Light - Reflection and Refraction: In-Text Question

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Q.1 Define the principal focus of a concave mirror.

Sol. When rays parallel to the principal axis of a concave mirror meet at a specific point on principle axis, this point is called "principal focus" of concave mirror.

Q.2 The radius of a curvature of a spherical mirror is 20 cm. What is its focal length?

Sol. Given: radius of a curvature R=20cm

$f = R/2$

$f = 20/2$

$f = 10cm.$

Q.3 Name a mirror that can give an erect and enlarged image of an object.

Sol. Concave mirror can form an erect and enlarge image of an object.

Q.4 Why do we prefer a convex mirror as a rear-view mirror in vehicles?

Sol. We prefer a convex mirror because this mirror can form erect and diminish image of wider view.

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Q.1 Find the focal length of a convex mirror whose radius of curvature is 32 cm.

Sol. Given: radius of curvature, R=32cm

So, focal length, $f = R / 2$

$= 32 / 2 = 16cm.$

Q.2 A concave mirror produces three times magnified (enlarged) real image of an object placed at 10 cm in front of it. Where is the image located?

Sol. Given: magnification, $m = -3$

Here, negative sign for real and inverted image.

Object distance, $u = -10$ cm

$m = -v / u$

$$-3 = \frac{-v}{-10}$$

$v = -30cm$

Thus, image is located 30 cm from the mirror in same side of object.

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Q.1 A ray of light travelling in air enters obliquely into water. Does the light ray bend towards the normal or away from the normal? Why?

Sol. The light ray bends towards the normal because water is optically denser than air and when light enters from rear medium to denser medium, it bends toward the normal.

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Q.2 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^{-1}.

Sol. Given: refracted index of glass, $n_g = 1.50$

The speed of light in vacuum = 3×10^8 m s^{-1}

$$Refractive\ index = \frac{speed\ of\ light\ in vacuum}{speed\ of\ light\ in\ glass}$$

Therefore, Speed of light in air = $= \frac{3\times10^8}{1.5} = 2x10^8 m/s$

Q.3 Find out, from Table, the medium having highest optical density. Also find the medium with lowest optical density.

Material medium	Refractive index	Material medium	Refractive index
Air	1.0003	Canada Balsam	1.53
Ice	1.31		
Water	1.33	Rock salt	1.54
Alcohol	1.36		
Kerosene	1.44	Carbon disulphide	1.63
Fused quartz	1.46	Dense flint glass	1.65
Turpentine oil	1.47	Ruby	1.71
Benzene	1.50	Sapphire	1.77
Crown glass	1.52	Diamond	2.42

Sol. Highest optical density is of diamond (n =2.42), lowest optical density is of air (n=1.0003).

Q.4 You are given kerosene, turpentine and water. In which of these does the light travel fastest? Use the information given in Table -

Material medium	Refractive index	Material medium	Refractive index
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Sol. Light can travel faster in a medium of low optical density. Among kerosene (n =1.44), turpentine (n =1.47) and water ((n =1.33)), light travels faster in water. Because water has lowest refractive index.

Q.5 The refractive index of diamond is 2.42. What is the meaning of this statement?

Sol. It means that

$$Refractive\ index = \frac{speed\ of\ light\ in\ vacuum}{speed\ of\ light\ in\ \text{diamond}}$$

$$2.42 = \frac{speed\ of\ light\ in\ vacuum}{speed\ of\ light\ in\ \text{diamond}}$$

$$speed\ of\ light\ in\ \text{diamond} = \frac{speed\ of\ light\ in\ vacuum}{2.42}$$

$$speed\ of\ light\ in\ \text{diamond} = \frac{1}{2.42}\ \text{x}\ Speed\ of\ light\ in\ vacuum$$

The speed of light in diamond is (1/2.42) times the speed of light in vacuum.

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Q.6 Define 1 dioptre of power of a lens.

Sol. One dioptre is defined as the power of lens whose focal length is 1 m.

Q.7 A convex lens forms a real and inverted image of a needle at a distance of 50 cm from it. Where is the needle placed in front of the convex lens if the image is equal to the size of the object? Also, find the power of the lens.

Sol. Given: Image distance, v = 50 cm,

Since, Size of image is equal to size of image and image is real and inverted.

Magnification, m = – 1.

Therefore, u = v / m = –50cm.

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

$$\frac{1}{f} = \frac{1}{50} - \left(\frac{-1}{50}\right) = \frac{1}{25}$$

f = 50cm

Therefore, power, $P = \frac{1}{f(m)} = \frac{100}{25}$ = 4D

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