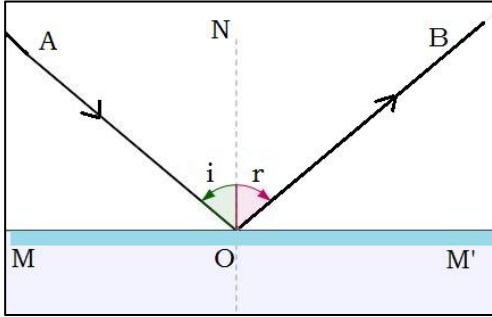
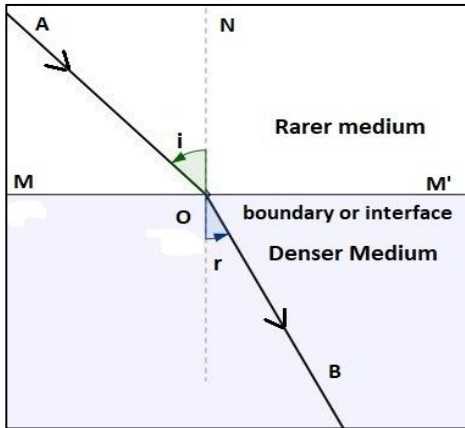
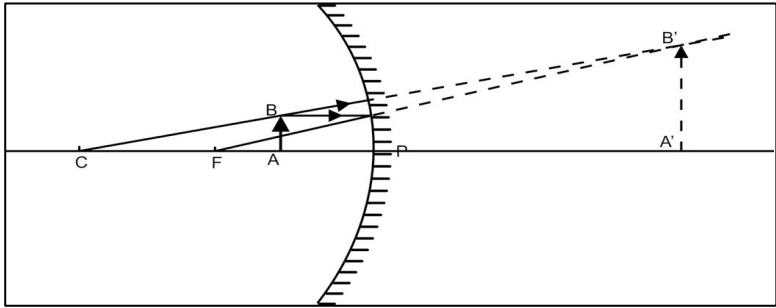
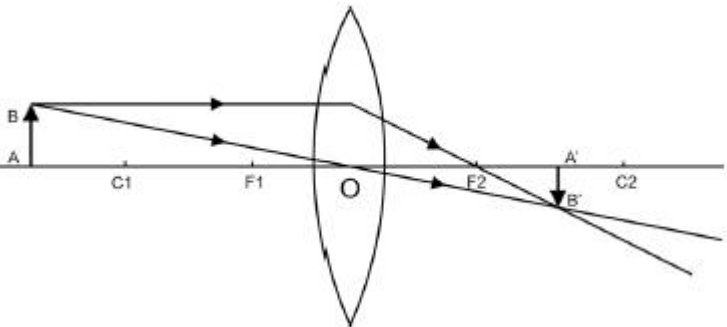


UNIT- 2 (OPTICS)

2 MARKS QUESTIONS WITH SOLUTIONS

Ques No.	Question/ Answer	Taxonomy Level	Marking Scheme
Q. 1	State Laws of Reflection.	Remembering	
Ans	<p>Laws of Reflection :</p> <p>1st law:The incident ray, the reflected ray and the normal to the surface at the point of incidence all lie in the same plane and that plane is perpendicular to the reflecting surface.</p> <p>2nd law: The angle of incidence is equal to the angle of reflection.</p> 		1 1
Q. 2	State Laws of Refraction.	Remembering	
Ans	<p>Laws of Refraction:</p> <p>1st law: The incident ray, the refracted ray and the normal to the interface at the point of incidence all lie in the same plane.</p> <p>2nd law: The ratio of the sine of the angle of incidence to the sine of the angle of refraction is a constant.</p> $\frac{\sin i}{\sin r} = \text{constant}$ <p>This is also known as Snell's law.</p> 		1 1
Q. 3	Define Refractive Index. Write the SI unit and dimension of Refractive Index.	Remembering	
Ans	<p>The refractive index of a medium is defined as the ratio of the speed of light in vacuum to the speed of light in the medium.</p> $\mu = \frac{c}{v}$ <p>Where μ = Refractive index of the medium c = speed of light in vacuum v = speed of light in the medium</p> <p>Refractive index is a unit-less and dimensionless quantity.</p>		1 1

Q. 4	Give two examples each for reflection and refraction in daily life.	Remembering	
Ans	<p>Uses of Reflection in Daily Life:</p> <ol style="list-style-type: none"> Mirrors: When light strikes a mirror, it reflects off the surface and forms an image. Reflective Road Signs: Road signs are often made with reflective materials that bounce light back toward drivers, making them visible at night. <p>Uses of Refraction in Daily Life:</p> <ol style="list-style-type: none"> Eyeglasses and Contact Lenses: Refraction helps correct vision by bending light to focus it properly on the retina. Lenses in Cameras and Binoculars: Refraction is used to focus light and magnify images in cameras, binoculars. 		<p>1</p> <p>1</p>
Q. 5	Draw the ray diagram of an object placed between Focus and Pole of a Concave mirror and explain the image formed.	Understanding	
Ans	 <p>When object is placed between Focus and Pole of a concave mirror, Image is</p> <ul style="list-style-type: none"> • Formed behind the mirror • Virtual • Erect • Magnified 		<p>1</p> <p>1</p>
Q. 6	Draw the ray diagram of an object placed beyond center of curvature (C1) of a convex lens and explain the image formed.	Remembering	
Ans	 <p>When object is placed beyond center of curvature (C1) of a convex lens, Image is</p> <ul style="list-style-type: none"> • Formed between another Focus (F2) and center of curvature (C2) • Real • Inverted • Diminished 		<p>1</p> <p>1</p>
Q. 7	Define Power of Lens and write its unit.	Remembering	

Ans	<p>The power of a lens is defined as the ability of the lens to converge or diverge light. Mathematically, it is defined as the reciprocal of focal length of lens.</p> $\text{Power of lens} = \frac{1}{f}$ <p>Where f is the focal length of the lens measured in meter. The unit of power is diopter.</p>		1 1
Q. 8	Define Critical angle.	Remembering	
Ans	Critical angle is defined as the angle of incidence in optically denser medium for which angle of refraction in the optically rarer medium is 90° .		2
Q. 9	Define Total Internal Reflection.	Remembering	
Ans	Total internal reflection is the phenomenon by virtue of which a ray of light traveling from a optically denser medium to a rarer medium is sent back to the same medium, when the ray is incident at an angle more than the critical angle for that medium.		2
Q. 10	Give two examples of applications of Total internal Reflection of light in daily life.	Applying	
	1. Optical fibres use total internal reflection to transmit light signals over long distances. 2. Diamonds dazzle so brightly because of total internal reflection.		1 1
Q.11	Refractive Index of water with respect to air is $\frac{4}{3}$ and Refractive Index of glass with respect to air is $\frac{3}{2}$. Find the refractive index of glass with respect to water?	Understanding	
Ans	<p>We know that</p> ${}^1\mu_2 = \frac{\mu_2}{\mu_1}$ <p>Then ${}^w\mu_g = \frac{\mu_g}{\mu_w} = \frac{3}{2} \div \frac{4}{3} = \frac{3}{2} \times \frac{3}{4} = \frac{9}{8}$</p>		2
Q. 12	Find the critical angle when a ray of light passes from glass medium to air medium? Given refractive index of glass is 1.5 ($\mu_{\text{glass}} = 1.5$)	Applying	
Ans	<p>We know that</p> $\sin(i_c) = \frac{1}{\mu_{\text{glass}}}$ <p>Given refractive index of glass medium = 1.5, Then</p> $\sin(i_c) = \frac{1}{\mu_{\text{glass}}} = \frac{1}{1.5} \approx 0.667$ $\Rightarrow i_c = \sin^{-1}(0.667) \approx 42^\circ$		2
Q.13	Calculate the magnifying power of a simple microscope of 0.05 m focal length. Distance of distinct vision is 0.25 m.	Applying	
Ans	<p>Given that Focal length of a simple microscope $f = 0.05$ m</p>		

	<p>Distance of distinct vision $D = 0.25 \text{ m}$</p> <p>Then the magnifying power $M = 1 + \frac{D}{f}$</p> $\Rightarrow M = 1 + \frac{0.25}{0.05} = 1 + 5 = 6$ <p>The magnifying power of the simple microscope is 6.</p>		2
Q. 14	An astronomical telescope set for normal adjustment has a magnifying power 10. If the focal length of the objective is 1 m. Find the focal length of eye-piece?	Applying	
Ans	<p>Given that</p> <p>Magnifying power of the telescope, $M = 10 \text{ m}$</p> <p>Focal length of the objective lens, $f_{\text{objective}} = 1 \text{ m}$</p> <p>The magnifying power of an astronomical telescope is</p> $M = \frac{f_{\text{objective}}}{f_{\text{eyepiece}}}$ $\Rightarrow f_{\text{eyepiece}} = \frac{f_{\text{objective}}}{M} = \frac{1}{10} = 0.1 \text{ m}$ <p>The focal length of eye-piece is 0.1 m.</p>		2
Q. 15	A convex lens of focal length 10 cm is placed at a distance of 12 cm from a wall. How far from the lens should an object be placed so as to form its real image on the wall?	Applying	
Ans	<p>Given that</p> <p>Focal length $f = 10 \text{ cm}$</p> <p>Image distance $v = 12 \text{ cm}$</p> <p>We know that</p> $\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$ $\Rightarrow \frac{1}{u} = \frac{1}{v} - \frac{1}{f}$ $\Rightarrow \frac{1}{u} = \frac{1}{12} - \frac{1}{10} = \frac{5 - 6}{60} = -\frac{1}{60}$ $\Rightarrow u = -60 \text{ cm}$ <p>The negative sign indicates that the object is placed on the same side of the lens as the incoming light.</p>		2

$$\Rightarrow uf - vf = uv$$

Dividing both sides by uvf , we get

$$\frac{uf}{uvf} - \frac{vf}{uvf} = \frac{uv}{uvf}$$

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

This is known as lens formula. It is valid for concave lens also.

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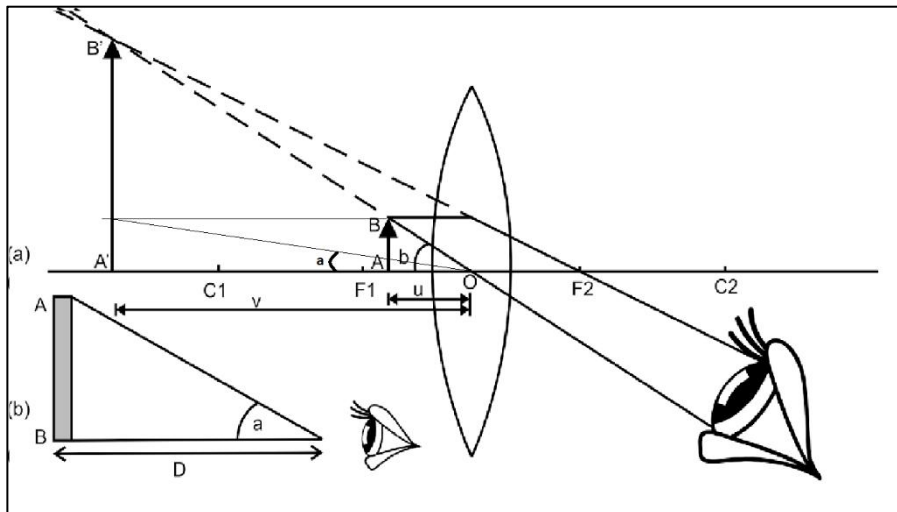
Q. 2

Explain the working of simple microscope with ray diagram. Derive the relation for magnifying power of Simple microscope.

Understanding

Ans

A microscope is an optical instrument used to magnify small objects. It is made up of lens or combination of lenses.



Principle:

- (i) When an object is placed between focus and optical center of convex lens, then its erect, virtual and magnified image is formed on the same side of the object.
- (ii) A single convex lens of short focal length constitutes a simple microscope which is commonly known as a magnifying glass or a reading glass.

Working:

- (i) The above ray diagram is the ray diagram of simple microscope. It consists of one convex lens.
- (ii) The object is observed by keeping eye close to convex lens and the image is clearly seen when it forms at distance of distinct vision, which is 25 cm for human eye.
- (iii) Let 'b' be the angle which eye made with image formed at $v = D$ and 'a' be the angle which eye (without lens) made with object kept at distance of distinct vision.

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Magnifying power or Magnification:

The magnifying power of a simple microscope is defined as the ratio between the angle subtended by the image at the eye to the object at the eye when both the image and the object are situated at the distance of distinct vision.

$$M = \frac{b}{a}$$

$$\Rightarrow M = \frac{b}{a} = \frac{\tan b}{\tan a}$$

But from the above diagram, in ΔAOB , $\tan a = \frac{AB}{D}$ and in $\Delta A'OB'$, $\tan b = \frac{A'B'}{D}$

$$\therefore M = \frac{\frac{A'B'}{D}}{\frac{AB}{D}} = \frac{A'B'}{AB}$$

$\Delta A'OB'$ and ΔAOB are similar triangles then

$$\frac{A'B'}{AB} = \frac{OA'}{OA} = \frac{-v}{-u} = \frac{D}{u}$$

$$\Rightarrow M = \frac{D}{u} \dots \dots \dots (1)$$

From Lens Equation

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

$$\Rightarrow \frac{1}{-D} - \frac{1}{-u} = \frac{1}{f}$$

$$\Rightarrow \frac{1}{u} = \frac{1}{f} + \frac{1}{D}$$

Multiply D on both sides of the above equation,

$$\frac{D}{u} = \frac{D}{f} + \frac{D}{D} = 1 + \frac{D}{f} \dots \dots \dots (2)$$

From above equation(1) and (2), $M = 1 + \frac{D}{f}$

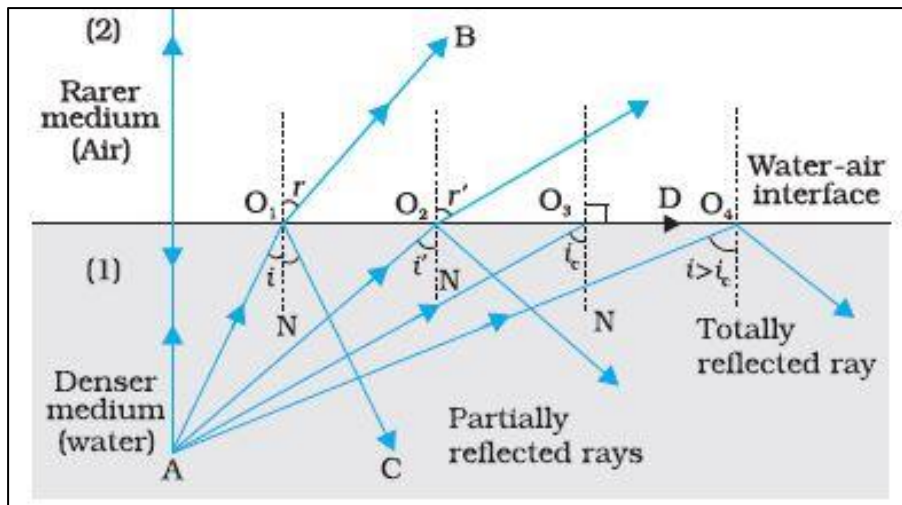
This equation gives magnification of simple microscope.

Q. 3

Define Critical angle and Total Internal Reflection with ray diagram.

Understanding

Ans



When a ray of light travels from denser medium to rarer medium, it moves away from the normal. So, as the angle of incidence increases in the denser medium, the angle of refraction also increases. For a particular angle of incidence, the angle of refraction is 90° . This angle of incidence is known as **critical angle**.

Critical angle is defined as the angle of incidence in optically denser medium for which angle of refraction in the optically rarer medium is 90° .

Total internal reflection is the phenomenon by virtue of which a ray of light traveling from a optically denser medium to a rarer medium is sent back to the same medium, when the ray is incident at an angle more than the critical angle for that medium.

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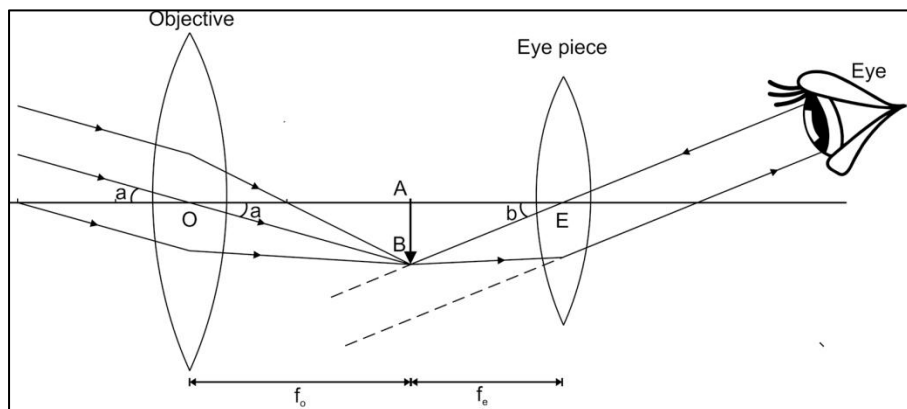
Q. 4

Explain the working of astronomical telescope. Derive the relation for magnifying power of astronomical telescope.

Understanding

Ans

An astronomical telescope is an optical instrument used to observe distant celestial objects like stars, planets, and galaxies.



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	<p>The simple astronomical telescope consists of two lenses as given in ray diagram.</p> <p>Objective Lens: The telescope has a large objective lens with a long focal length. This lens collects light from a distant object (like a star or planet) and forms a real, inverted, and diminished image at its focal point.</p> <p>Eyepiece: The eyepiece is a smaller lens with a short focal length. It's positioned so that the image formed by the objective lens falls just inside its focal point.</p> <p>Working Principle: The objective lens forms real and diminished image AB of the object. The eyepiece enlarges the image AB (which is object for eyepiece) and forms magnified virtual image. In normal adjustment the image AB is formed at the focus of eyepiece and its magnified and enlarged virtual image is formed at infinity. If the final image formed by the eyepiece lies at infinity. The distance between the objective and eyepiece is the sum of their focal length, $f_o + f_e$</p> <p>Magnifying power: The magnifying power (M) of a telescope is defined as the ratio of the angle subtended by the final image at the eye to the angle subtended by the object at the eye.</p> $M = \frac{b}{a}$ $M = \frac{b}{a} = \frac{\tan b}{\tan a} \dots \dots \dots (1)$ <p>In ΔABO and ΔABE</p> $\frac{\tan b}{\tan a} = \frac{\frac{AB}{EA}}{\frac{AB}{OA}} = \frac{OA}{EA}$ <p>Hence from equation (1)</p> $M = \frac{OA}{EA}$ $\Rightarrow M = \frac{f_o}{f_e}$ <p>Thus, the magnification of astronomical telescope in normal adjustment is equal to the ratio of the focal length of objective to the focal length of eyepiece.</p>		<p>1</p> <p>1</p> <p>1</p> <p>1</p>
Q. 5	Explain the Comatic aberration with a neat diagram.	Understanding	
Ans	<p>Coma:</p> <p>i) In spherical aberration the light rays coming from the object</p>		

$$\Rightarrow u_e = -\frac{150}{31}$$

(Here negative sign indicates that the image is between objective and eyepiece.)

To get the value of v_o ,

$$\text{As } v_o + u_e = 28 \text{ cm}$$

$$\Rightarrow v_o = 28 - \frac{150}{31}$$

$$\Rightarrow v_o = \frac{718}{31} \text{ cm}$$

From lens equation,

$$\frac{1}{v_o} - \frac{1}{u_o} = \frac{1}{f_o}$$

$$\Rightarrow \frac{31}{718} - \frac{1}{u_o} = \frac{1}{3}$$

$$\Rightarrow \frac{1}{u_o} = \frac{31}{718} - \frac{1}{3} = \frac{93 - 718}{2154}$$

$$\Rightarrow \frac{1}{u_o} = -\frac{625}{2154}$$

$$\Rightarrow u_o = -\frac{2154}{625} = -3.45 \text{ cm}$$

The distance between object and objective lens is 3.45 cm.

(ii) The magnifying power of compound microscope is given by

$$M = \frac{-v_o}{u_o} \left[1 + \frac{D}{f_e} \right]$$

$$\Rightarrow M = -\left(\frac{718}{31}\right) \times \frac{625}{2154} \left[1 + \frac{25}{6} \right]$$

$$\Rightarrow M = -34.72$$

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Here negative sign shows that the final image is inverted.

Q. 7

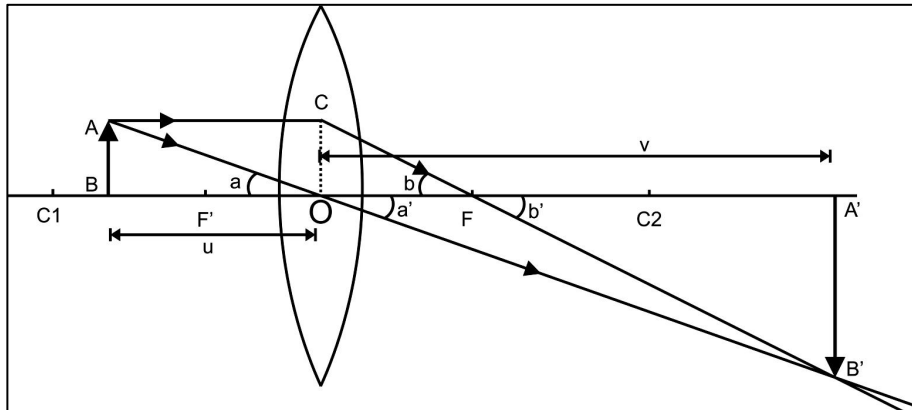
Explain magnification of lens. Derive the formula for magnification of image using lens formula.

Understanding

Ans

The ratio of the size of image to the size of object is known as the image magnification.

$$m = \frac{\text{size of image}}{\text{size of object}} = \frac{I}{O} = \frac{A'B'}{AB} \dots\dots\dots(1)$$



From the figure,

ΔCOF and $\Delta A'FB'$ are similar,

$$\frac{OC}{A'B'} = \frac{OF}{A'F}$$

$$\Rightarrow \frac{AB}{A'B'} = \frac{OF}{A'F} \text{ [as } OC=AB \text{]}$$

$$\Rightarrow \frac{A'B'}{AB} = \frac{A'F}{OF}$$

$$\Rightarrow m = \frac{A'B'}{AB} = \frac{(v-f)}{f} \dots\dots\dots(2)$$

By using lens formula,

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

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

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

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$$\Rightarrow \frac{v-f}{f} = -\frac{v}{u} \dots \dots \dots (3)$$

Combining equations (2) and (3),

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

Here negative sign indicates inverse image and magnification is given by $\frac{v}{u}$

Hence $m = \frac{\text{size of image}}{\text{size of object}} = \frac{\text{Image distance}}{\text{Object distance}}$