Chapter 10: Light Reflection and Refraction

Q1. What do you mean by principal focus?

Ans: All incident light rays which are passing parallel to the principal axis of the concave mirror meet at a specific point after reflecting from the concave mirror. That specific point is known as the principal focus of a concave mirror.

Q2. What is the focal length of a spherical mirror if the radius of curvature is 30cm?

Ans: Radius (R) of curvature = 30cm

We know that, Radius (R) of curvature = 2 x Focal length (F)

Therefore, Focal Length = Radius of curvature (R)/2

F = 30/2,

F = 15cm

Hence, focal length of given spherical mirror is 15cm.

Q3. Which mirror can give an enlarged and erect image of an object*?*

Ans: The image will be virtual, erect and enlarged in a concave mirror if the object is placed between the principal focus and pole of the concave mirror.

Q4. Why do we use convex mirrors as rearview mirrors in all vehicles?

Ans: Convex mirrors are used as rearview mirrors because they produce virtual, diminished and erect image of objects. They also provide a wide angle view so that the driver could get a view of the traffic behind him/her.

Q5. If the radius of curvature of the convex mirror is 30cm, find the focal length.

Ans: Radius (R) of curvature = 30 cm

Radius (R) of curvature = 2 x (f) Focal length

R = 2f

f = R/2 = 30/2 = 15cm

Hence, the focal length (f) of the given convex mirror is 15 cm.

Q6. A real image is produced which is 3 times enlarged by concave mirror when placed at a distance of 20 cm in front of it. What will the position of the image produced?

Ans: Given, u = -20 cm

Since image is real and inverted,

m = -3

m = -v / u

-3 = -v/ -20

v= -60 cm

Negative sign indicates that the image is real and image is formed at 60 cm in front of the mirror.

Q7. A light ray traveling in air enters into water obliquely. Does the light ray bend towards the normal or away from the normal? Why?

Ans*:* The light rays bend towards the normal because when rays of light travel to an optically denser medium from an optically rarer medium, it will bend towards the normal. We know that, water is optically denser than air, so the light rays traveling from air into the water bends towards the normal.

Q8. Light enters from air to glass having a refractive index of 2.0. What is the speed of light in the glass? The speed of light in vacuum is 3 x 10^8 m/s.

Ans*:* Refractive index of a medium nm is given by,

nm=Speed of light in vacuumSpeed of light in the medium=cv

Speed of light in vacuum, c = 3×10^8 m/s.

Refractive index of a glass, n_g=2.0

Speed of light in glass

v=cng=3×1082=1.5×108m/s

Q9. Find the medium which has the most high optical density and the most low optical density

Material Medium	***Refractive Index***	***Material Medium***	***Refractive Index***
Diamond	*2.42*	*Crown Glass*	*1.52*
Sapphire	*1.77*	*Benzene*	*1.5*
Ruby	*1.71*	*Turpentine Oil*	*1.47*
Dense flint glass	*1.65*	*Fused Quartz*	*1.46*
Carbon Disulphide	*1.63*	*Kerosene*	*1.44*
–	*–*	*Alcohol*	*1.36*
Rock salt	*1.54*	*Water*	*1.33*
–	*–*	*Ice*	*1.31*
Canada balsam	*1.53*	*Air*	*1.003*

Ans:

Medium with highest optical density = diamond

Medium with lowest optical density = Air

The optical density of any medium is directly proportional to the refractive index of that medium. So, the medium with the highest refractive index will obviously have the highest optical density. From the above table, it is known that Diamond has the highest refractive Index. Therefore, it will have the highest optical density too. Likewise, Air has the lowest refractive Index. Therefore, it will have the lowest optical density.

Q10. Among kerosene, water and turpentine, which allows light to travel faster?

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–	*–*	*Ice*	*1.31*
Canada balsam	*1.53*	*Air*	*1.003*

Ans: Light can travel faster through the medium with lesser optical density. The medium with the least refractive index will have the least optical density. So, from the above table, Water has the least optical density where the light can travel faster.

Q11. What do you mean by this statement "Diamond's refractive index is 2.4"?

Ans: The refractive index n_m of a medium is given by the relation,
nm=speed of light in airspeed of light in the medium=cv
Where, c is the light's speed in vacuum/air.

Diamond's refractive index is 2.4. It means that the speed of light in diamond is reduced by a factor 2.4 compared to its speed in air.

Q12. Define one dioptre.

Ans: One dioptre is the measurement of the power of the lens with focal length 1m. The reciprocal of the focal length of a lens is defined as the power of the lens. If P is the power of a lens of focal length F in meters,
Then P =1/ f (in meters)

Dioptre is the SI unit of power of the lens. It is denoted by D.

So, $1D=1m^{-1}$

Q13. An inverted and real image of a needle is formed with a convex lens at a distance of 40 cm from the lens. What would be the position of the needle

placed in front of the lens if the image is equal to the size of the object? What is the power of the lens?

Ans: v = 40 cm

Since the image is real and of the same size, the position of the image should be double the focal length. Hence, the object should be at 2f.

V = 2f = 40, f = 20 cm.

Power = 1/f = 100/20 = 5D

Q14. The focal length of a concave lens is 4m. Find the power of the lens.

Ans: Given that, Focal length (f) = -4m.

We Know That, Power of lens, P=1f

Therefore, P=1−4m

P = -0.25 D

Q15. Choose one of the below materials which can't be used to manufacture a lens?

(a) Plastic

(b) Water

(c) Glass

(d) Clay

Ans: (d) Clay

Q16. A concave mirror produces an erect, virtual image bigger than the object. What would be the object's position?

(a) At the centre of curvature

(b) Between its principal focus and the centre of Curvature

(c) Between its principal focus and pole of the mirror.

(d) Beyond the centre of curvature

Ans: (c) Between its principal focus and pole of the mirror.

Q17. To get a real image of the same size as the object, where should the object be placed in front of a convex lens?

(a) At twice the (f) focal length
(b) Between the principal focus and optic centre of the lens
(c) At infinity
(d) At the principal focus of the lens
Ans: (a) At twice the focal length

Q18. A thin spherical lens and a spherical mirror have a focal length of 15 cm each. The lens and mirror are likely to be:
(a) Both convex
(b) Both concave
(c) The lens is concave, but the mirror is convex
(d) The lens is convex, but the mirror is concave
Ans: (b) Both concave.

Q19. No matter how far you stand from a mirror, your Image appears erect. The mirror is likely to be
(a) Convex
(b) Plane
(c) Concave
(d) Either plane or convex
Ans: (d) Either plane or convex.

Q20. Which one of the below lenses would you use while reading small letters in a dictionary?
(a) A concave lens of focal length 50cm
(b) A convex lens of focal length 5 cm
(c) A concave lens of focal length 5 cm.
(d)A convex lens of focal length 50cm
Ans: (b) A convex lens of focal length 5 cm.

Q21. What would be the nature of the image and range of the object to obtain erect image using a concave mirror of focal length 20cm? Is the obtained image smaller or larger than the object?
Ans: Given that, focal length of concave mirror (f) = -20cm

The object should be at a distance lesser than the focal length to get an erect image in the concave mirror. The image formed will be erect, enlarged and virtual.

Q22. What is the type of mirror used in the following situations? Support your answer with reason.
(a) Side/rear-view mirror of a vehicle
(b) Solar furnace.
(c)Headlights of a car
Ans: (a) Convex mirror because it always gives an erect image and enables the driver to view much larger area.
(b) Concave or parabolic mirror because it can concentrate sunlight at the focus to produce heat in the solar furnace.

(c) A concave mirror, to get powerful and parallel beams of light.

Q23. A black paper is covered over half of the convex lens. Will the lens produce the image of the object completely? Verify your answer experimentally. Explain your observations.
Ans: Yes, even when one-half of the lens is covered with a black paper, the complete image of the object will be formed. Take a convex lens and focus the light from a distant object onto a screen. As expected, an image (sharp) is formed at a distance equal to the focal length Cover the lower or the upper half of the lens and focus the light from the same object onto the same screen. You will be able to get a sharp image again; however, the brightness of the image will be less

in the second case. The same effect will be seen even if the lens is half covered with black stripes.

Q24. An object 6cm in length is held 20cm away from a converging lens of focal length 15 cm. Draw a ray diagram and find the position, size and the nature of the image formed.
Ans:

Using the lens formula,

1f=1v–1u

115=1v–1(−20)

115–120=1v

5300=1v

v=3005=60

=60cm

m=vu=h’h

60−20=h6

h=360−20=–18cm

Therefore, the image formed on the other side of the lens is inverted, real and bigger than the size of the object.

Q25. The focal length of a concave mirror is 20cm and it forms an image 15cm away from the lens. How far is the object situated from the lens? Draw the ray diagram.

Ans: Given that,

f=−20cm

v=−15cm

Using the lens formula,

1f=1v–1u

1u=1v–1f

1u=1–15–1–20

1u=–5300

u=−3005=–60cm

Therefore, the object is at 60cm away from the lens. The ray diagram is given as follows:

Q26. An object is 5 cm away from the convex mirror of focal length 10 cm. Find the nature and position of the image.

Ans: Given that,

f=+10cm

u=−5cm

For mirror, we have

1f=1u+1v

1v=1f–1u

110–1−5

1v=(5+10)50=1550

v=5015=3.33cm

The image must be erect, virtual in nature.

Q27. What does it mean when the magnification of the object produced by a plane mirror is +1?

Ans*:* This means that the size of the image is equal to the size of the object.

Q28. An object 2.0 cm high is placed at a distance of 10 cm in front of a convex mirror having a radius of curvature 20 cm. What will be the position, nature and size of the image?

Ans: h_o **=** +5.0 cm**,**

u = -20 cm,

We Know that,

f=R2=+10cm

Using mirror formula,

1f=1u+1v

We get,

1v=1f–1u=110–1−10

=210

v=102=5cm

Using m=h1h0=–vu , We get

h1=–5×5−10=2.5

Since v is +ve, The image is virtual.

Since h_1 = 2.5cm > 2 cm, the image is enlarged.

Q29. An object of size 7.0 cm is placed at 27 cm in front of a concave mirror of focal length 18 cm. At what distance from the mirror should a screen be placed so that a sharp focused image can be obtained? Find the size and the nature of the image.

Ans: Given,

$h_0 = 6$ cm

u = -28 cm

f = -20 cm

Using 1f=1u+1v , we get

1v=1f–1u=1−20–1–28

=–120+128=(−7+5)140=−2140

v=–70cm

Using m=h1h0=–vu , we get

h1=–h0×vu=–6×–70–28=–15cm

Since h_1 is greater than h_0, the image is enlarged. As the value of h_1 is –ve, the image is inverted. Since v is –ve, the image is real.

Q30. Find the focal length of a lens of power -2.5D. What type of lens is it?

Ans: We know that,

f=1pm

f=–12.5m

=−1002.5 cm=–40 cm

Focal length of a lens is –ve, which means it is a concave lens.

Q31. A doctor has prescribed a corrective lens of power +2 D. What is the focal length of the lens? Is the prescribed lens diverging or converging?

Ans: Given,

P = +2 D

f=100p cm=1002.0=100020

= +50 cm = 0.5 m

The focal length is +ve, so it is a convex lens. Hence, it a converging lens.