Practice Questions - Term I

Date: 12/11/2021

Subject: Physics

Topic : Light: Reflection and Refraction

Class: X

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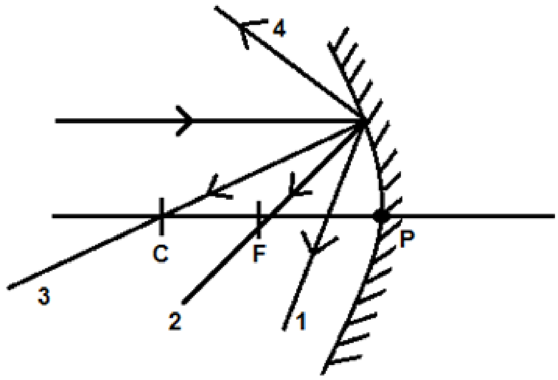
1. Ray of light falling parallel to the principal axis follows which path after reflection?



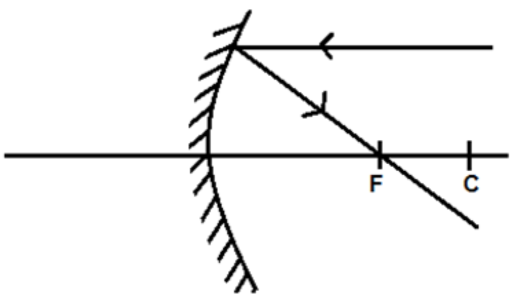
A. 1

B. 2

C. 3

D. 4

A ray parallel to the principal axis passes through the focus after reflection from a concave mirror as shown.



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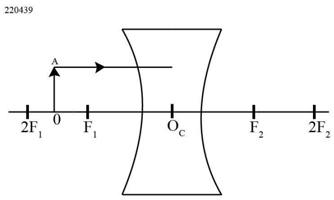
2. Which of the following mirrors can form a real image of an object?

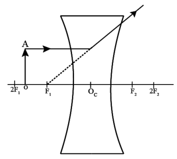
   - A. Convex
   - B. Concave
   - C. Plane
   - D. All of the above

   A convex and a plane mirror always form virtual images. Only a concave mirror can form a real image.

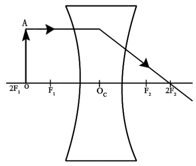
3. Trace the correct path of the light ray after passing through the concave lens:



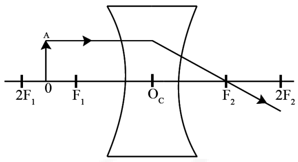
A.



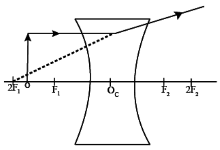
B.



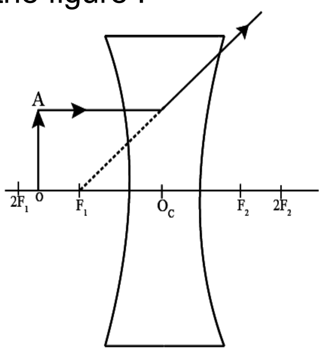
C.



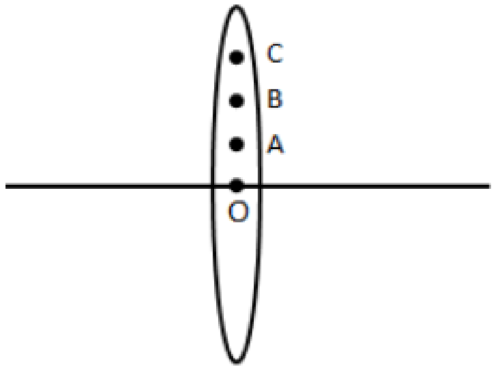
D.



A light ray coming from an object and running parallel to the principal axis of the lens gets diverged after passing through a concave lens. The ray when traced back seems to originate from the virtual focus of the lens as shown in the figure :



4. Towards which point should the incident light ray be directed, so that the ray passes undeviated?



A. A

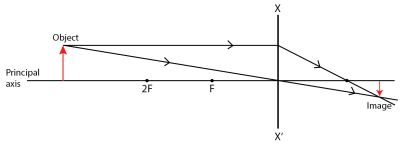
B. C

C. B

D. O

For a thin convex lens, the light ray passing through the optical centre would pass undeviated. The optical centre is represented by O in the given image.

5. Identify the optical object XX' used based on the ray diagram shown.



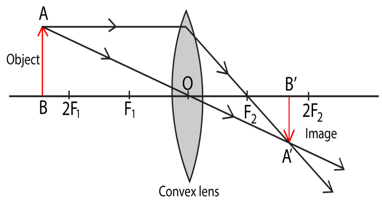
A. Concave mirror

B. Convex mirror

C. Concave lens

D. Convex lens ✓

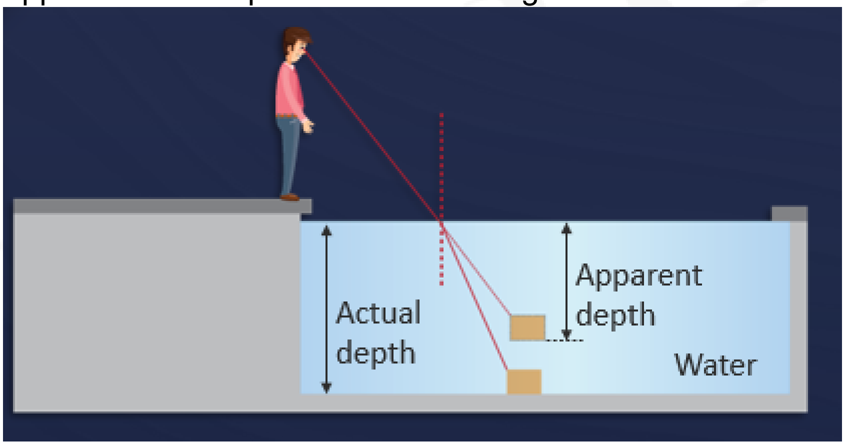
This is a convex lens. The rules of ray diagrams for image formation are followed similar to that of a convex lens, as shown.



6. The swimming pool appears to be less deep than it actually is. Which of the following phenomenon is responsible for this?

- A. Reflection of light
- B. Diffusion of light
- C. Refraction of light ✔
- D. Scattering of light

When we look into a pool of water, we do not see the actual depth of the pool. We see a virtual image of the bottom of the pool. This is because, light rays from the bottom of the pool are bent away from the normal as they pass from water into the air (beacuse air is the rarer medium and water is the denser medium). This phenomenon is called the refraction of light. Due to this, the image of the bottom of the pool seems nearer to us and the pool appears less deep as shown in the figure.



7. Refractive index of diamond is 2.42 and that of carbon disulphide is 1.63. Calculate refractive index of diamond with respect to carbon disulphide.

A. 1.48

B. 0.67

C. 2.42

D. 1.63

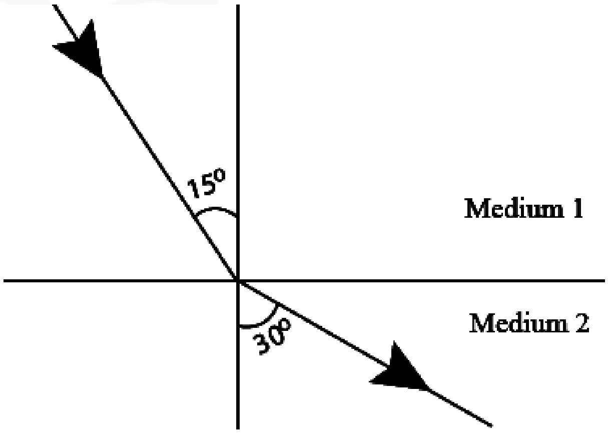
Given:
Refractive index of diamond, $n_1 = 2.42$
Refractive index of carbon dispulphide, $n_2 = 1.63$

Refracitve index of diamond with respect to carbon disulphide will be:

$$n_{12} = \frac{n_1}{n_2}$$

$$n_{12} = \frac{2.42}{1.63} = 1.48$$

8. Choose the optically denser medium from the given figure:



A. Medium 2

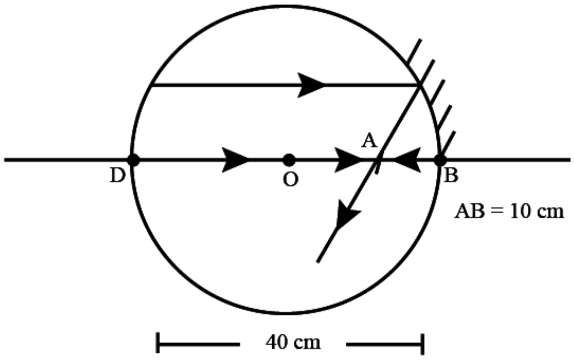
B. Medium 1

C. Both media have the same optical density

D. Cannot be determined

When light travels from a rarer to a denser medium, it bends towards the normal and when light travels from a denser to a rarer medium, it bends away from the normal. In the figure, we can see that the light ray bends away from the normal. Therefore, we can infer that medium 1 is denser.

9. If AB = 10 cm & DB = 40 cm (diameter). What is the radius of curvature and the focal length of the spherical glass respectively?



A. 40 cm, 10 cm

B. 20 cm, 20 cm

C. 40 cm, 5 cm

D. 20 cm, 10 cm

Solution 1:
Focus is at point A since parallel rays after reflection pass through point A.
Since AB is equal to 10 cm, the focal length is equal to 10 cm.
$f = -10\ cm$

Now, focal length is half the radius of curvature. So,
$f = \frac{R}{2}$
$R = 2f = -20\ cm$

Solution 2:
Diameter of the sphere, $d = DB = 40\ cm$
Radius of curvature is half of diameter.
$R = -d/2 = -20\ cm$

Now, focal length (f) is half of the radius of curvature.
$f = \frac{R}{2} = -10\ cm$

10. An object kept at $20\ cm$ from a spherical mirror gives rise to an image $15\ cm$ behind the mirror. The focal length of the mirror is:

A. $-60\ cm$

B. $-30\ cm$

C. $90\ cm$

D. $60\ cm$

Given:
Object Distance, $u = -20\ cm$
Image Distance, $v = +15\ cm$
($\because$ image is formed behind the mirror)

Using Mirror Formula,
$$\frac{1}{u} + \frac{1}{v} = \frac{1}{f}$$
$$\frac{1}{-20} + \frac{1}{15} = \frac{1}{f}$$
$f = +60\ cm$
Since f is positive, mirror used here is convex mirror.

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11. An object is placed at a distance of 10 cm from a concave mirror of radius of curvature 0.6 m. Which of the following statement is incorrect?

    - A. The image is formed at a distance of 15 cm from the mirror.
    - B. The image formed is real.
    - C. The image is at 1.5 times the distance of the object.
    - D. The image formed is virtual and erect.

Given :
Radius of curvature, $R = -0.6\ m = -60\ cm$
Object distance, $u = -10\ cm$

Focla length of the mirror will be:

$$f = \frac{-R}{2}$$
$$f = -30\ cm$$

Using mirror formula,

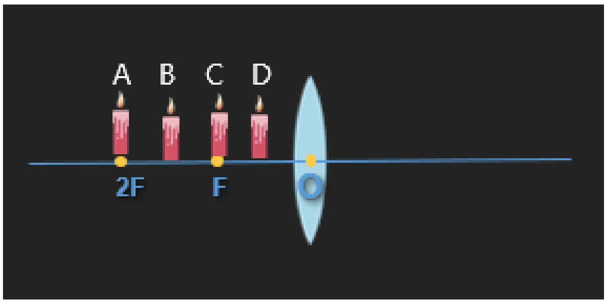
$$\frac{1}{\mathrm{f}} = \frac{1}{\mathrm{v}} + \frac{1}{\mathrm{u}}$$
$$\frac{1}{\text{-30}} = \frac{1}{\mathrm{v}} + \frac{1}{\text{-10}}$$
$$v = 15\ cm$$

$$\frac{v}{u} = \frac{15}{-10} = -1.5$$

Image is formed on the other side of the lens, so it is virtual. Also, a concave mirror forms an erect image when it is virtual.

So, the incorrect statement is that the image is real.

12. Where should the candle be placed so that the convex lens produces positive magnification?



A. A

B. B

C. C

D. D ✔

When the object is placed between focus and optical center, the image formed is virtual, erect and enlarged. So, the candle should be placed at A.

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13. A 3 cm high object is placed at a distance of 80 cm from a concave lens of focal length 20 cm. Find the size of the image formed.

A. 0.1 cm

B. 0.4 cm

C. 0.2 cm

D. 0.6 cm

Given:
Object distance, $u = -80\ cm$
Focal length, $f = -20\ cm$
Object height, $h = +3\ cm$

Using the lens formula,

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

$$\frac{1}{v} - \frac{1}{-80} = \frac{1}{-20}$$

$$v = -16\ cm$$

Using formula for magnification,

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

$$\frac{h'}{+3} = \frac{-16}{-80}$$

$$h' = \frac{h}{5} = \frac{3.0}{5} = 0.6\ cm$$

Height of the image is 0.6 cm. Positive sign shows that the image is erect.

14. The power of a lens is -4 D. Find the focal length and type of the lens?

A. 25 cm, convex lens

B. 25 cm, concave lens

C. 40 cm, concave lens

D. 40 cm, convex lens

Given, Power of the lens $P = \ -4\ D$

We know, $P = \frac{1}{focal\ length}$

So, $focal\ length = \frac{1}{-4} = \ -0.25\ m = -25\ cm.$

Minus sign indicates that it is a concave lens, as the focal length of a concave lens is negative.

Therefore, it is a concave lens of focal length 25 cm.

15. Assertion (A) : Refractive index has no units.
Reason (R) : Refractive index is ratio of two similar quantities.

A. Both A and R are true and R is the correct explanation of A

B. Both A and R are true and R is not the correct explanation of A

C. A is true but R is false

D. A is False but R is true

Absolute refractive index of a medium is given by:

$n = \frac{c}{v}$

where:
c : Speed of light in vacuum
v : Speed of light in medium

Since it is the ratio of same quantity (speed), it is unitless.

So, the assertion and reason, both are correct. Reason explains the assertion.

16. For a light ray passing from air to water, according to Snell's law:
(n represents refractive index of the medium, θ_{air} is the angle of incidence and θ_{water} is the angle of refraction)

A. $n_{air}\sin(\theta_{air}) = n_{water}\sin(\theta_{water})$

B. $n_{air}\sin(\theta_{water}) = n_{water}\sin(\theta_{air})$

C. $n_{air}\sin(\theta_{air}) = n_{water}\sin(\theta_{water}) = 1$

D. $n_{air}\sin(\theta_{water}) = n_{water}\sin(\theta_{air}) = 1$

According to Snell's law, for a light ray travelling from one medium to another, the ratio of sines of angle of incidence to the angle of refraction is a constant. This constant is the refractive index of medium 2 with respect to medium one.

$$\frac{n_{water}}{n_{air}} = \frac{\sin(\theta_{air})}{\sin(\theta_{water}}$$

$$\implies n_{air}\sin(\theta_{air}) = n_{water}\sin(\theta_{water})$$

17. A student focussed the image of a candle flame on a white screen using a lens. He noted down the position of the candle screen and the lens as mentioned below:
Position of candle = 12.0 cm
Position of lens = 50.0 cm
Position of the screen = 88.0 cm

(i) What type of device is used?

A. Convex lens

B. Cconcave lens

C. Plane mirror

D. Glass slab

As the image is formed on a screen, it is real. A real image cannot be formed by a concave lens. Only convex lens can produce real images.

18. A student focussed the image of a candle flame on a white screen using a lens. He noted down the position of the candle screen and the lens as mentioned below:
Position of candle = 12.0 cm
Position of lens = 50.0 cm
Position of the screen = 88.0 cm

(ii) What is the focal length of the lens used?

A. 12 cm

B. 19 cm

C. 22 cm

D. 25 cm

Given:
Position of candle = 12.0 cm
Position of lens = 50.0 cm
Position of the screen = 88.0 cm

Measuring all the distances from the pole, we get:
Object distance, $u = 12 - 50 = -38\ cm$
Image distance, $v = 88 - 50 = +38\ cm$

Using lens formula,
$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$
$$\frac{1}{+38} - \frac{1}{-38} = \frac{1}{f}$$
$$f = +19\ cm$$

Focal length of the lens is positive. So, it should be a convex lens.

19. A student focused the image of a candle flame on a white screen using a lens. He noted down the position of the candle screen and the lens as mentioned below:
Position of candle = 12.0 cm
Position of lens = 50.0 cm
Position of the screen = 88.0 cm

(iii) What is the nature of the image? Is it enlarged?

A. Virtual, Enlarged

B. Real, Enlarged

C. Real, Diminished

D. Real, Same size

Given:
Position of candle = 12.0 cm
Position of lens = 50.0 cm
Position of the screen = 88.0 cm

Measuring all the distances from the pole, we get:
Object distance, $u = 12 - 50 = -38\ cm$
Image distance, $v = 88 - 50 = +38\ cm$

Since the image is formed on the other side of the lens, it is real.

Using formula of magnification,

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

$$m = \frac{+38}{-38} = -1$$

Magnification of -1 suggests that the image is inverted and the same size as that of the object.

20. A student focussed the image of a candle flame on a white screen using a lens. He noted down the position of the candle screen and the lens as mentioned below:
Position of candle = 12.0 cm
Position of lens = 50.0 cm
Position of the screen = 88.0 cm

(iv) Nature of image if he shift the candle between 12 cm and 31 cm?

A. Inverted, Real, Diminished

B. Inverted, Real, Enlarged

C. Erect, Virtual, Diminished

D. Erect, Virtual, Enlarged

When the object is between 12 cm and 31 cm, the object distance is in the range:
$u \in (-19\ cm, 0)$
But, -19 cm is the focal length of the lens. So, the object is placed between the focus and the optic centre. This means that the image formed is enlarged, virtual and erect.