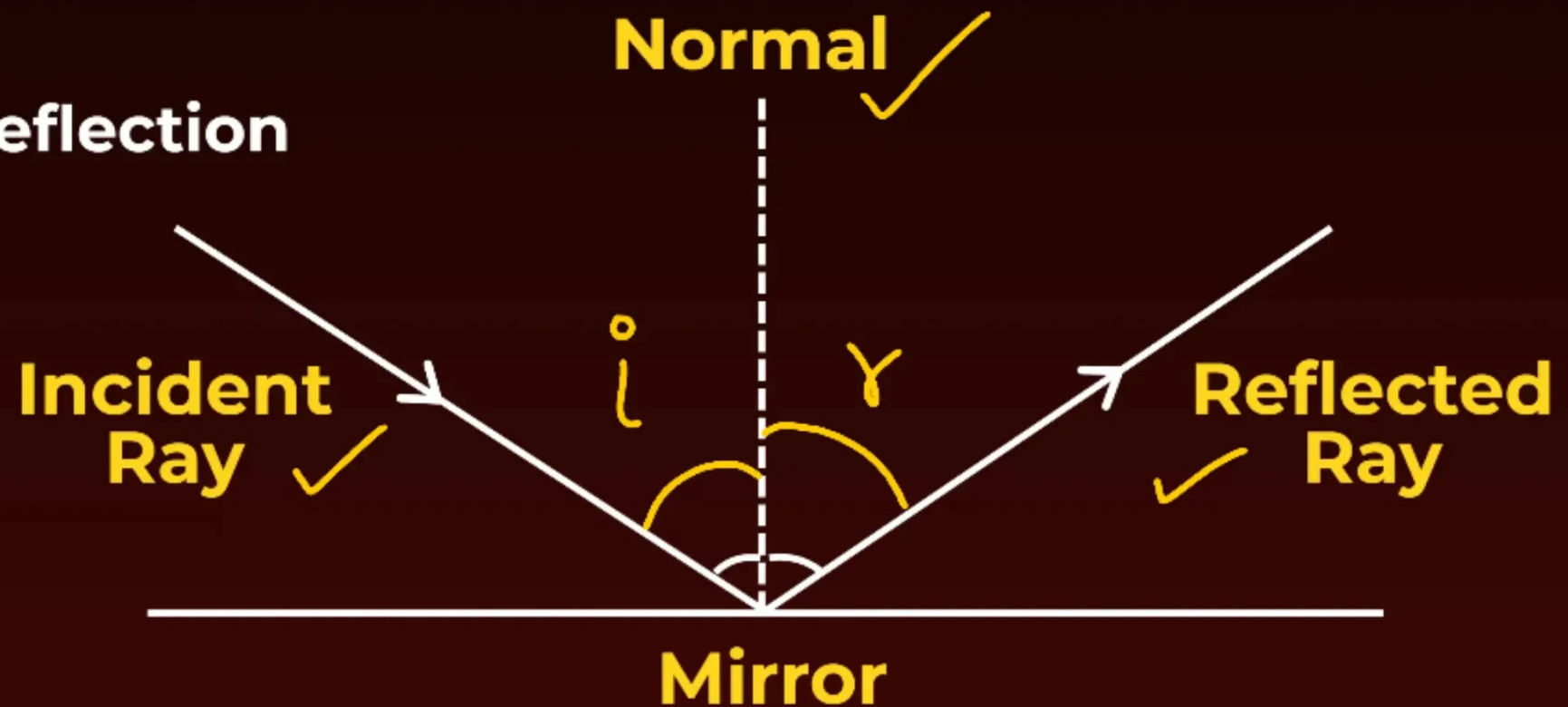
Bahut Saare PYQS

Reflection of Light

The Bouncing back of light when it hits a polished surface like mirror

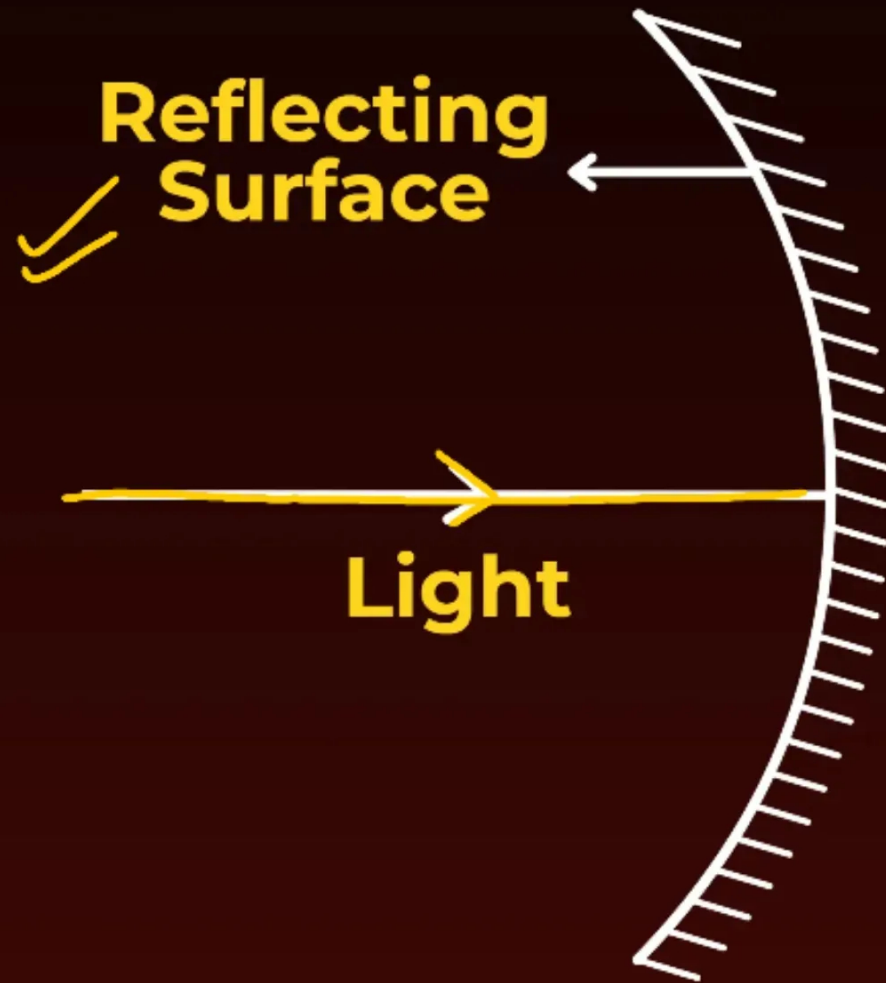
Law_s of Reflection

- $\angle i = \angle r$ ✓
Angle of incidence = Angle of reflection
- The incident ray, the reflected ray & the normal, all lie in the same plane.

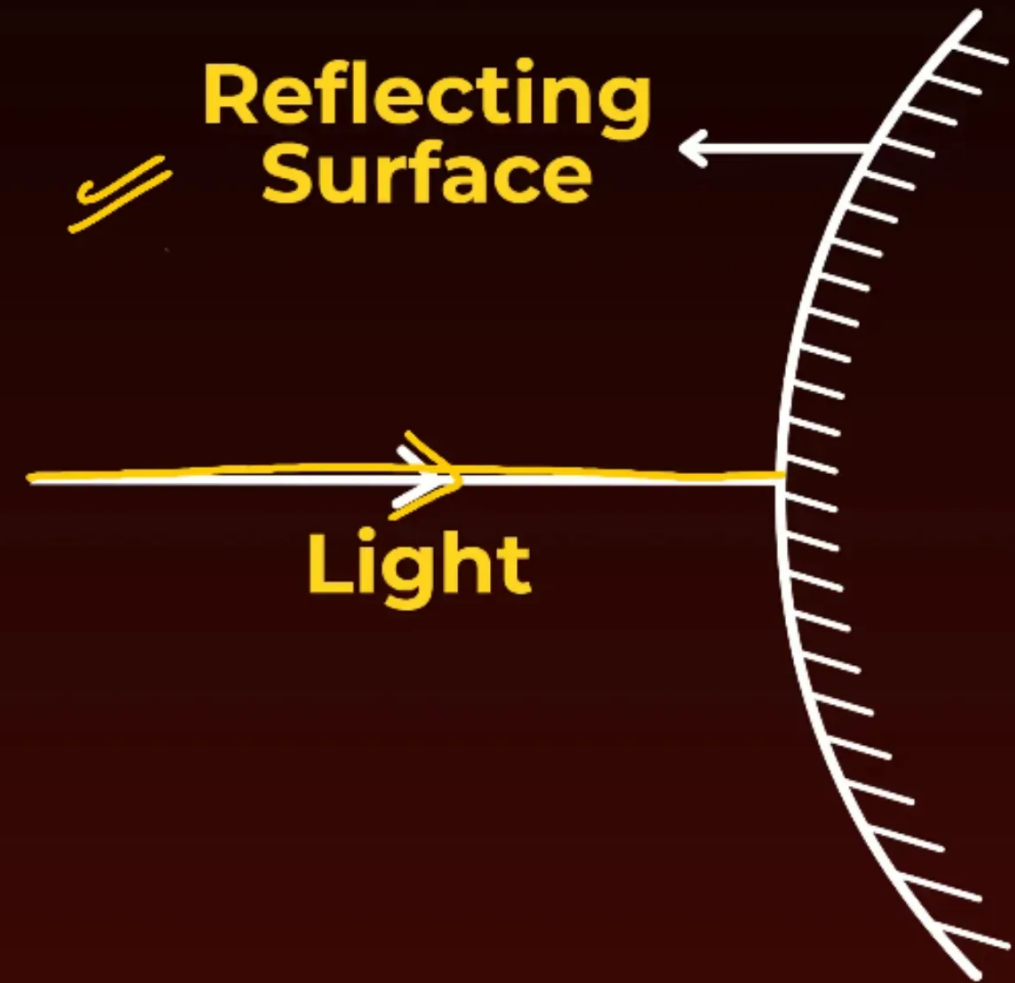


Spherical Mirror

Concave Mirror ^{→ Gufa}

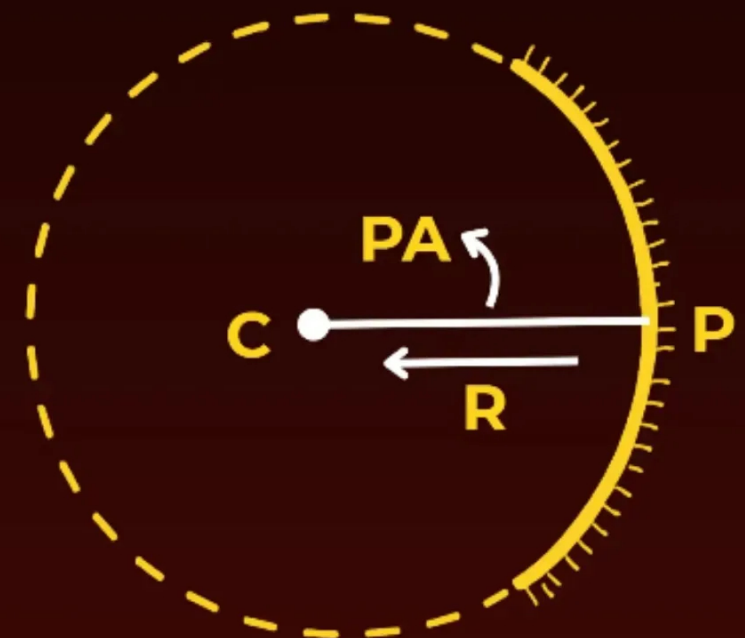
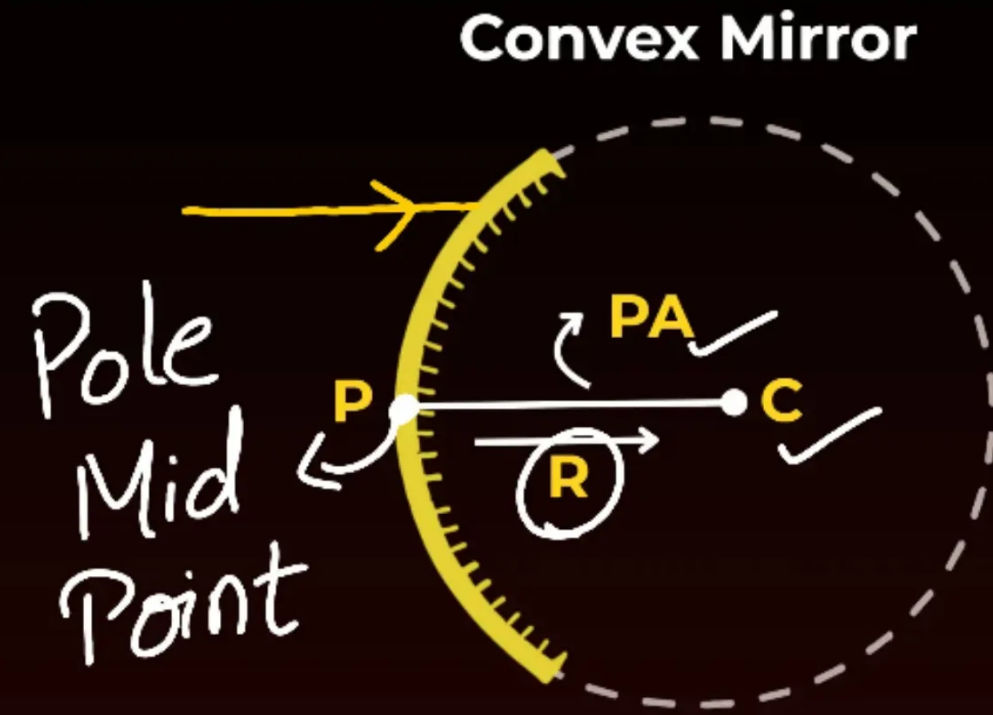


Convex Mirror



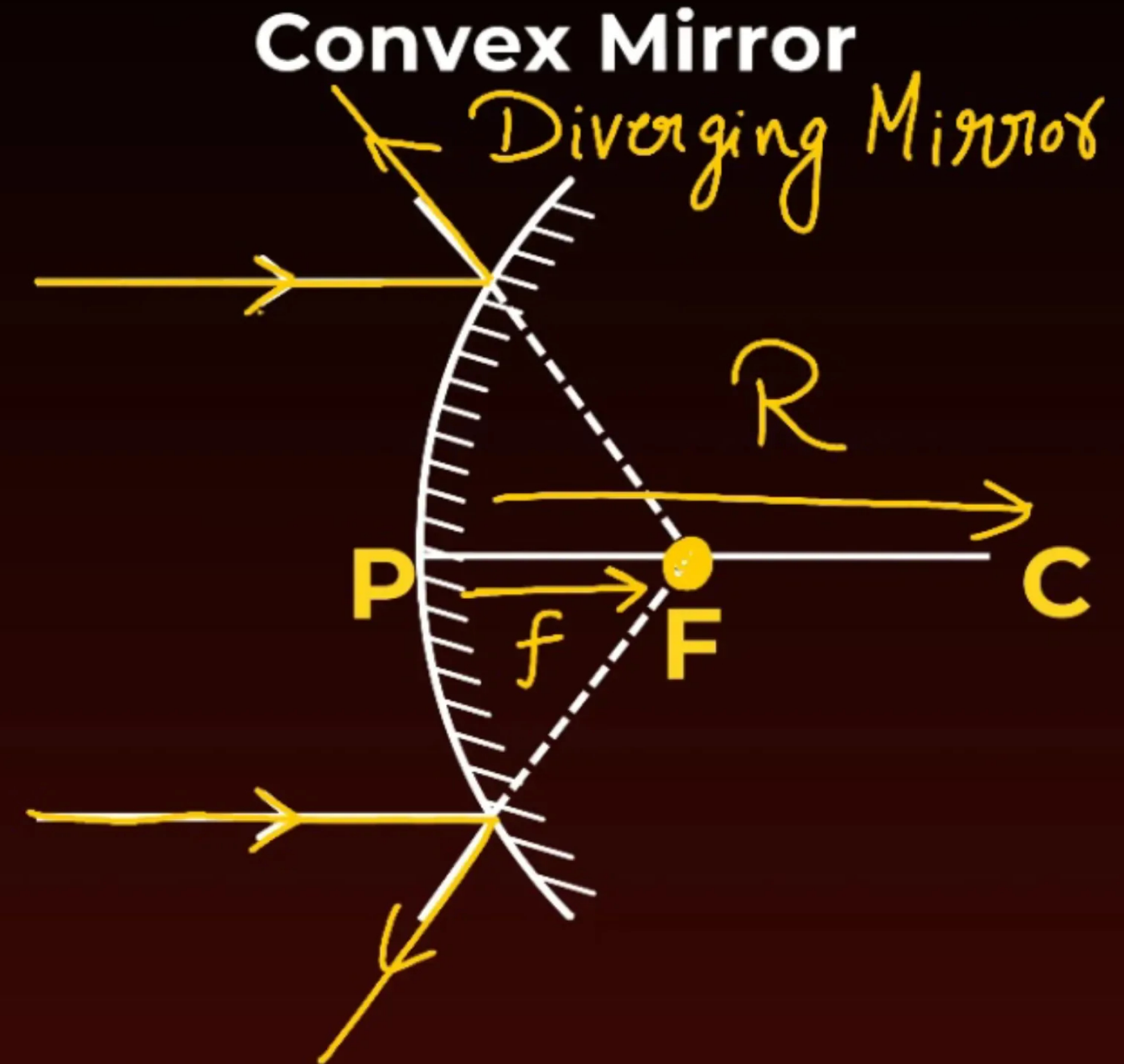
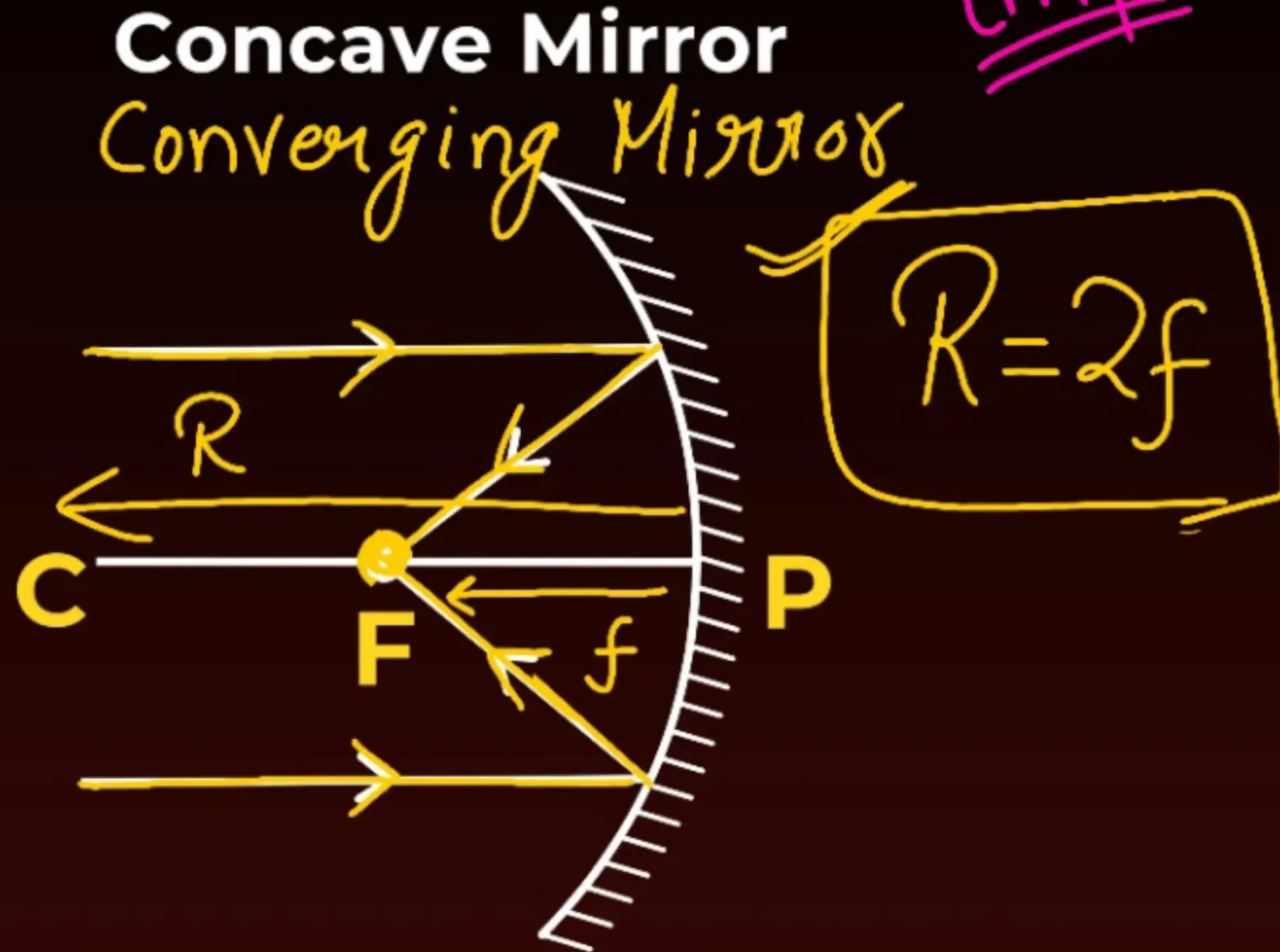
Spherical Mirrors

- Pole (P): ✓
- Centre of Curvature (C): ✓
- Principal Axis (PA): ✓
- Radius of Curvature (R): ✓



Concave Mirror

Principal Focus (F) & Focal length (f)



For spherical mirror: $R = 2f$

Image formation and characteristics

- ▶ At least two rays of light meet $\Rightarrow$ Image
- ▶ If rays of light actually meet $\Rightarrow$ Real $\rightarrow$ Ulti Inverted $\uparrow \downarrow$
- ▶ If rays of light appear to meet $\Rightarrow$ Virtual $\rightarrow$ Erect $\uparrow \uparrow$
Seedhi

Image formation : Concave Mirror - Rules

①

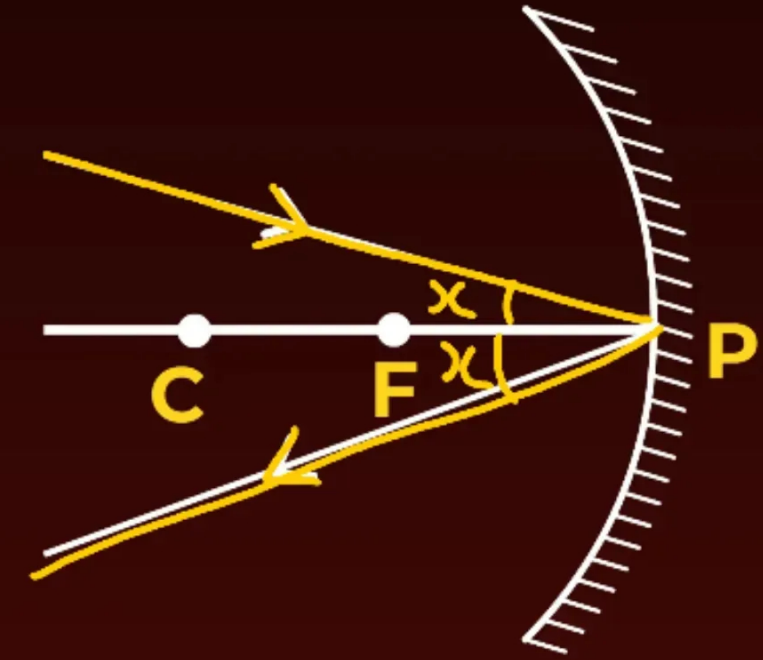
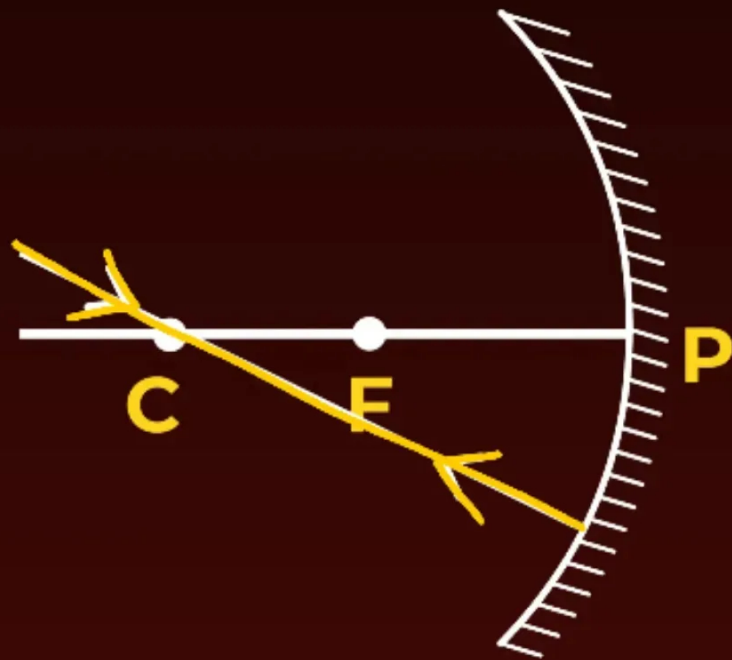
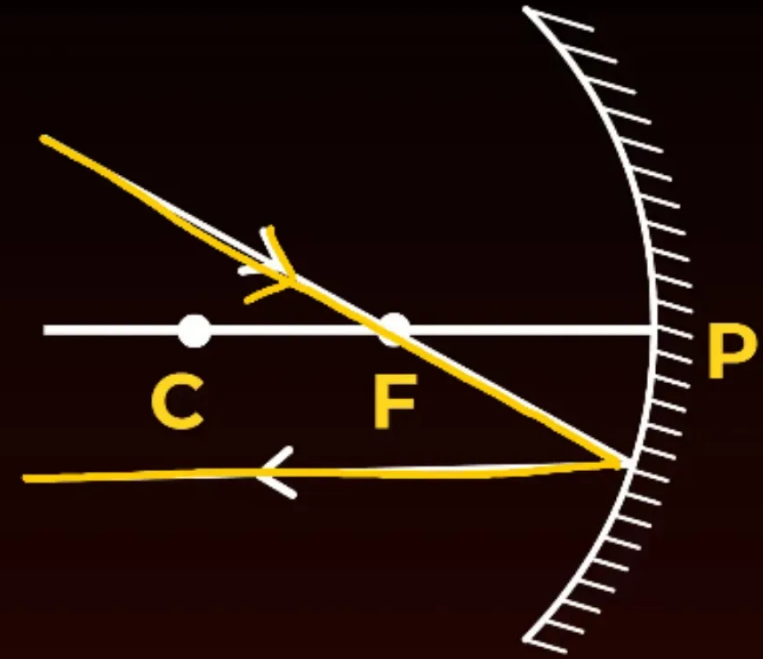
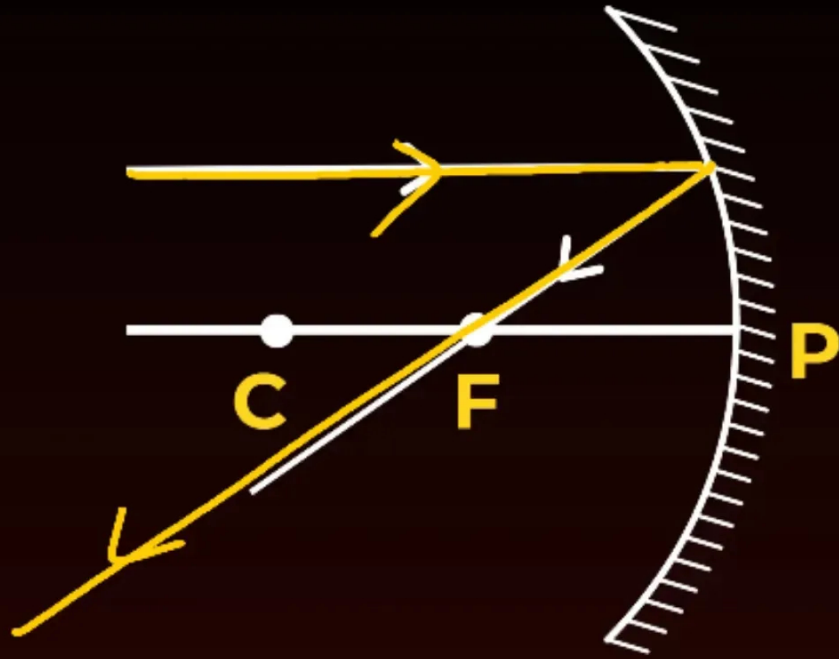
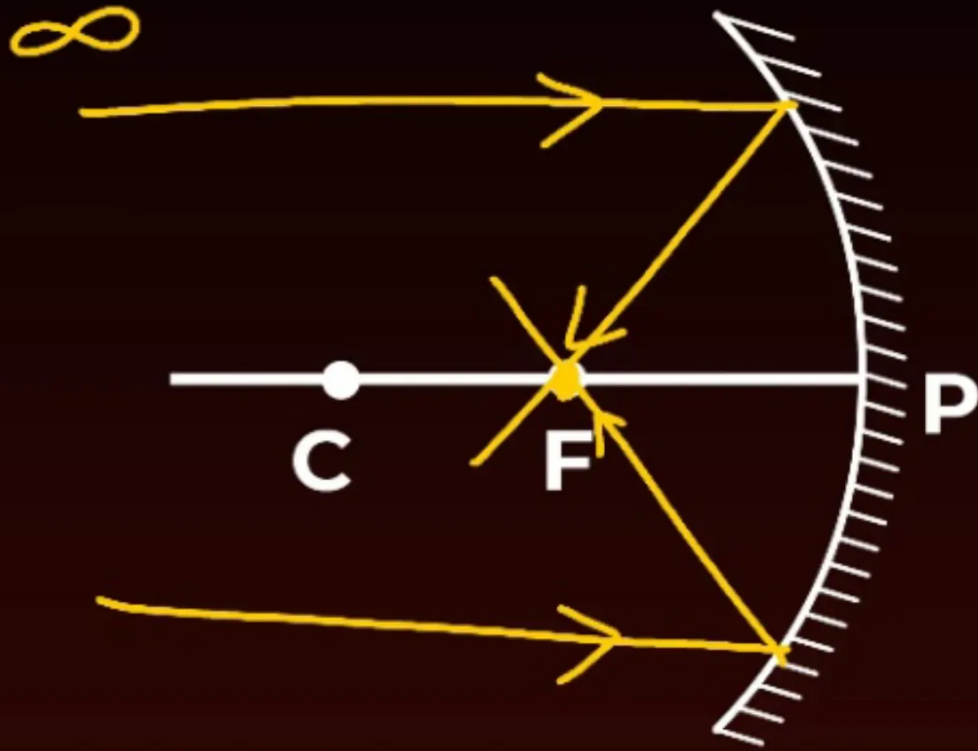


Image formation for Concave Mirror

Object at ∞ ✓

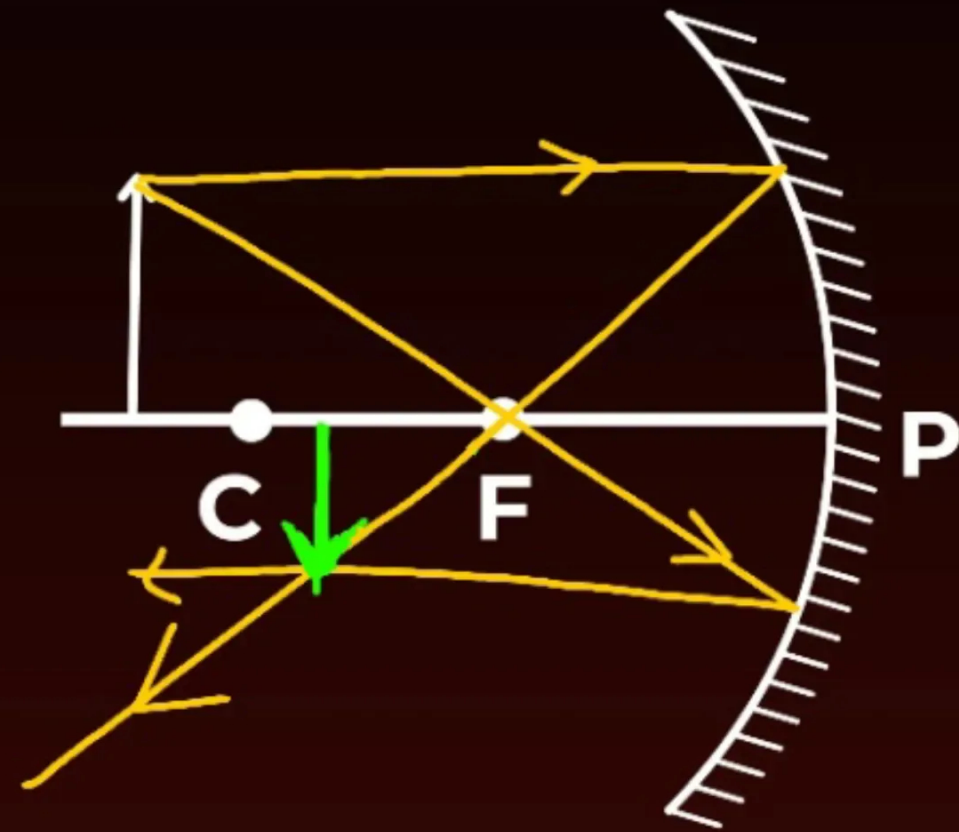


CHARACTERISTICS

- Image at Focus. ✓
- Real, Inverted, Highly Diminished. ✓

Point sized.

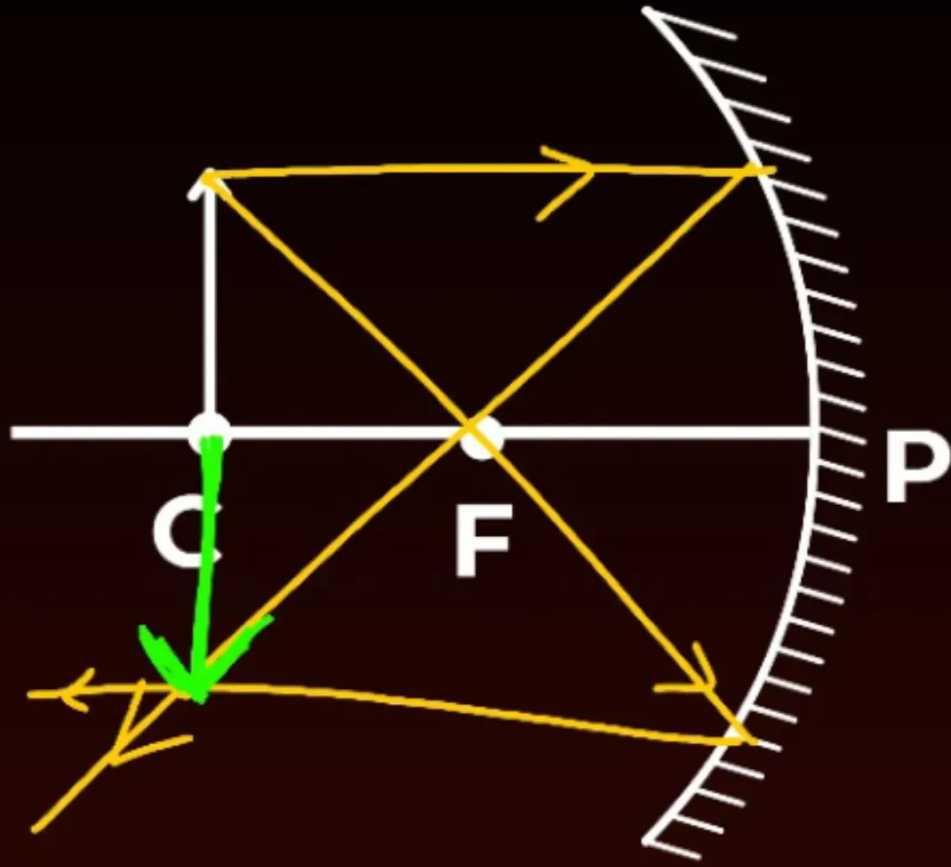
Object beyond C



CHARACTERISTICS

- Image between C & F.
- Real, Inverted, Diminished.

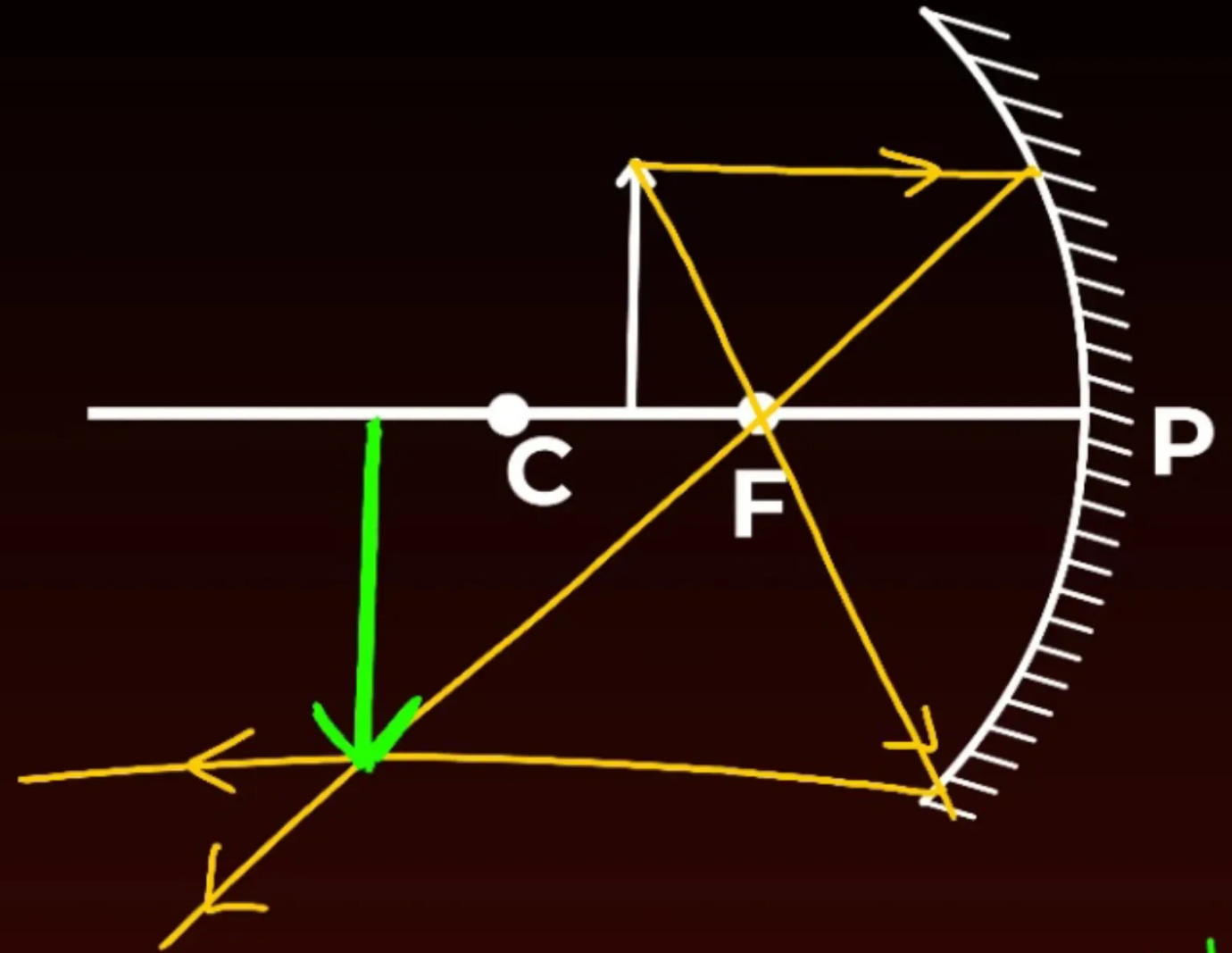
Object at C *special*



CHARACTERISTICS

- Image at C. ✓
- Real, Inverted, Same size.

Object between C & F

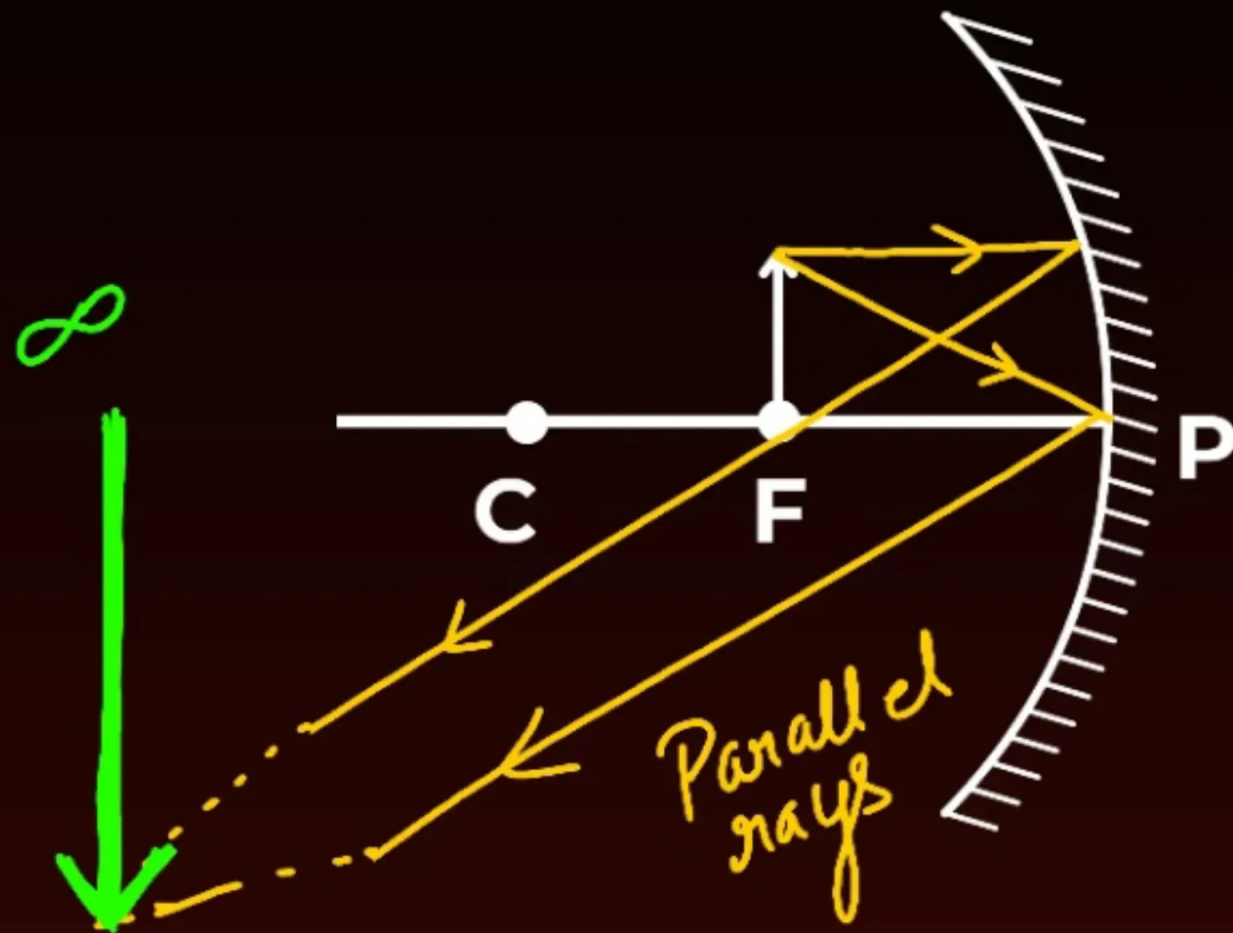


CHARACTERISTICS

- Image beyond C. ✓
- Real, Inverted, Magnified.

Enlarged

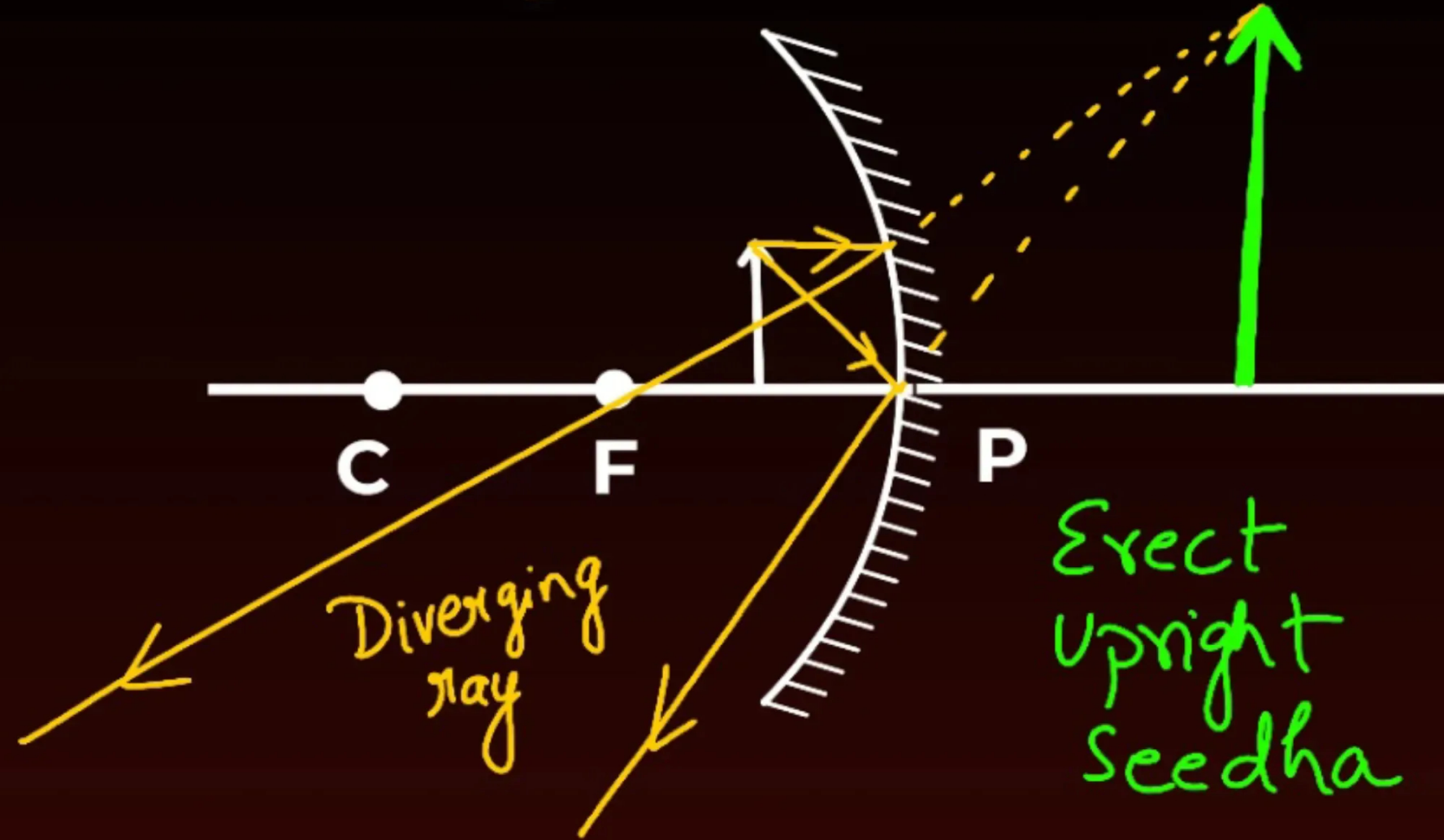
Object at F



CHARACTERISTICS

- Image at infinity. ✓
- Real, Inverted, Highly Magnified.

Object between F & P

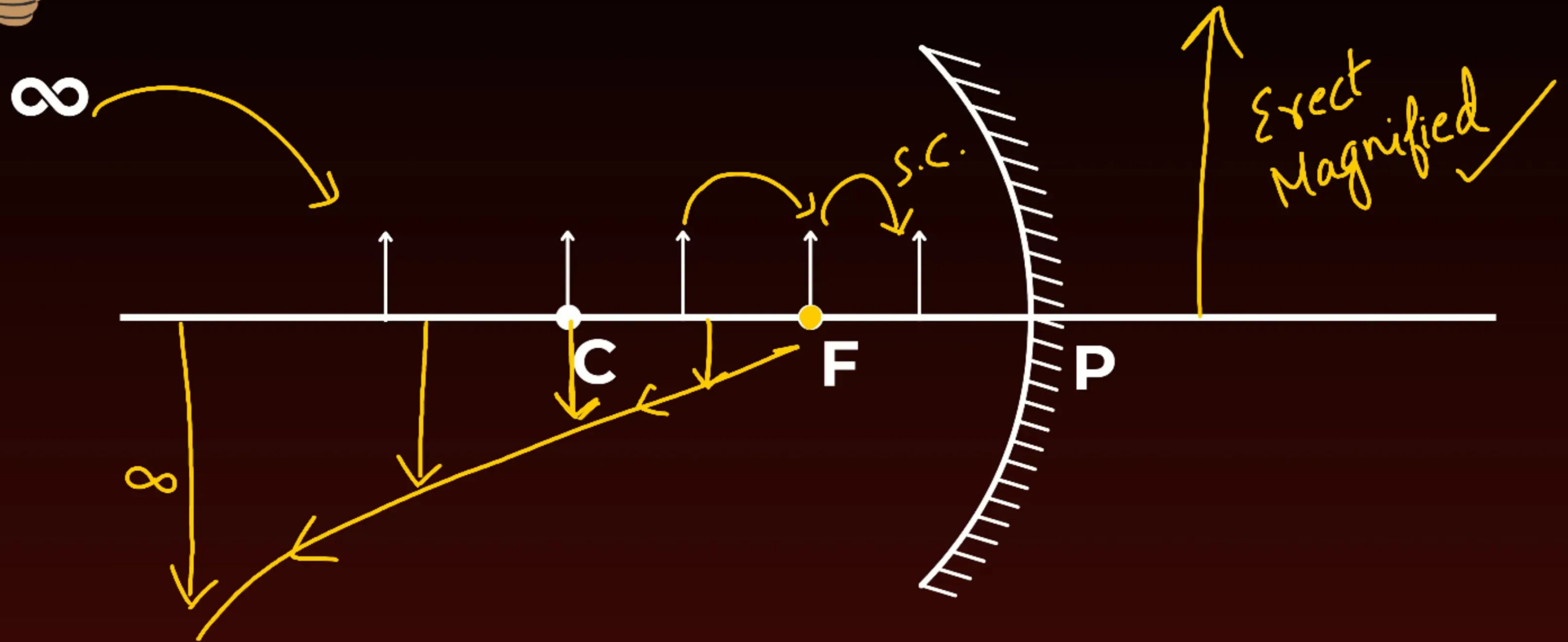


CHARACTERISTICS

- Image behind mirror. ✓
- Virtual, Erect, Magnified.



Alakh Sir Konzept (ASK)

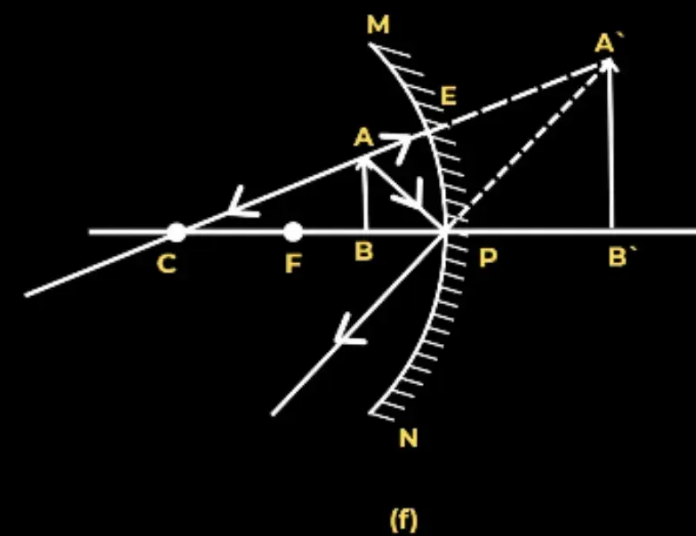
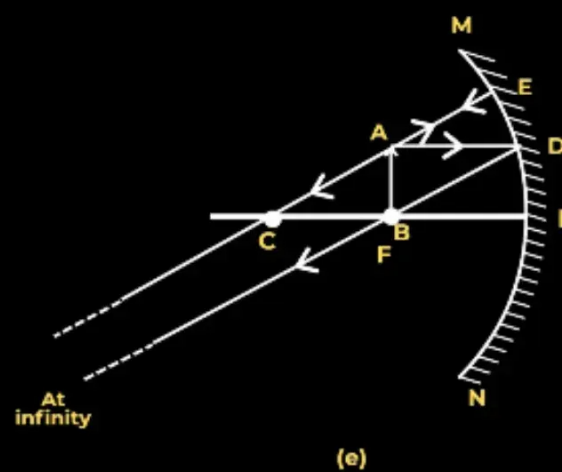
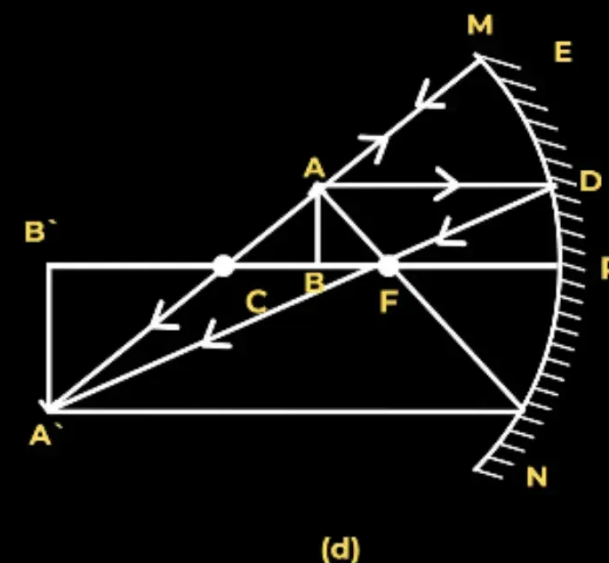
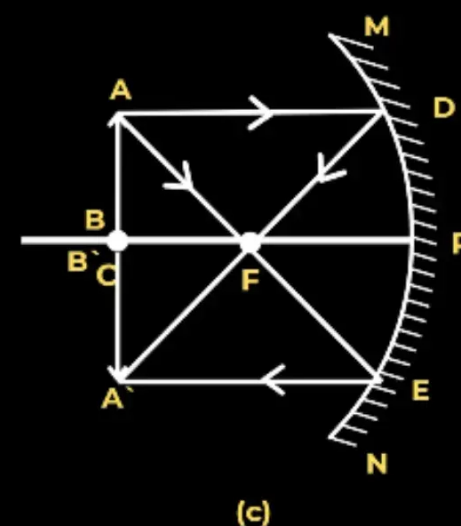
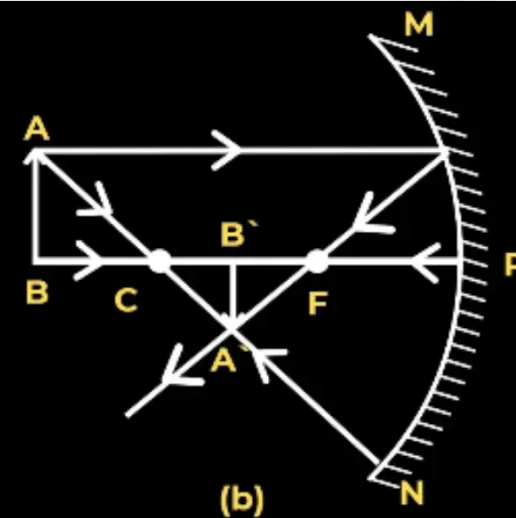
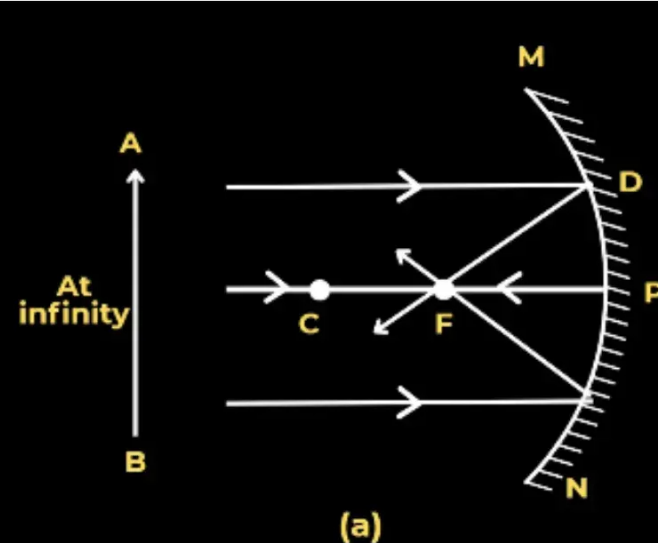


Summary for Concave Mirror

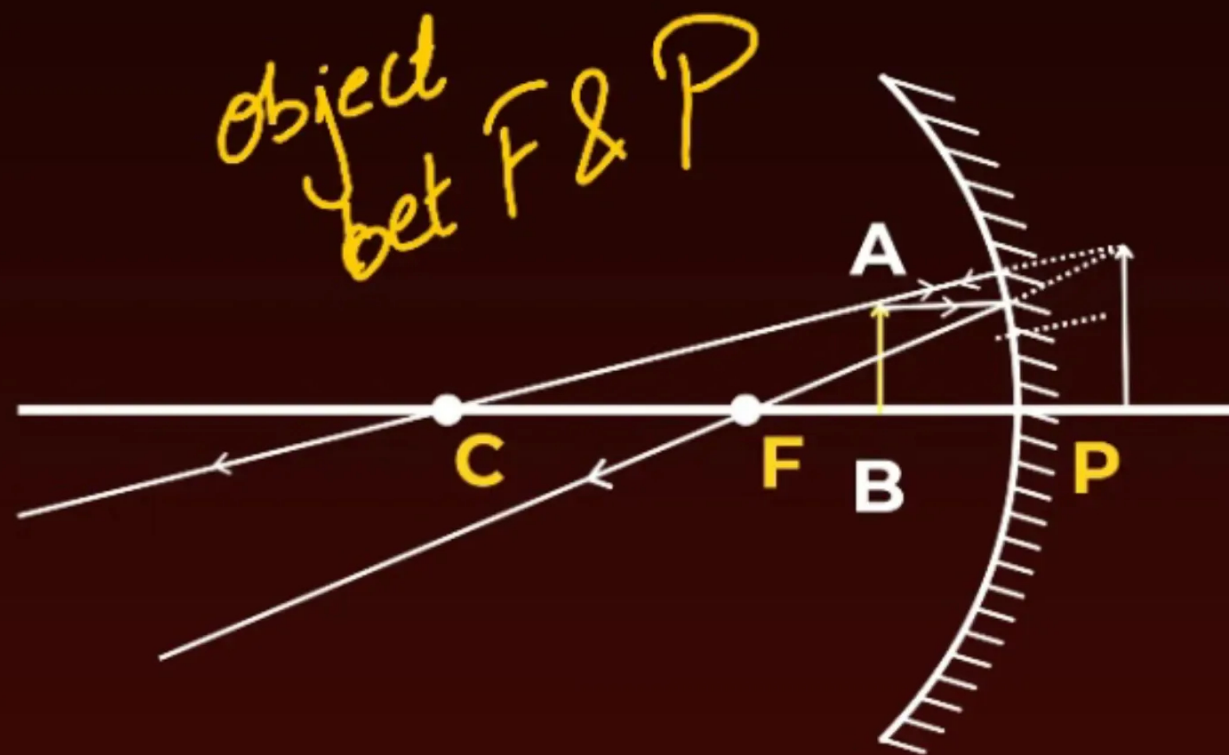
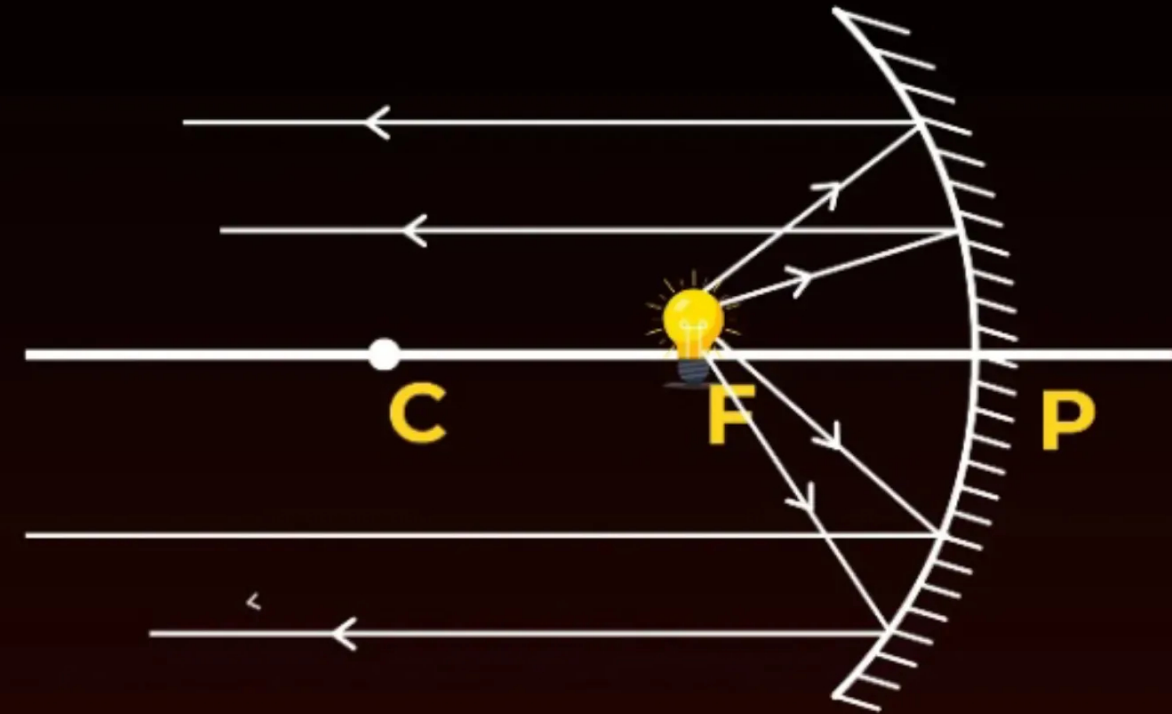
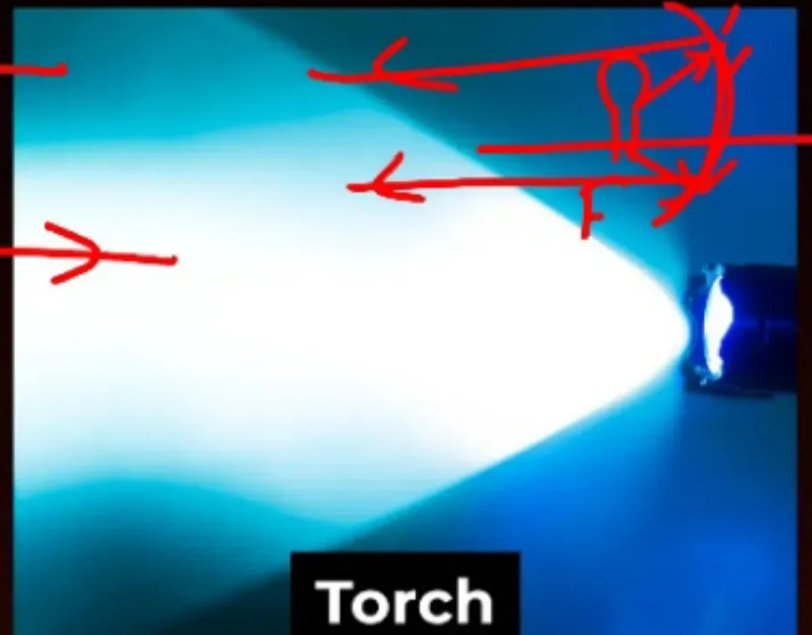
Learn

Position of the Object	Position of the Image	Size of the Image	Nature of the Image
At infinity	At the focus F	Highly diminished, point-sized	Real and inverted
Beyond C	Between F and C	Diminished	Real and inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	Enlarged	Virtual and erect

Position of the Object	Position of the Image	Size of the Image	Nature of the Image
At infinity	At the focus F	Highly diminished, point-sized	Real and inverted
Beyond C	Between F and C	Diminished	Real and inverted
At C	At C	Same size	Real and inverted
Between C and F	Beyond C	Enlarged	Real and inverted
At F	At infinity	Highly enlarged	Real and inverted
Between P and F	Behind the mirror	Enlarged	Virtual and erect

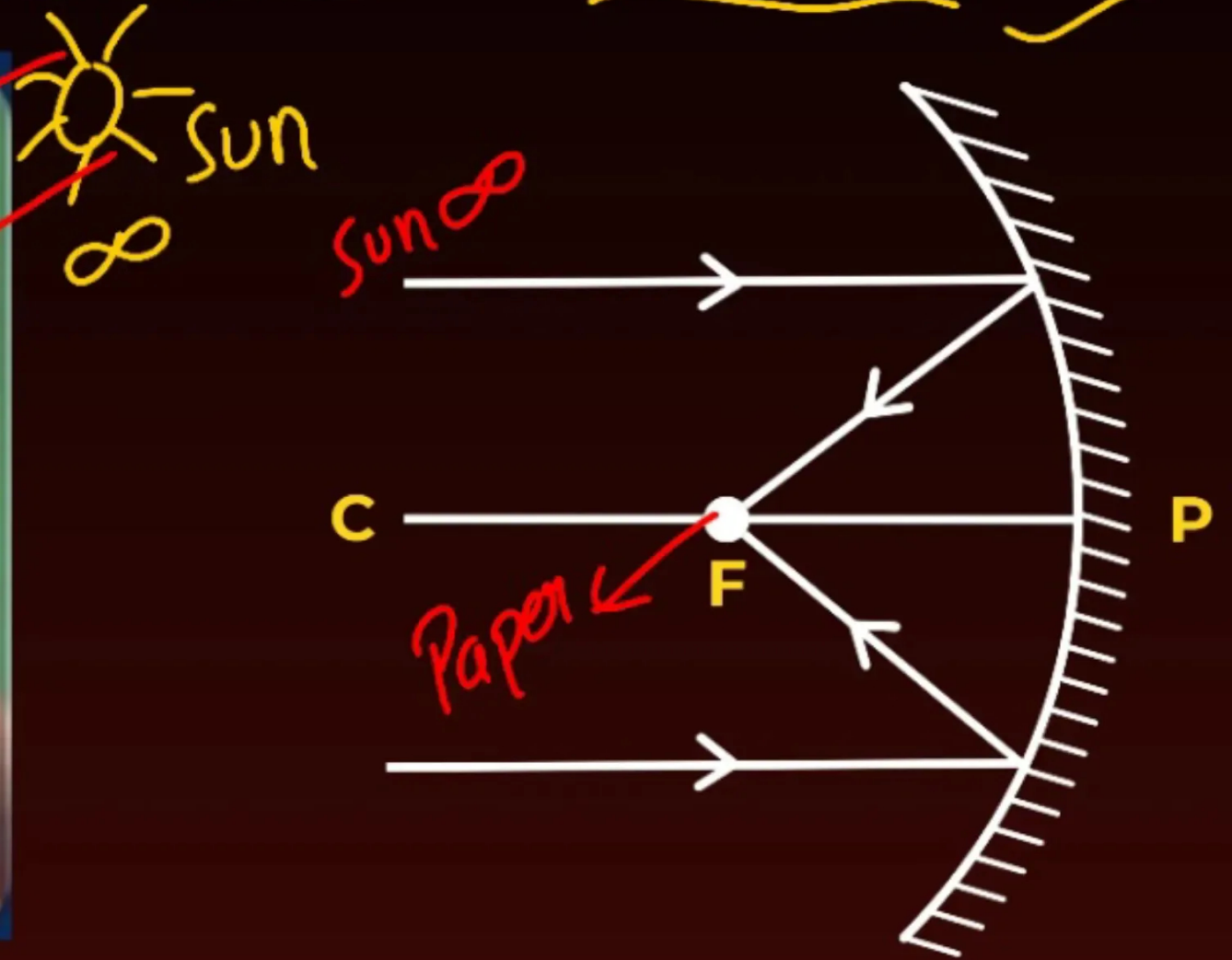
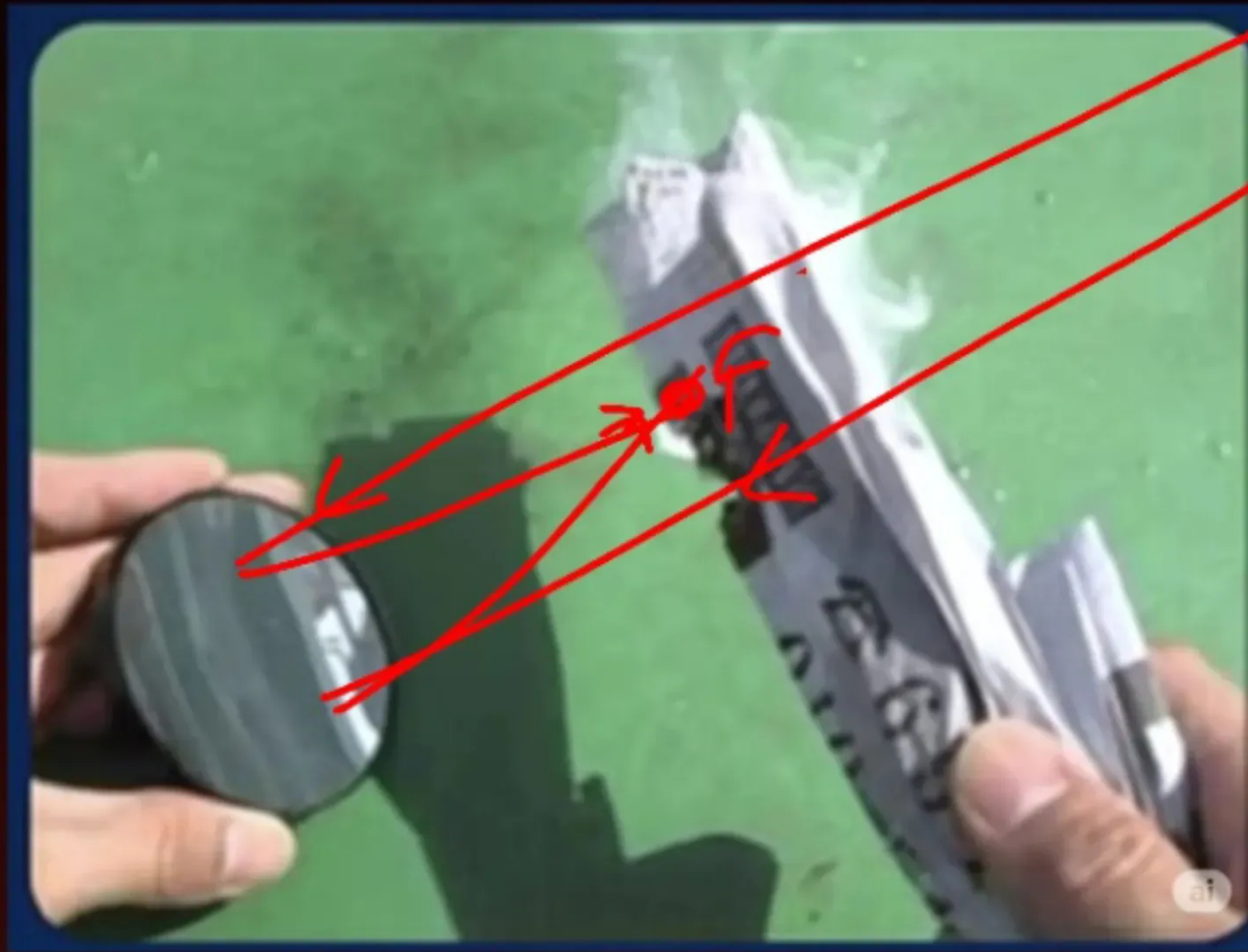


Use of Concave Mirror



Use of Concave Mirror

To Concentrate sunlight to produce heat → solar furnace



Activity 9.2

An object is placed at a distance of 30 cm from the reflecting surface of a concave mirror of radius of curvature 40 cm. The image formed is

$$R = 40\text{cm} \quad R = 2f \quad 40 = 2f \quad f = \frac{40}{2} = 20\text{cm}$$

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A Virtual and magnified

X

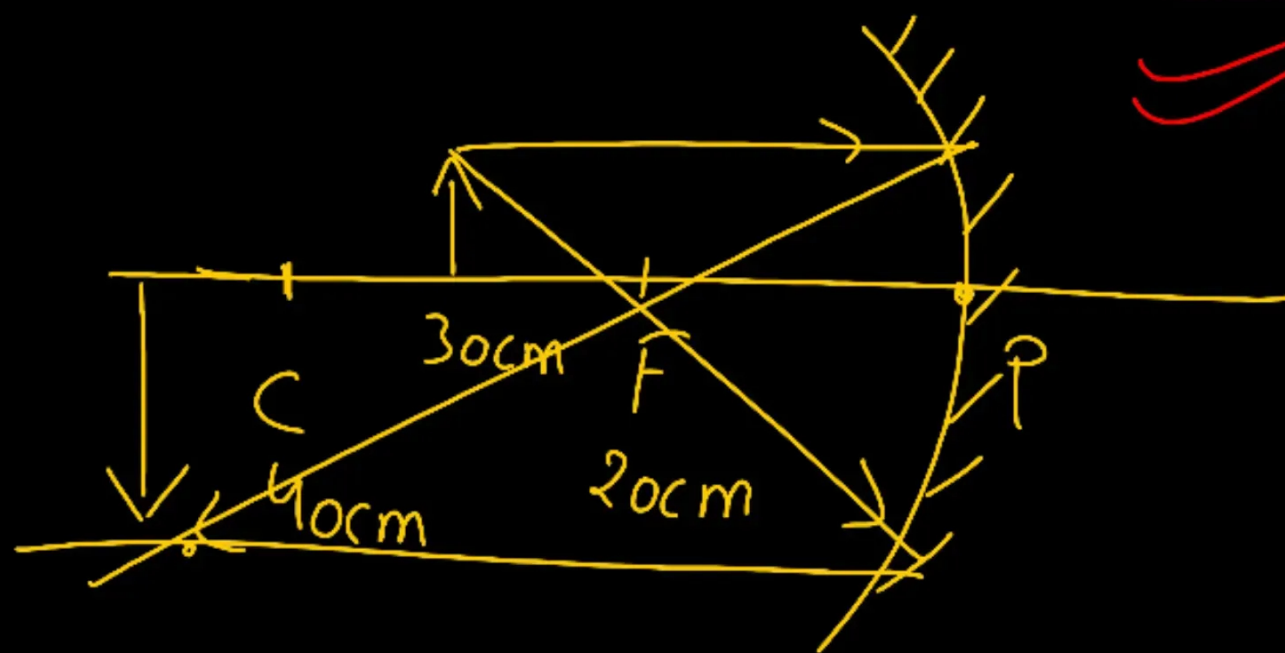
B Virtual and diminished

X

C Real and magnified

✓

D Real and diminished



A student wants to obtain an erect image of an object using a concave mirror of 10cm focal length. What will be the distance of the object from mirror?

A

Less than 10 cm ✓

B

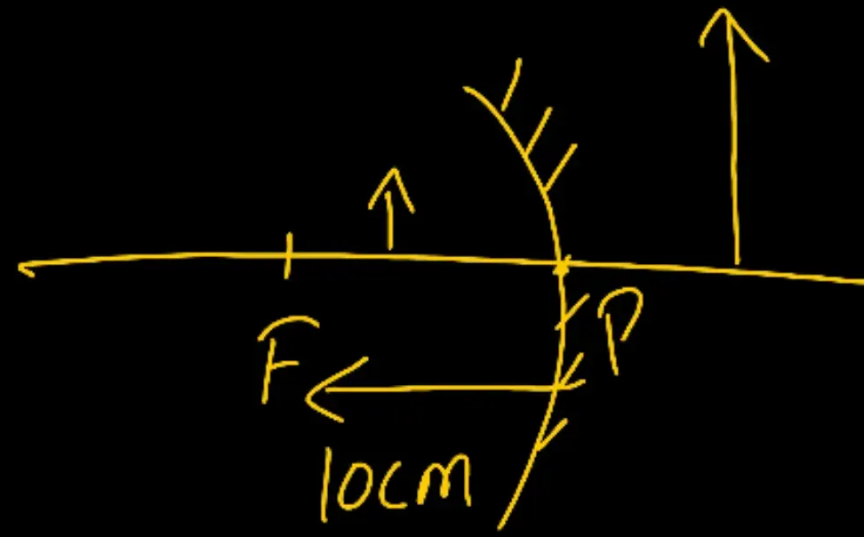
10cm

C

between 10 cm and 20 cm

D

more than 20 cm



CBSE 2023 ✓

Erect
↓
F & P

The image of an object placed in front of a concave mirror of focal length 15cm is of the same size as the object. The distance between the object and its image is

A

15 cm

B

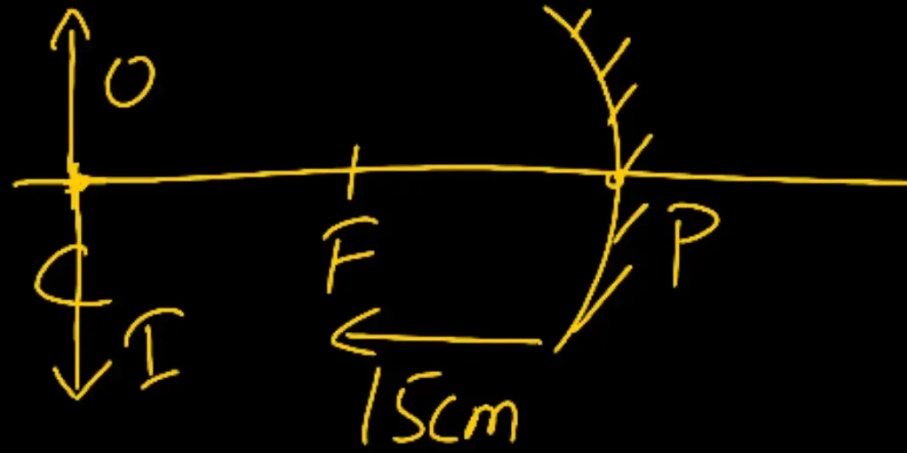
30cm

C

60 cm

D

Zero ✓



CBSE Term
(2021-2022)

Three concave Mirrors

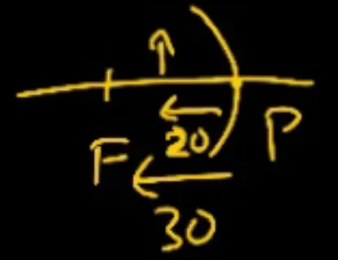
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Case	Mirror	Focal Length (cm)	Object Distance (cm)
1	A	20	45
2	B	15	30
3	C	30	20

→ Object beyond C $\Rightarrow$ Image between C & F

→ " at C

→ " between F & P



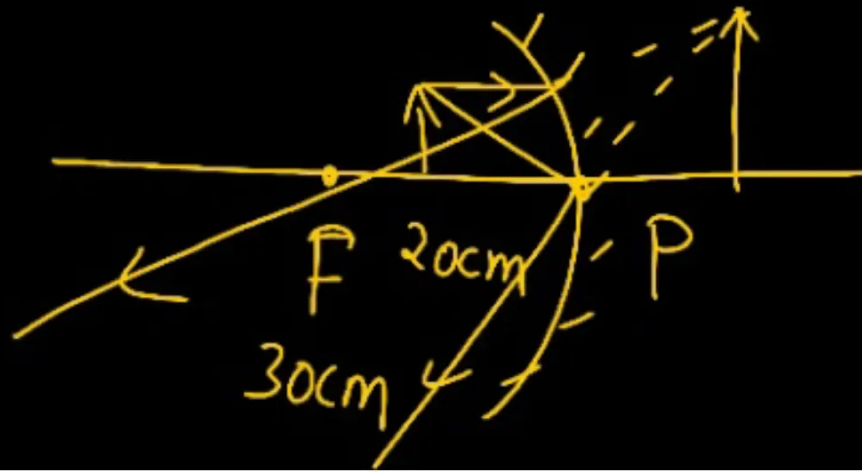
a) In which one of the above cases the mirror will form a diminished image of the object? Justify your answer.

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

c) What is the nature and size of the image formed by mirror C? Draw ray diagram to justify your answer.

Image at C $\left\{ \begin{array}{l} \rightarrow \text{Real} \\ \rightarrow \text{Inverted} \\ \rightarrow \text{Same size} \end{array} \right.$

$\rightarrow$ Image behind the mirror
 $\rightarrow$ Virtual, Erect, Magnified



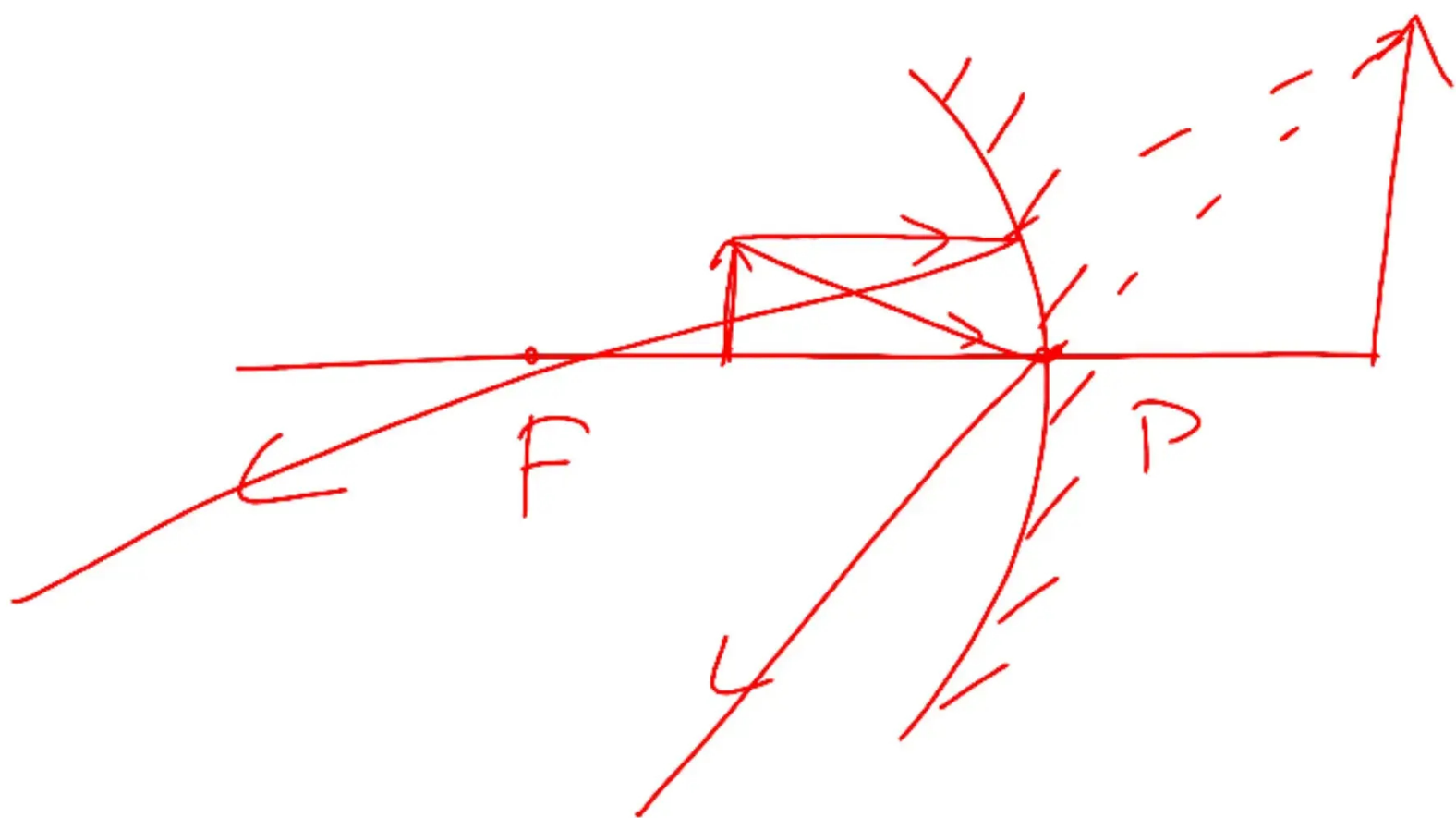
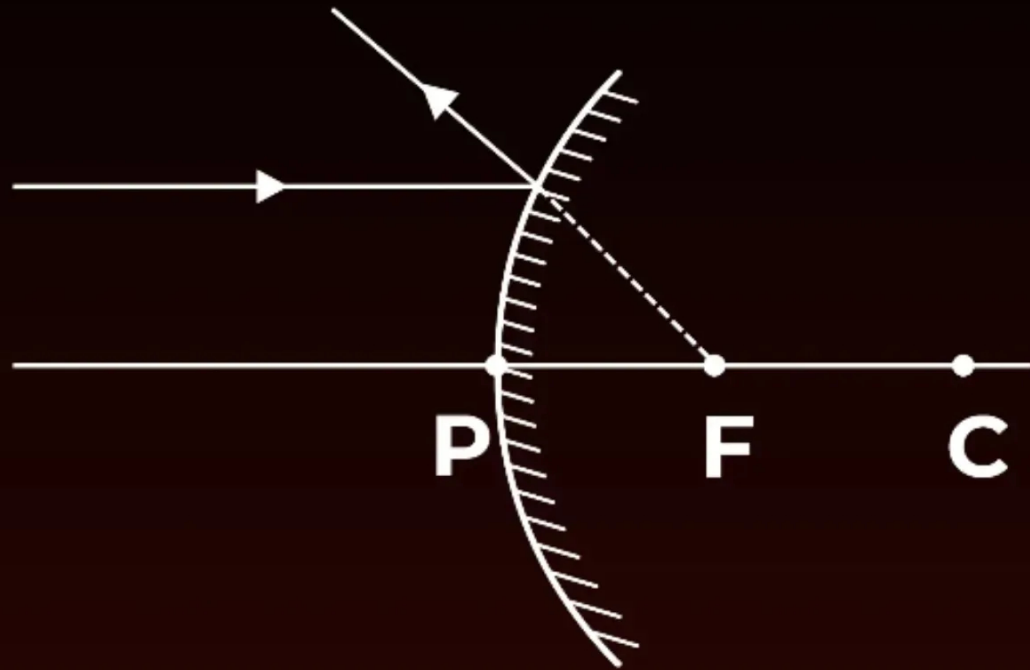


Image formation : Convex Mirror - Rules

1)



2)

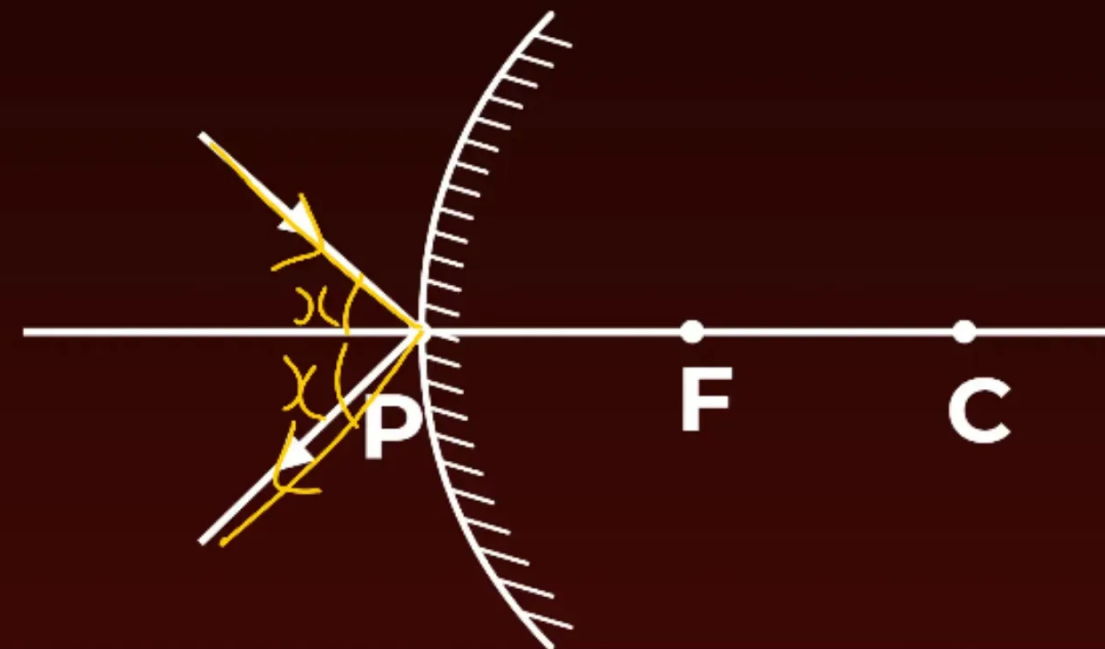
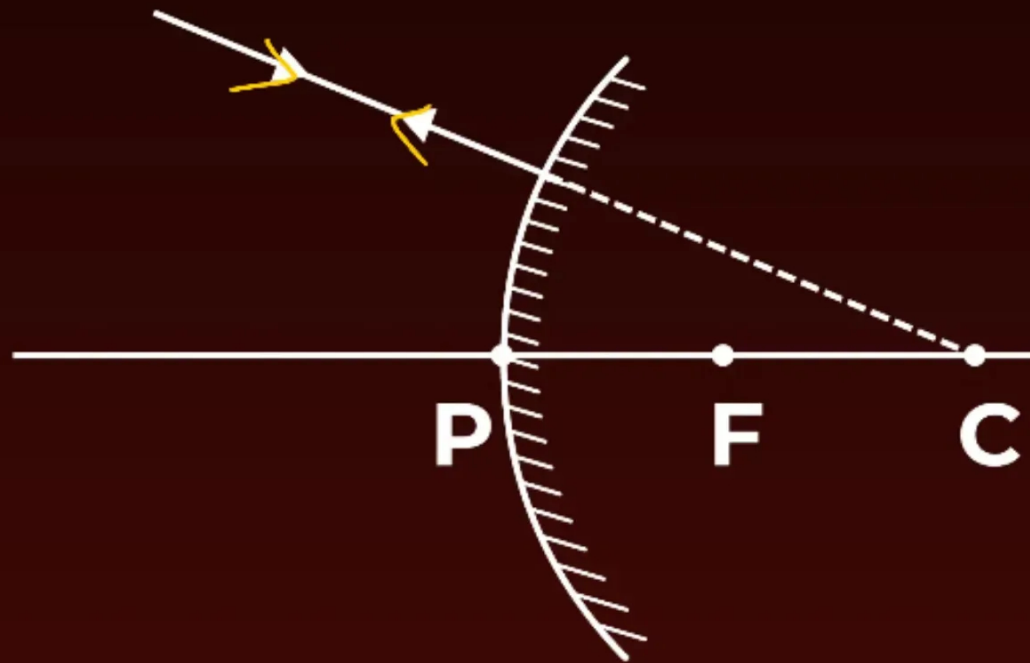
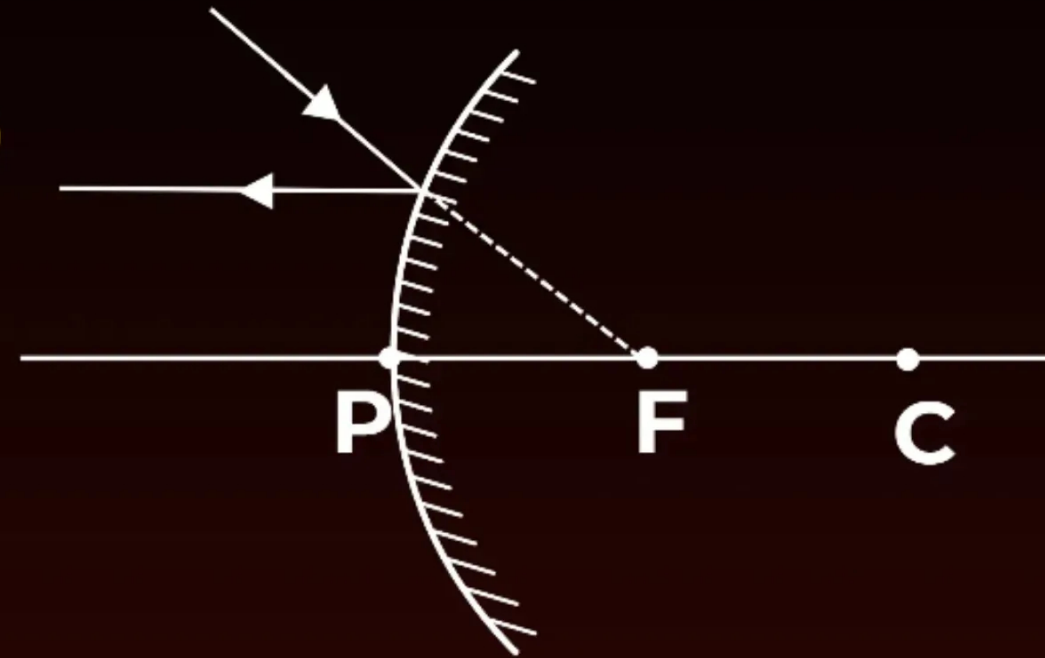
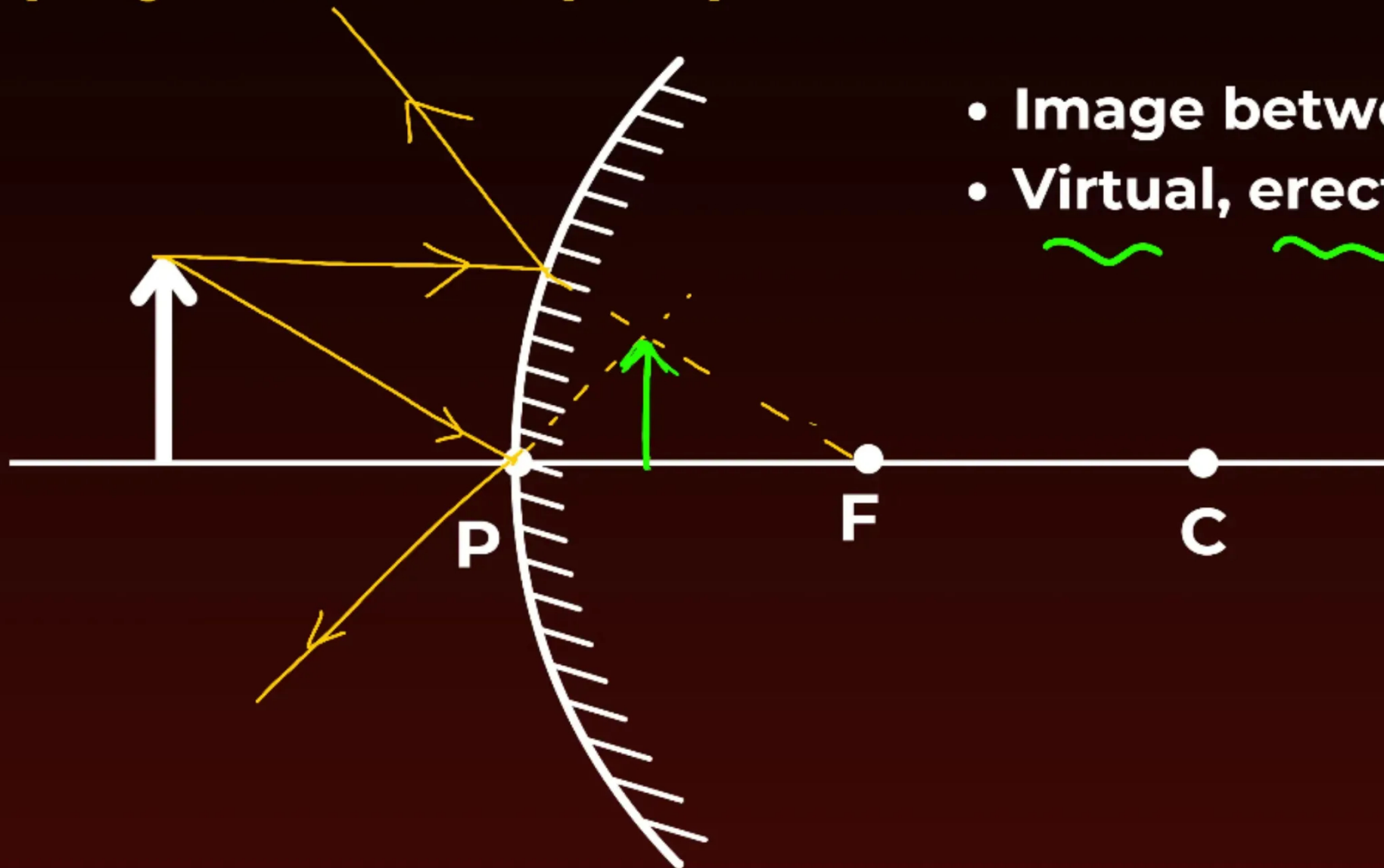


Image formation of Convex Mirror

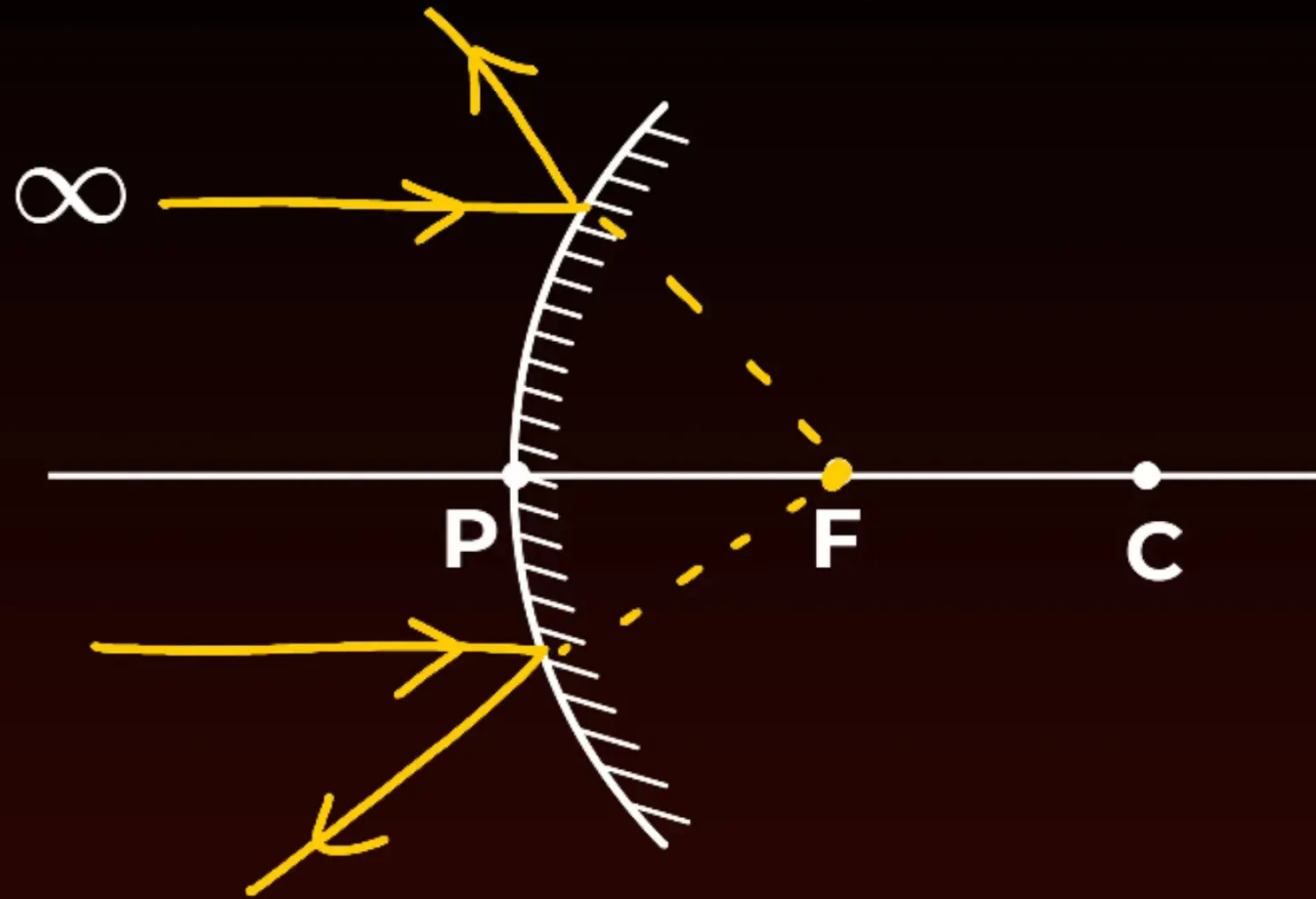
→ Seedhi
Choti
Image

Object at finite distance
(anywhere except ∞)



- Image between F & P. ✓
- Virtual, erect (upright), diminished

Object at infinity ∞



CHARACTERISTICS

- Image at F. ✓
- Virtual, erect, highly diminished (point sized) ✓

Position of the Object	Position of the Image	Size of the Image	Nature of the Image
At infinity ✓	At the focus F ✓	Highly diminished, point-sized ✓	Virtual and erect ✓
Between infinity and the pole P of the mirror ✓	Between F and P ✓	Diminished ✓	Virtual and erect ✓

Use of Convex Mirror

→ Rear View → Seedhi
Choti
Convex



Reason : ✓

1. Upright / erect image.
2. Wider field of view.

→ diminished

Rear- view mirrors ✓

Summary : Concave & Convex Mirror

Concave Mirror

Inverted

Erect | Upright

{ Enlarged }

{ Seedhi +
Badi image }

Convex Mirror

- Only erect & virtual image.
- Always diminished
{ Seedhi + Choti image }

List four properties of the images formed by convex mirrors when objects are placed anywhere in front of their reflecting surfaces.

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- 1) Virtual Image ✓
- 2) Upright / Erect Image ✓
- 3) Diminished Image ✓
- 4) On other side of mirror with respect to object

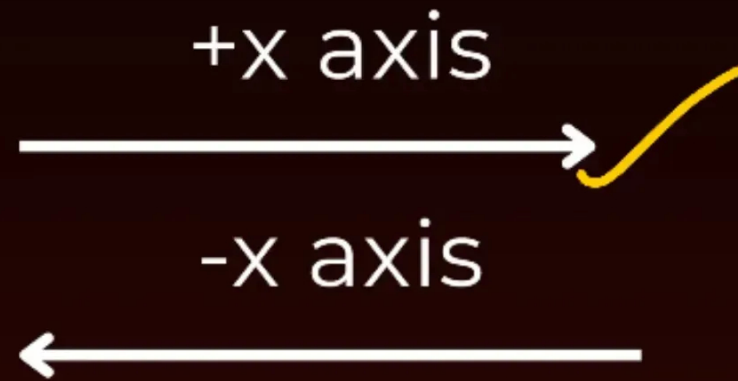
(Between F & P)

Sign Convention

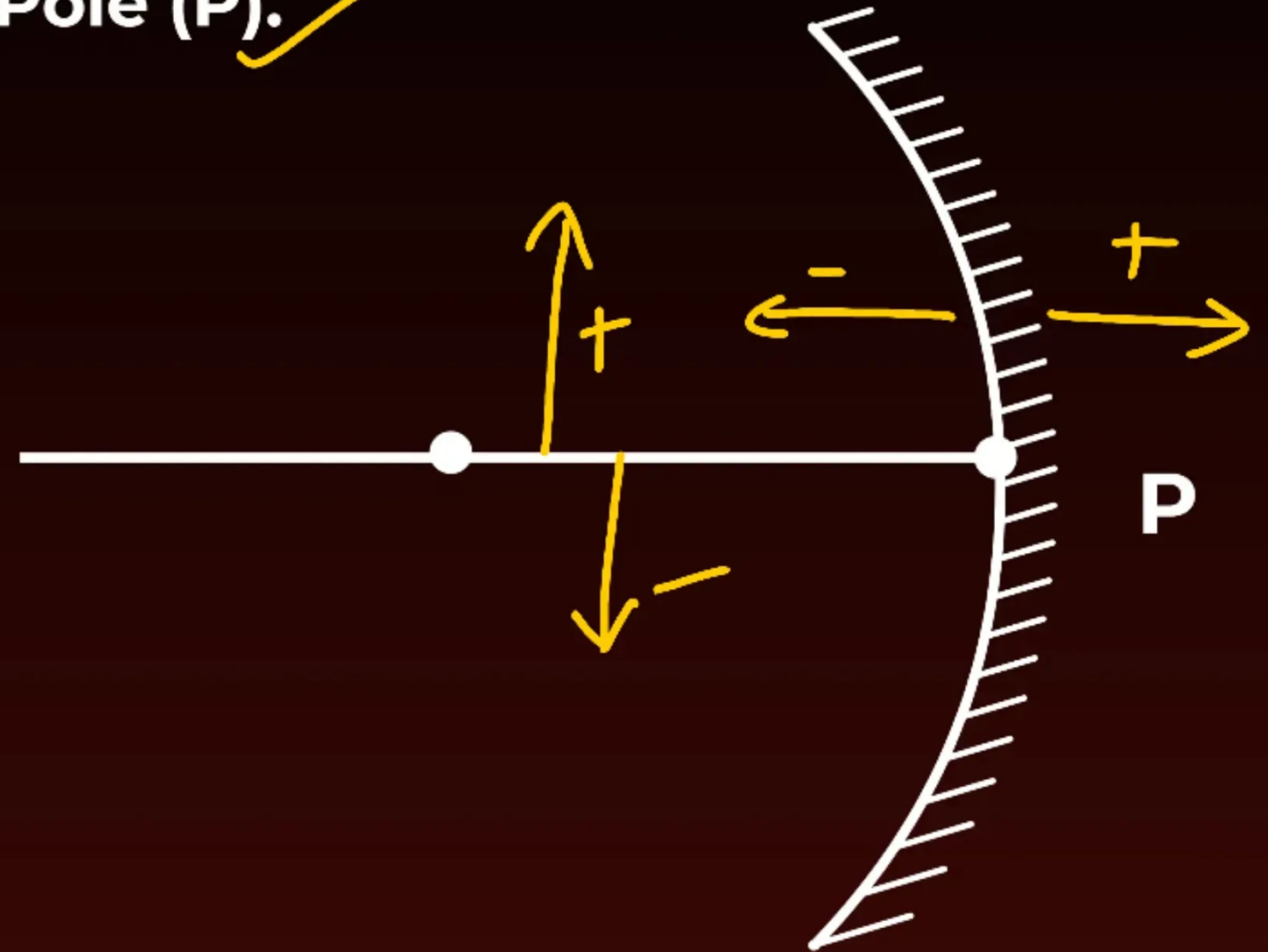
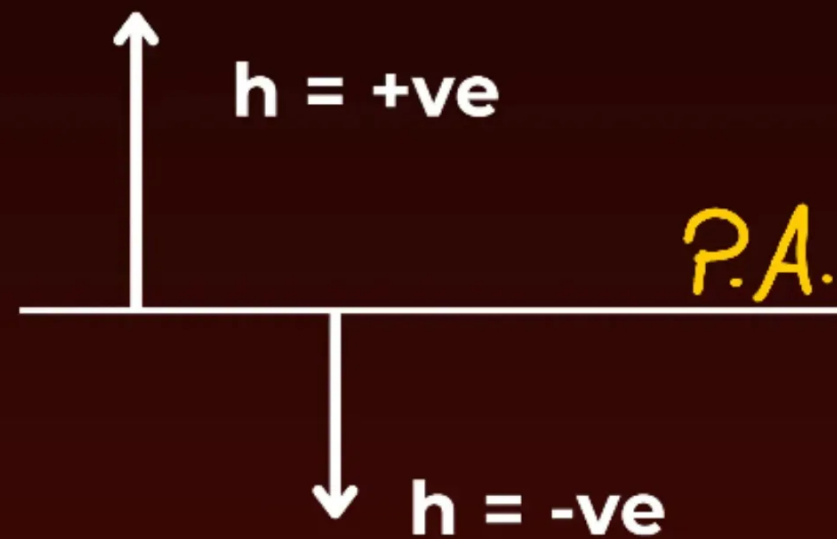


1) All distances are measured from Pole (P). ✓

2)



3)



Mirror Formula

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

Learn

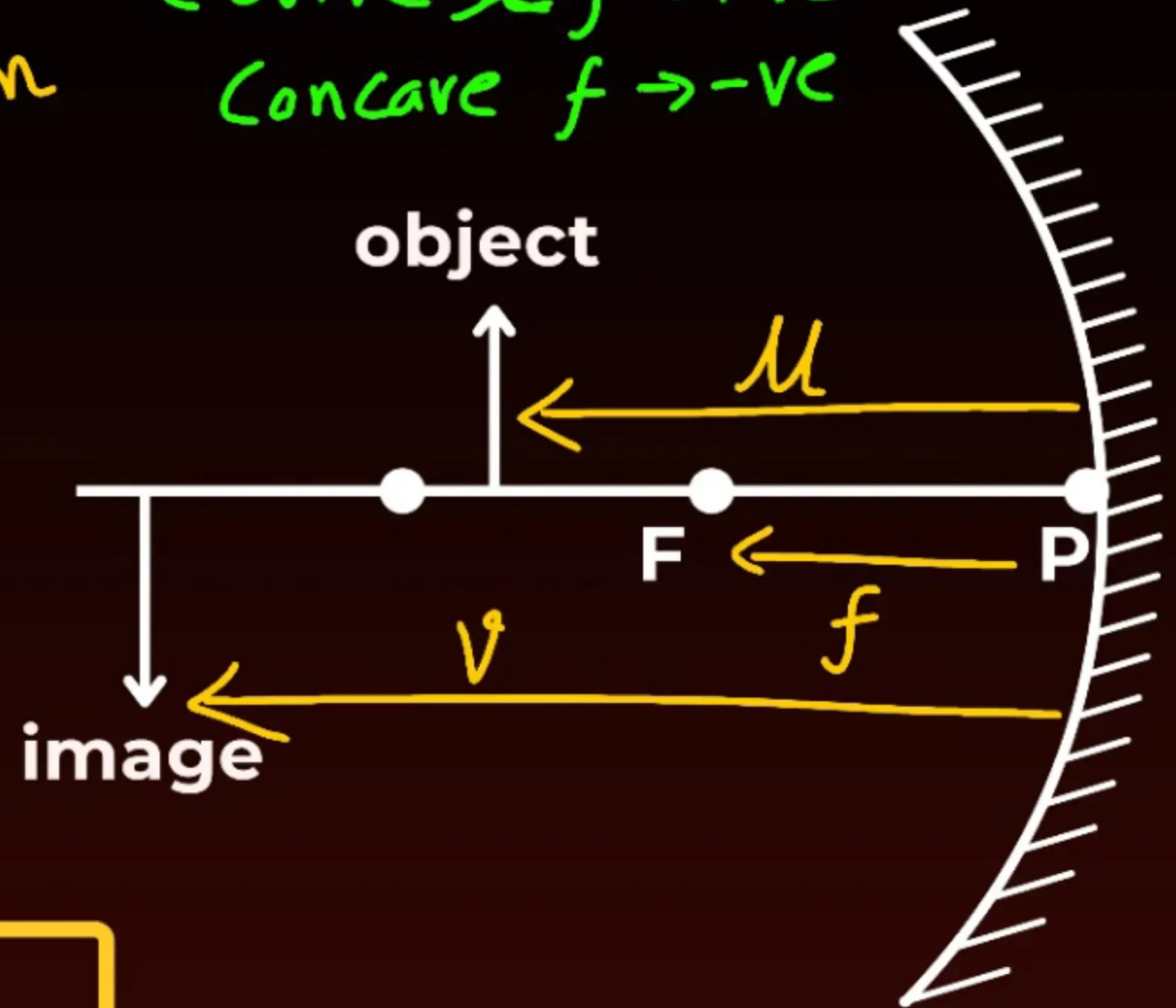
f = focal length

u = object distance ✓

v = image distance ✓

NOTE: 1) $u \rightarrow$ always -ve
2) Convex $\rightarrow f \rightarrow +ve$

Convex $f \rightarrow +ve$
Concave $f \rightarrow -ve$



An object is placed at a distance of 10 cm in front of a concave mirror of focal length 15 cm. Use mirror formula to determine the position of the image formed in this mirror.

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

$$u = -10\text{cm}$$

$$f = -15\text{cm}$$

$$-\frac{1}{15} = \frac{1}{v} + \frac{1}{-10}$$

$$\frac{1}{v} = \frac{1}{10} - \frac{1}{15}$$

$$\frac{1}{v} = \frac{3-2}{30} = \frac{1}{30}$$

$$v = 30\text{cm.}$$

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An object is placed at a distance of 18 cm from the pole of a concave mirror of focal length 12 cm. Find the position of the image formed in this case.

Concave

$$f = -12 \text{ cm}$$

$$v = ?$$

$$u = -18 \text{ cm}$$

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

Comment

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An object is placed at a distance of 30 cm from the pole of a concave mirror. If its real and inverted image is formed at 60 cm in front of the mirror, the focal length of the mirror is :

A

-15 cm

$f = ?$

$$u = -30 \text{ cm}$$

$$v = -60 \text{ cm}$$

$$f = -20 \text{ cm}$$

Image is at
Screen
↓
Real, Inverted

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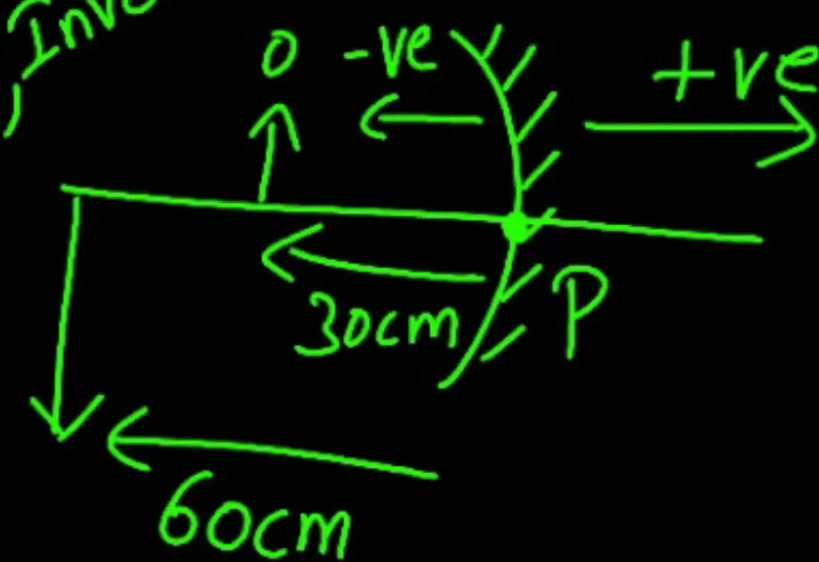
B

-20 cm

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

$$= \frac{1}{-60} + \frac{1}{-30}$$

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



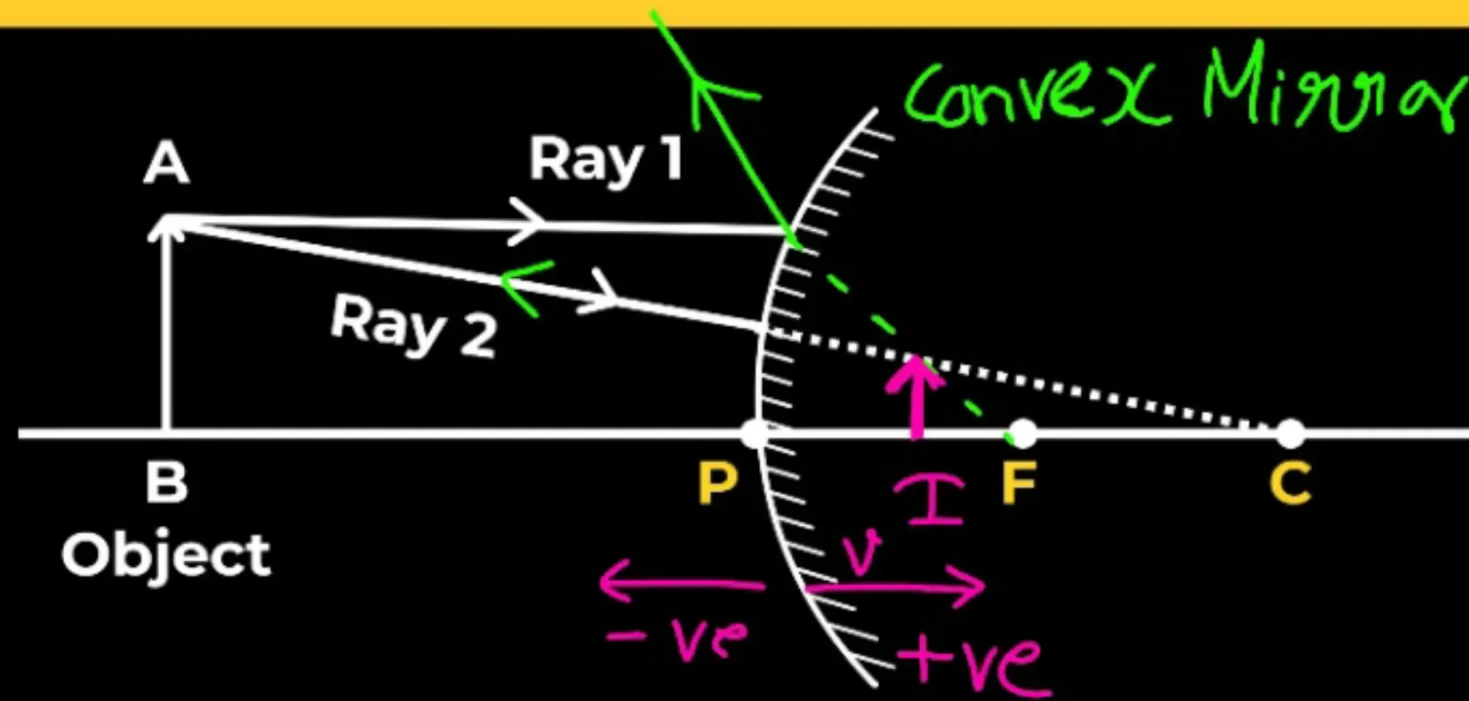
C

+ 20 cm

D

+ 15 cm

a) Complete the following ray diagram to show the formation of image :



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b) Mention the nature, position and size of the image formed in this case.

Erect, virtual, diminished Betw F & P

c) State the sign of the image distance in this case using the Cartesian sign convention. $+ve$

Magnification (m)

$$m = \frac{h_i}{h_o}$$

→ lens/mirror

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

h_i = height of image
 h_o = height of object

u = object distance ✓
 v = image distance ✓

A convex mirror used for rear view on an automobile has a focal length of 1.5 m. If a 3 m high bus is located at 6.0 m from the mirror, use mirror formula to determine the position and size of the image of the bus as seen in the mirror.

$$f = +1.5 \text{ m}$$

$$u = -6 \text{ m}$$

$$v = ?$$

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

$$\frac{1}{1.5} = \frac{1}{v} + \frac{1}{-6}$$

$$\frac{1}{v} = \frac{1}{6} + \frac{102}{453}$$

$$\frac{1}{v} = \frac{1}{6} + \frac{2}{3}$$

$$= \frac{1+4}{6}$$

$$\frac{1}{v} = \frac{5}{6}$$

$$v = \frac{6}{5} = +1.2 \text{ m}$$

$$h_o = 3 \text{ m}$$

$$h_i = ?$$

$$m = \frac{h_i}{h_o}$$

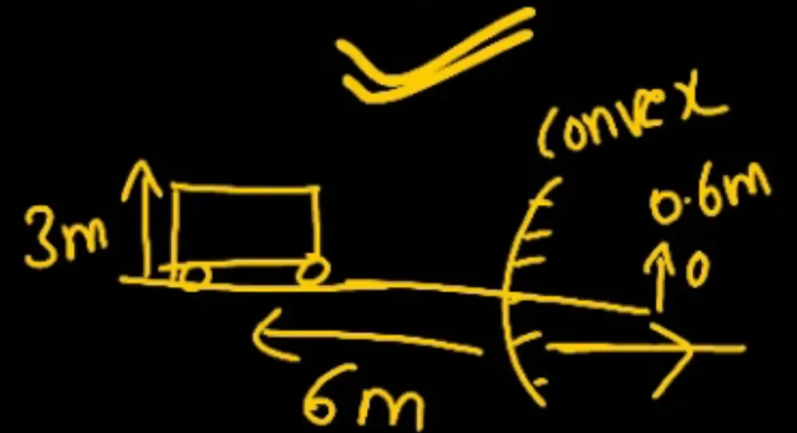
$$\frac{1}{5} = \frac{h_i}{3}$$

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

$$= +\frac{6}{5} = \frac{1}{5}$$

$$\rightarrow h_i = \frac{3}{5} = 0.6 \text{ m}$$

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Magnification (m) & Nature of image

$$m = \frac{h_i}{h_o}$$

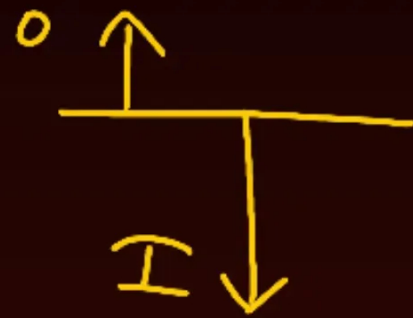
$$h_i = m \times h_o$$

1) $m = 2$

$$h_i = 2 \times h_o$$

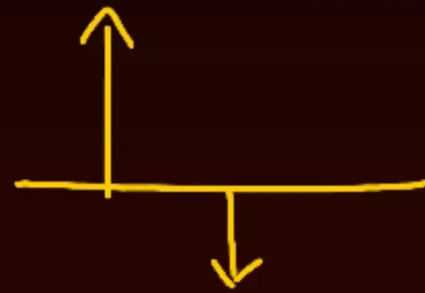
2) $m = \frac{1}{2}$
 $h_i = \frac{1}{2} h_o$

3) $m = -2$
 $h_i = -2 \times h_o$



4) $m = -\frac{1}{2}$

$$h_i = -\frac{1}{2} h_o$$

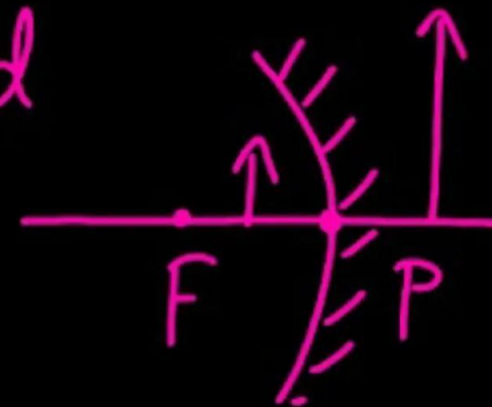


"The linear magnification produced by a spherical mirror is +3". Based on this statement answer the following questions :

- a) What is the type of the mirror? *Concave Mirror*
- b) Where is the object located? *Between F & P*
- c) List two properties of the image formed (other than the size/ magnification) .
• Virtual • Erect • Behind the mirror

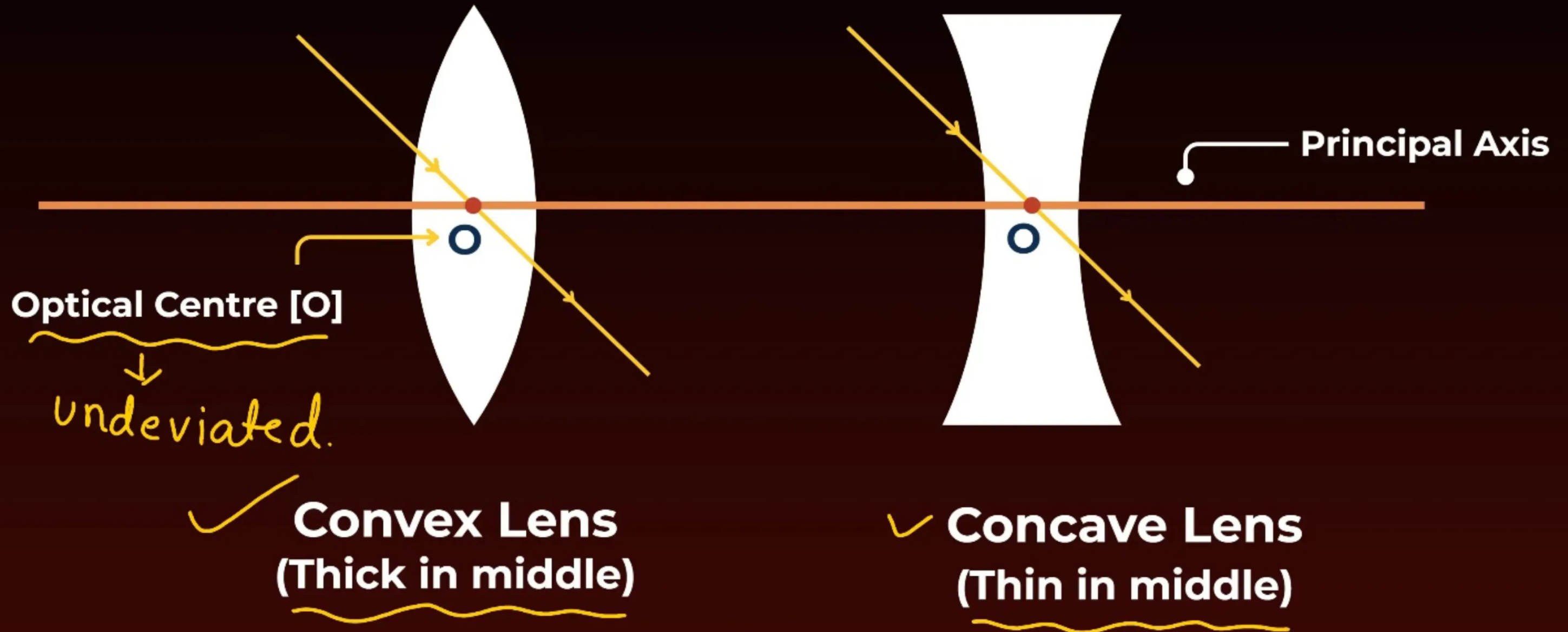
$$m = +3$$
$$h_i = 3 \times h_o$$

Erect Magnified



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Spherical lens

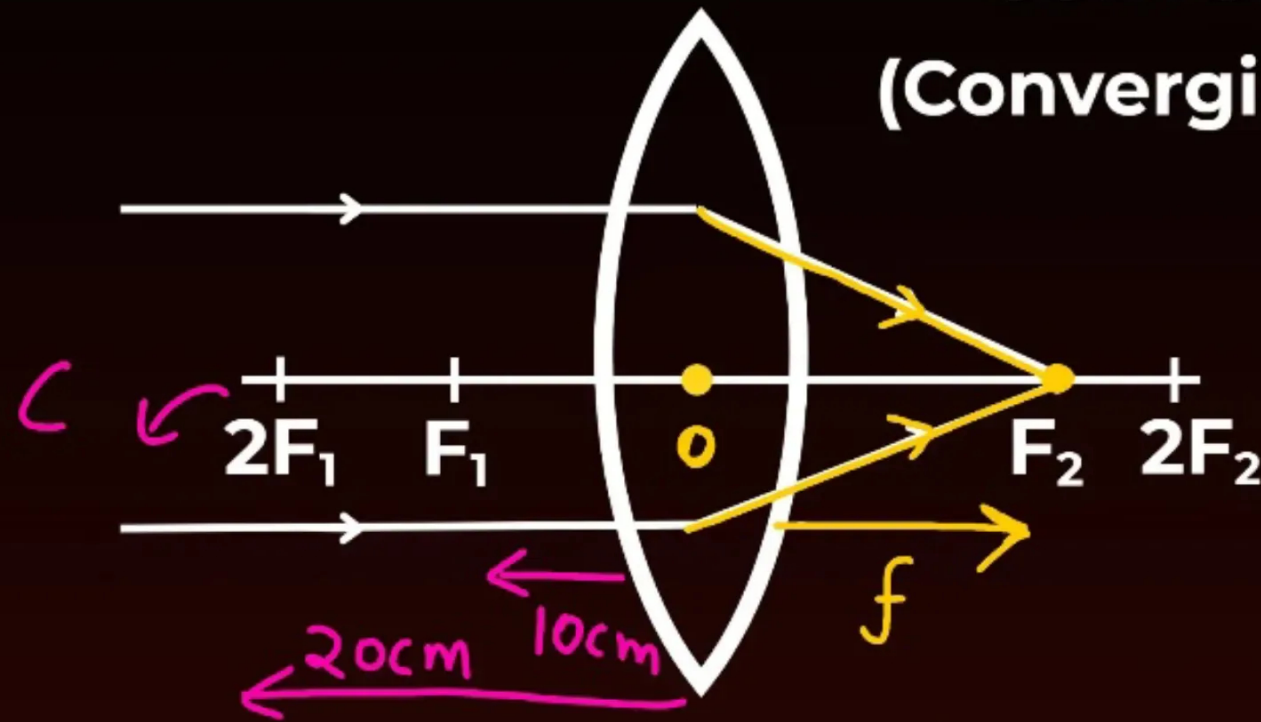


Principal Focus (F) & Focal Length (f)

1) Convex Lens ✓

Note : They have two F
- F_1 & F_2 due to two
curved surfaces.

Convex Lens (Converging Lens) ✓



2) Concave Lens ✓

Concave Lens (Diverging Lens) ✓

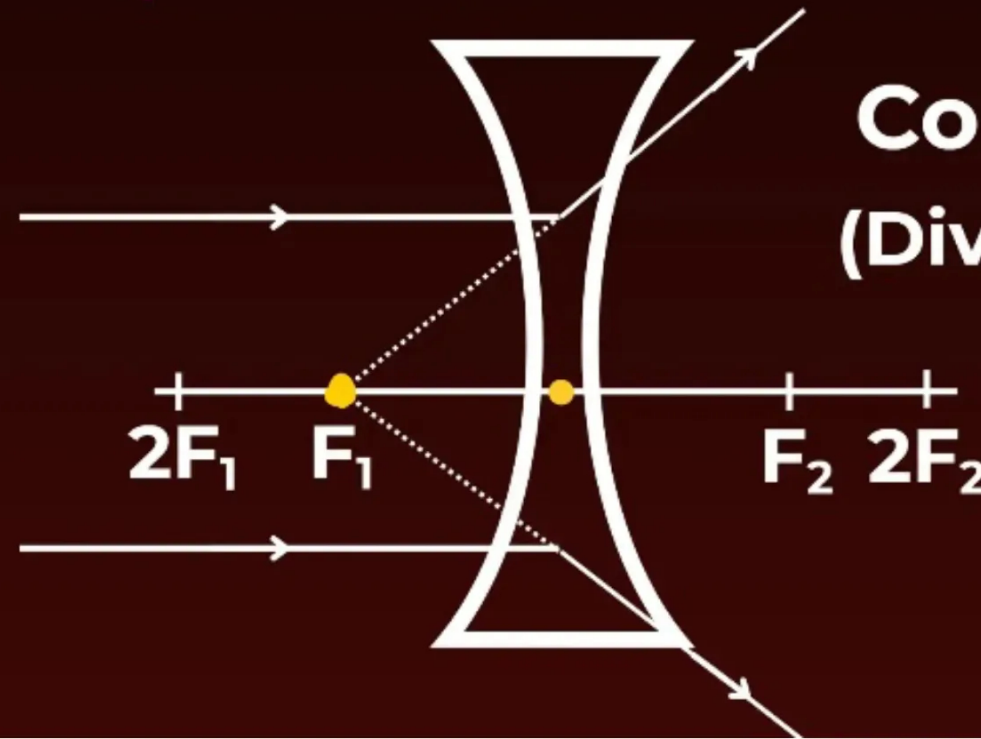
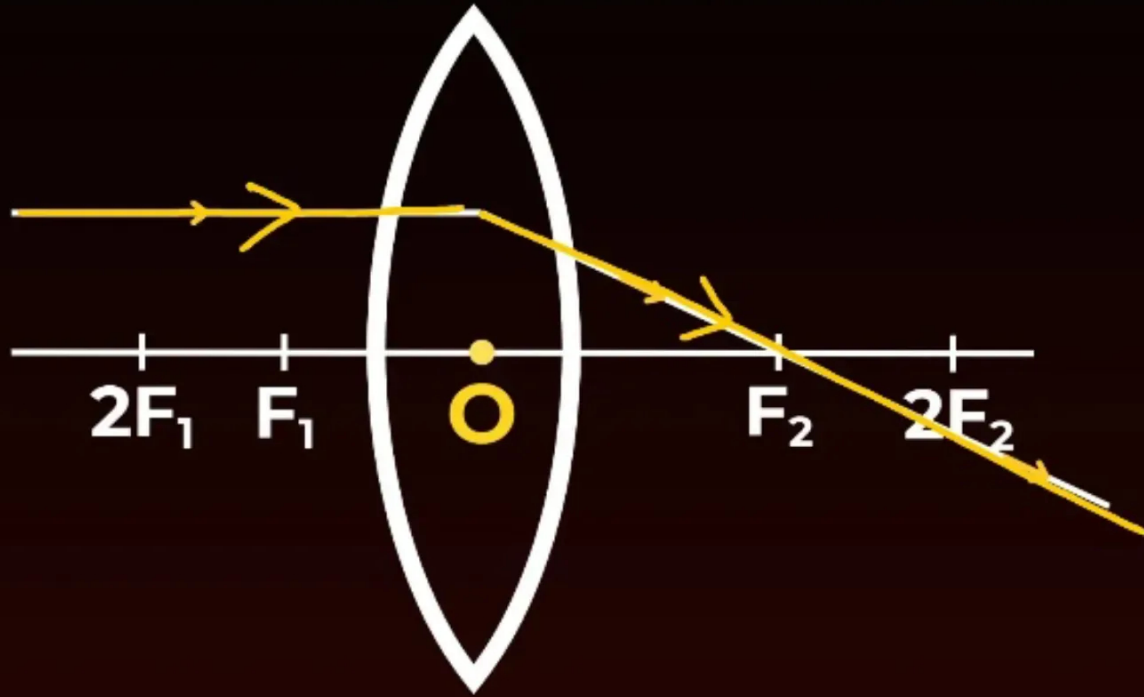
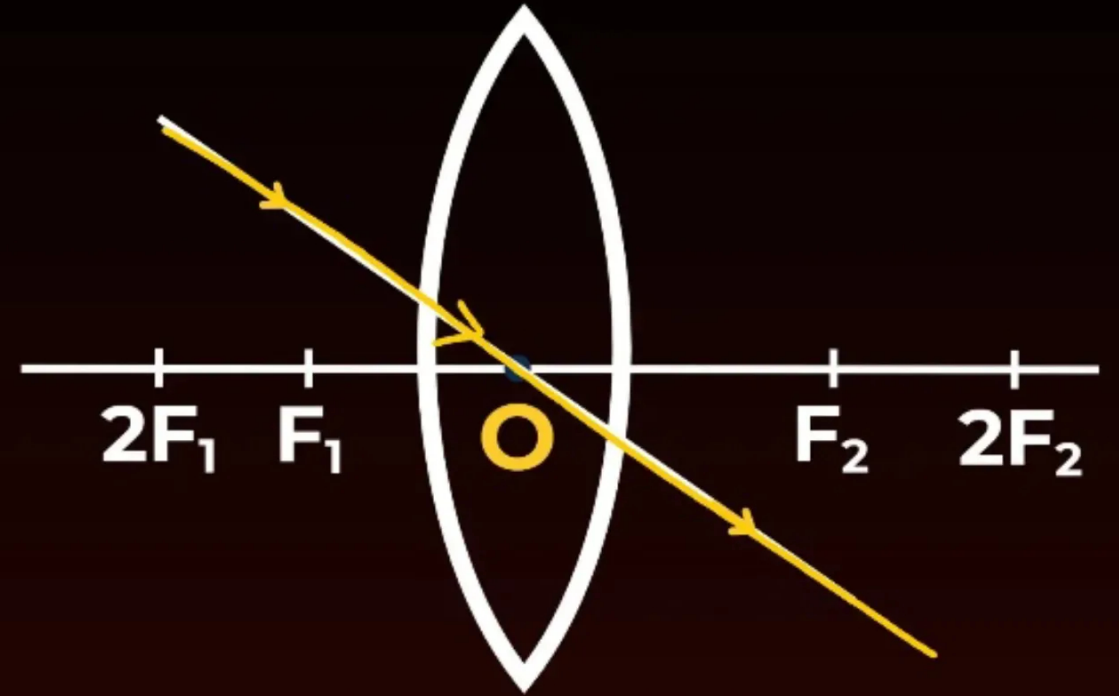


Image Formation (Convex Lens)-Rules

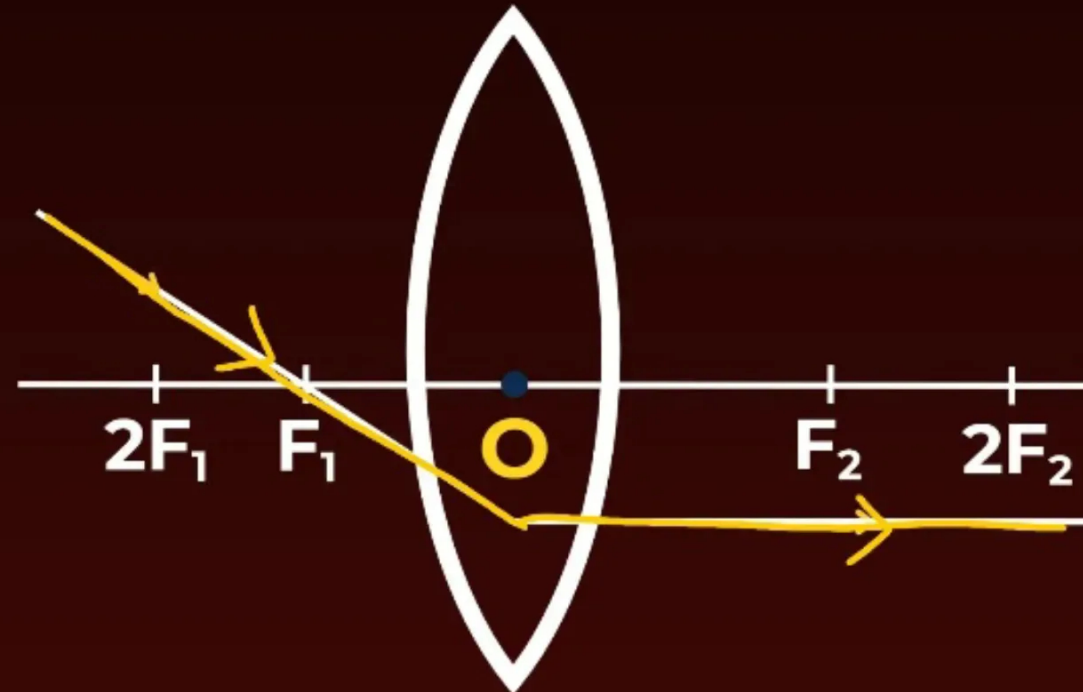
1.



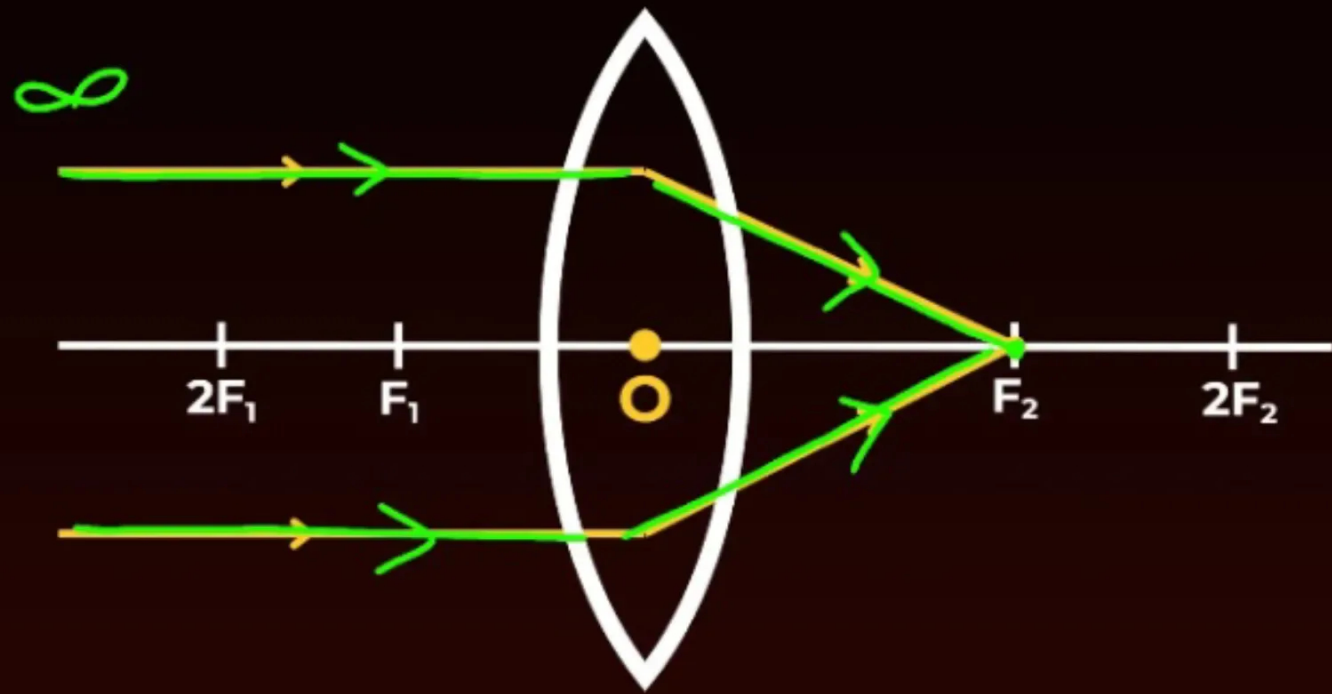
2.



~~3.~~



Object at ∞



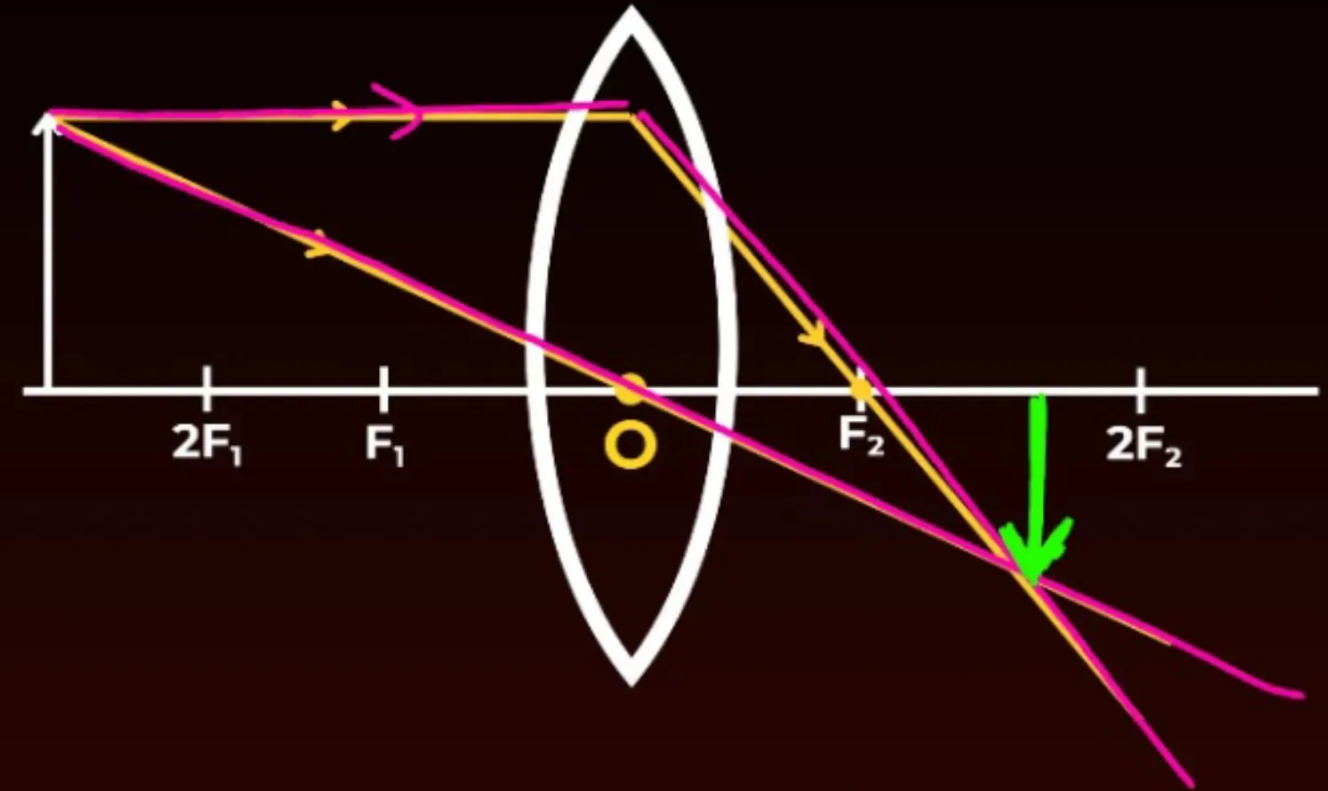
CHARACTERISTICS OF IMAGE

Image at F_2 ✓

Real, Inverted, Highly Diminished

Point sized

Object Beyond $2F_1$

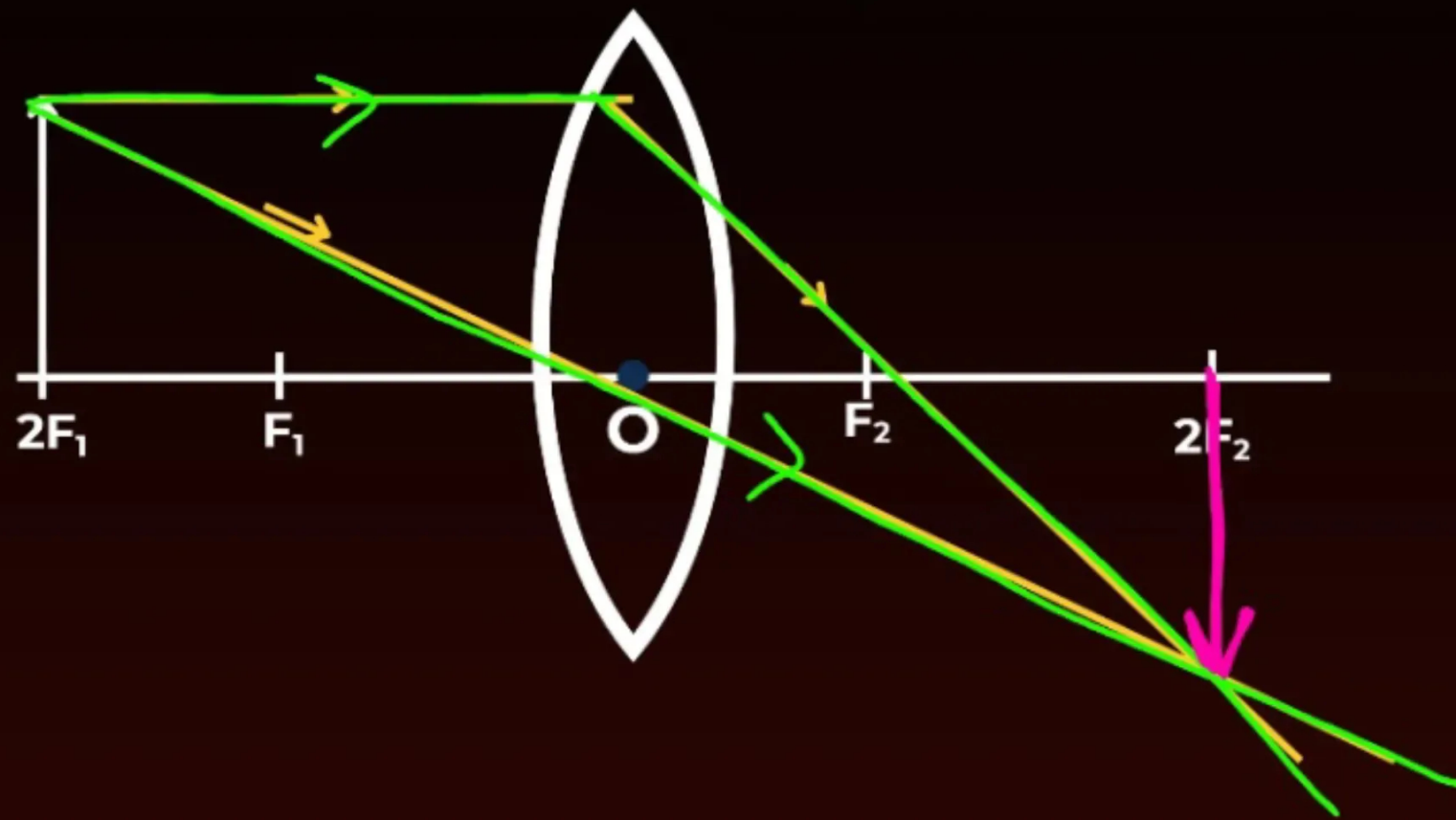


CHARACTERISTICS OF IMAGE

Image between F_2 & $2F_2$ ✓

Real, Inverted, Diminished

Object at $2F_1$ ✓

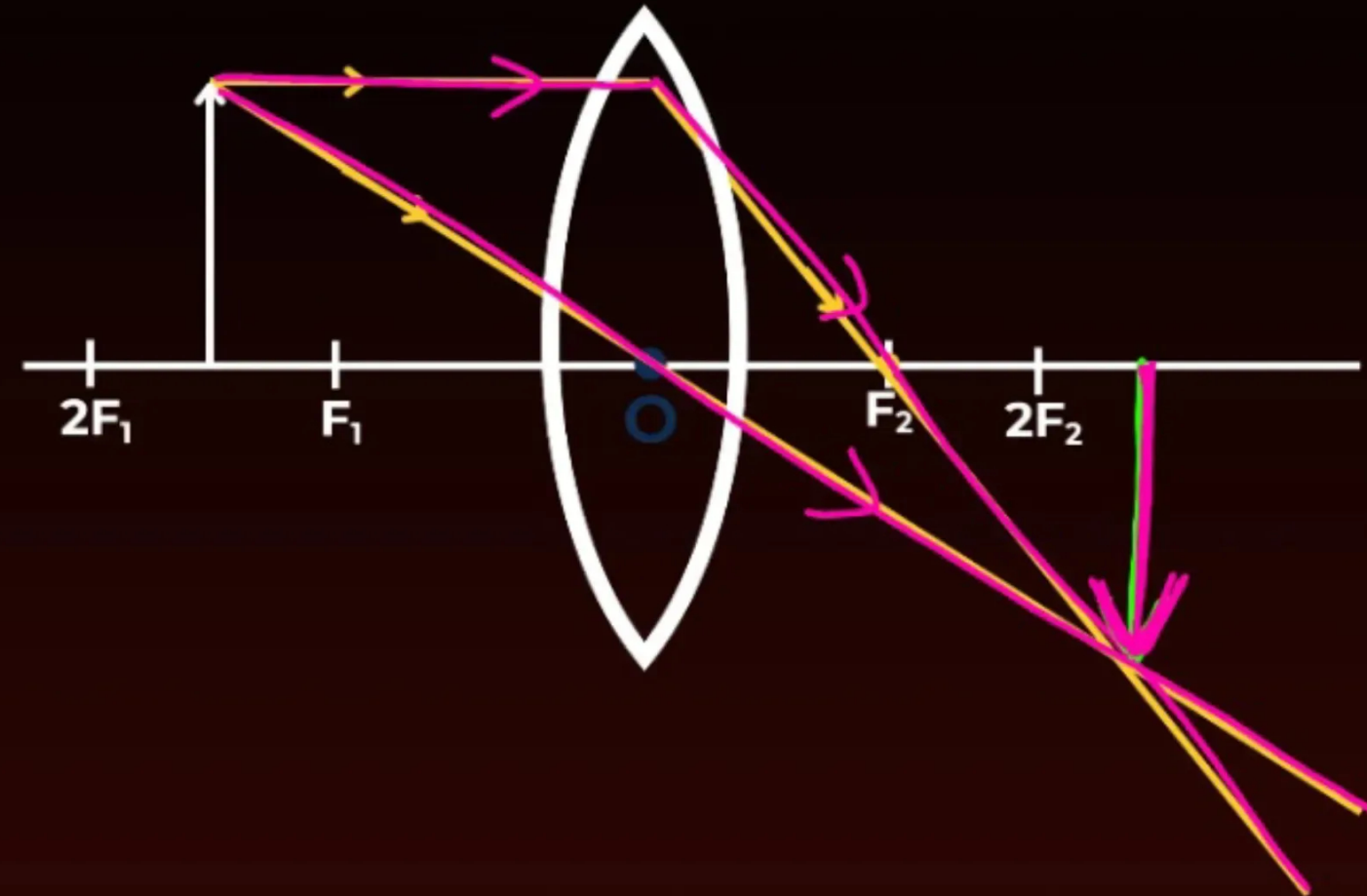


CHARACTERISTICS OF IMAGE

Image at $2F_2$ ✓

Real, Inverted, Same size

Object Between $2F_1$ & F_1

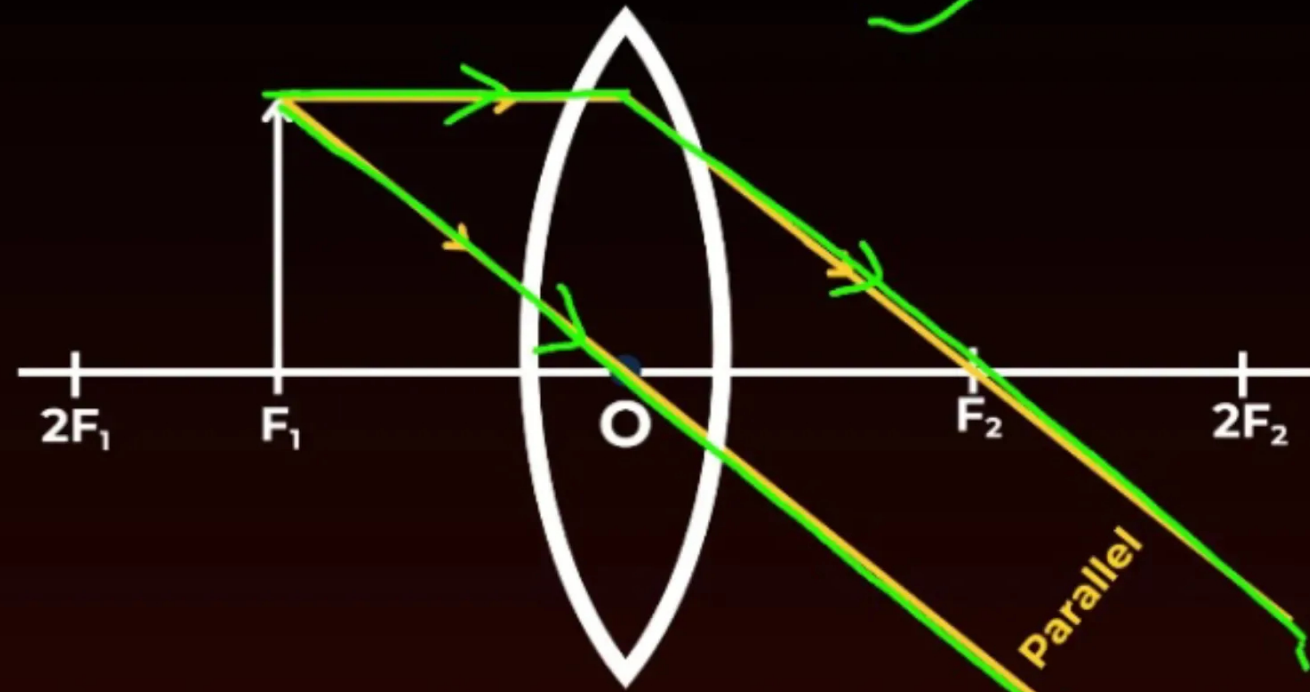


CHARACTERISTICS OF IMAGE

Image Beyond $2F_2$ ✓

Real, Inverted, Magnified

Object at F_1

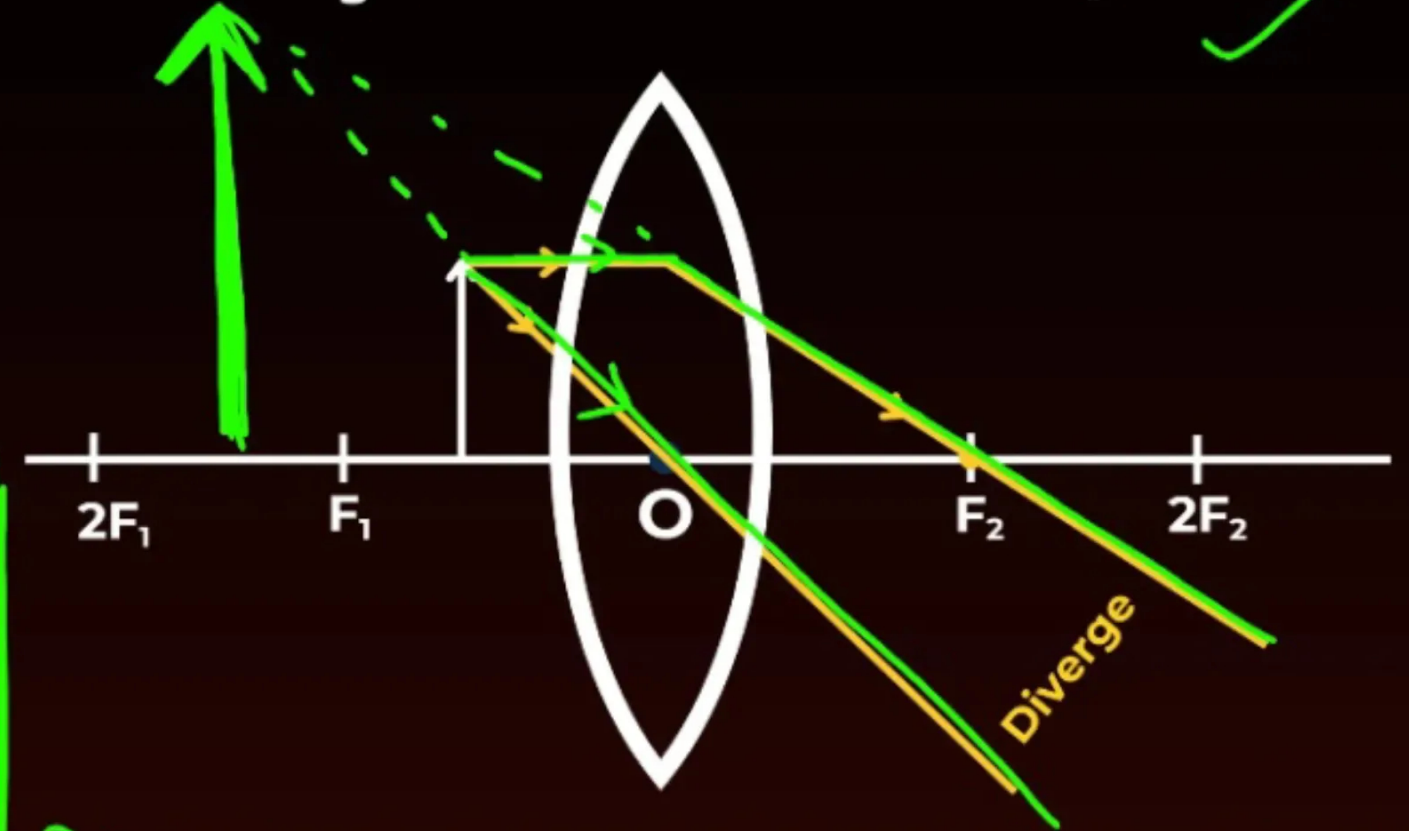


CHARACTERISTICS OF IMAGE

Image at ∞

Real, Inverted, Highly Magnified

Object Between F_1 & O



CHARACTERISTICS OF IMAGE

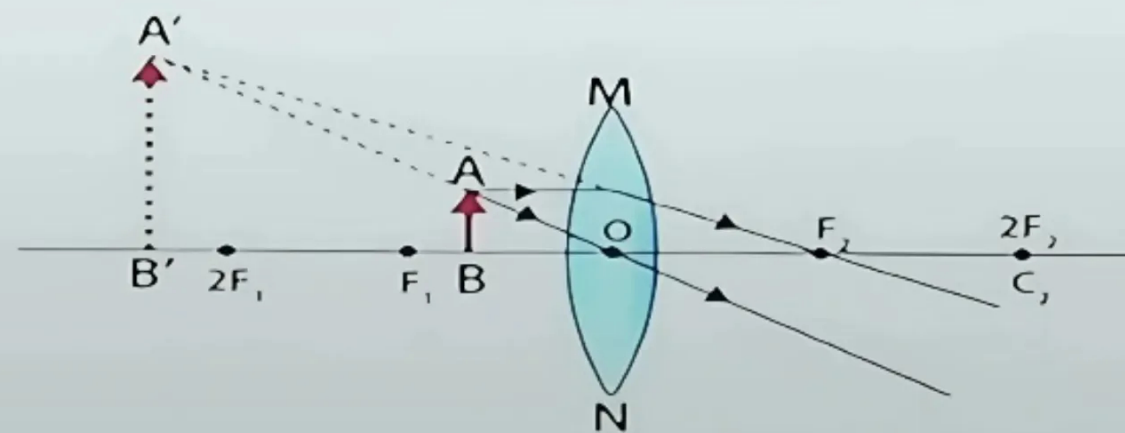
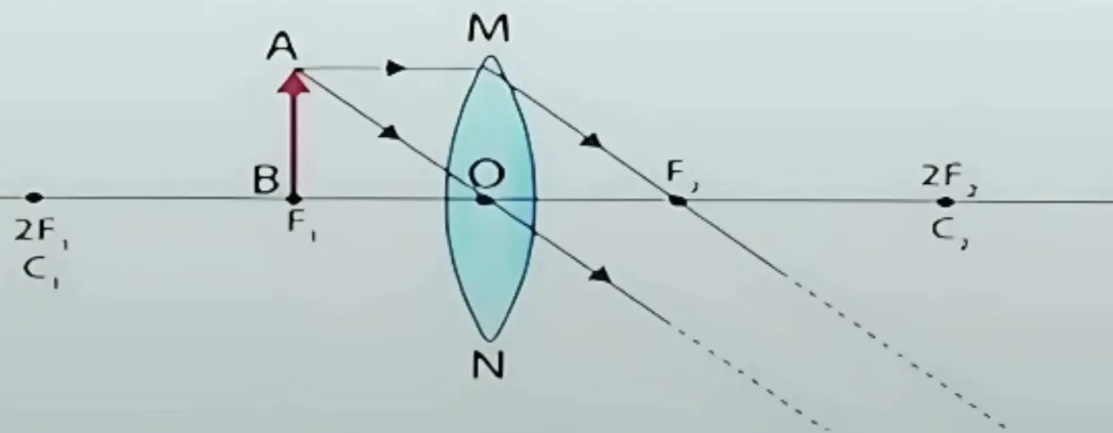
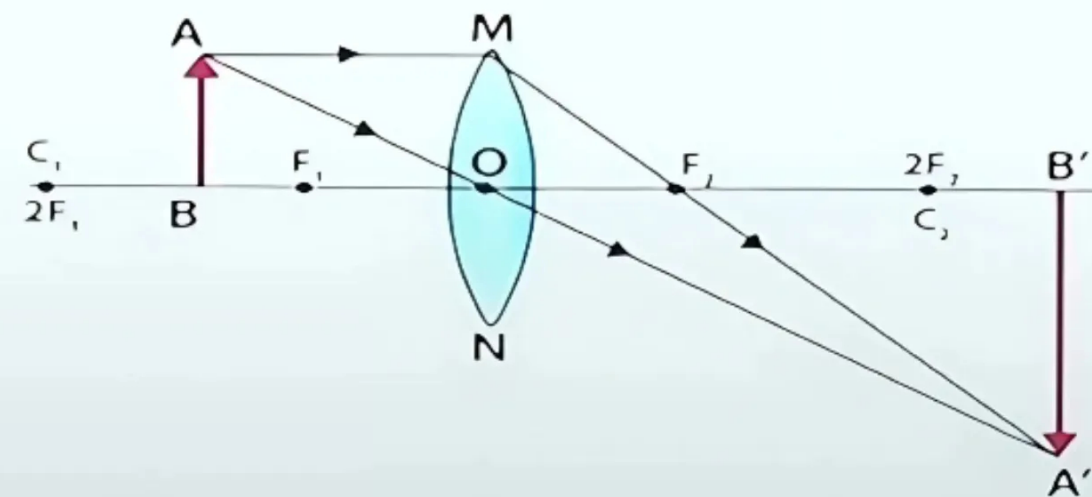
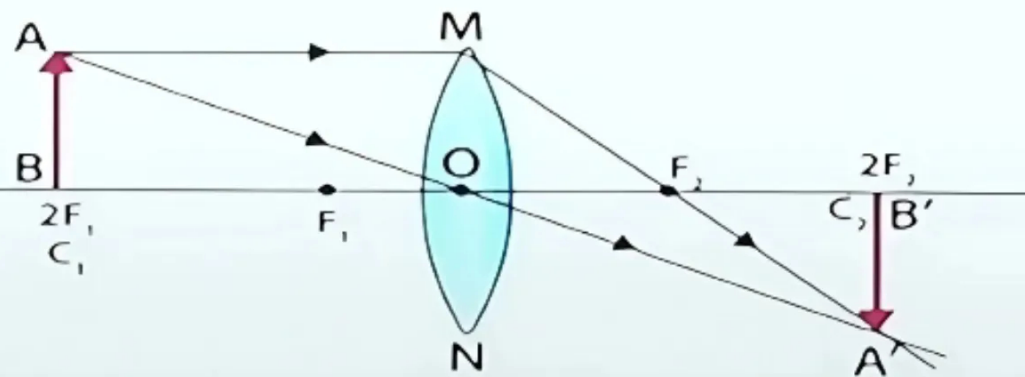
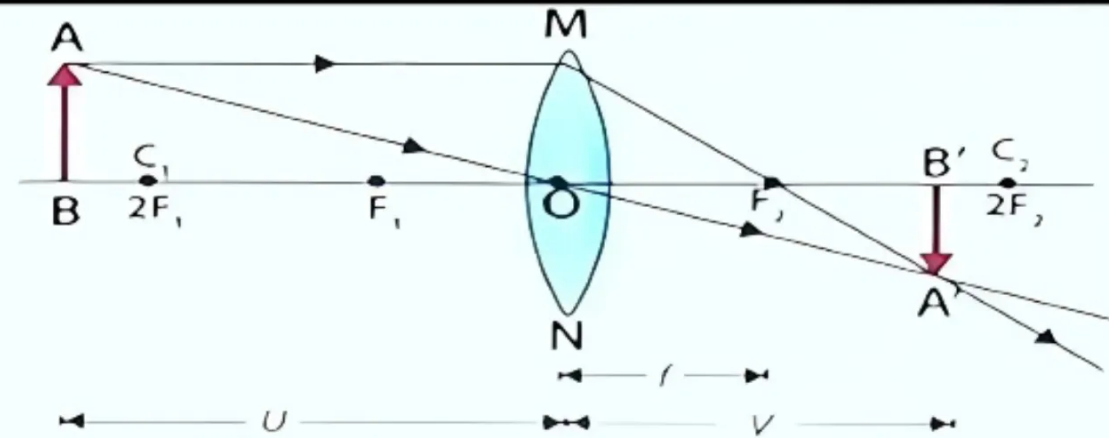
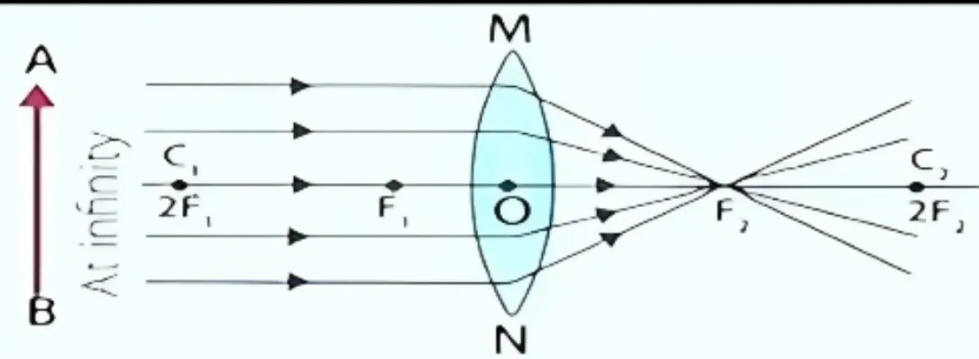
Image on same side of Object

Virtual, Erect, Magnified

Image Formation Summary (Convex Lens)

Learn

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus F_2	Highly diminished, point-sized	Real and inverted
Beyond $2F_1$	Between F_2 and $2F_2$	Diminished	Real and inverted
At $2F_1$	At $2F_2$	Same size	Real and inverted
Between F_1 and $2F_1$	Beyond $2F_2$	Enlarged	Real and inverted
At focus F_1	At infinity	Infinitely large or highly enlarged	Real and inverted
Between focus F_1 and optical centre O	On the same side of the lens as the object	Enlarged	Virtual and erect



At what distance from a convex lens should an object be placed to get an image of the same size as that of the object on a screen?

A

Beyond twice the focal length of the lens.

(CBSE 2024)

B

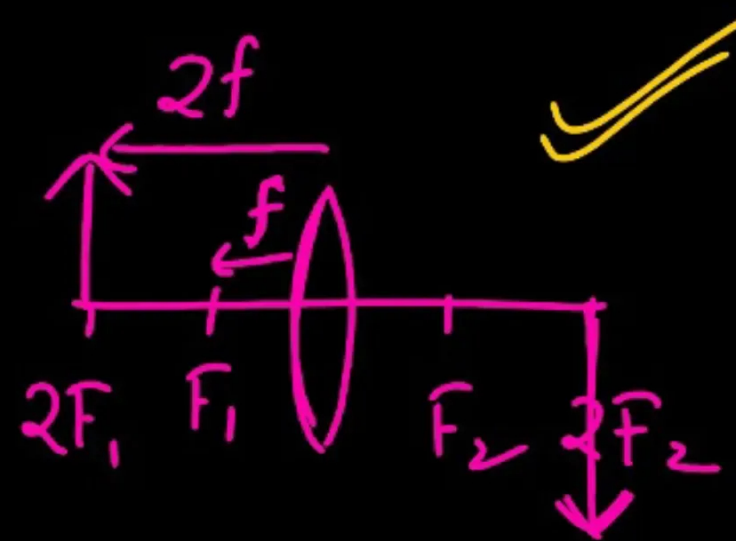
At the principal focus of the lens.

C

At twice the focal length of the lens.

D

Between the optical centre of the lens and its principal focus.



When an object is placed beyond $2F$ of a convex lens, the nature of the image is formed is :

A

Real, Inverted and Diminished

B

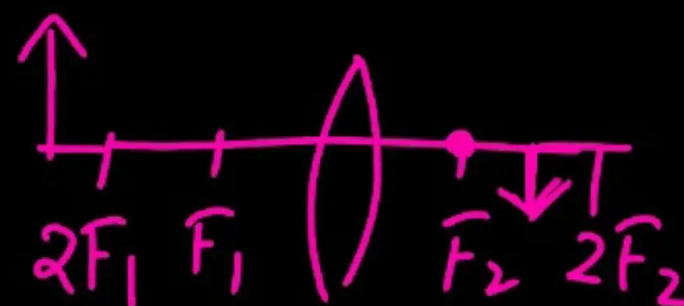
Real, Erect and Magnified

C

Virtual, Erect and Magnified

D

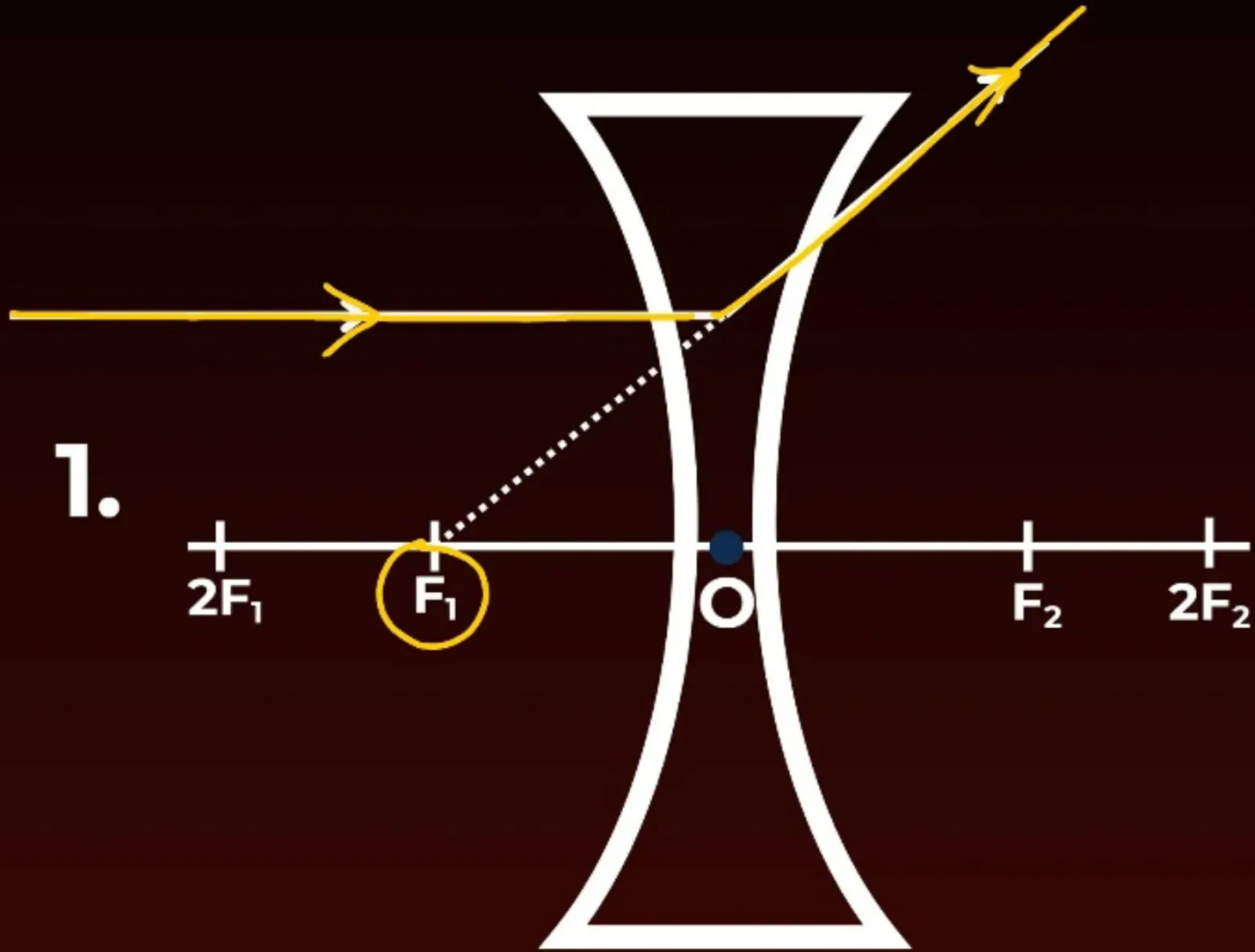
Real, Inverted and Magnified



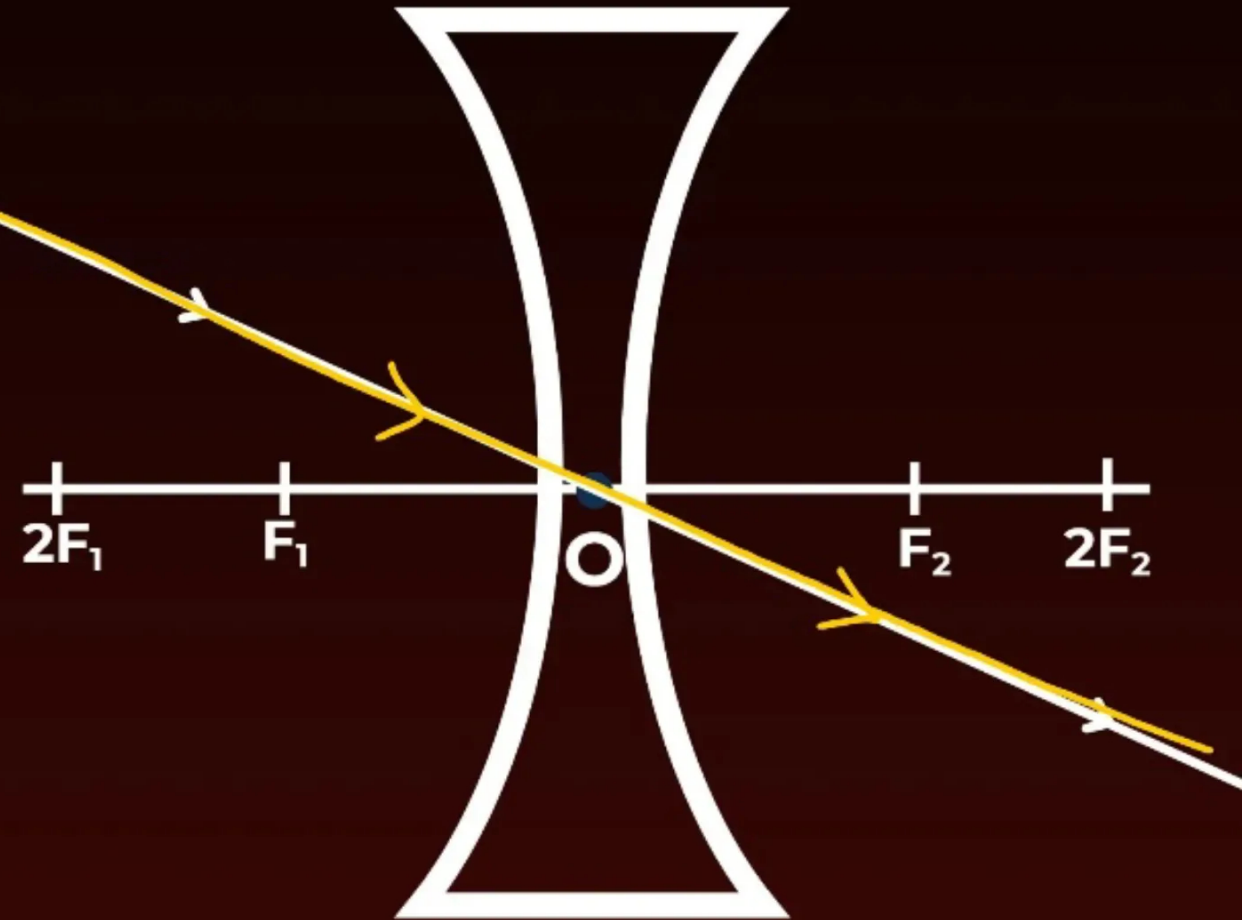
(CBSE 2023)

Image Formation (Concave Lens)-Rules

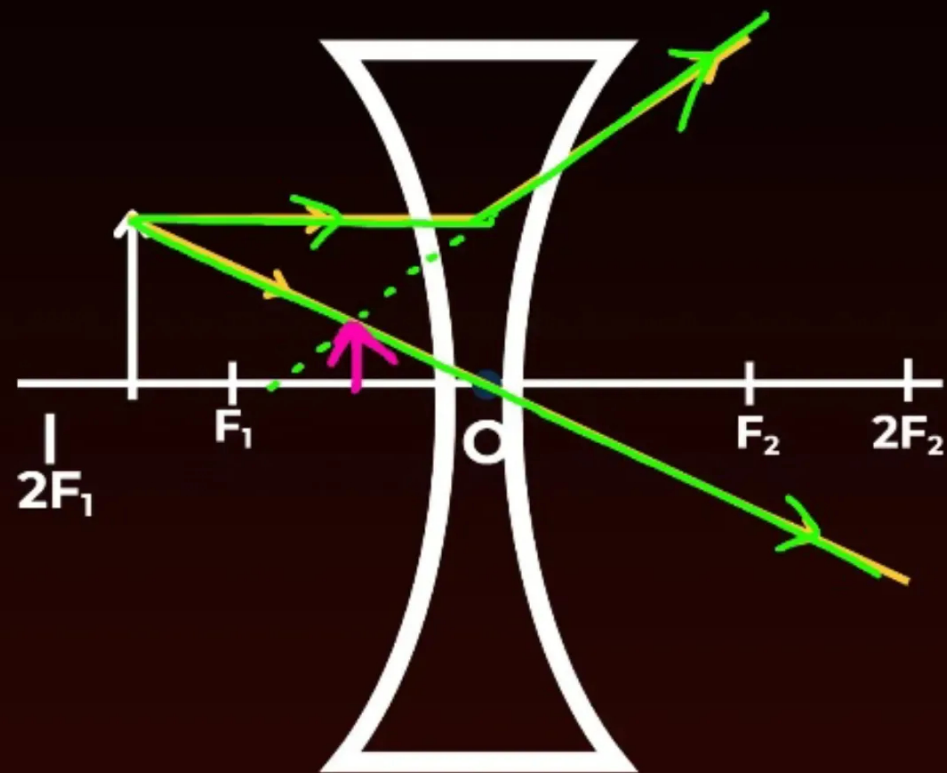
1.



2.



**Object at finite distance
(anywhere except ∞)**

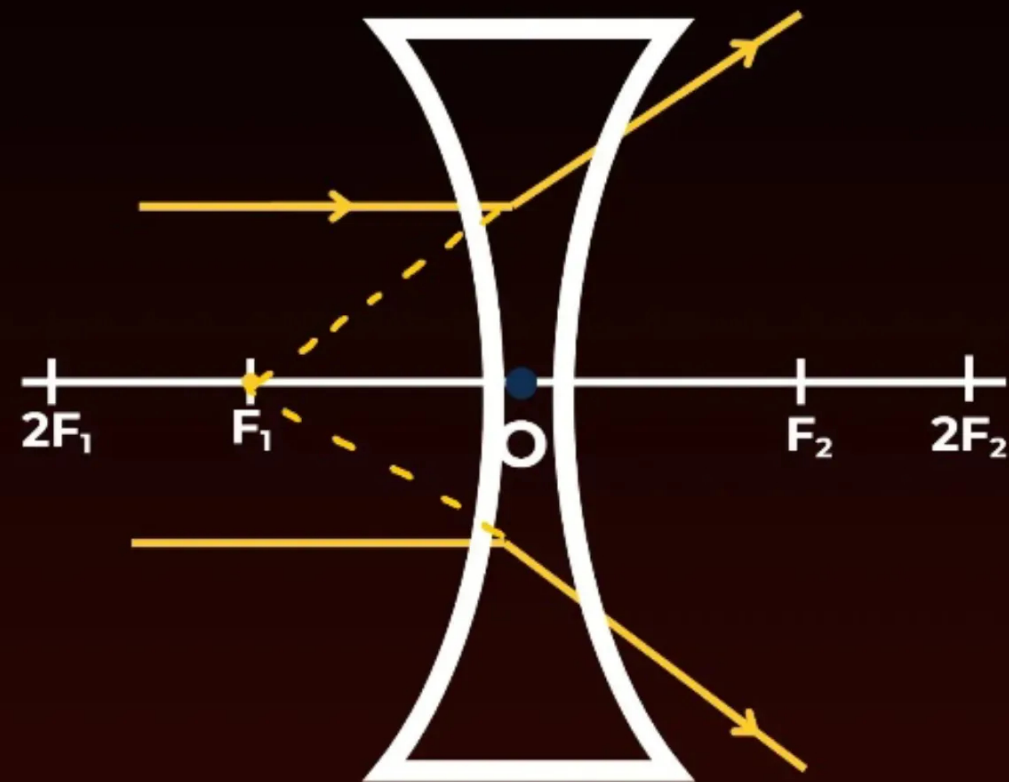


CHARACTERISTICS OF IMAGE

Image between F_1 & O

Virtual, Erect, Diminished

Object at ∞



CHARACTERISTICS OF IMAGE

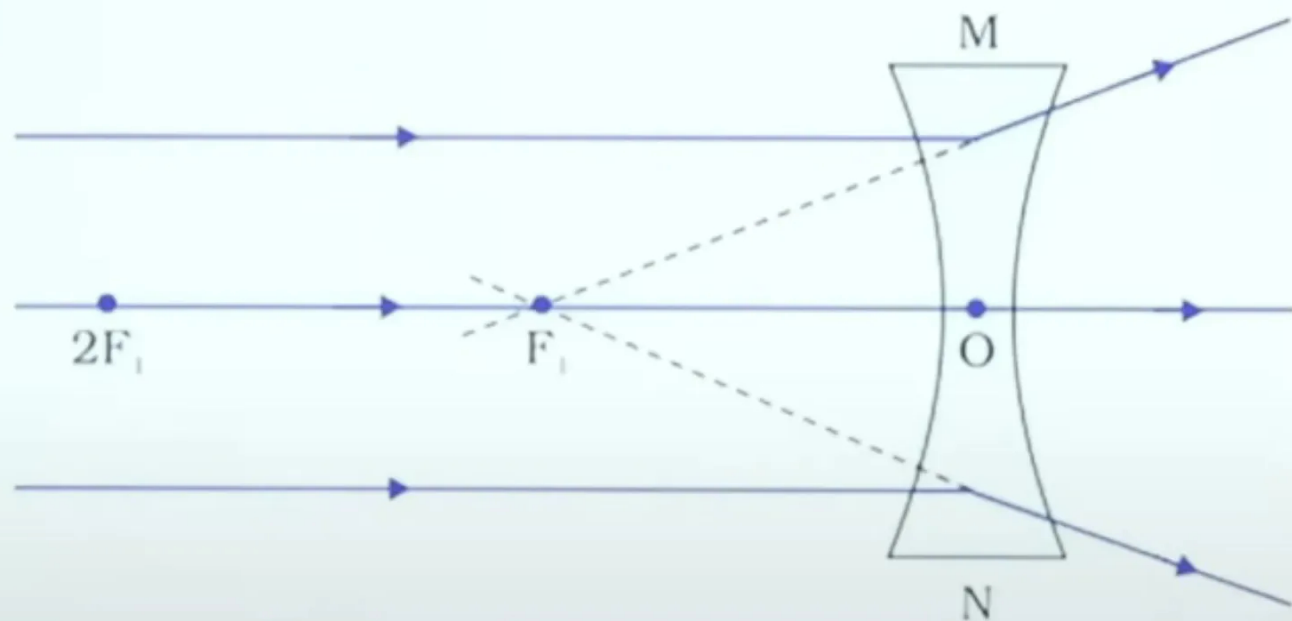
Image at F_1

Virtual, Erect, Highly Diminished

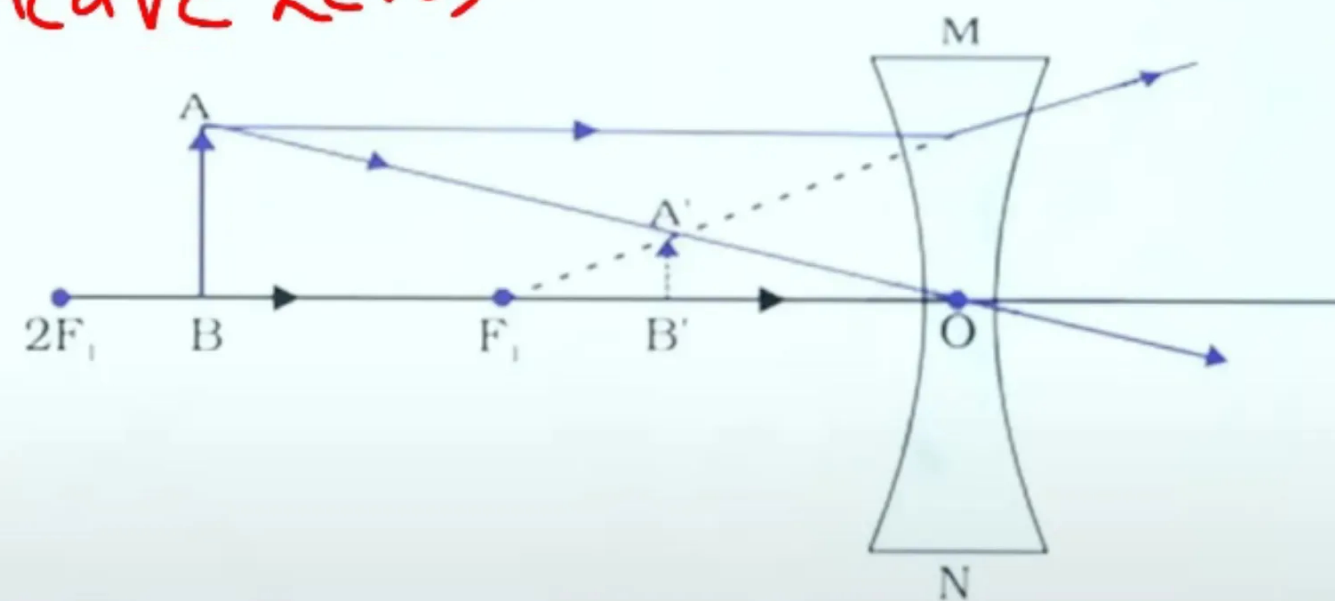
point sized

Position of the object	Position of the image	Relative size of the image	Nature of the image
At infinity	At focus F_1	Highly diminished, point-sized	Virtual and erect
Between infinity and optical centre O of the lens	Between focus F_1 and optical centre O	Diminished	Virtual and erect

Concave Lens



(a)



(b)

Summary of Convex & Concave Lens

Convex Lens

Inverted



Erect | Upright
Magnified



Concave Lens

Virtual
Erect
Diminished

- Erect / Upright
- Diminished

{ Seedhi + Choti image }

Sign Convention, Lens Formula & Magnification

Pole $\rightarrow$ Optical Centre

1. Here all distances are measured from the optical centre (O) of the lens. ✓
2. Rest all same rule for sign



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

$$m = \frac{h_i}{h_o} \quad \checkmark$$

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

$u \rightarrow$ always $-ve$ ✓
Convex $\rightarrow +ve$
 $f = +ve$

Same Rule

An object of height 4.0 cm is placed at a distance of 30 cm from the optical centre of a convex lens of focal length 20 cm.

Use lens formula to determine

a) the distance of the image from the optical centre and

b) height of the image formed. 8 cm (Inverted)

(CBSE 2025)

$$f = +20 \text{ cm}$$

$$u = -30 \text{ cm}$$

$$h_o = 4 \text{ cm}$$

$$v = ?$$

$$h_i = ?$$

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

$$\frac{1}{20} = \frac{1}{v} - \frac{1}{-30}$$

$$\frac{1}{v} = \frac{1}{20} - \frac{1}{30}$$

$$\frac{1}{v} = \frac{3-2}{60} = \frac{1}{60}$$

$$v = 60 \text{ cm}$$

$$m = \frac{h_i}{h_o}$$

$$m = \frac{v}{u} = \frac{60}{-30}$$

$$m = -2$$

$$-2 = \frac{h_i}{4}$$

$$h_i = -8 \text{ cm}$$

“The value of magnification ‘m’ for a lens is -2.” Using new Cartesian Sign Convention and considering that an object is placed at a distance of 20 cm from the optical centre of this lens, state :

- (i) the nature of the image formed; *Real, Inverted, Magnified* $m = \frac{h_i}{h_o} \mid h_i = m \times h_o$
(ii) size of the image compared to the size of the object; *double of object*
(iii) position of the image and $v = ?$ $v = +40\text{cm}$
(iv) sign of the height of the image $\rightarrow -ve$
- (CBSE 2025)**

$$m = -2$$

$$h_i = -2 \times h_o$$

$$u = -20\text{cm}$$

↑
—
↓
Inverted
Real
Magnified

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

$$-2 = \frac{v}{u}$$

$$-2 = \frac{v}{-20}$$

$$v = +40\text{cm}$$

The image of a candle flame formed by a lens is obtained on a screen placed on the other side of the lens. According to new cartesian sign convention, if the image is three times the size of the flame, then the lens is

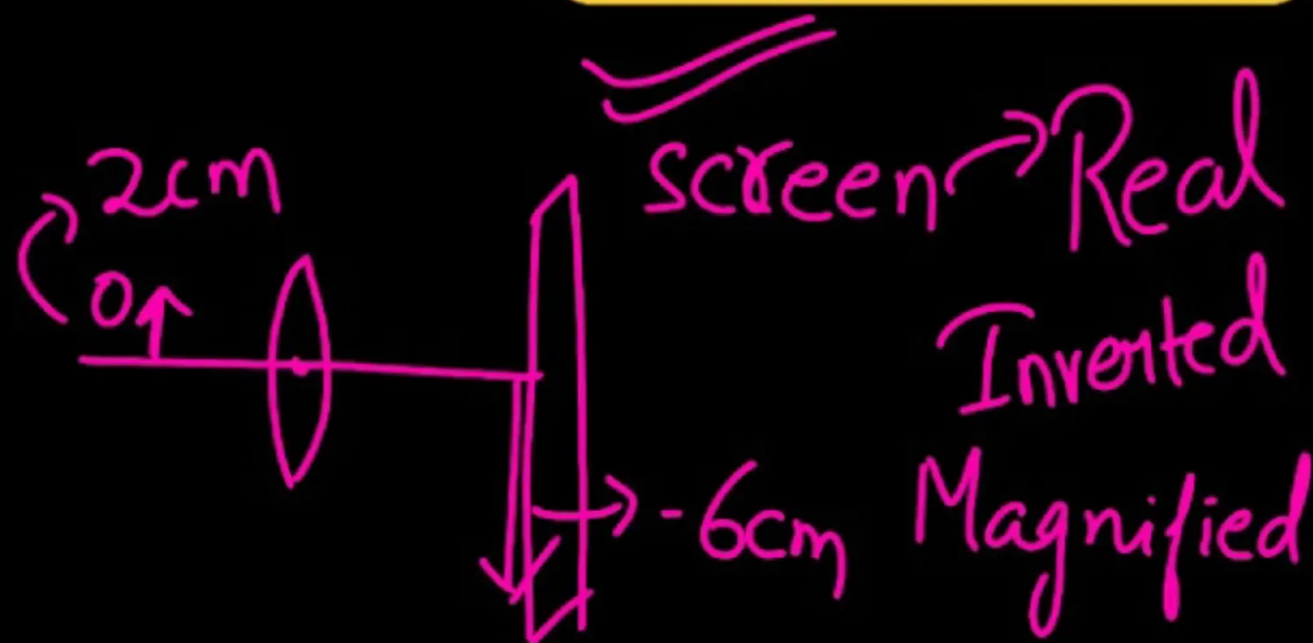
(CBSE Term | 2021-22)

A Concave and Magnification is +3

B Concave and Magnification is -3

C Convex and Magnification is -3

D Convex and Magnification is +3



Power of a Lens

$P = -3$
 $P = -6$ } concave diverging lens
 } convex lens
 } concave lens

The **power of a lens (P)** is its ability to converge or diverge rays of light.

It is defined as the **reciprocal of the focal length (f)** of the lens: $f = 10\text{cm} = \frac{10}{100} = 0.1\text{m}$

Diapetre (D) $P = \frac{1}{f}$ always in metre

$$\left\{ f \text{ (in m)} = \frac{\text{cm}}{100} \right\}$$

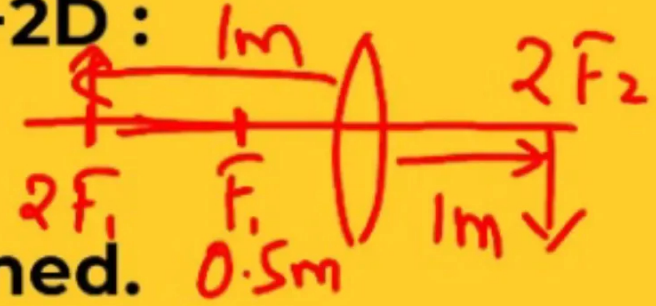
$P = +2$
 $P = +5$ } converging convex lens

Power of Combination

$$P = P_1 + P_2 + P_3 + \dots$$

$$P = \frac{1}{f_1} + \frac{1}{f_2} + \frac{1}{f_3} + \dots$$

An object is kept at a distance of 1 m from a lens of power +2D :



(i) Identify the type of lens.

(ii) Calculate its focal length and distance of the image formed.

(CBSE 2023)

$$P = +2D$$

($f = +ve$)
Convex lens

Converging lens

$$P = \frac{1}{f} \text{ in metres}$$

$$2 = \frac{1}{f}$$

$$f = \frac{1}{2} \text{ m}$$

$$f = \frac{1}{2} \times 100 = 50 \text{ cm}$$

$$f = \frac{1}{2} \text{ m}$$

$$u = -1 \text{ m}$$

$$v = ?$$

$$\frac{1}{v} = 1$$

$$v = 1 \text{ m}$$

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

$$\frac{1}{\frac{1}{2}} = \frac{1}{v} - \frac{1}{-1}$$

$$2 = \frac{1}{v} + 1$$

The power of a combination of two lenses in contact is +1.0D. If the focal length of one of the lenses of the combination is +20.0 cm, the focal length of the other lens would be

A

-120.0 cm

B

+80.0 cm

C

-25.0 cm

D

-20.0 cm

$$P = P_1 + P_2$$

$f \rightarrow$ in metre

(CBSE Term | 2021-22)

$$P = \frac{1}{f_1} + \frac{1}{f_2}$$

$$1 = \frac{1}{\frac{20}{100}} + \frac{1}{f_2}$$

$$1 = 5 + \frac{1}{f_2}$$

$$\frac{1}{f_2} = -4$$

$$f_2 = -\frac{1}{4} \text{ m}$$

$$f_2 = -\frac{1}{4} \times 100 = -25 \text{ cm}$$

An object is placed at a distance of 20 cm from the optical centre of a concave lens and its image is formed on the same side of the lens as the object. If the distance of the image from optical centre of the lens is 10 cm, use lens formula to determine:

- (i) focal length, and
- (ii) power of the lens in new Cartesian sign conventions.

H.W.

$$f = ?$$

$$P = ?$$

CBSE 2025

easy

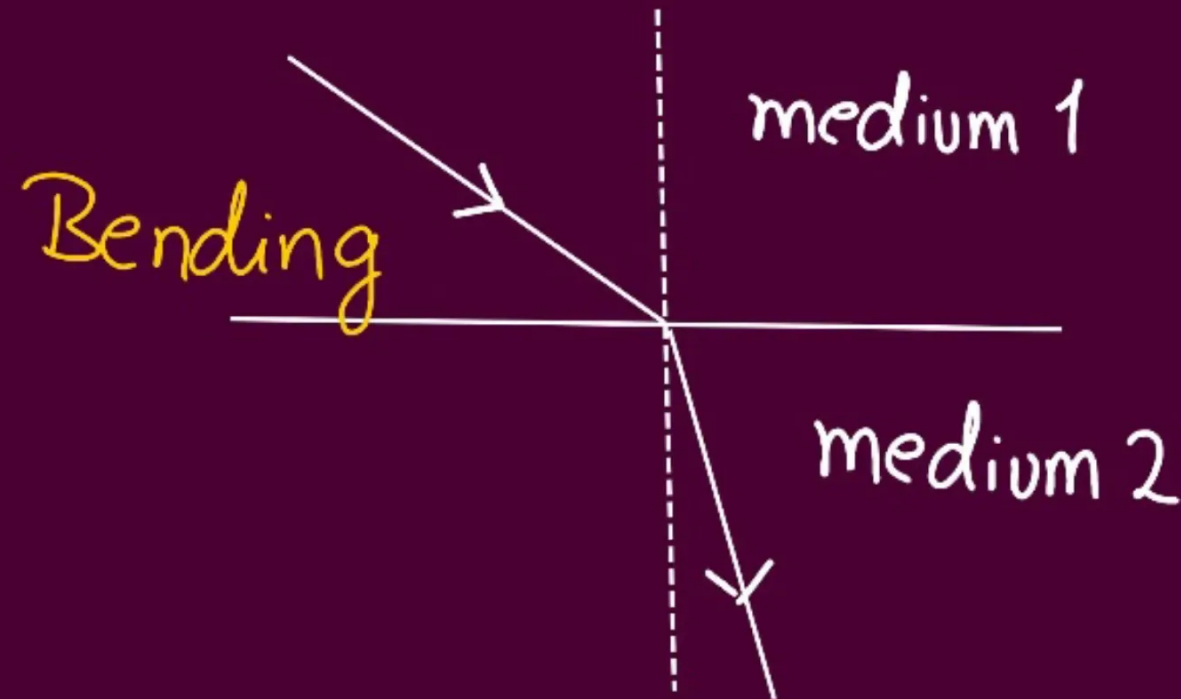
Comment

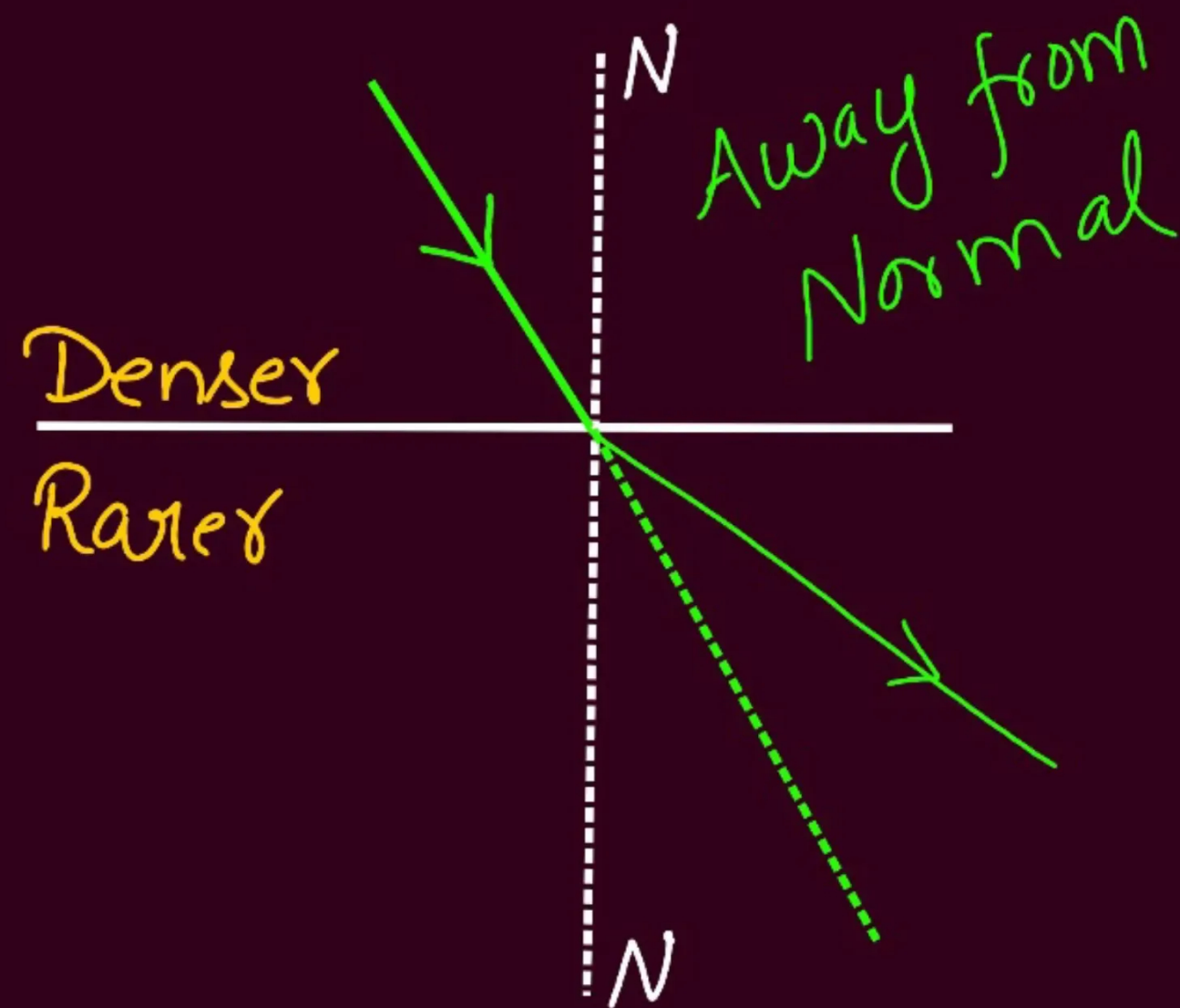
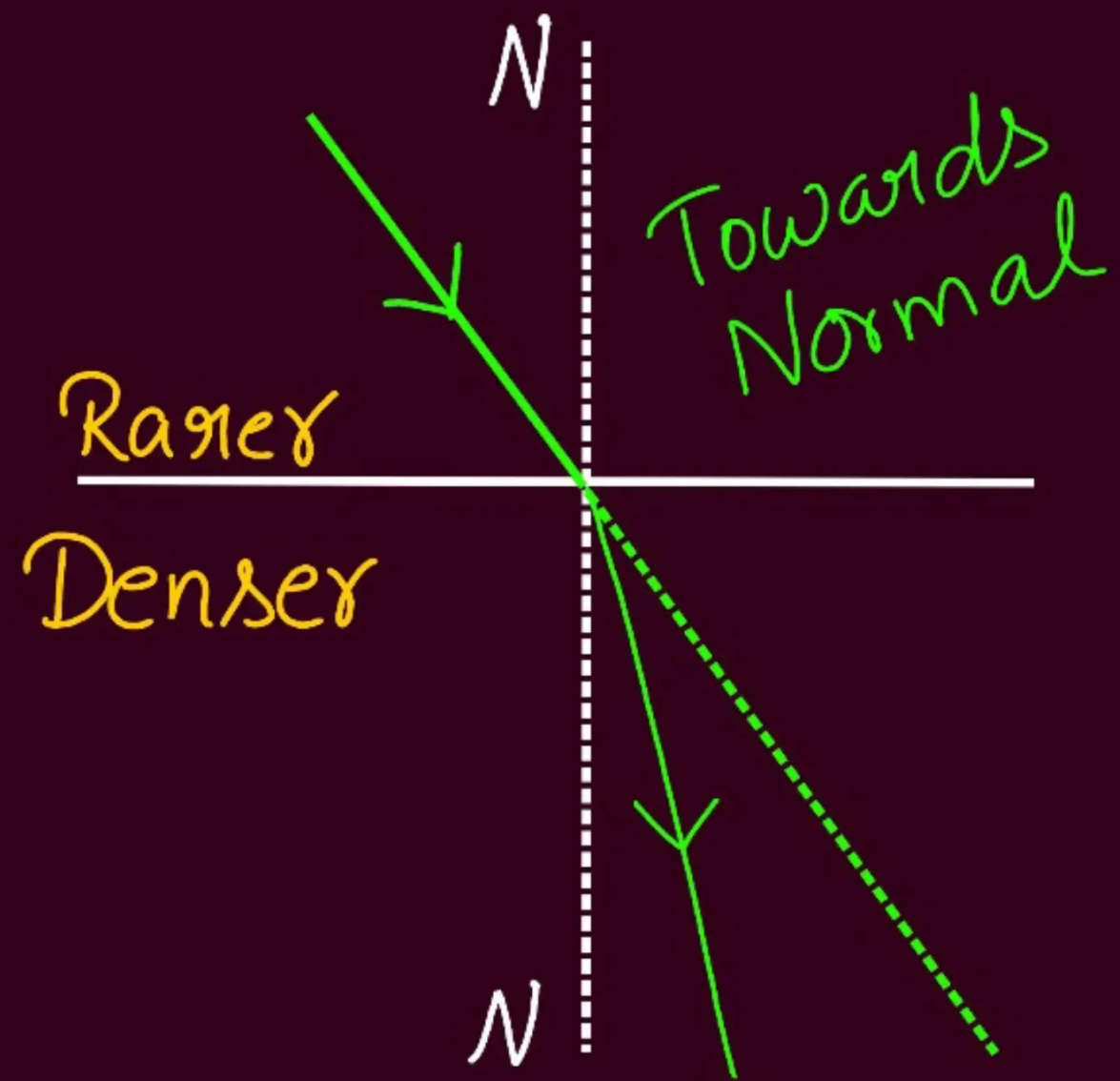
Refraction of Light

The bending of light ray when it travels from one medium to another

Cause of Refraction?

Refraction occurs because light travels with different speed in different medium





Denser $\rightarrow$ Jisme Speed of light कम ho!

Absolute Refractive Index (R.I)

$\eta \uparrow$ Dense $\uparrow$
Optically

1) Absolute R.I. of any medium X is $\eta_x \rightarrow$

$$\eta_x = \frac{c}{v_x}$$

$c \rightarrow$ Speed of light in air/vacuum $= 3 \times 10^8 \text{ m/s}$

$v_x \rightarrow$ Speed of light in X

Absolute R.I. of water $\rightarrow \eta_w$

$$\eta_w = \frac{c}{v_w}$$

$v_w \rightarrow$ Speed of light in water.

Absolute R.I. of Glass

$$n_g = \frac{c}{v_g}$$

$v_g \rightarrow$ Speed of light
in glass

$$c = 3 \times 10^8 \text{ m/s}$$

$$n \propto \frac{1}{v}$$

$n \uparrow \Rightarrow v \downarrow \Rightarrow$ Dense

① $n_A = 2$

$n_B = 5 \rightarrow$ Dense
 $\rightarrow$ Speed of light $\downarrow$

Absolute refractive indices of water and glass are $\frac{4}{3}$ and $\frac{3}{2}$ respectively

In which one of the two media is the speed of light more?

Wa water

$$n_w = \frac{4}{3} = 1.33 \rightarrow v \uparrow \rightarrow \text{rarer}$$

$$n_g = \frac{3}{2} = 1.5 \rightarrow \text{Denser} \rightarrow v \downarrow$$

$$n_w < n_g$$
$$\text{rarer} < \text{Denser}$$

✓✓ (CBSE 2023)

Refractive Index (R.I)

(n) → kitna dense? [optically]

R.I. of 2 w.r.t 1

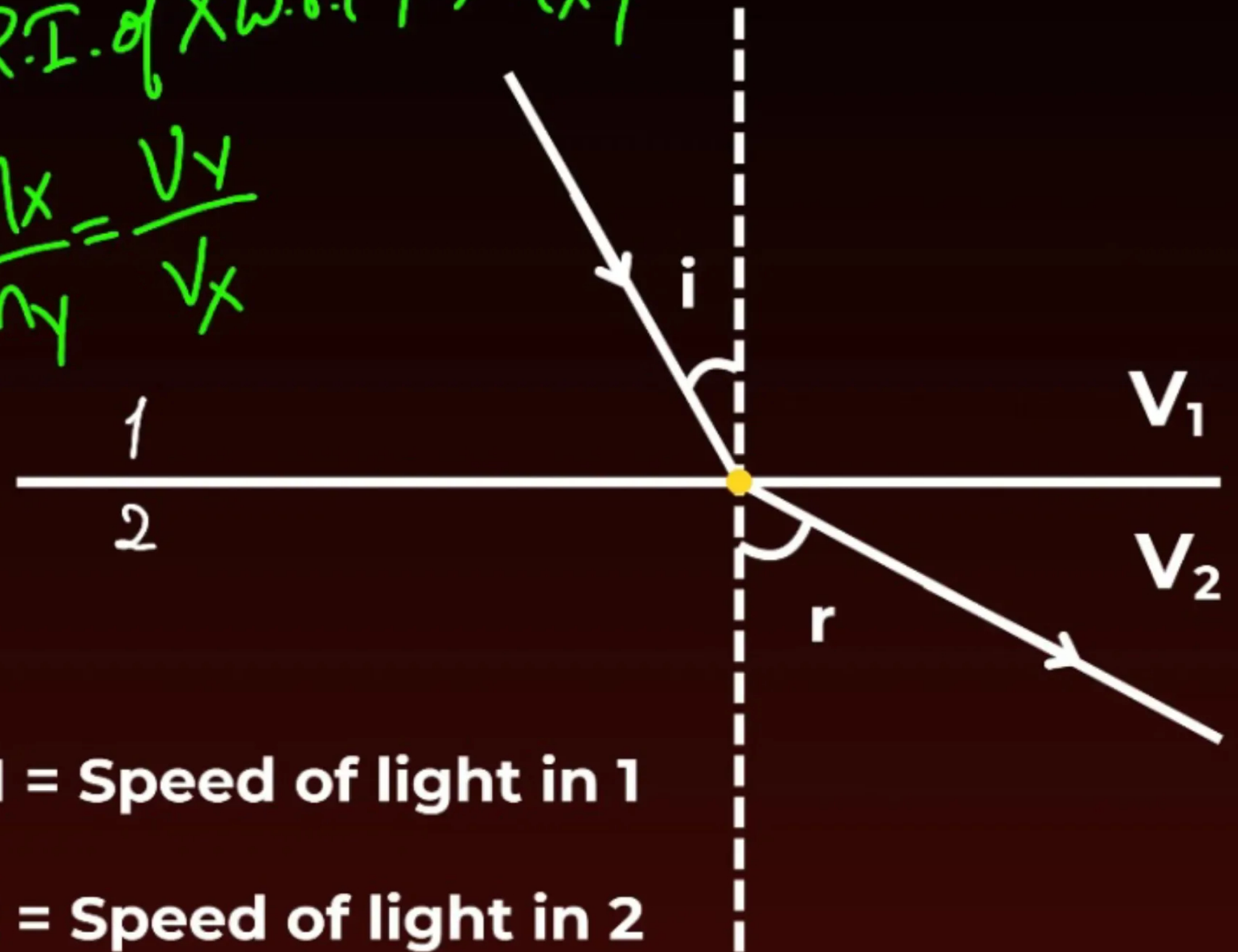
$$n_{21} = \frac{n_2}{n_1} = \frac{v_1}{v_2}$$

R.I. of A w.r.t B

$$n_{AB} = \frac{n_A}{n_B} = \frac{v_B}{v_A}$$

R.I. of X w.r.t Y → n_{xy}

$$\frac{n_x}{n_y} = \frac{v_y}{v_x}$$



v_1 = Speed of light in 1

v_2 = Speed of light in 2

If the absolute refractive indices of two media X and Y are $\frac{6}{5}$ and $\frac{4}{3}$ respectively, then the refractive index of Y with respect to X will be :

(CBSE 2025)

☒ A

$$\frac{10}{9}$$

☐ B

$$\frac{9}{10}$$

☐ C

$$\frac{9}{8}$$

☐ D

$$\frac{8}{9}$$

$$n_x = \frac{6}{5}$$

$$n_y = \frac{4}{3}$$

R.I.
Y w.r.t X

$$n_{yx} = \frac{n_y}{n_x}$$

$$= \frac{\frac{4}{3}}{\frac{6}{5}} = \frac{4}{3} \times \frac{5}{6} = \frac{10}{9}$$

Absolute refractive index of water and glass is $\frac{4}{3}$ and $\frac{3}{2}$ respectively. If the speed of light in glass is 2×10^8 m/s, the speed of light in water is:

$$n_w = \frac{4}{3}$$

$$n_g = \frac{3}{2}$$

$$v_g = 2 \times 10^8 \text{ m/s}$$

$$v_w = ?$$

R.I. of g w.r.t w

$$n_{gw} \Rightarrow \frac{n_g}{n_w} = \frac{v_w}{v_g}$$

$$\frac{\frac{3}{2}}{\frac{4}{3}} = \frac{v_w}{2 \times 10^8}$$

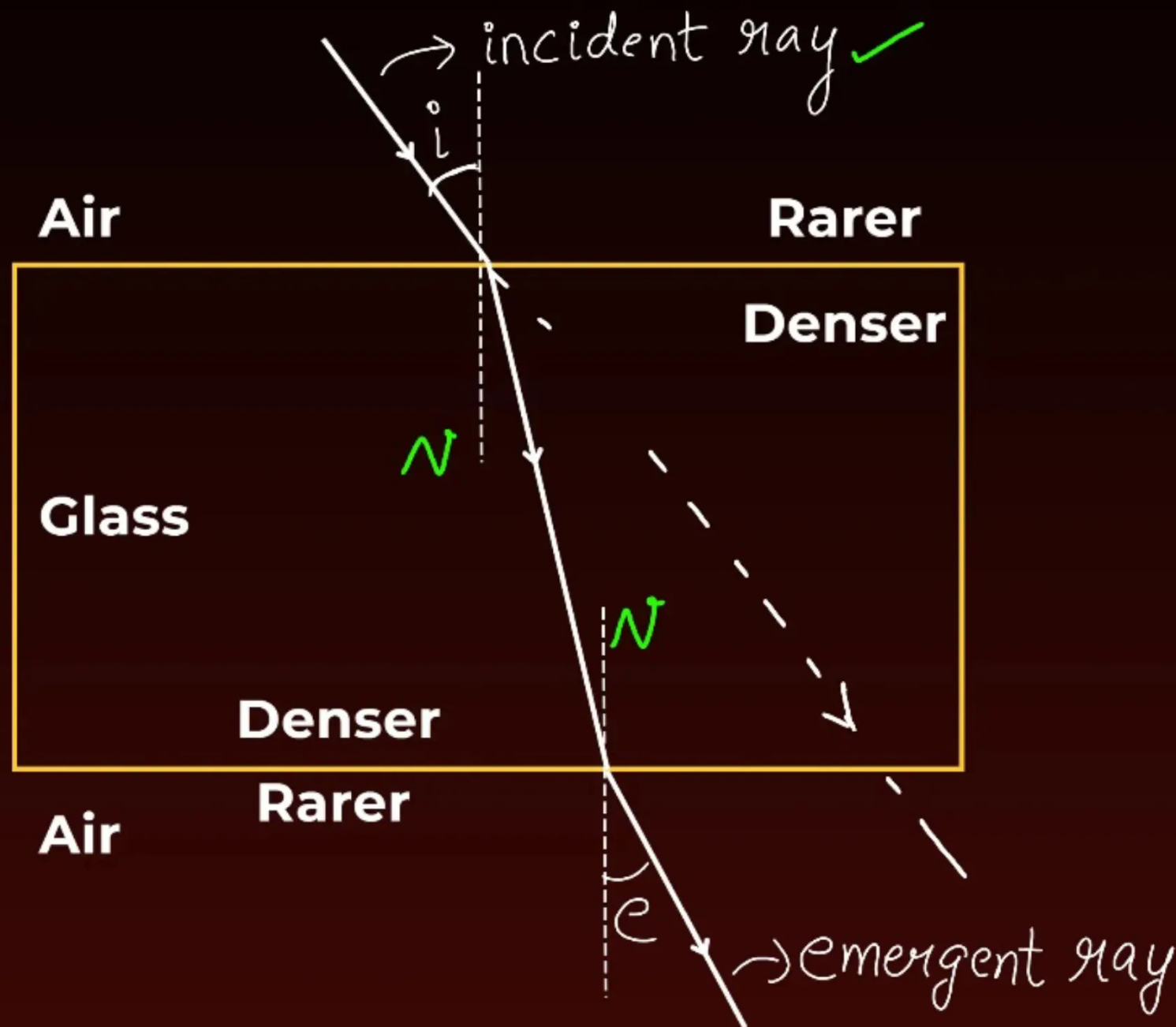
(CBSE 2025)

$$\frac{3}{2} \times \frac{3}{4} = \frac{v_w}{2 \times 10^8}$$

$$\frac{9}{4} \times 10^8 = v_w$$

$$2.25 \times 10^8 \text{ m/s} = v_w$$

Refraction Through A Glass Slab



provided medium on both side is same

To remember:

- Emergent ray is parallel to the incident ray ✓✓

- $\angle e = \angle i$ ✓✓

$\angle$ of emergence

$\angle$ of incidence

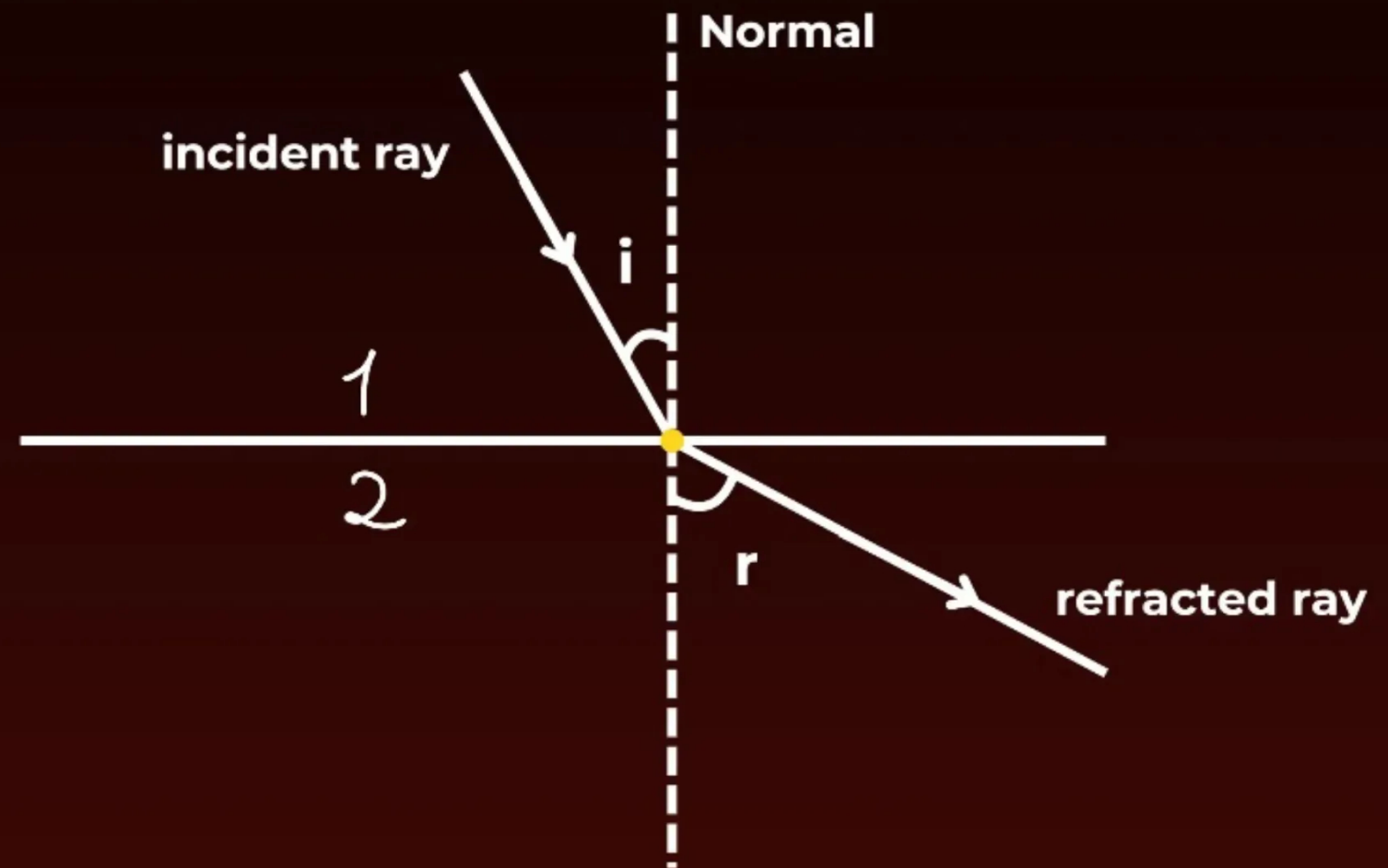
Laws of Refraction

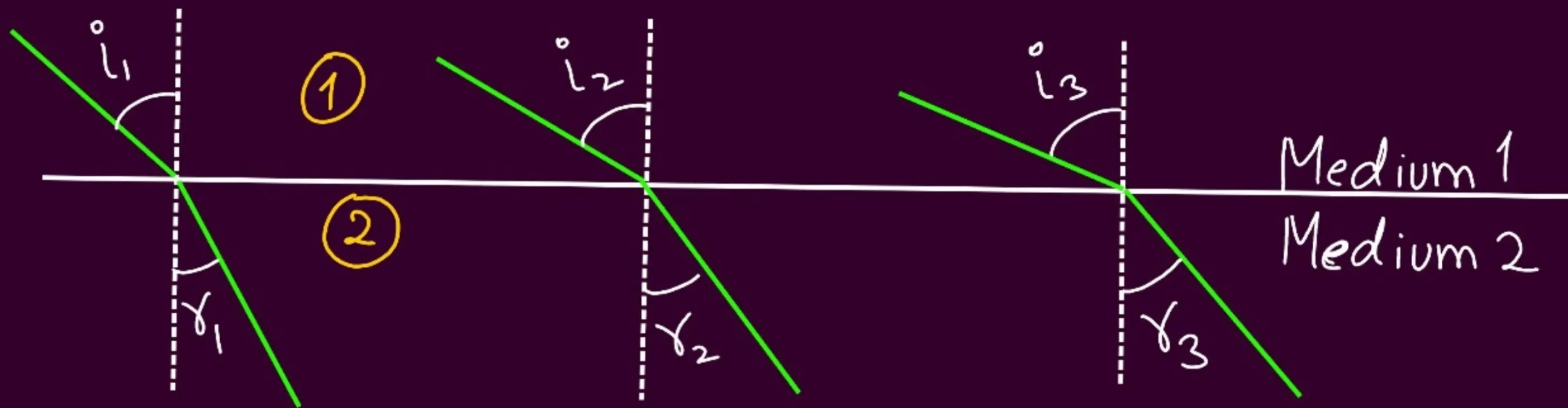
- ✓ The incident ray, Normal & the refracted ray lies on the same plane
- The ratio of sine of Angle of incidence to the sine of angle of refraction remain constant for a given pair of media.

(Snell's Law)

$$\frac{\sin i}{\sin r} = \text{Constant}$$

$$\frac{\sin i}{\sin r} = n_{21}$$



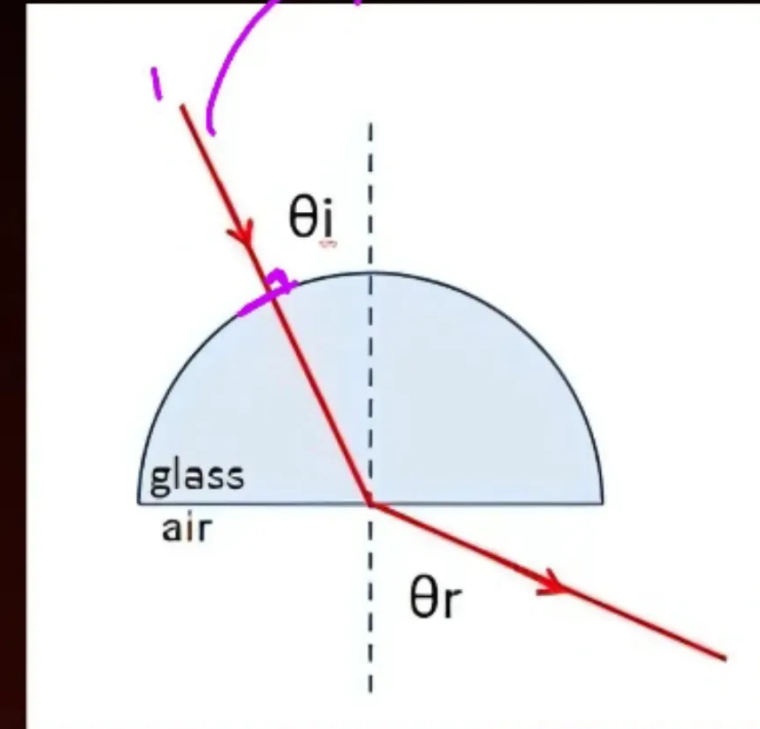
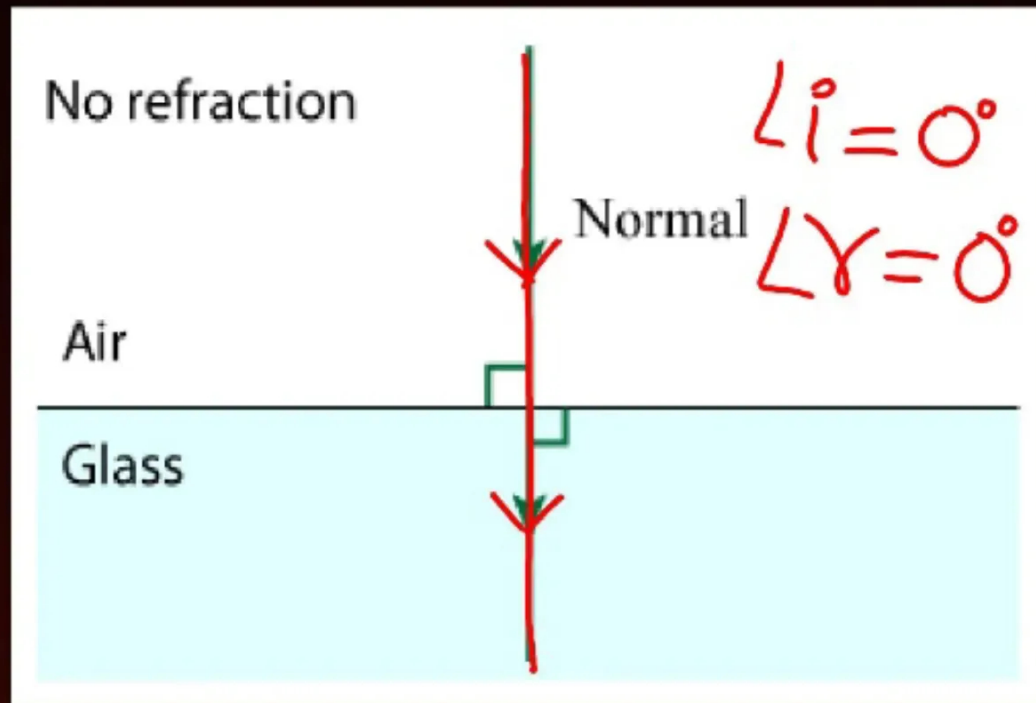


$$\frac{\sin i_1}{\sin r_1} = \frac{\sin i_2}{\sin r_2} = \frac{\sin i_3}{\sin r_3} = n_{21} = \text{Constant}$$

Case of No Bending

→ No refraction

1. Normal incidence



$$n_1 = n_2$$

2. No medium change or no change in refractive index

