Light

Light: form of energy that enables us to see...
↳ particle nature
↳ Wave (electromagnetic)
↳ Dual nature

Beam of light: group of reflected rays...

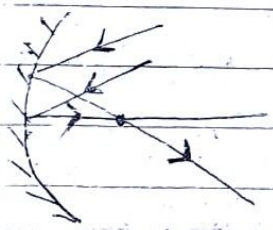
Reflection:

↳ It is of two types: (i) Regular reflection
(ii) Diffused [Irregular] reflection

Image:

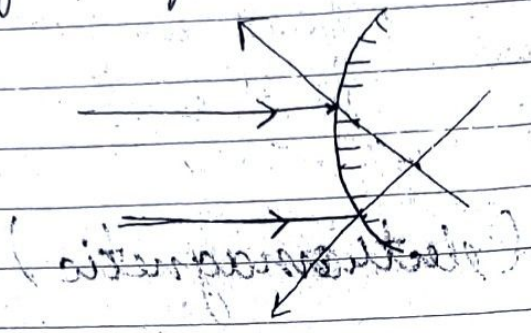
↳ It is of two types:

(i) Real Image → Reflected ray actually meet



→ Usually Inverted
→ Eg: Cinema hall
→ formed on the screen

(ii) Virtual image → Rays appear to meet



→ ~~ww~~ usually erect
→ plane mirror - Eg
→ ~~behind~~ formed behind the screen

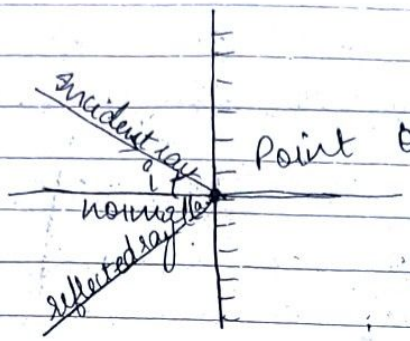
1. Incident Ray: That ray of light wi[illegible] falls on reflecting surface.

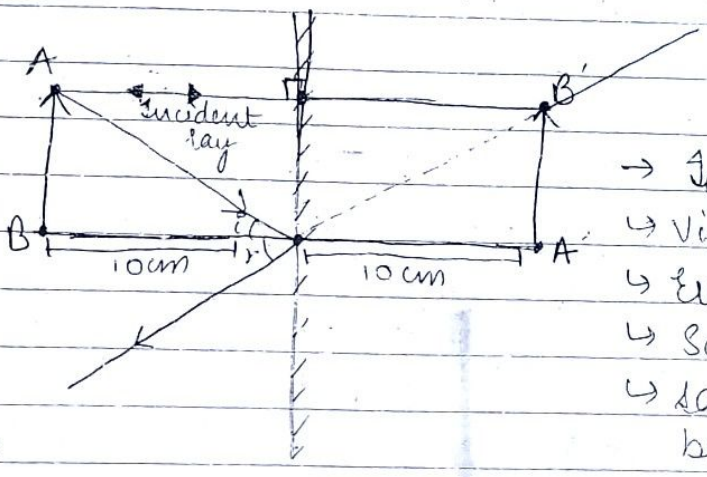
2. Reflected Ray: That ray of light wi[illegible] back by the reflecting su[illegible] with bounces [illegible]ace.

3. Point of Incidence: The point on wh[illegible] ray ~~co~~ meets the reflecting surface.

4. ~~Ag~~ Angle of Incidence: The angle formed between the normal and the incident ray.

5. Normal: Ray of light perpendicular to the pla[illegible]





→ Image
↳ Virtual
↳ Erect
↳ Same size
↳ Same distance behind the mirror as in front
↳ Laterally inverted

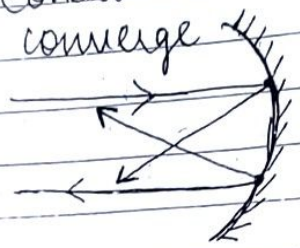
Questions

a) 15 cm, 10 cm

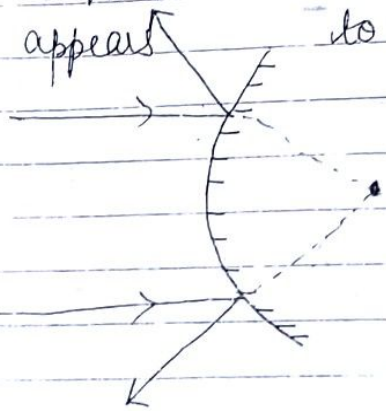
b) 4cm 27cm of f(x) = 18cm

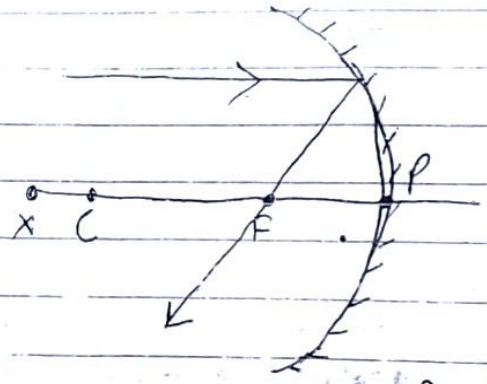
Spherical Mirror: Mirror which are cut out of a sphere spherical reflecting surface...

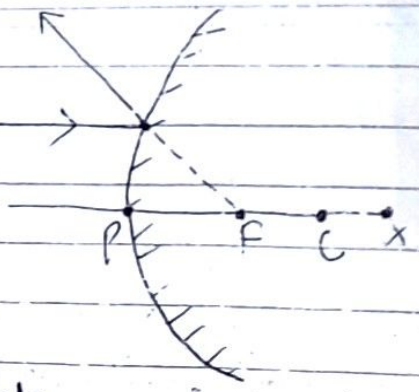
(i) Concave Mirror → A parallel beam of light rays converge after reflection...



(ii) Convex Mirror : A parallel beam of light rays appears to diverge after reflection...







P = Pole
PX = principle Axis
C = Center of curvature
PC = Radius of curvature
F = focus
PF = focal length

When a ray of light falls normally on the mirror it makes an angle of 90° that is it makes an angle of 90° with the mirror. That is the angle of incidence is zero. Hence, angle of incident is also zero. therefore it retraces its path.

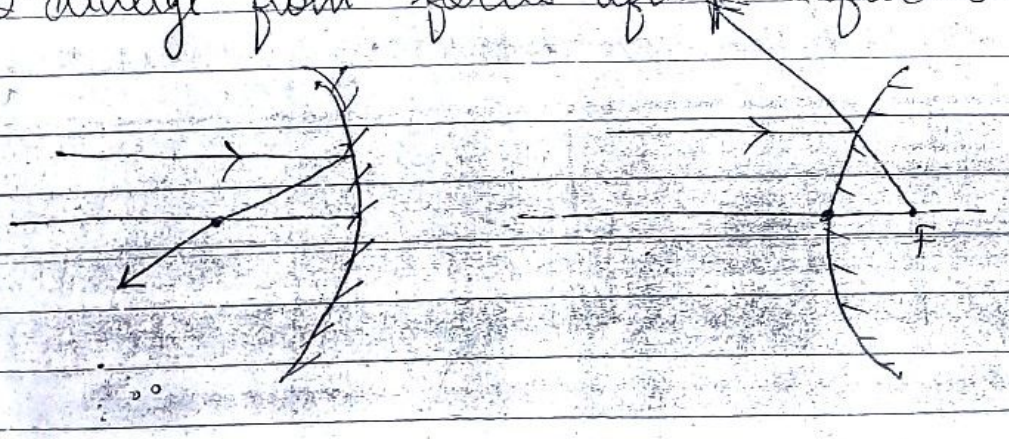
Focus :

1. Principle focus of a concave mirror is a point on the principle axis where ~~lines~~ rays || to principle axis converge after ~~reflection~~ reflection.

2. Principle focus of a convex mirror is a point on the principle axis where rays || to principle axis appear to diverge after reflection

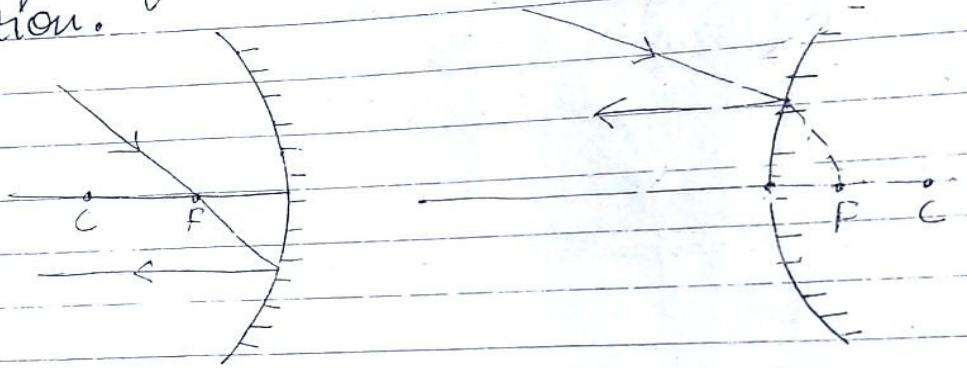
Rules Of Image formation by Spherical Mirror ...

Rule 1: A rays of light || to principle axis after reflection ~~appear~~ passes through focus or appear to diverge from focus after reflection ...



Rule 2: A ray of light passing through centre of curvature retraces its path...

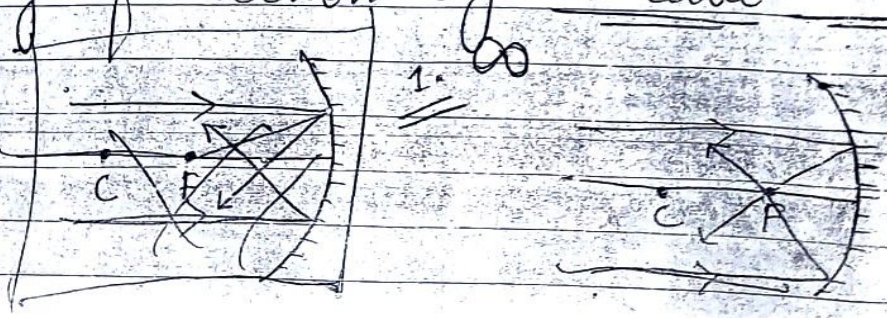
Rule 3: A ray of light passing through the focus of curvature falls ∥ to the principle axis after reflection.



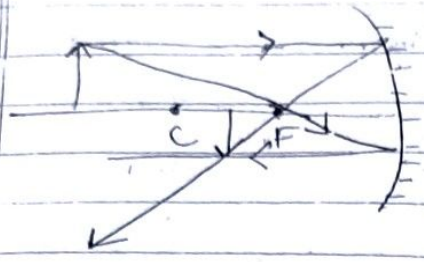
Rule 4: A ray of light incident on pole get reflected by the same angle.

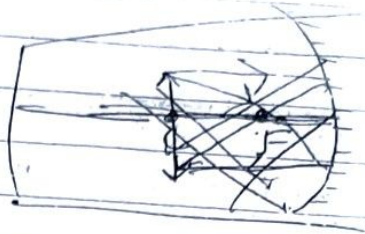
Image formation By Concave Mirror

1.

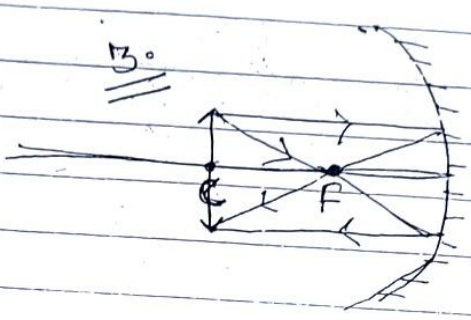


2.

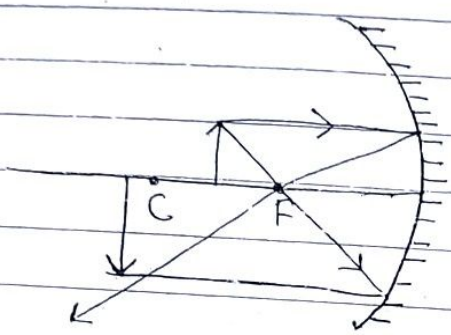




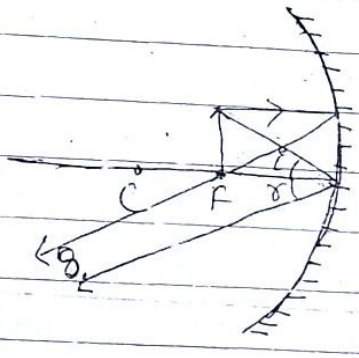
3.



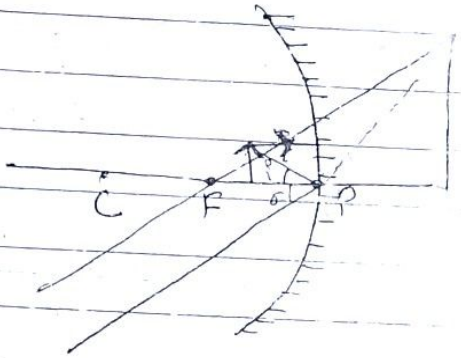
4.



5.



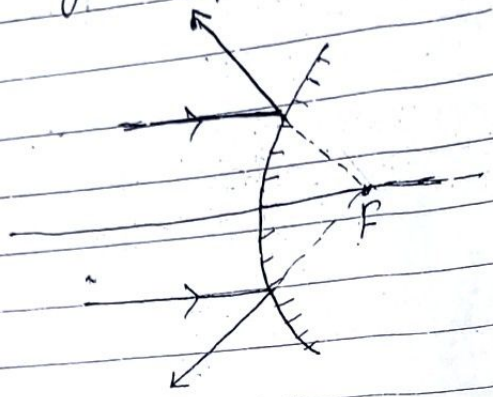
6.



Object	Image	Nature	Size
∞	F	Real & inverted	diminished
Beyond C	B/w C & F	" & "	diminished
At C	At C	" & "	same
B/w C & F	Beyond C	" & "	Enlarged
At F	At ∞	" & "	Highly enlarg
B/w P & F	Behind the Mirror	Virtual & erect	Highly enla

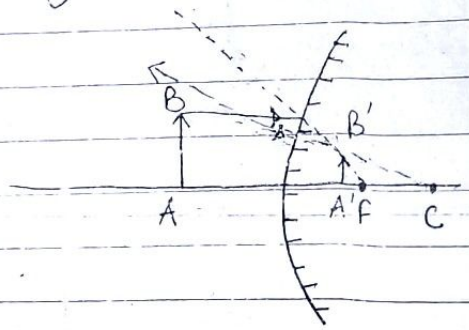
Image formation of Convex Mirror

1.



Object → At ∞
Image → Behind the mirror
Nature → Virtual and Erect
Size → Diminished

2.



Object → In front of
Image → Behind the
Nature → Virtual and
Size → Diminished

Sign Convention

1. All distances are measured from pole...
2. All distances in the direction of incident ray are taken as positive...
3. All distances in the direction opposite to incident ray are taken as negative...

4. All distances measured above the principal axis are taken as positive...
5. All distances measured below the principal axis are taken as negitive...

Mirror formula

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

f = focal length
v = image distance
u = object distance
m = magnification $= \frac{h_i}{h_o} = -\frac{v}{u}$

h_i = size of image
h_o = size of object

Questions...

1. Find the nature, position & size of the image formed when a 2cm nail is kept in front of a concave mirror of focal length 20cm at a distance of 30cm

$h_o = 2\text{cm}$
$f = -20\text{cm}$
$u = -30\text{cm}$

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

$$\Rightarrow \frac{1}{-20} = \frac{1}{v} + \frac{1}{(-30)}$$

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

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

$$\Rightarrow \frac{20-30}{600} = \frac{1}{v}$$

$$\Rightarrow \frac{-10}{600} = \frac{1}{v}$$

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

Nature = Real

$$\frac{-v}{u} = \frac{h_i}{h_o} \Rightarrow \frac{+60}{+30} = \frac{h_i}{2} \Rightarrow h_i = -4\text{cm}$$

Inverted

2. An object is kept at a distance of 10 cm of a convex mirror of focal length 20 cm ..... Calculate the nature position of the image formed.

Ans

$u = -10\ cm$

$f = 20\ cm$

$V = ?$

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

$$\frac{1}{V} + \frac{1}{-10} = \frac{1}{20}$$

$$\frac{1}{V} = \frac{1}{20} + \frac{1}{10}$$

$$\frac{1}{V} = \frac{1+2}{20} = \frac{3}{20}$$

$$\frac{1}{V} = \frac{3}{20}$$

$$\frac{20}{3} = V$$

$$V = 6.67\ cm$$

Virtual

3. A 4 cm pin is kept 30 cm away from a mirror of focal length 15 cm. Calculate nature, position and size of the image formed

Ans

$h_o = 4\ cm$

$u = -30\ cm$

$f = 15\ cm$

$$\therefore \frac{1}{u} + \frac{1}{V} = \frac{1}{f} \Rightarrow \frac{1}{-30} + \frac{1}{V} = \frac{1}{15}$$

$$\frac{1}{v} = \frac{1}{15} + \frac{1}{30}$$

$$\frac{1}{v} = \frac{2+1}{30}$$

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

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

$$\boxed{v = 10\text{cm}}$$

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

$$\frac{h_i}{4} = \frac{+10}{-30}$$

$$\boxed{h_i = \frac{4}{3}\text{ cm}}$$

Virtual

4. Where should an object be kept in front of a concave mirror of focal length 20cm to get a real image 2 times the object and at a distance of 15cm from the mirror

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

$m = 2$ times

$u = 15$ cm

$$\frac{1}{u} + \frac{1}{v} = \frac{1}{-20}$$

$$\frac{1}{-15} + \frac{1}{v} = \frac{1}{-20}$$

$$\frac{1}{v} = \frac{-1}{20} + \frac{1}{15}$$

$$\frac{1}{v} = \frac{1}{60}$$

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

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

$$2 = \frac{-60}{u}$$

$$u = \frac{-60}{2}$$

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

$u = ?$

$f = -20\text{cm}$

$m = -2$

$V = -15$

$m = 2$

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

$v = 2u$

5. A concave mirror forms 2 times magnified image of an object. find the nature, position and size of the image formed also the object distance if the focal length is 15cm

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

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

Sol

$m = 2$

$f = -15\,cm$

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

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

$\frac{1}{-15} = \frac{v+u}{vu}$

$\frac{-vu}{+15} = v + u$

$-\frac{uv}{15} - u = v$

$-\frac{uv}{15} = 15u = v$

$-\frac{u(v+15)}{15} = v$

$-u = \frac{15v}{v+15}$

$u = \frac{-15v}{v+15}$

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

$2 = -\frac{v}{u} \times \frac{v+15}{-15v}$

$2 \times 15 = v + 15$

$30 = v$

$30 - 15 = v$

$15 = v$

6. Calculate 2 possible distances from a concave mirror to get 3 times magnified image if focal length of the mirror is 10cm.

Sol

$m = 3$

$f = 10\,cm$

Real

$m = -3$

$\frac{-v}{u} = +3$

$v = 3u$

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

$\frac{1}{-10} = \frac{1}{3u} + \frac{1}{u}$

$\frac{1}{10} = \frac{4}{3u}$

$3u = 40$

$u = \frac{-40}{3}$

Virtual

$m = 3$

$\frac{-v}{u} = 3$

$v = -3u$

$\frac{1}{-10} = \frac{1}{-3u} + \frac{1}{u}$

$-\frac{1}{10} = \frac{u - 3u}{-3u^2}$

$\frac{1}{10} = \frac{1}{v} - \frac{1}{-5}$ $\quad v = -5 \times -\frac{20}{5}$

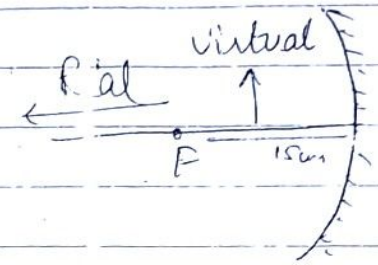
$3u = -20$ $\quad \boxed{v = 20\ cm}$

$\boxed{u = -\frac{20}{3}\ cm}$

7. where should an object be kept in front of a concave mirror of focal length of 15cm to get a real image.

$f = -15\ cm$

$u \geq 15\ cm$



Refraction

→ It is the bending of light rays one light moves from one medium to another medium.

⇒ Optically Denser medium

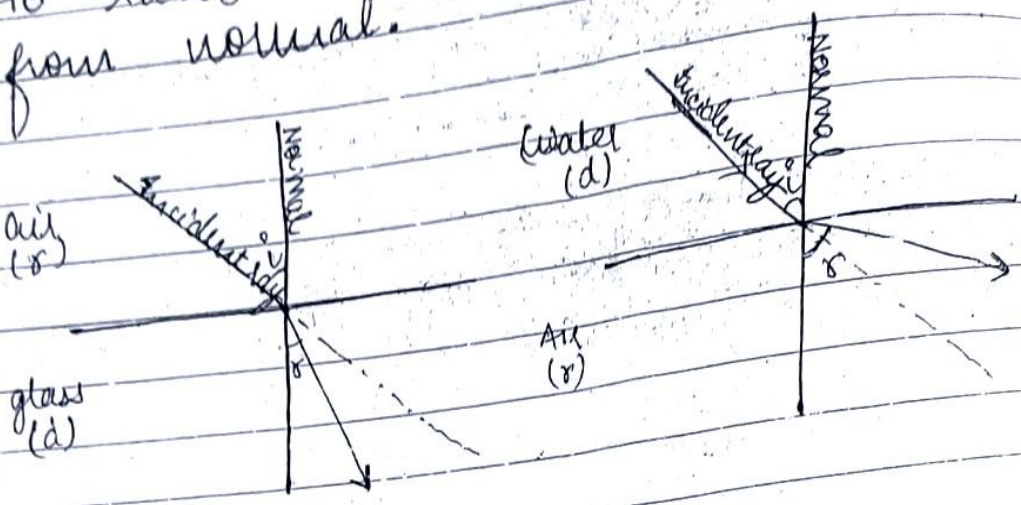
The medium in which the speed of light is less is known as optically denser medium

Optically rarer medium

The medium in which the spread of light is more is known as

* when light moves from rarer medium to denser medium it bends towards the normal.

* When light moves from denser medium to rarer medium it bends away from normal.



Laws of Refraction

→ The incident ray, the normal at the point of incidence and the refracted ray and the normal all lie on the same pla

→ The ratio of ~~sign~~ sine of angle of incidence to ~~sign~~ sine of refraction is always constant for a given pair of media. This constant is known as refractive index. This law is known Snell's law

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

= Refractive Index = n

↳ It is denoted by n

↳ It has no unit.

Refractive Index (RI)

→ Absolute RI
- ↦ One medium is always air/vaccum
- ↦ Incident ray lies in air
- ↦ Always calculated w.r.t air
- ↦ n_m^a / n_{ma} / ^an_m / $_an_m$

↳ Refractive index of medium w.r.t air

It formula is

$$= \frac{\text{speed of light in air}}{\text{speed of light in medium}}$$

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

→ Relative RI
- ↦ Both the medium are other than air
- ↦ $n_p^q = \frac{\text{speed of light in } q}{\text{speed of light in } p}$
- ↦ $n_p^q = \frac{n_p^a}{n_q^a}$

Q1. Find the RI of glass w.r.t air if speed of light in glass is 2×10^8 m/s

Q2. Find the speed of light in water if RI of water is 1.33 or $\frac{4}{3}$.

Q3. The refractive index of glass is 1.5 while RI of water is 1.33. Calculate the RI of water w.r.t glass.

* Higher the value of Refractive Index denser is the medium less is the speed of light in that medium

* $n_p^a = \frac{1}{n_a^p}$

$n_p^a \times n_a^p = 1$

Q. The RI of diamond is 2.42. Explain.

Answers

Ans 1. $\frac{3 \times 10^8}{\alpha \times 10^8} = \frac{3}{\alpha} = 1.5$ *

Ans 2. RI = 1.33

$1.33 = \frac{\text{Speed of light in air}}{\text{speed of light in water}}$

$1.33 = \frac{3 \times 10^8}{\text{Speed of light in water}}$

$\frac{3 \times 10^8}{1.33} = \text{Speed of light in water}$

$\frac{3 \times 10^{10}}{133} = \text{Speed of light in water}$

R.I of glass = 1.5
R.I of water = 1.33

$$\mu_w^g = \frac{\mu_w^a}{\mu_g^a} = \frac{\frac{3\times10^8}{1.33}}{\frac{3\times10^8}{1.5}}$$

$$= \frac{3\times10^{10}}{8.33} \div \frac{3\times10^8}{1.5}$$

$$= 3\times10^{8}$$

$$\frac{1330}{1500} = \frac{133}{150}$$

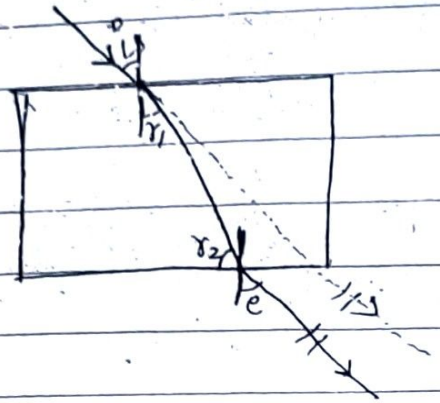
16

Q1. A light of wave length 500×10^{-10} m enters glass is 1.5. Find (i) frequency of light in Glass (ii) (iii)

Sol: λ air = 500 Å
$= 500 \times 10^{-10}$ m

$V_{air} = 3\times10^8$ m/s
$V_{air} = f_{air} \times 500 \times 10^{-10}$
$f_{air} = \frac{3\times10^{8+10}}{500}$
$= 0.6\times10^{16}$ Hz

Glass Slab



Principle of Reversibility of Light...

→ When a light passes through a glass slab at air glass medium. The light ben → towards the normal at the glass air m -um. The light bends away from the normall by the same amount.

→ Hence, the incident ray and the emergent are || to each other. If the light could have entered from the other side it w have followed the same path. This is k as principle of reversibility of light.

Lateral Displacement: The ⊥ distance the intended incident ray and the em -ent ray is known as Lateral Displa -ent.

Optical Lenses

Convex Lens

⇒ lens which is thinner at the edge and thicker in the middle converges a ll beam of light ...

Concave Lens

⇒ A lens which is thinner in the middle and thicker ~~in~~ at the edges, it diverge a ll beam of light after refraction ...

~~The C~~

Optical Centre: The centre of the lens is known as optical centre

: It is a straight light passing through.

principle focus of a Concave Lens: It is a point on the principle axis from wh rays ll to principal axis appear to di ge after refraction.

Rules of Image formation In Case of Lenses ...

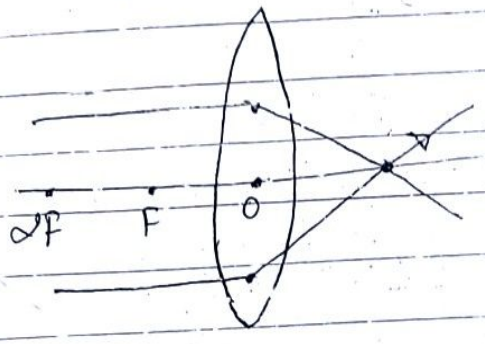
→ A ray of light ll to principle axi passes through the focus or appear to diverge from focus after refrac

→ A ray of light passing through the optic centre of goes undeviated.

A ray of light passing through the focus goes || to the principle axis after refraction.

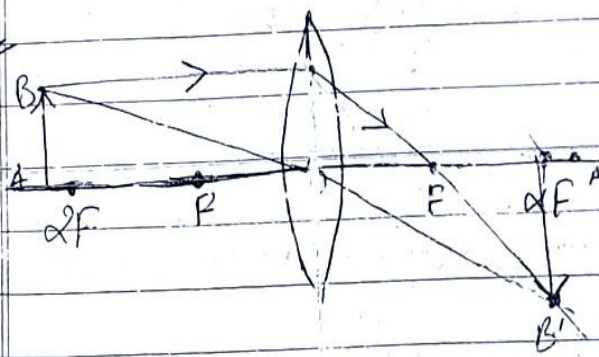
Image formation By Convex Lens

1.



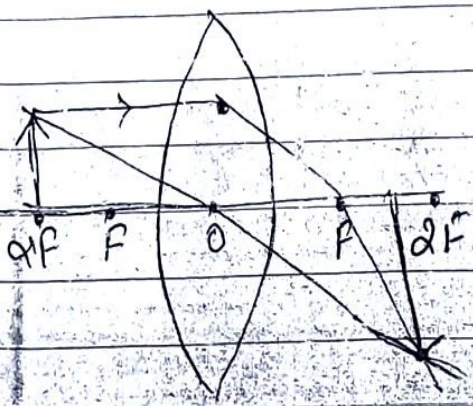
At ∞
At F
Diminished
Real & Inverted

2.



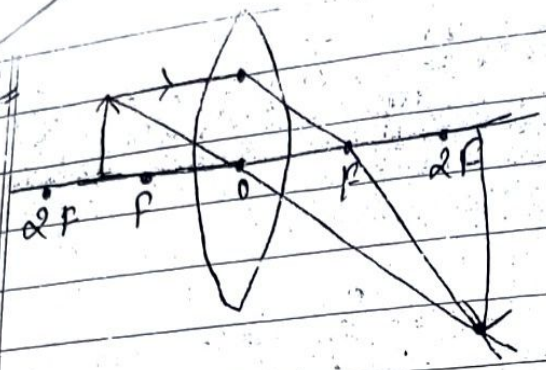
Beyond 2F
B/w F & 2F
Diminished
Real & inverted

3.



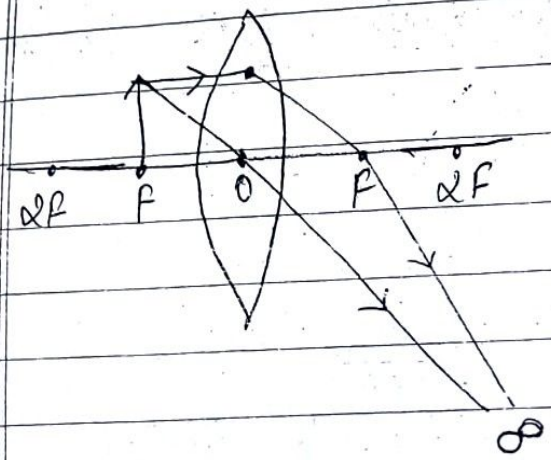
At 2F
At 2F
Same Size
Real & inverted

4.



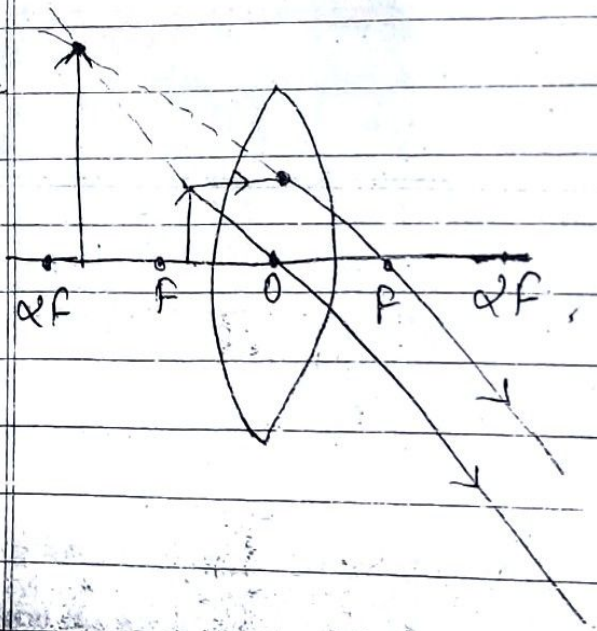
Blw F & 2F
Beyond 2F
& Enlarged
Real & inverted

5.



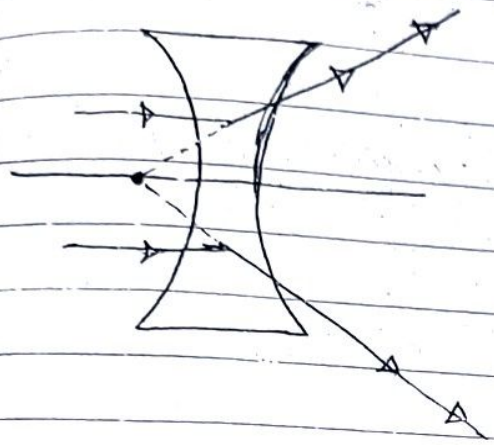
At F
At ∞
Enlarged
Real & inverted

6.

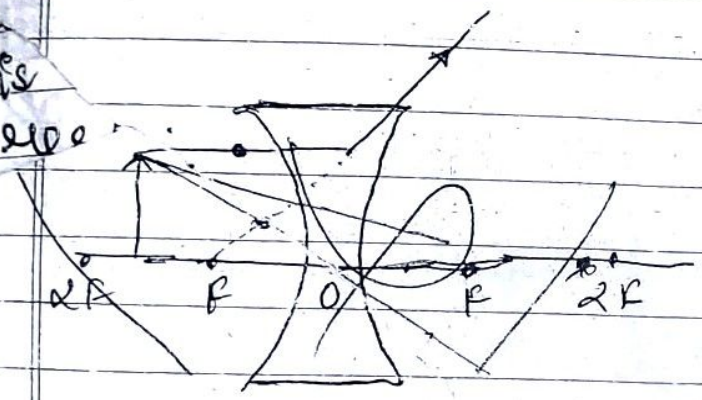


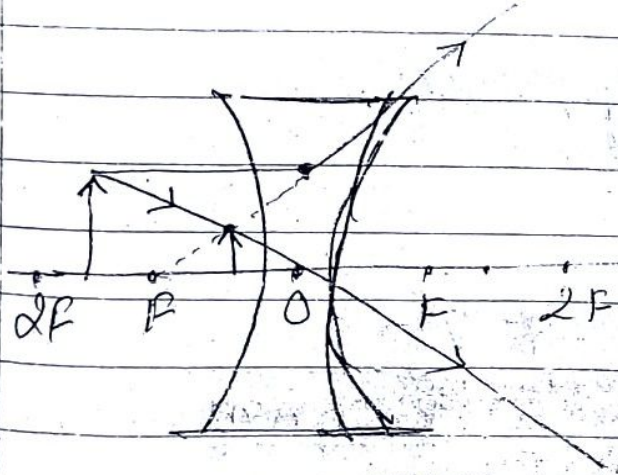
Blw 0 & F
In front of lens
Enlarged
Virtual & Erect

Image formation By Concave Lens



Virtual &, Erect
Diminished
Infront of the lens





Virtual
Erect
Diminished
In front of lens

	Mirror		Lens	
	Concave	Convex	Concave	Convex
u	−	−	−	+
f	−	+	−	+
v	Real (+virtual) (v<f)	virtual	virtual	Real (+ve) (v>f) (virtual)
m	− ve	+	+	−
hi	− ve	+	+	−
ho	+	+	+	−

Power of lens

Degree of convergence or divergence.

OR

It is numerically equal to reciprocal of focal length.

P unit = Dioptre

denote = D

$$ID = \frac{1}{m} - 1$$

$$ID = \frac{i}{1m}$$ Or

$$P = \frac{1}{f(in\ m)}$$

$$P = \frac{100}{f(in\ cm)}$$

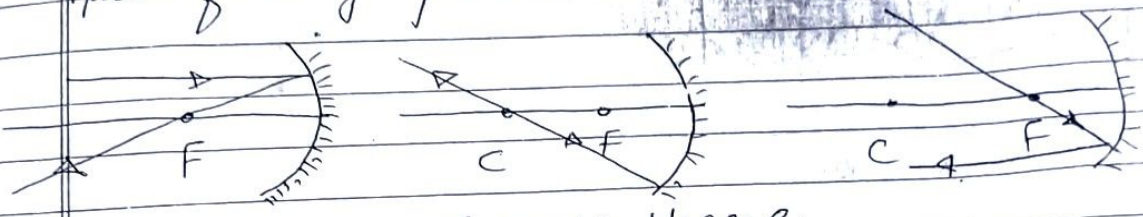
Concave	Convex
f = −ve	f = +ve
P = −ve	P = +ve

Quick Notes

LIGHT

* Magnification of a plane mirror is 1.
* When a plane mirror is turned by an angle θ, its image is turned by 2θ.
* $f = \frac{R}{2}$, $R = 2f$

Rules of Image formation



CONCAVE MIRROR

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

$m = \frac{-v}{u} = \frac{h_i}{h_o}$ [m = magnification]

u = object distance, v = image distance, f = focal length

* $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$ [Lens formula]

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

	Concave Mirror	Convex Mirror	Concave ~~Mirror~~ lens	Convex lens
u	-ve	-ve	-ve	-ve
f	-ve	+ve	-ve	+ve
v	-ve (Real)	+ve [Virtual	-ve [Virtual]	+ve (Real)
	+ (u<f) (O&F) (virtual)			-ve [O&F] (Virtual)
—	-ve.	+ve	+ve	—

New Digamber Public School
class X Subject: Physics

Topic: Light

State laws of reflection of light.

Define Principle focus.

Draw ray diagrams for image formation by mirrors and lenses.

Define refraction of light and state laws of refraction of light.

Write the mirror and lens formula. Also mention sign convention for mirrors and lenses.

Define:-

① Focal length of a plane mirror?.

② Reflection.

③ Radius of a plane mirror.

④ Real image.

⑤ Virtual image.

⑥ power of a plane mirror.

⑦ Snell's law.

⑧ Focal length of a concave mirror.

⑨ power and its S.I. unit.

⑩ power of sun-glasses?

⑪ Diffused reflection

⑫ Len's formula.

⑬ An Image

⑭ Angle of incidence.

⑮ principal focus of a concave mirror.

⑯ 1 dipotre of power of a lens.

(17) Laws of refra

(17) Laws of reflection?

(18) (i) Regular reflection.
(ii) Diffused reflection.

(19) Magnification.

(20) Mirror formula.

(21) Lateral displacement.

(22) Basic laws of reflection.

(23)

Pankhudi Marand

1. What is the angle of reflection if a ray falls normally on a plane mirror?
2. The image of an object formed by a lens on the screen is not in sharp focus. Suggest a method to get clear focussing of the image on the screen without disturbing the position of the object, the lens or the screen.
3. What is the value of ${}_1n_2 \times {}_2n_1$?
4. What is the speed of light in glass of refractive index 1.5? The speed of light in vacuum is $3 \times 10^8\ ms^{-1}$.
5. The refractive index of dense flint glass is 1.65 and for alcohol it is 1.36, with respect to air. What is the refractive index of dense flint glass with respect to alcohol?
6. The refractive index of water is 4/3 and for glass it is 3/2, with respect to air. What is the refractive index of glass with respect to water?
7. With respect to air, the refractive index of ice is 1.31 and that of rock salt is 1.54. Calculate the refractive index of rock salt with respect to ice.
8. Light enters from air into glass plate which has a refractive index of 1.50. Calculate the speed of light in glass. The speed of light in air is $3 \times 10^8\ ms^{-1}$.
9. If you are driving a car, what type of mirror would you prefer to use for observing traffic at your back and why?

10. Given the refractive index of water and glass is 4/3 and 3/2 respectively. Write the relation & find the value of refractive index of water with respect to glass and glass with respect to water.

11. Light enters from air to glass having refractive index 1.50. What is the speed of light in the glass? The speed of light in vacuum is 3×10^8 m/s.

12. You are given kerosene, turpentine and water. In which of these does the light travel faster? Given refractive indices of kerosene, turpentine and water are 1.44, 1.47 and 1.33 respectively.

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

14. An object 50 cm tall is placed on the principal axis of a convex lens. Its 20 cm tall image is formed on the screen placed at a distance of 10 cm from the lens. Calculate the focal length of the lens.

15. A 5.0 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 20 cm. The distance of the object from the lens is 30 cm. By calculation determine (i) the position & (ii) the size of the

image formed.

16. An object 3.0 cm high is placed perpendicular to the principal axis of a concave lens of focal length 15.0 cm. The image is formed at a distance of 10.0 cm from the lens. Calculate -
(i) distance at which the object is placed and
(ii) size and nature of the image formed.

17. Where should an object be placed from a converging lens of focal length 20 cm, so as to obtain a real image of magnification 2?

18. Find the position of an object which when placed in front of a concave mirror of focal length 20 cm produces a virtual image, which is twice the size of the object.

Questions

Exercise - 1

1. An object is placed in front of a plane mirror. If the mirror is moved away from the object through a distance x, by how much distance will the image move

2. A ray of light falls on a plane mirror. Show that if the mirror is tilted through an angle q, the reflected ray tilts through an angle 2q.

3. A 2cm high object is placed at a distance of 32cm from a concave mirror. The image is real, inverted and 3cm in size. Find the focal length of the mirror and the position where the image is formed.

4. A ray of light travelling in air falls on the surface of a glass slab. The ray makes an angle of 45° with the normal to the surface. Find the angle made by the refracted ray with the normal within the slab. Refractive index of glass = 3/2.

5. Yellow light of wavelength 590 nm travelling in air is refracted into water . Find the wavelength of this light in water.

6. A cube of edge 6 cm is placed over a printed page. At what distance from the top surface of the cube will be letters appear when seen from above ? Refractive index of glass = 1.5.

7. An object is placed on the principal axis of a concave lens at a distance of 20 cm from it. If the focal length of the lens is also 20 cm, find the location of the image.

8. A beam of light travelling to the principal axis of a concave lens appears to diverge from a point 20 cm behind the lens after passing through the lens. Find the power of the lens.

9. A convex lens of power 4D is placed at a distance of 40 cm from a wall. At what distance from the lens should a candle be placed so that its image is formed on the wall ?

10. A convex lens of focal length 20 cm is placed in contact with a concave lens of focal length 12.5 cm in such a way that they have the same principal axis. Find the power of the combination.

11. A convex mirror used for rear-view on an automobile has a radius of curvature of 3.00 m. If a bus is located at 5.00 m from this mirror, find the position, nature and size of the image.

12. An object, 4.0 cm in size, is placed at 25.0 cm in front of a concave mirror of focal length 15.0 cm. At what distance from the mirror should a screen be placed in order to obtain a sharp image ? Find the nature and the size of the image.

13. A concave lens has focal length of 15 cm. At what distance should the object from the lens be placed so that it forms an image at 10 cm from the lens ? Also, find the magnification produced by the lens.

14. A 2.0 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 10 cm. The distance of the object from the lens is 15 cm. Find the nature, position and size of the image. Also find its magnification.

15. An object placed in front of a diverging mirror at a distance of 30 cm, forms a virtual and erect image which is 1/5 of the size of the object. Calculate : (i) the position of the image, (ii) the focal length of the diverging mirror.

16. A light of wavelength 500 nm in air enters a glass block of refractive index 1.5. Find (a) speed; (b) frequency; (c) wavelength of light in glass. Velocity of light in air is 3×108 m/s.

17. Consider a system of two plane mirror inclined to each other at a right angle. Show that when a ray of light is incident on the system, the outgoing ray is parallel to the incident ray and this result is independent of the incident direction.

18. A near sighted person wears eye glass with power of -5.5D for distant vision. His doctor perscribes a correction of +1.5D in near vision section of his bifocals, which is measured relative to main part of the lens.

(i) What is the focal length of his distant viewing part of lens ?

(ii) What is the focal length of near vision section of the lens ?

19. The radius of curvature of a convex mirror used on a moving automobile is 2.0 m. A truck is coming behind it at a constant distance of 3.5 m. Calculate (i) the position, and (ii) the size of image relative to the size of the truck. What will be the nature of the image ?

20. The refractive index of dense flint glass is 1.65, and for alcohol, it is 1.36 with respect to air. What is the refractive index of the dense flint glass with respect to alcohol ?

21. A convex lens forms a real and inverted image of a needle at a distance of 50 cm from the lens. Where is the needle placed in front the convex lens, so that this image is of the same size as the object ? Also, find the power of the lens.

22. A person can not see objects distinctly at distances less than 1 m. Calculate the power of the spectacles lens that he should use in order to read a book at a distance of 25 cm.

23. Name the type of mirror used in the following situations :

(a) Head lights of a car.

(b) Side rear view mirror of a vehicle.

(c) Solar furnace.

Support your answer with reason.

24. What kind of lens can form a (i) Virtual, erect, diminished image? (ii) virtual, erect, magnified image?

25. Which lens has greater power, a convex lens of focal length 10 cm or a convex lens of focal length 20 cm?

26. A man standing in front of a special mirror finds his image having a small face, big tummy and legs of normal size. What are the shapes of three parts of the mirror?

27. Can you change focal length of a given spherical mirror by changing the object distance from the mirror?

28. Can you change linear magnification of a spherical mirror by changing the object distance from the mirror?

29. What is the basic cause of refraction?

30. What are the conditions for no refraction of light?

31. A concave mirror is used as a head mirror by ENT specialists. The same mirror can also be used as a shaving mirror. Why?

ANSWER KEY

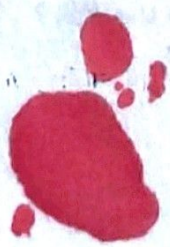
1. 2x 3. f = _19.2 cm, v = _48 cm 4. 28° 5. 442.5 nm 6. 4 cm 7. -10 cm 8. -5D 9. _cm

10. -3D 11. 1.15 m, +0.23 12. -37.5 m, -6.0 cm 13. -30 cm, +0.33 14. +30 cm, -4.0 cm, m = -2

15. (i) 6 cm (ii) 7.5 cm 16. (a) 2 × 108 m/s (b) Same (c) 333.3 nm

18. (i) -18.18 cm (ii) -25 cm 19. (i) 0.78 m (ii) 0.22 20. 1.21 21. -50 cm, 4 D 22. +3 D

Exercise-3



PREVIOUS YEARS BOARD (CBSE) QUESTIONS :

VERY SHORT ANSWER QUESTIONS (CARRYING 1 MARKS EACH)

1. If the magnification of a body of size 1 m is 2, what is the size of the image ? (2003)

2. What is the power of a concave lens of focal length 25 cm ? (2004)

3. What will be the focal length of a lens whose power is given as +2.0 D ? (2004)

4. Where will the image be formed by a concave mirror when an object is placed between the pole and the focus point of the mirror ? (2005)

5. What is the value of focal length of a plane mirror ? (2005)

6. A ray of light is incident on a convex mirror as shown in fig. Redraw the above diagram after completing the path of the light ray after reflection from the mirror. (2006)

7. Copy fig. in your answer book and show the direction of the light ray after reflection. (2008)

8. The refractive index of diamond is 2.42. What is the meaning of this statement in relation to speed of light ?

(2008)

9. Draw fig. in your answer book and show the formation of image of the object AB with the help of suitable rays.

10. Draw fig. in your answer book and show the formation of image of the object AB with the help of suitable rays.

11. Draw fig. in your answer book and show the formation of image with the help of suitable rays.

SHORT ANSWER QUESTIONS (CARRYING 2 MARKS EACH)

12. Give the characteristics of image formed by a plane mirror. (2003)

13. An object is placed at 0·06 m from a convex lens of focal length 0·1 m. Calculate the position of the image?

14. An object is placed at a distance of 20 cm in front of a convex mirror of radius of curvature 30 cm. Find the position and nature of the image. (2004)

15. Light enters from air into diamond, which has a refractive index of 2.42. Calculate the speed of light in diamond. The speed of light in air is 3 × 108 ms_1. (2005)

16. With the help of ray diagrams, show the formation of the images of an object by a concave mirror. When it is placed (i) beyond the centre of curvature (ii) at the centre of curvature. (2005)

17. Draw ray diagrams to show the formation of image of an object by a concave mirror, when it is placed (i) between its centre of curvature C and focus F (ii) between pole P of mirror and its focus F. (2005)

18. With respect to air, the refractive index of ice is 1·31 and that of rock salt is 1·54. Calculate the refractive index of rock salt w.r.t. ice. (2005)

19. Draw ray diagrams to show the formation of image of an object by a concave lens when the object is placed.

(i) at infinity (ii) between infinity and optical centre of the lens. (2005)

20. Draw a ray diagram to show the position and nature of the image formed when an object is placed between focus F and pole P of a concave mirror. (2006)

21. Draw ray diagrams to show the formation of the image of an object by a convex mirror, when it is placed

(i) at infinity and (ii) between infinity and pole of the mirror. (2006)

22. Draw a labelled ray diagram to locate the image of an object formed by a convex lens of focal length 20 cm when the object is placed 20 cm away from the lens.

23. Explain with the help of a diagram, why a pencil partly immersed in water appears to be bent at the water surface. (2008)

24. Draw the ray diagrams to represent the nature, position and relative size of the image formed by a convex lens for the object placed (i) at 2 F1 (ii) between F1 and optical centre O of the lens. (2008)

SHORT ANSWER QUESTIONS (CARRYING 3 MARKS EACH)

25. Calculate the distance at which an object should be placed in front of a thin convex lens of focal length 10 cm to obtain a virtual image of double its size. (2003)

26. A convex lens of focal length 40 cm is placed in contact with a concave lens of focal length 25 cm. What is the power the combination ? (2003)

27. Find the position of an object, which when placed in front of a concave mirror of focal length 20 cm produces a virtual image, which is twice the size of the object. (2003)

28. A concave lens made of a material of refractive index n1 is kept in a medium of refractive index n2. A parallel beam of light is incident on the lens. Complete the path of rays of light emerging from the concave lens if

(i) $n1 > n2$ (ii) $n1 = n2$ (iii) $n1 < n2$. (2003)

29. Find the position, nature and size of the image formed by a convex lens of focal length 20 cm of an object 4 cm high placed at a distance of 30 cm from it. (2004)

30. A convex lens has focal length of 30 cm. Calculate at what distance should the object be placed from the lens so that it forms an image at 60 cm on the other side of the lens ? Find the magnification produced by the lens in this case. (2004)

31. Find the option, nature and size of the image of an object 3 cm high placed at a distance of 9 cm from a concave of focal length 18 cm. (2004)

32. An object 4 cm high is placed 40-0 cm in front of a concave mirror of focal length 20 cm. Find the distance from the mirror, at which a screen be placed in order to obtain a sharp image. Also find the size and nature of the image formed. (2005)

ISM BANSAL XG

THE EMERALD HEIGHTS INTERNATIONAL SCHOOL

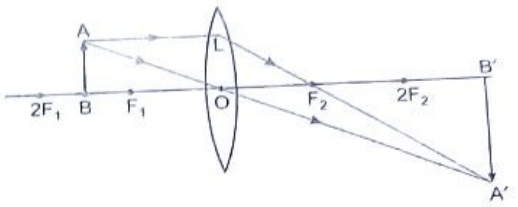
SESSION : 2016-17

2+10 copies

CLASS- X SUB- PHYSICS

PRACTICE QUESTIONS (Light)

1. Study the ray diagram given alongside and answer the following questions:
   (a) State the type of lens used in the following figure.
   (b) List two properties of the image formed.
   (c) In which position of the object will the magnification be –1? **[CCE 2013]**



2. Draw ray diagrams to describe the nature, position and relative size of the image formed by a:
   (a) convex lens for the object placed at $2F_1$, and
   (b) concave mirror for the object when it is placed between pole P and focus F. **[CCE 2011]**

3. Define the term 'magnification'. What do you mean by positive and negative values of magnification? Write the formula for magnification of a mirror and a lens explaining the symbols used in the formula. **[CCE 2013]**

4. An object of size 5 cm is placed at a distance of 25 cm from the pole of a concave mirror of radius of curvature 30 cm. Calculate the distance and size of the image so formed. What will be the nature of the image? **[Ans:** 37.5 cm, 7.5 cm, real and inverted**]**

5. An object 2 cm in size is placed 30 cm in front of a concave mirror of focal length 15 cm. At what distance from the mirror should a screen be placed in order to obtain a sharp image? What will be the nature and size of the image formed? Draw a ray diagram to show the formation of the image in this case. **[Ans:** 30 cm, 2 cm, real and inverted**]**

6. An object 1 cm tall is placed at a distance of 15 cm from a concave mirror of focal length 10 cm. Find the position, size and nature of the image formed by this mirror. **[CCE 2013]**
   [Ans: Real and inverted image of 2 cm size at a distance of 30 cm from the mirror**]**

7. A car is situated 30 m from a convex mirror of focal length 3.0 m. Find the position, nature and magnification of the image formed. What is the use of such a mirror?
   [Ans: Virtual and erect image of relative size $\frac{1}{11}$ situated at 2.73 m behind the mirror**]**

8. Find the position of an object placed in front of a concave mirror of focal length 20 cm so as to have an image 4 times enlarged. **[Ans:** 25 cm for real and enlarged image, and 15 cm for virtual and enlarged image**]**

9. (a) State the factors on which the relative refractive index of a pair of media depends.
   (b) Light enters from air into water, which has refractive index of 1.33. Calculate the speed of light in water. The speed of light in air is 3×10^8 m s^{-1}. **[CCE 2013]** **[Ans:** (b) 2.26×10^8 m s^{-1}**]**

10. A 4 cm tall object is placed perpendicular to the principal axis of a convex lens of focal length 24 cm. The distance of the object from the lens is 16 cm. Find the position, size and nature of the image formed by using the lens formula. **[CCE 2012]**
    [Ans: Virtual, erect and 12 cm tall image at a distance of 48 cm on the same side of the lens as the object.**]**

11. A convex lens has a focal length of 10 cm. At what distance from the lens should the object be placed so that it forms a real and inverted image 20 cm away from the lens? What would be the size of the image formed if the object is 2 cm high? Show the formation of image by drawing a ray diagram. **[Ans:** 20 cm, 2 cm**]**

12. A concave lens of power –2.0 D is used to form an image of an object of size 9 cm kept at a distance of 25 cm from it. Find the nature, size and position of the image formed. **[CCE 2013]**
    [Ans: Virtual and erect image of 6 cm size at 16.7 cm from the lens**]**

13. A needle placed 45 cm from a lens forms an image on a screen placed 90 cm on the other side of the lens. Identify the type of the lens. Determine its focal length and the power. What is the size of the image if needle is 5 cm in height? **[CCE 2011]** **[Ans:** Convex lens, 30 cm, +3.3 D, 10 cm**]**

14. A convex lens has a focal length of 25 cm. Calculate the distance of the object from the lens if the image is to be formed on the opposite side of the lens at a distance of 75 cm from the lens. What is the nature and relative size of the image? **[Ans:** 37.5 cm, real, inverted and 2 times enlarged image**]**

15. A concave lens has focal length of 20 cm. At what distance from the lens a 5 cm tall object be placed so that it forms an image at 15 cm from the lens? Also, calculate the size of the image formed. **[CCE 2011]**
    [Ans: 60 cm, 1.25 cm**]**

16 Where should a slide be placed in front of a projector lens so as to obtain a real image on a screen whose linear magnification is 20. Given that focal length of the lens is 10 cm. [Ans: 10.5 cm]

17. An object is placed at 60 cm from a concave lens of focal length 12 cm. At what distance from the lens its image is formed? What is its magnification? [Ans: 10 cm, $\frac{1}{6}$]

18 Two lenses are of powers $P_1 = +0.5$ D and $P_2 = -2.5$ D. Out of the two, identify the converging lens and the diverging lens. Give reason for your choice. Find the focal length of each. [CCE 2013]
[Ans: Lens 1 converging of $f_1 = +200$ cm, lens 2 diverging of $f_2 = -40$ cm]

19 Which of the two lenses has a greater power?
(a) a convex lens of focal length 5 cm, and (b) a convex lens of focal length 50 cm.
Justify your answer. [CCE 2011] [Ans: A convex lens of focal length 5 cm]

20 A convex lens of power +5 D is placed at a distance of 40 cm from a wall. At what distance from the lens should a candle be placed so that its sharp image is formed on the wall? [Ans: 40 cm]

21. Two lenses have powers +2.5 D and –0.5 D respectively. Calculate the power as well as the focal length of the combination of two lenses in contact. [Ans: +2.0 D, +50 cm]

22 (a) Define 1 dioptre power of a lens.
(b) Two thin lenses of focal lengths +10 cm and –5 cm are kept in contact. Find the focal length and power of this combination of lenses. [CCE 2011] [Ans: (b) –10 cm, –10 D]

23 Two lenses of powers +3.5 D and –1.5 D are placed in contact. What is the power and focal length of the lens combination. If an object be placed at a distance of 75 cm from the lens combination, then find the position and nature of the image. [Ans: +2.0 D, +50 cm, 150 cm from lens, real, inverted and enlarged image]

24 A 2 cm high candle flame is placed at a distance of 80 cm from a white screen. On placing a convex lens exactly at the mid-point of the candle and the screen, a distinct image of the flame is seen on the screen. What is the focal length of the lens and the size of the image of candle flame? Draw a ray diagram to show the formation of the image. [Ans: 20 cm, 2 cm]

25. A student focussed the image of a candle flame on a white screen by placing the flame at various distances from a convex lens. He noted his observation in the following table:

Distance of the flame from the lens (cm)	60	40	30	24	12
Distance of the screen from the lens (cm)	20	24	30	40	70

Analyse the above table and answer the following questions:
(a) What is the focal length of a convex lens?
(b) Which set of observation is incorrect, and why?
(c) Draw a ray diagram to show the image formation for any correct set of observation. [CCE 2011, 12]
[Ans: (a) 15 cm, and (b) the last set with $u = 12$ cm and $v = 70$ cm because in this case, image will be virtual and cannot be obtained on a screen.]

26. Define power of a lens. What is its unit?
One student uses a lens of focal length +50 cm and another of –50 cm. What is the nature and power of the lens used by them? [Ans: Converging and +2 D, diverging and –2 D]

27. How are power and focal length of a lens related?
You are provided with two lenses of focal lengths 20 cm and 40 cm respectively. Which lens will you use to obtain more convergent light, and why? [Ans: Lens of focal length 20 cm]

28. The size of a virtual image of an object by a mirror, having a focal length of 30 cm, is observed to be reduced to $\frac{1}{4}$th of its size. At what distance the object has been placed from the mirror? What is the nature of the mirror? [Ans: 90 cm, convex mirror]

29. The size of a real image of an object by a mirror, having a focal length of 20 cm, is observed to be reduced to $\frac{1}{3}$rd of its size. At what distance the object has been placed from the mirror? What is the nature of the mirror? [Ans: 80 cm, concave mirror]

30 Draw ray diagrams to show the formation of a three times magnified (i) real image, and (ii) virtual image of an object kept in front of a converging lens. Mark the positions of object, F, 2F, O and position of image clearly in the diagram.
An object of size 6 cm is kept at a distance of 25 cm from the optical centre of a converging lens of focal length 10 cm. Calculate the distance of the image from the lens and size of the image. [Ans: 16.7 cm, 4 cm]