Light - Reflection and Refraction

82. 4.5 cm needle is placed 12 cm away from a convex mirror of focal length 15 cm. Give the location of image and magnification. Describe what happens to the image as the needle is moved farther from the mirror.

2014/2015 [3 Marks]

Object – distance, u = - 12 cm
Focal length, f = 15 cm

By using mirror formula,

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

$$\frac{1}{15} = \frac{1}{v} + \frac{1}{-12}; \frac{1}{v} = \frac{1}{15} + \frac{1}{12}$$

$$\frac{1}{v} = \frac{4+5}{60} \Rightarrow v = \frac{20}{3}\text{cm}$$

Image distance = $\frac{20}{3}$cm = 6.66 cm

Magnification, m = $\frac{-v}{u} = \frac{-6.66}{-12}$

m = 0.55

As the object is moved farther from the mirror, image gets diminished.

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83. (a) State Snell's Law. If n_{ab} is the refractive index of medium 'b' with respect to 'a' and n_{ba} is the refractive index of medium 'a' with respect to medium 'b' prove that:

$$n_{ab} \times n_{ba} = 1$$

(b) If the refractive index of medium – A with respect to medium – B is 4/5, then find the refractive index of medium – B with respect to medium – A.

2012/2015 [3 Marks]

(a) **Snell's law**: The ratio of sine of angle of incidence to the sine of angle of refraction is a constant, for the light of a given colour and for the given pair of media.

$$n_{ga} = \frac{n_a}{n_b} \quad , \quad n_{ba} = \frac{n_b}{n_a}$$

$$n_{ab} \times n_{ab} = \frac{n_a}{n_b} \times \frac{n_b}{n_a} = 1$$

Hence proved.

(b) $$n_{ab} = \frac{4}{5} = \frac{n_a}{n_b}$$

$$n_{ba} = \frac{n_b}{n_a} = \frac{5}{4} = 1.25$$

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84. A convex lens is of focal length 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.

2014/2015 [3 Marks]

Focal length of lens = +30 cm

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

$$\frac{1}{u}=\frac{1}{v}-\frac{1}{f}=\frac{1}{60}-\frac{1}{30}=\frac{1-2}{60}=\frac{-1}{60}$$

u = - 60 cm

So object distance should be 60 cm.

$$m=\frac{v}{u}=\frac{60}{-60}=-1$$

Height of image is same as that of the object.

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85. (a) "The refractive index of kerosene is 1.44". What is meant by this statement?
(b) A ray of light strikes a glass slab at an angle of incidence equal to 30°. Find the refractive index of glass given that the angle of refraction is 19.5 (Take sin $19.5=\frac{1}{3}$ and $\sin 30=\frac{1}{2}$)

2014/2015 [3 Marks]

(a) The refractive index of kerosene is 1.44. It means that speed of light in air is 1.44 times the speed of light in kerosene.

(b) Angle of incidence (i) = 30°
Angle of refraction (r) = 19.5°

According to law of refraction,

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

Here constant will represent refractive index of glass.

Refractive index of glass = $\frac{\sin i}{\sin r}$

$$n=\frac{\sin 30^\circ}{\sin 19.5^\circ}=\frac{1}{2}\times\frac{3}{1}=\frac{3}{2}=1.5$$

Thus refractive index of glass is 1.5.

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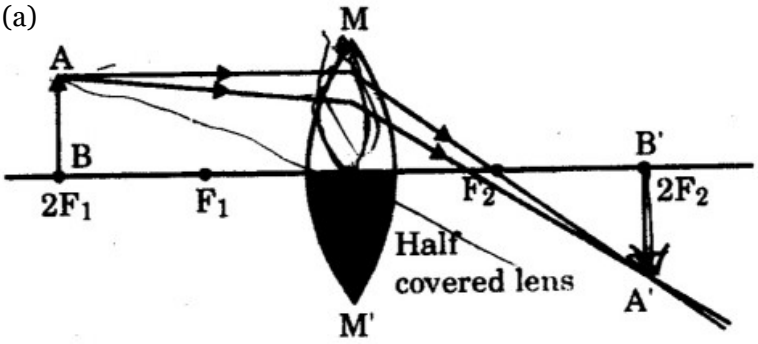
86. One half of a convex lens is covered with a black paper.
(a) Show the formation of image of an object placed at $2F_1$, of such covered lens with help of ray diagram. Mention the position and nature of image.
(b) Draw the ray diagram for the same object at same position in front of the same lens, now uncovered. Will there be any difference in the image obtained in the two cases? Give reason for your answer.

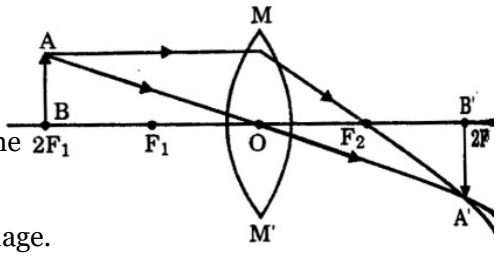
2014/2015 [3 Marks]

(a)



The image is formed at $2F_2$ and is real and inverted.

(b)



The image is formed at $2F_2$ and it is real and inverted but this is more intense and bright than the image formed from the half covered lens.
This is because covered lens does not allow proper light for formation of image.