PETIT SEMINAIRE HIGHER SECONDARY SCHOOL – PUDUCHERRY

UNIT – 2 OPTICS

STD: X SELF – EVALUATION

I. Choose the best answer:

1. 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
2. Where should an object be placed so that a real and inverted image of same size is obtained by a convex lens - (B) 2f
3. A small bulb is placed at the principal focus of a convex lens. When the bulb is switched on, the lens will produce - (C)a parallel beam of light
4. Magnification of a convex lens is - (C) either positive or negative
5. A convex lens forms a real, diminished point size image at focus. Then the position of the object is at - (B)infinity
6. Power of a lens is – 4D, then its focal length is - (C) -0.25 m
7. In a myopic eye, the image of the object is formed - (C) in front of the retina
8. The eye defect 'presbyopia' can be corrected by - (D) bifocal lenses
9. 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
10. If VB, VG, VR be the velocity of blue, green and red light respectively in a glass prism, then which of the following statement gives the correct relation? - (C) $V_B < V_G < V_R$

II. Fill in the blanks:

1. The path of the light is called as Ray of the light
2. The refractive index of a transparent medium is always greater than One
3. If the energy of incident beam and the scattered beam are same, then the scattering of light is called as Elastic scattering.
4. According to Rayleigh's scattering law, the amount of scattering of light is inversely proportional to the fourth power of its Wavelength
5. Amount of light entering into the eye is controlled by Iris

III. True or False (If false give the correct statement):

1. Velocity of light is greater in denser medium than in rarer medium.- False

Correct statement: Velocity of light is greater in rarer medium than in denser medium.

2. The power of lens depends on the focal length of the lens - **True**
3. Increase in the converging power of eye lens cause 'hypermetropia' – **True**
4. The convex lens always gives small virtual image - **False**

Correct statement: Only concave lens always gives small virtual image.

IV. Match the following:

S.No	Column 1	Column 2
1	Retina	Screen of the eye
2	Pupil	Path way of light
3	Ciliary muscles	Power of accommodation
4	Myopia	Far point comes closer
5	Hypermetropia	Near point moves away

V. Assertion & Reasoning:

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

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

   (a)If both the assertion and reason are true and the reason is the correct explanation of assertion

2. **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.

   (a)If both the assertion and reason are true and the reason is the correct explanation of assertion.

VI. Answer briefly:

1. What is refractive index?

   The ratio of sine of the angle of incidence to the sine of the angle of refraction. It can also be defined as the ratio of the speed of light in air to the speed of light in medium. It has no unit.

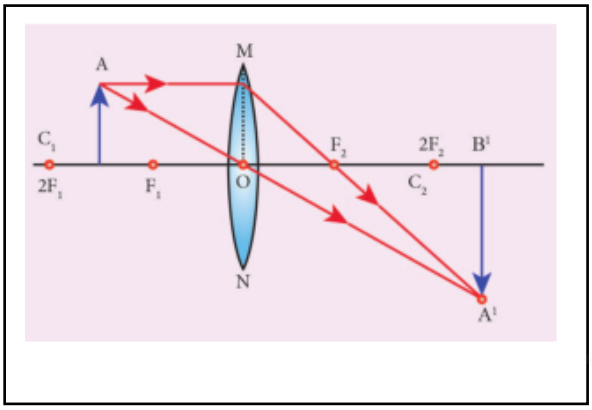
2. State Snell's law?

   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. This law is also known as Snell's law.

$$\frac{\text{Sin i}}{\text{Sin r}} = \frac{\mu_2}{\mu_1}$$

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



4. Define dispersion of light?

When a beam of white light or composite lights refracted through any transparent media such as glass or water, it is spilt into its component colours. This phenomenon is called as dispersion of light.

5. State Rayleigh's law of scattering?

It states that "the amount of scattering of light is inversely proportional to the fourth power of its wavelength"

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

6. Differentiate convex lens and concave lens?

S. No	Convex Lens	Concave Lens
1	A convex lens is thicker in the middle than at edges.	A concave lens is thinner in the middle than at edges.
2	It is a converging lens.	It is a diverging lens.
3	It produces mostly real images.	It produces virtual images.
4	It is used to treat hypermeteropia.	It is used to treat myopia.

7. What is power of accommodation of eye?

The ability of the eye lens to focus nearby as well as the distant

objects on the retina of the eye is called power of accommodation of the eye.

8. What are the causes of 'Myopia'?

   Myopia is caused due to,

   (i) Lengthening of eye ball.

   (ii) The focal length of the eye lens is reduced. i.e., excessive curvature of the eye lens. The eye lens becomes more convergent.

9. Why does the sky appear in blue colour?

   When sunlight passes through the atmosphere, the blue colour (shorter wavelength) is scattered to a greater extent than the red colour (longer wavelength). This scattering causes the sky to appear in blue colour.

10. Why are traffic signals red in colour?

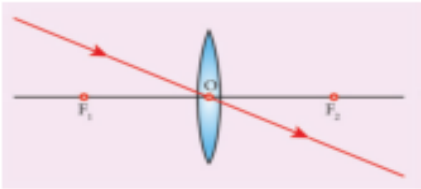
    Red colour has longest wavelength and scattered by a least amount and travels longer distance in atmosphere. So it is used in traffic signals.

VII. Give the answer in detail:

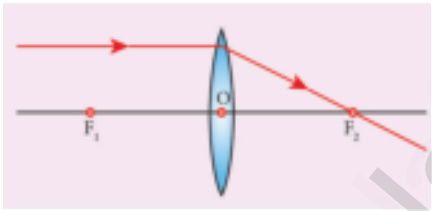
1. List any five properties of light?
   - Light is a form of energy
   - Light always travels along a straight line
   - Light does not need any medium for its propagation. It can even travel through vacuum.
   - The speed of the light in vacuum or air is, $c = 3 \times 10^8$ ms^{-1}.
   - Different coloured light has different wavelength and frequency.
   - Among the visible light, violet light has the lowest wavelength and red light has the highest wavelength.
   - When the light is incident on the interface between two media, it is partly reflected and partly refracted.
   - Since, light is in the form of waves, it is characterized by a wavelength (λ) and a frequency (v), which are related by the following equation: $c = v \lambda$ (c – velocity of light).
2. Explain the rules for obtaining images formed by a convex lens with the

help of ray diagram?

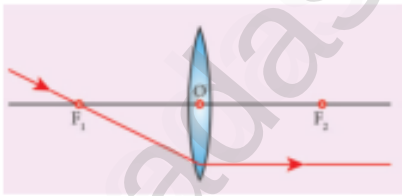
Rule 1: When a ray of light strikes the convex lens obliquely at its optical centre, it continues to follow its path without any deviation.



Rule 2: When a ray parallel to the principal axis strikes a convex lens, the refracted rays are converged to (convex lens) the principal focus.



Rule 3: When a ray passing through (convex lens) 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?

S.No	Myopia	Hypermetropia
1	It is also known as short sightedness occurs due to the lengthening of eye ball	It is also known as long sightedness, occurs due to the shortening of eye ball
2	With this defect, nearby objects can be seen clearly but distant objects cannot be seen clearly.	With this defect, distant objects can be seen clearly, but nearby objects cannot be seen clearly.
3	The focal length of eye lens is reduced or the distance between eye lens and retina increases.	The focal length of eye lens is increased or the distance between eye lens and retina decreases.

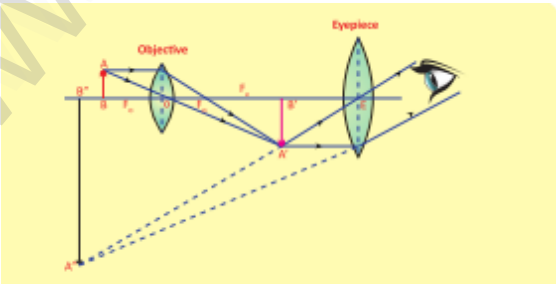
4	The far point will not be infinity for such eyes and the far point has come closer.	The near point will not be at 25 cm for such eyes and the near point has moved farther.
5	Due to this, the images of distant objects are formed before the retina.	Due to this, the image of nearby objects are formed behind the retina
6	This defect can be corrected by using a concave lens	This defect can be corrected by using a convex lens.
7	A suitable focal length of the concave lens to be used to correct this defect.	A suitable focal length of the convex lens to be used to correct this defect.

4. Explain the construction and working of a Compound Microscope?

It is used to see the tiny objects. It has higher magnification power than simple microscope.

Construction:

- A compound microscope consists of two convex lenses.
- The lens with the shorter focal length is placed near the object and is called as objective lens or objective piece.
- The lens with the larger focal length and larger aperture placed near the observer's eye is called eye lens or eye piece. Both the lenses are fixed in a narrow tube with adjustable provision.



Working:

- The object (AB) is placed at a distance slightly greater than the focal length of objective lens ($u > f_o$). A real, inverted and magnified image (A'B') is formed at the other side of the object lens.
- This image behaves as the object for the eye lens. The position of

the eye lens is adjusted in such a way, that the image (A'B') falls within the principal focus of the eye piece. This eye piece forms a virtual, enlarged and erect image (A''B'') on the same side of the object.

- Compound microscope has 50 to 200 times more magnification power than the simple microscope.

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: Convex lens, f = 10 cm; u = - 20 cm; v = ?

   Lens Formula: $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

   $$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} \qquad = \frac{1}{10} + \frac{1}{-20} = \frac{2-1}{20} = \frac{1}{20}$$

   V = 20 cm.

   Nature of the image: Real and inverted image.

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: Concave lens, f = - 15 cm; u = - 10 cm; v = ?

   h = 3 cm (Height of the object); h_1 = ? (Height of the image).

   Lens Formula: $\frac{1}{f} = \frac{1}{v} - \frac{1}{u}$

   $$\frac{1}{v} = \frac{1}{f} + \frac{1}{u} \qquad = \frac{1}{-15} + \frac{1}{-10} = \frac{-25}{150} = \frac{-1}{6}$$

   V = - 6 cm.

   Magnification: $m = \frac{h_1}{h} = \frac{v}{u}$

   $$\frac{h_1}{3} = \frac{-6}{-10}$$

   $h_1 = 0.6 \times 3 = 1.8$ cm

   Height (size) of the image h_1 = 1.8 cm.

IX. HOT Questions:

1. 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?

(a) Yes, he can get the image

(b) Yes, The focal length becomes double. (The focal length of the plano – convex is double the focal length of the convex lens).

2. The eyes of the nocturnal birds like owl are having a large cornea and a large pupil. How does it help them?

These features increase the field of vision and an increase retinal surface and help them to collect more ambient light during night.