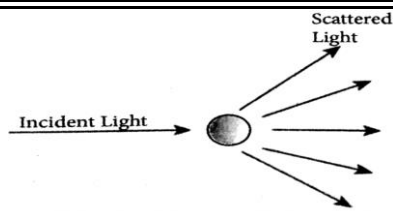


# UNIT - 2

# OPTICS



## I. Choose the correct answer

- The refractive index of four substances A, B, C and D are 1.31, 1.43, 1.33, 2.4 respectively. The speed of light is maximum in  
 a) A                      b) B                      c) C                      d) D
- Where should an object be placed so that a real and inverted image of same size is obtained by a convex lens [MAY - 2022]  
 a) f                      b) 2f                      c) infinity                      d) between f and 2f
- A small bulb is placed at the principal focus of a convex lens. When the bulb is switched on, the lens will produce [PTA - 3]  
 a) a convergent beam of light                      b) a divergent beam of light  
 c) a parallel beam of light                      d) a coloured beam of light
- Magnification of a convex lens is  
 a) positive                      b) negative                      c) either positive or negative                      d) zero
- A convex lens forms a real, diminished point sized image at focus. Then the position of the object is at  
 a) focus                      b) infinity                      c) at 2f                      d) between f and 2f
- Power of a lens is  $-4D$ , then its focal length is  
 a) 4m                      b)  $-40m$                       c)  $-0.25 m$                       d)  $-2.5 m$
- In a myopic eye, the image of the object is formed  
 a) behind the retina    b) on the retina                      c) in front of the retina    d) on the blind spot
- The eye defect 'presbyopia' can be corrected by [PTA - 2, SEP - 2020]  
 a) convex lens                      b) concave lens                      c) convex mirror                      d) Bifocal lenses
- Which of the following lens would you prefer to use while reading small letters found in a dictionary?  
 a) A convex lens of focal length 5 cm                      b) A concave lens of focal length 5 cm  
 c) A convex lens of focal length 10 cm                      d) A concave lens of focal length 10 cm
- If  $V_B$ ,  $V_G$ ,  $V_R$  be the velocity of blue, green and red light respectively in a glass prism, then which of the following statement gives the correct relation?  
 a)  $V_B = V_G = V_R$                       b)  $V_B > V_G > V_R$                       c)  $V_B < V_G < V_R$                       d)  $V_B < V_G > V_R$

## II. Fill in the blanks

- The path of the light is called as ray of light.
- The refractive index of a transparent medium is always greater than one.
- If the energy of incident beam and the scattered beam are same, then the scattering of light is called as elastic scattering.
- According to Rayleigh's scattering law, the amount of scattering of light is inversely proportional to the fourth power of its wavelength.
- Amount of light entering into the eye is controlled by iris.

### III. True or False. If false correct it.

- Velocity of light is greater in denser medium than in rarer medium. [False]  
\*Velocity of light is **lesser** in denser medium than in rarer medium.
- The power of lens depends on the focal length of the lens. [True]
- Increase in the converging power of eye lens cause 'Hypermetropia'. [False]  
\*Increase in the converging power of eye lens cause '**myopia**'.
- The convex lens always gives small virtual image. [False]  
\*The **concave** lens always gives small virtual image.

### IV. Match the following.

Column - I	Column - II	Answer
1. Retina	a) Path way of light	1- d) Screen of the eye
2. Pupil	b) Far point comes closer	2- a) Path way of light
3. Ciliary muscles	c) Near point moves away	3- f) Power of accommodation
4. Myopia	d) Screen of the eye	4- b) Far point comes closer
5. Hypermetropia	f) Power of accommodation	5- c) near point moves away

### V. Assertion & Reasoning type

Mark the correct choice as

- If both the assertion and the reason are true and the reason is the correct explanation of assertion.
- If both the assertion and the reason are true, but the reason is not the correct explanation of the assertion.
- Assertion is true, but the reason is false.
- Assertion is false, but the reason is true.

- Assertion :** If the refractive index of the medium is high (denser medium) the velocity of the light in that medium will be small.

**Reason :** Refractive index of the medium is inversely proportional to the velocity of the light.

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

- Assertion :** Myopia is due to the increase in the converging power of eye lens.

**Reason :** Myopia can be corrected with the help of concave lens.

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

### VI. Answer briefly

- What is refractive index?

The ratio of speed of light in vacuum to the speed of light in a medium is refractive index.

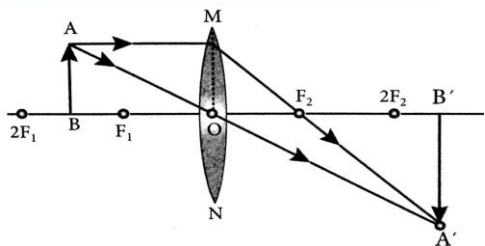
$$\mu = \frac{c}{v}$$

- State Snell's law (or) State Second law of refraction.

The ratio of the sine of the angle of incidence and sine of the angle of refraction is equal to the ratio of refractive indices of the two media. [AUG - 2022]

$$\frac{\sin i}{\sin r} = \frac{\mu_2}{\mu_1}$$

3. Draw a ray diagram to show the image formed by a convex lens when the object is placed between F and 2F. [MDL – 19]



4. Define dispersion of light.

Refraction of white light or composite light into its component colours when passed through any transparent media is called dispersion of light.

5. State Rayleigh's law of scattering. [PTA-3]

The amount of scattering of light is inversely proportional to the fourth power of its wavelength.

$$S \propto \frac{1}{\lambda^4}$$

6. Differentiate convex lens and concave lens.

[PTA-3]

Convex lens	Concave lens
1. Thicker in the middle.	1. Thinner in the middle.
2. Converging lens.	2. Diverging lens.
3. Produces real images mostly.	3. Produces only virtual images.
4. Used to treat Hypermetropia.	4. Used to treat myopia.

7. What is power of accommodation of eye?

It is the ability of the eye lens to focus nearby as well as the distant objects by changing the focal length of eye lens with the help of ciliary muscles.

8. What are the causes of 'Myopia'?

[MDL – 19]

- ❖ It occurs due to the lengthening of eye ball.
- ❖ The focal length of eye lens is reduced or the distance between eye lens and retina increases.
- ❖ The image of distant objects are formed before retina.

9. Why does the sky appear in blue colour?

[PTA – 1]

By Rayleigh's law of scattering blue colour of sunlight scatters the most by the atmosphere. Thus, the sky appears blue in colour.

10. Why are traffic signals red in colour?

[PTA – 4]

Red light has longest wavelength and scatters less. Thus it travels longer and hence it is used in traffic signals to stop the vehicle.

## VII. Give the answer in detail.

1. List any five properties of light. (Write any five points)

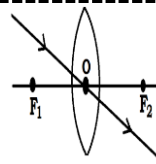
[MAY - 2022]

- ❖ Light is a form of energy.
- ❖ Light always travels along a straight line.
- ❖ Light does not need any medium for its propagation. It can even travel through vacuum.
- ❖ The speed of light in air (or) vacuum is  $c = 3 \times 10^8 \text{ ms}^{-1}$
- ❖ Different coloured light has different wavelength and frequency.

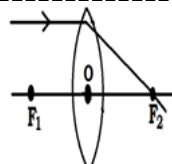
## 2. Explain the rules for obtaining images formed by a convex lens with the help of ray diagram.

**Rule - 1**

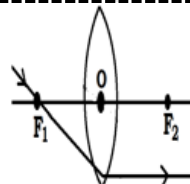
When a ray of light strikes the convex lens obliquely at its **optical centre**, it continues to follow its path **without any deviation**.

**Rule - 2**

When rays **parallel to the principal axis** strike a convex lens, the refracted rays are **converged to the principal focus**.

**Rule - 3**

When a ray **passing through the principal focus** strikes a convex lens, the refracted ray will be **parallel to the principal axis**.



## 3. Differentiate the eye defects: Myopia and Hypermetropia. [AUG - 22, SEP - 21, PTA - 6]

Myopia (short sightedness)	Hypermetropia (long sightedness)
1. Nearby objects can be seen clearly.	1. Nearby objects cannot be seen clearly.
2. Distant objects cannot be seen clearly.	2. Distant objects can be seen clearly.
3. Due to lengthening of eye ball	3. Due to shortening of eye ball.
4. Far point comes closer.	4. Near point moves farther.
5. Image is formed before retina.	5. Image is formed behind retina.
6. Corrected using concave lens.	6. Corrected using convex lens.

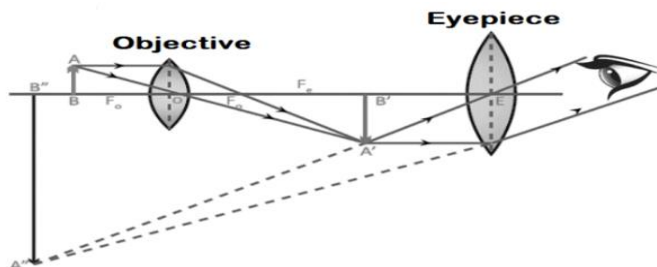
## 4. Explain the construction and working of a 'Compound Microscope'.

**Construction :**

- ❖ It consists of two convex lenses.
- ❖ Objective lens: have shorter focal length, placed near object.
- ❖ Eye lens: have larger focal length and larger aperture, placed near the observer's eye.
- ❖ Both lenses are fixed in a narrow tube with adjustable provision.

**Working :**

- ❖ Object AB is placed beyond the focal length of objective lens ( $u > F_o$ )
- ❖ A real, inverted and magnified image A'B' is formed at the other side of objective lens.
- ❖ A'B' acts as the object for eye lens.
- ❖ Eye lens is adjusted, so that A'B' falls within its principal focus.
- ❖ Virtual, enlarged and erect image A''B'' is formed on the same side of object.



### VIII. Numerical Problems

1. An object is placed at a distance 20 cm from a convex lens of focal length 10 cm. Find the image distance and nature of the image.

Given :  $f = 10$  cm,  $u = -20$  cm,  $v = ?$

$$\begin{aligned} \text{Solution : } \frac{1}{f} &= \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{10} + \frac{1}{-20} \\ &= \frac{2-1}{20} = \frac{1}{20} \\ v &= 20 \text{ cm} \end{aligned}$$

Image distance is 20 cm.

Nature of image is Real and inverted image.

#### \*Sign convention rules\*

**f** → +ve for convex

-ve for concave

**u** → -ve always

**v** → +ve if image is on right

-ve if image is on left

2. An object of height 3 cm is placed at 10 cm from a concave lens of focal length 15 cm. Find the size of the image.

Given :  $f = -15$  cm,  $u = -10$  cm,  $h = 3$  cm,  $h' = ?$

$$\begin{aligned} \text{Solution : } \frac{1}{f} &= \frac{1}{v} - \frac{1}{u} \Rightarrow \frac{1}{v} = \frac{1}{f} + \frac{1}{u} = \frac{1}{-15} + \frac{1}{-10} = \frac{-2-3}{30} \\ \frac{1}{v} &= -\frac{5}{30} = -\frac{1}{6} \\ v &= -6 \text{ cm} \end{aligned}$$

$$\text{Magnification } m = \frac{v}{u} = \frac{-6}{-10} = 0.6$$

$$\text{Magnification } m = \frac{h'}{h} = \frac{h'}{3} = 0.6$$

$$h' = 0.6 \times 3 = 1.8 \text{ cm}$$

∴ Height of the image  $h'$  is 1.8 cm.

### IX. Higher order thinking (HOT) questions

- While doing an experiment for the determination of focal length of a convex lens, Raja suddenly dropped the lens. It got broken into two halves along the axis. If he continues his experiment with the same lens, (a) can he get the image? (b) Is there any change in the focal length?
  - Yes. He got the image. But, with less intensity.
  - No. There is no change in the focal length, because it is cut along the axis.
- The eyes of the nocturnal birds like owl are having a large cornea and a large pupil. How does it help them? (or) How owls could see at night?
  - ❖ Nocturnal birds are the birds that are active at night. *Ex : Owl*
  - ❖ Large cornea and large pupil, increases the amount of light entering into its eyes.
  - ❖ Thus, it helps them to see clearly in dim light.