



INDIAN SCHOOL AL WADI AL KABIR

Class: X	Department: SCIENCE 2020-2021 SUBJECT-PHYSICS	Date of submission: 30.08.2020
Worksheet No:4 With answers	Topic: LIGHT -REFLECTION AND REFRACTION-PART 2	Note: A4 FILE FORMAT [PORTFOLIO]
NAME OF THE STUDENT	CLASS & SEC:	ROLL NO.

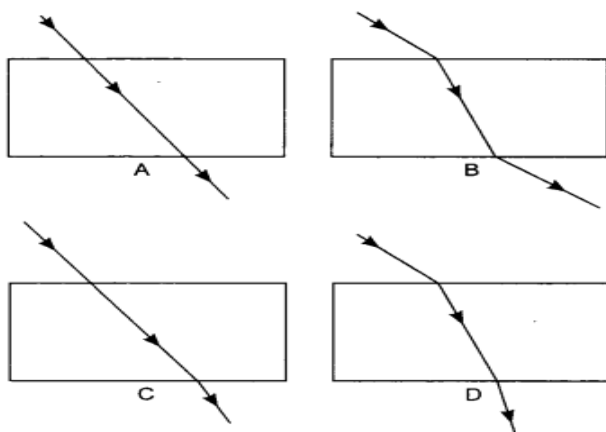
OBJECTIVE TYPE QUESTIONS

- Power of the lens is $-4D$, its focal length is
(a) 4 m (b) $-40m$
(c) -0.25 m (d) -25 m
Ans:- (c)-0.25m
- The SI unit of power of lens is
(a) Metre (b) Centimetre
(c) dioptre (d) m^{-1}
Ans:- (c) dioptre
- The refractive index of transparent medium is greater than one because
(a) Speed of light in vacuum $<$ speed of light in transparent medium
(b) Speed of light in vacuum $>$ speed of light in transparent medium
(c) Speed flight in vacuum = speed of light in transparent medium
(d) Frequency of light wave changes when it moves from rarer to denser medium
Ans:- (b) Speed of light in vacuum $>$ speed of light in transparent medium
- You are given three media A, B and C of refractive index 1.33, 1.65 and 1.46. The medium in which the light will travel fastest is
(a) A
(b) B
(c) C
(d) equal in all three media
Ans:- (a) A
- A divergent lens will produce
(a) always real image
(b) always virtual image

- (c) both real and virtual image
- (d) none of these

Ans:- (b) always virtual image

6. The path of a ray of light coming from air passing through a rectangular glass slab traced by four students are shown as A, B, C and D in figure. Which one of them is correct?



- (a) A
- (b) B
- (c) C
- (d) D

Ans:- (b) B

ASSERTION AND REASONING

DIRECTION: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
- (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
- (c) Assertion (A) is true but reason (R) is false.
- (d) Assertion (A) is false but reason (R) is true.
- (e) Both Assertion and Reason are false.

7. **Assertion :** Higher is the refractive index of a medium or denser the medium, lesser is the velocity of light in that medium.

Reason : Refractive index is inversely proportional to velocity.

Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

8. **Assertion :** Refractive index has no units.

Reason : The refractive index is a ratio of two similar quantities.

Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

9. **Assertion :** The speed of light in glass depends on colour of light.

Reason : The speed of light in glass $v_g = \frac{c}{n_g}$, the refractive index (n_g) of glass is different for different colours.

Ans : (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).

ONE MARK TYPE QUESTIONS

10. The focal length of a concave lens is considered to be _____ .
(positive/negative)

Ans:- negative

11. When is the magnitude of the power of a lens equal to its focal length?

Ans : The magnitude of the power of a lens is equal to its focal length when the focal length is 1 metre.

12. What is the unit of refractive index?

Ans : No unit

13. How does the size of the image change as the object is brought closer from infinity towards the convex lens?

Ans : As the object is brought closer from infinity towards the convex lens, the size of image increases. When the object is at infinity, point-sized image is formed, while object at focus gives highly enlarged image.

TWO MARKS TYPE QUESTIONS

14. Find the power of a convex lens which forms a real and inverted image of magnification **-1** of an object placed at a distance of **20 cm** from its optical centre.

Ans: A convex lens forms an image of magnification -1 when the object is placed at 2F, . For focal length, f, we have,

$$2f=20\text{cm}$$

$$f=10\text{cm}=0.1\text{m}$$

$$\text{Power of lens, } P=1/f=1/0.1=10 \text{ D}$$

15. What is the velocity of light in a glass slab of refractive index 1.5?

Ans:-

$$\text{we know that refractive index } n = \frac{\text{speed of light in vacuum}}{\text{speed of light in medium}}$$

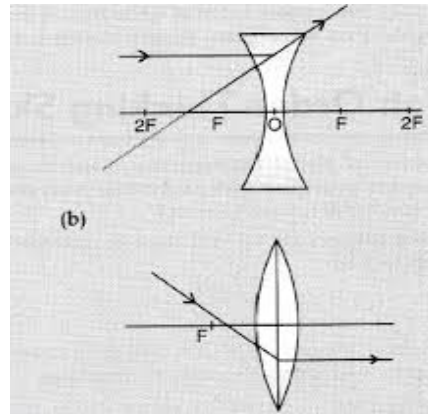
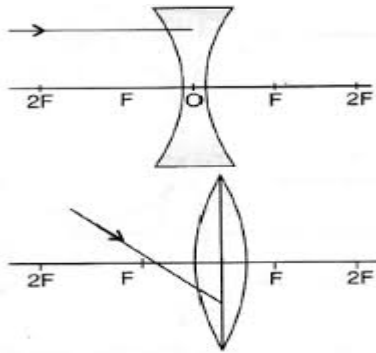
$$\text{where } c = 3 \times 10^8 \text{ m/s}$$

$$1.5 = \frac{c}{v}$$

$$v = \frac{3 \times 10^8}{1.5}$$

$$v = 2 \times 10^8 \text{ m/s}$$

16. Redraw the ray diagram given below in your answer book and complete the path of ray.



Ans:-

THREE MARKS TYPE QUESTIONS

17. One student uses a lens of focal length **+50 cm** and another **-50 cm**. State the nature and find the power of each lens. Which of the two lenses will always give a virtual and diminished image irrespective of the position of the object?

Ans:- *The first lens of focal length $f = +50$ cm, is a **convex** lens.*

*The second lens of focal length $f = -50$ cm is a **concave** lens.*

Power of the convex lens,	Power of the concave lens,
$P_1 = \frac{1}{f_1}$	$P_2 = \frac{1}{f_2}$
$= \frac{1}{+0.5 \text{ m}}$	$= \frac{1}{-0.5 \text{ m}}$
$= +2 \text{ D}$	$= -2 \text{ D}$

*The **concave** lens always gives a virtual and diminished image irrespective of the object's position.*

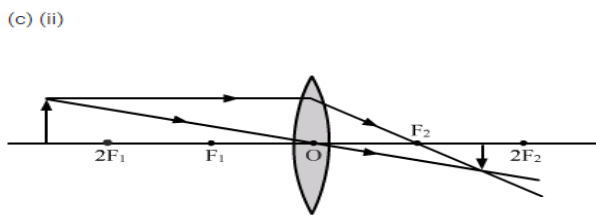
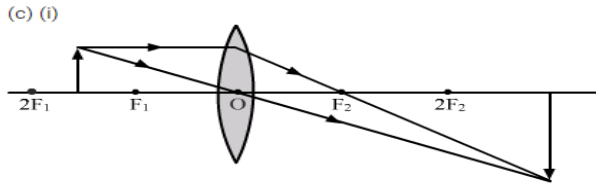
18. A student wants to project the image of a candle flame on the walls of school laboratory by using a lens:

- Which type of lens should he use and why?
- At what distance in terms of focal length 'F' of the lens should he place the candle flame so as to get (i) a magnified, and (ii) a diminished image respectively on the wall?
- Draw ray diagram to show the formation of the image in each case?

Ans:- a) The student should use a convex lens because with the help of convex lens, he would be able to project image on the walls because convex lens will form a real image.

b) (i) In order to form a magnified image on the wall, the candle flame should be placed between F and $2F$ from the lens.

(ii) In order to form a diminished image on the wall, the candle flame should be placed at a distance greater than $2F$ from the lens.

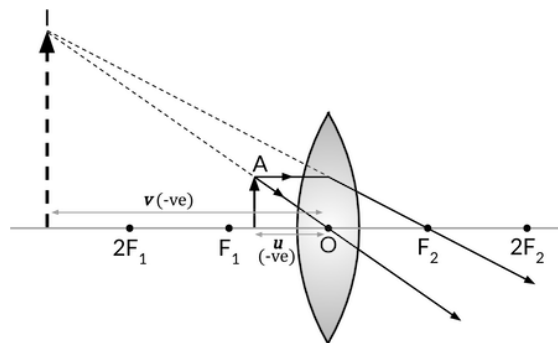


FIVE MARKS TYPE QUESTIONS

19. Draw a ray diagram to show the formation of image by a convex lens when an object is placed in front of the lens between its optical centre and principal focus.)

In the above ray diagram, mark the object distance (u) and the image distance (v) with their proper signs (+ve or -ve as per the new Cartesian sign convention) and state how these distances are related to the focal length (f) of the convex lens in this case].

Ans:-



The object distance (u) and the image distance (v) are both negative.

These are related to the focal length of the lens, f , by the lens formula,

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

20. State the law of refraction of light that defines the refractive index of a medium with respect to the other. Express it mathematically. How is the refractive index of any medium 'A' with respect to a medium 'B' related to the speed of propagation of light in

two media *A* and *B*? State the name of this constant when one medium is vacuum or air.

The refractive indices of glass and water with respect to vacuum are $\frac{3}{2}$ and $\frac{4}{3}$ respectively. If the speed of light in glass is 2×10^8 , find the speed of light in (i) vacuum, (ii) water.

Ans:-The second law of refraction is also known as Snell's law of refraction and it states that the ratio of sine of the angle of incidence to the sine of refraction is constant for a given pair of media. It establishes a relation between angle of incidence and angle of refraction.

It can be expressed mathematically as follows :

$$\frac{\sin i}{\sin r} = n$$

n is constant and is known as refractive index.

The refractive index of any medium 'A' with respect to a medium 'B' related to the speed of propagation of light in two media A and B can be written as follows:

$${}^B n_A = \frac{v_B}{v_A}$$

Let, absolute refractive index of glass, $n_g = \frac{3}{2}$.

Absolute refractive index of water, $n_w = \frac{4}{3}$

Speed of light in glass, $v_g = 2 \times 10^8 \text{ m/s}$

(i) Speed of light in vacuum, $n_g = \frac{c}{v_g}$

$$c = n_g \times v_g = \frac{3}{2} \times 2 \times 10^8 = 3 \times 10^8 \text{ m/s.}$$

(ii) Speed of light in water, $n_w = \frac{c}{v_w}$

$$v_w = \frac{c}{n_w} = \frac{3 \times 10^8}{\left(\frac{4}{3}\right)} = 2.25 \times 10^8 \text{ m/s.}$$

PREVIOUS YEAR BOARD QUESTIONS

21. Analyse the following observation table showing a variation of image-distance (*v*) with object-distance (*u*) in case of a convex lens and answer the questions that follow without doing any calculations: CBSE 2016

S. No.	Object distance u (cm)	Image distance v (cm)
1	-90	+18
2	-60	+20
3	-30	+30
4	-20	+60
5	-18	90
6	-10	100

(a) What is the focal length of the convex lens ? Give a reason to justify your answer.

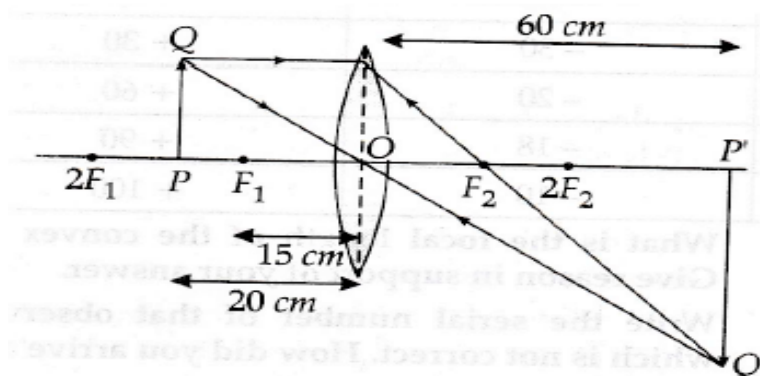
(b) Write the serial number of the observation which is not correct. On what basis have you arrived at this conclusion ?

(c) Select an appropriate scale and draw a ray diagram for the observation at S.No.4. Also, find the approximate value of magnification.

(a) From S. No- 3, we can say that the radius of curvature of the lens is 30 cm because when an object is placed at the centre of curvature of a convex lens, its image is formed on the other side of the lens at the same distance from the lens. And, we know that focal length is half of the radius of curvature. Thus, the focal length of the lens is +15 cm.

(b) S. No- 6 is not correct as the object distance is between focus and pole so for such lenses the image formed. is always virtual but in this case, a real image is forming as the image distance is positive.

(c) Approximate value magnification for distance object - 20 cm and image distance +60 cm is 3.

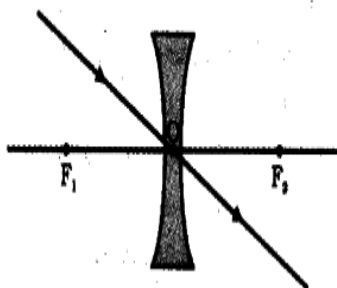


22. Draw a ray diagram to show the path of the refracted ray in each of the following cases. A ray of light incident on a concave lens is : CBSE 2014

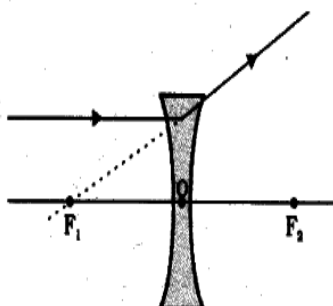
- (i) passing through its optical centre.
- (ii) parallel to its principal axis.
- (iii) directed towards its principal focus.

Ans:-

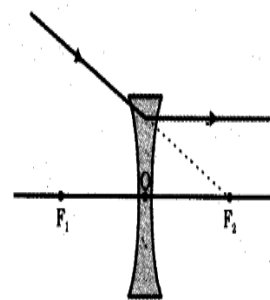
(i) Passing through its optical centre.



(ii) parallel to its principal axis.



(iii) Directed towards its principal focus.



EXEMPLAR QUESTIONS

23. A doctor has prescribed a corrective lens of power +1.5 D. Find the focal length of the lens. Is the prescribed lens diverging or converging ?

Ans:-

$$P = -1.5 \text{ D}$$

$$P = 1/f$$

$$f = 1/P = 1/(-0.5) = -0.66 \text{ m} = -66.6 \text{ cm}$$

Since focal length is negative, it is a diverging lens.

24. 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

Ans:-

A concave lens always forms a virtual, erect image on the same side of the object.

Image-distance $v = -10 \text{ cm}$;

Focal length $f = -15 \text{ cm}$;

Object-distance $u = ?$

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

$$\text{or, } \frac{1}{u} = \frac{1}{v} - \frac{1}{f}$$

$$\frac{1}{u} = \frac{1}{-10} - \frac{1}{(-15)} = -\frac{1}{10} + \frac{1}{15}$$

$$\frac{1}{u} = \frac{-3+2}{30} = \frac{-1}{30}$$

$$\text{or, } u = -30 \text{ cm}$$

Thus, the object-distance is 30 cm.

Magnification $m = v/u$

$$m = \frac{-10 \text{ cm}}{-30 \text{ cm}} = \frac{1}{3} = +0.33$$

The positive sign shows that the image is erect and virtual. The image is one-third of the size of the object.

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