CBSE · CLASS 12 · PHYSICS

WORKSHEET-1

TIME: 15 min

MAX. MARKS: 15

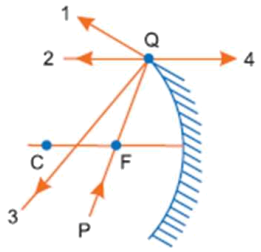
TOPIC: 9.1 INTRODUCTION; 9.2 REFLECTION OF LIGHT BY SPHERICAL MIRRORS

Name: _____ Roll No.: _____ Date: _____

ANSWER THE FOLLOWING

- Q.No. 1–3 carry 1 mark each and Q.No. 4–5 carry 2 marks each.

1. The direction of a ray of light incident on a concave mirror is shown by PQ, while the directions in which the ray would travel after reflection are shown by four rays marked 1, 2, 3 and 4 (figure alongside). Which of the four rays correctly shows the direction of the reflected ray? [1]



(a) 1 **(b)** 2 **(c)** 3 **(d)** 4

2. A concave mirror of focal length 15 cm forms an image having twice the linear dimensions of the object. The position of the object, when the image is virtual, will be [1]

(a) 22.5 cm **(b)** 7.5 cm **(c)** 30 cm **(d)** 45 cm

3. A short pulse of white light is incident from air to a glass slab at normal incidence. After travelling through the slab, the first colour to emerge is [1]

(a) blue **(b)** green **(c)** violet **(d)** red

4. Match the corresponding entries of Column 1 with Column 2. [Where m is the magnification produced by the mirror] [2]

COLUMN – 1	COLUMN – 2
A) $m = -2$	**p)** Convex mirror
B) $m = -½$	**q)** Concave mirror
C) $m = +2$	**r)** Real image
D) $m = +½$	**s)** Virtual image

(a) $A \rightarrow p$ and s; $B \rightarrow q$ and r; $C \rightarrow q$ and s; $D \rightarrow q$ and r

(b) $A \rightarrow r$ and s; $B \rightarrow q$ and s; $C \rightarrow q$ and r; $D \rightarrow p$ and s

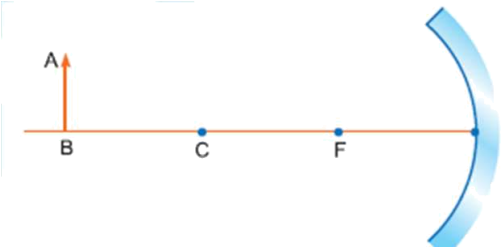
(c) $A \rightarrow q$ and r; $B \rightarrow q$ and r; $C \rightarrow q$ and s; $D \rightarrow p$ and s

(d) $A \rightarrow p$ and r; $B \rightarrow p$ and s; $C \rightarrow p$ and q; $D \rightarrow r$ and s

5. An object AB is kept in front of a concave mirror as shown in the figure. [2]

(i) Complete the ray diagram showing the image formation of the object.

(ii) How will the position and intensity of the image be affected if the lower half of the mirror's reflecting surface is painted black?



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WORKSHEET–2

TIME: 15 min

MAX. MARKS: 15

TOPIC: 9.2 REFLECTION OF LIGHT BY SPHERICAL MIRRORS

Name: _____ Roll No.: _____ Date: _____

ANSWER THE FOLLOWING

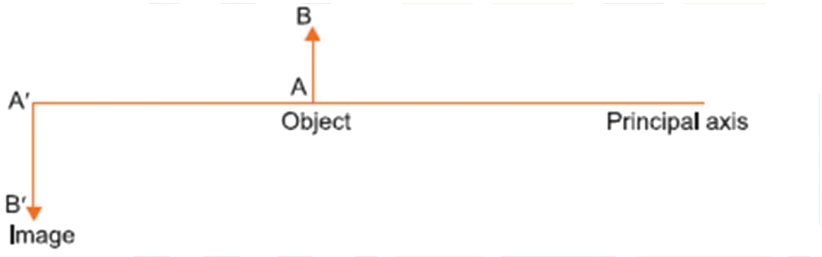
- Marks are indicated against each question.

1. A small candle 2.5 cm in size is placed 27 cm in front of a concave mirror of radius of curvature 36 cm. At what distance from the mirror should a screen be placed in order to receive a sharp image? Describe the nature and size of the image. If the candle is moved closer to the mirror, how should the screen be moved? **[3]**

2. A 4.5 cm needle is placed 12 cm away from a convex mirror of focal length 15 cm. Give the location of the image and the magnification. Describe what happens if the needle is moved farther from the mirror. **[2]**

3. Use the mirror equation to show that **[3]**
(a) an object placed between *f* and 2*f* of a concave mirror produces a real image beyond 2*f*.
(b) a convex mirror always produces a virtual image independent of the location of the object.
(c) an object placed between the pole and focus of a concave mirror produces a virtual and enlarged image.

4. Redraw the diagram given below and mark the position of the centre of curvature of the spherical mirror used in the given set-up. **[2]**



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WORKSHEET–3

TIME: 15 min

MAX. MARKS: 15

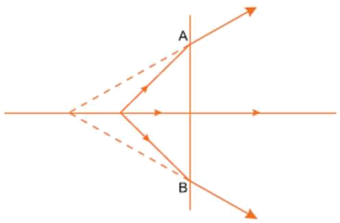
TOPIC: 9.3 REFRACTION; 9.4 TOTAL INTERNAL REFLECTION

Name: _____ Roll No.: _____ Date: _____

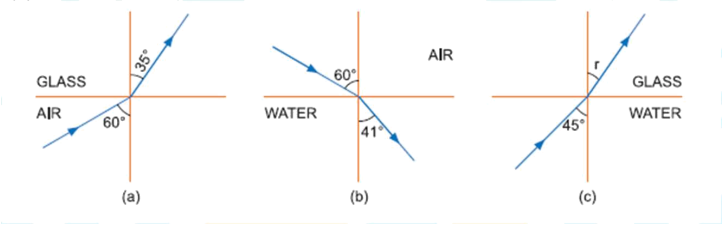
ANSWER THE FOLLOWING

- All questions carry 2 marks each.

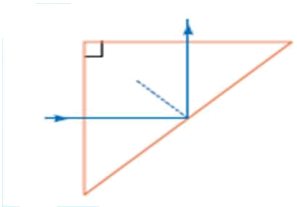
1. The line *AB* in the ray diagram represents a lens. State, with reason, whether the lens is convex or concave. **[2]**



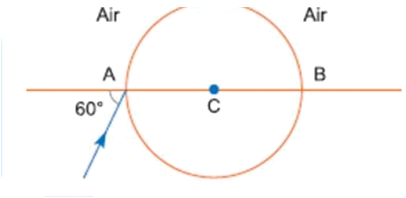
2. Fig. (a) and (b) show refraction of an incident ray in air at 60° with the normal to a glass–air and water–air interface, respectively. Predict the angle (*r*) of refraction of an incident ray in water at 45° with the normal to a water–glass interface [fig. (c)]. **[2]**



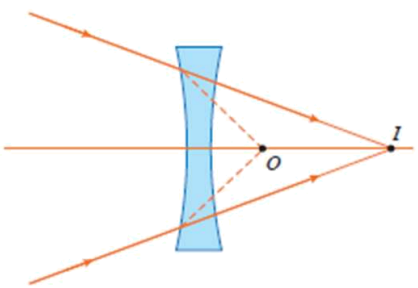
3. A ray of light incident normally on one face of a right isosceles prism is totally reflected as shown in the figure. What must be the minimum value of the refractive index of glass? Give relevant calculations. **[2]**



4. A ray of light falls on a transparent sphere with centre C as shown in the figure. The ray emerges from the sphere parallel to the line *AB*. Find the angle of refraction at A if the refractive index of the material of the sphere is 1.732. **[2]**



5. A lens is placed in the path of a beam of light which converges to the point *O* in the absence of the lens. The distance between the lens and the point is 15 cm. At what distance from the point *O* will the beam converge if the lens is a concave lens of focal length 25 cm? **[2]**



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WORKSHEET–4

TIME 15 min

MAX. MARKS 15

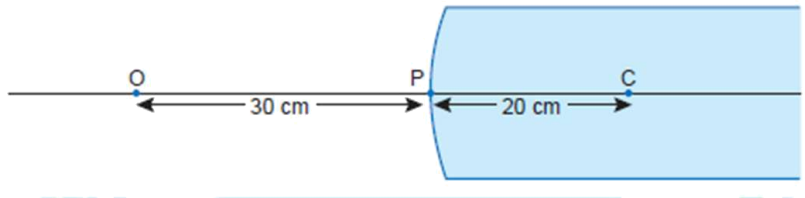
TOPIC: 9.5 REFRACTION AT SPHERICAL SURFACES AND BY LENSES

Name: _____ Roll No.: _____ Date: _____

ANSWER THE FOLLOWING

- Q.No. 1–2 carry 1 mark each and Q.No. 3–5 carry 2 marks each.

1. A spherical convex surface of radius of curvature 20 cm, made of glass (n = 1.5), is placed in air. Find the position of the image formed, if a point object is placed 30 cm in front of the convex surface on the principal axis. [1]

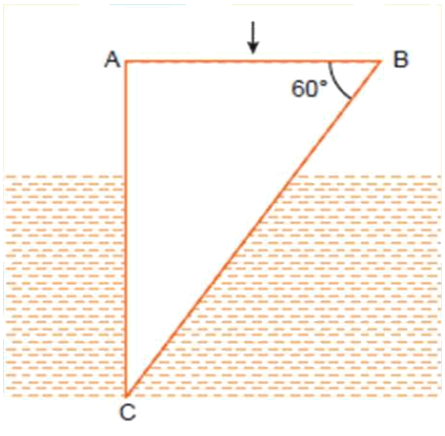


2. How does the focal length of a lens change when red light incident on it is replaced by violet light? Give a reason for your answer. [1]

3. A converging lens of refractive index 1.5 is kept in a liquid medium having the same refractive index. What is the focal length of the lens in this medium? [2]

4. Calculate the radius of curvature of an equi-concave lens of refractive index 1.5, when it is kept in a medium of refractive index 1.4, to have a power of −5 D. [2]

5. **(a)** A ray of light is incident normally on the face *AB* of a right-angled glass prism of refractive index ${}_{a}n_{g}$ = 1.5. The prism is partly immersed in a liquid of unknown refractive index. Find the value of the refractive index of the liquid so that the ray grazes along the face *BC* after refraction through the prism. [2]
(b) Trace the path of the rays if it were incident normally on the face *AC*.



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WORKSHEET-5

TIME: 15 min

MAX. MARKS: 10

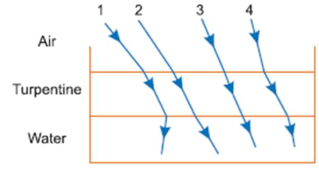
TOPIC: 9.5 REFRACTION AT SPHERICAL SURFACES AND BY LENSES

Name: _____ Roll No.: _____ Date: _____

ANSWER THE FOLLOWING

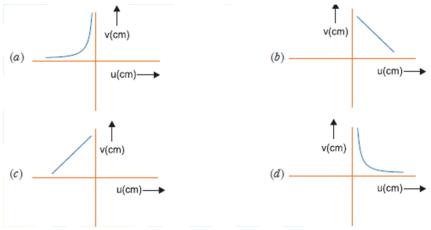
- Q.No. 1–2 carry 1 mark each and Q.No. 3–6 carry 2 marks each.

1. The optical density of turpentine is higher than that of water while its mass density is lower. The figure shows a layer of turpentine floating over water in a container. For which one of the four rays incident on turpentine in the figure is the path shown correct? [1]



(a) 1 **(b)** 2 **(c)** 3 **(d)** 4

2. A student measures the focal length of a convex lens by putting an object pin at a distance *u* from the lens and measuring the distance *v* of the image pin. The graph between *u* and *v* plotted by the student should look like [1]



(a) a **(b)** d **(c)** b **(d)** c

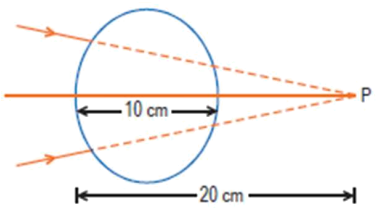
3. The refractive index of a material of a concave lens is n_1. It is immersed in a medium of refractive index n_2. A parallel beam of light is incident on the lens. Trace the path of the emergent rays when [2]

(i) $n_2 = n_1$ **(ii)** $n_2 > n_1$ **(iii)** $n_2 < n_1$

4. The radii of curvature of both the surfaces of a lens are equal. If one of the surfaces is made plane by grinding, will the focal length of the lens change? Will the power change? [2]

5. A concave lens of refractive index 1.5 is immersed in a medium of refractive index 1.65. What is the nature of the lens? [2]

6. A converging beam of light travelling in air converges at a point P as shown in the figure. When a glass sphere of refractive index 1.5 is introduced in the path of the beam, calculate the new position of the image. Also draw the ray diagram for the image formed. [2]



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WORKSHEET-6

TIME 15 min | MAX. MARKS 15

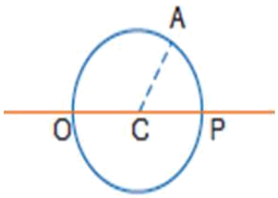
TOPIC: 9.5 REFRACTION AT SPHERICAL SURFACES AND BY LENSES

Name: _____ Roll No.: _____ Date: _____

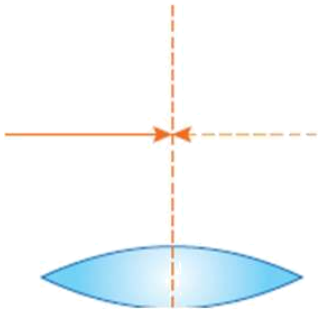
ANSWER THE FOLLOWING

- Marks are indicated against each question.

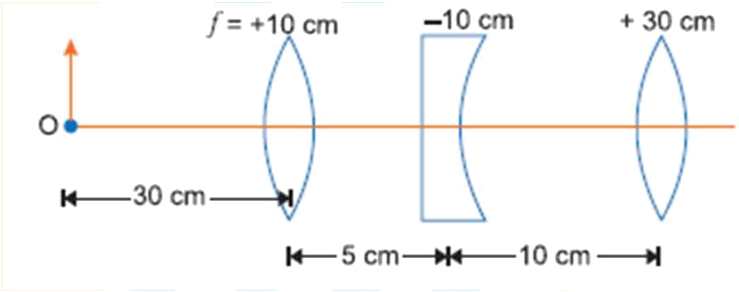
1. A point 'O' marked on the surface of a glass sphere of diameter 20 cm is viewed through the glass from the position directly opposite to the point *O*. If the refractive index of the glass is 1.5, find the position of the image formed. Also, draw the ray diagram for the formation of the image. **[2]**



2. A symmetric biconvex lens of radius of curvature *R* and made of glass of refractive index 1.5 is placed on a layer of liquid placed on top of a plane mirror, as shown in the figure. An optical needle with its tip on the principal axis of the lens is moved along the axis until its real, inverted image coincides with the needle itself. The distance of the needle from the lens is measured to be *x*. On removing the liquid layer and repeating the experiment, the distance is found to be *y*. Obtain the expression for the refractive index of the liquid in terms of *x* and *y*. **[2]**



3. Find the position of the image formed of an object 'O' by the lens combination given in the figure.

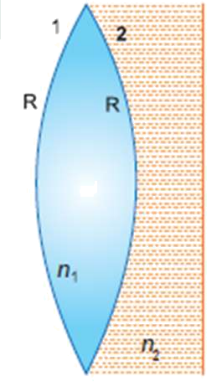


4. A biconvex lens with its two faces of equal radius of curvature *R* is made of a transparent medium of refractive index n_1. It is kept in contact with a medium of refractive index n_2 as shown in the figure. **[3]**

(a) Find the equivalent focal length of the combination.

(b) Obtain the condition when this combination acts as a diverging lens.

(c) Draw the ray diagram for the case $n_1 > (n_2 + 1)/2$, when the object is kept far away from the lens. Point out the nature of the image formed by the system.



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WORKSHEET–7

TIME: 15 min

MAX. MARKS: 15

TOPIC: 9.6 REFRACTION THROUGH A PRISM

Name: _____ Roll No.: _____ Date: _____

ANSWER THE FOLLOWING

- Marks are indicated against each question.

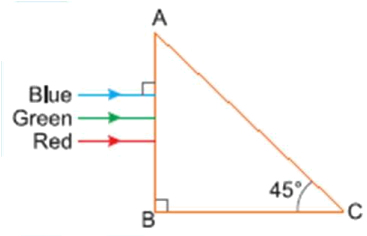
1. A ray of light incident at an angle θ on a refracting face of a prism emerges from the other face normally. If the angle of the prism is 5° and the prism is made of a material of refractive index 1.5, the angle of incidence is [1]

(a) 7.5° **(b)** 5° **(c)** 15° **(d)** 2.5°

2. The refractive index of the material of a prism is 2 and the angle of the prism is 30°. One of the two refracting surfaces of the prism is made a mirror inwards, by silver coating. A beam of monochromatic light entering the prism from the other face will retrace its path (after reflection from the silvered surface) if its angle of incidence on the prism is [1]

(a) 60° **(b)** 45° **(c)** 30° **(d)** zero

3. A beam of light consisting of red, green and blue colours is incident on a right-angled prism. The refractive indices of the material of the prism for the red, green and blue wavelengths are 1.39, 1.44 and 1.47 respectively. The prism will [1]



(a) not separate the three colours at all

(b) separate the red colour part from the green and blue colours

(c) separate the blue colour part from the red and green colours

(d) separate all the three colours from one another

4. A ray of light passing from air through an equilateral glass prism undergoes minimum deviation when the angle of incidence is ¾ th of the angle of the prism. Calculate the speed of light in the prism. [2]

5. An equilateral glass prism has a refractive index 1.6 in air. Calculate the angle of minimum deviation of the prism, when kept in a medium of refractive index $4\sqrt{2}/5$. [2]

6. **(a)** A ray of light is incident normally on the face *AB* of a right-angled glass prism of refractive index ${}_{a}n_{g}$ = 1.5. The prism is partly immersed in a liquid of unknown refractive index. Find the value of the refractive index of the liquid so that the ray grazes along the face *BC* after refraction through the prism. [3]

(b) Trace the path of the rays if it were incident normally on the face *AC*.

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WORKSHEET-8

TIME: 15 min

MAX. MARKS: 15

TOPIC: 9.6 REFRACTION THROUGH A PRISM

Name: _____ Roll No.: _____ Date: _____

ANSWER THE FOLLOWING

- Q.No. 1–2 carry 1 mark each and Q.No. 3–5 carry 2 marks each.

1. The reddish appearance of the rising and setting sun is due to [1]

(a) reflection of light **(b)** diffraction of light

(c) scattering of light **(d)** interference of light

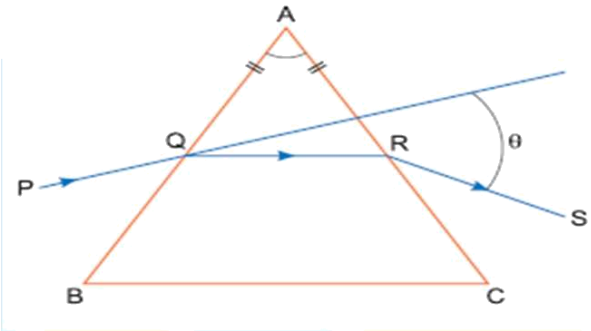
2. A setting sun appears to be at an altitude higher than it really is. This is because of [1]

(a) absorption of light **(b)** reflection of light

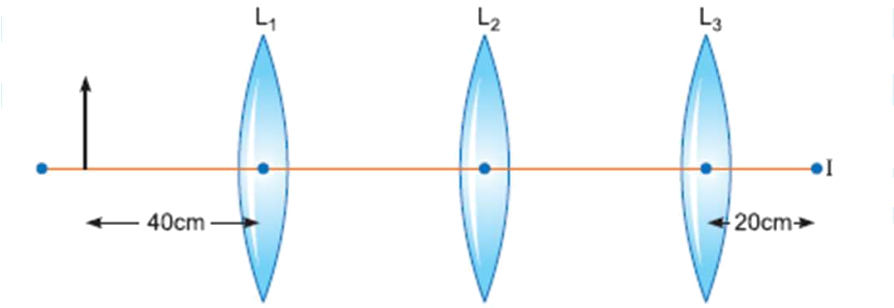
(c) refraction of light **(d)** dispersion of light

3. At what angle should a ray of light be incident on the face of a prism of refracting angle 60° so that it just suffers total internal reflection at the other face? The refractive index of the prism is 1.524. [2]

4. A ray *PQ* incident on the refracting face *BA* is refracted in the prism *BAC* as shown in the figure and emerges from the other refracting face *AC* as *RS* such that *AQ* = *AR*. If the angle of the prism *A* = 60° and the refractive index of the material of the prism is √3, calculate the angle θ. [2]



5. You are given three lenses L_1, L_2 and L_3, each of focal length 20 cm. An object is kept at 40 cm in front of L_1, as shown. The final real image is formed at the focus '*I*' of L_3. Find the separations between L_1, L_2 and L_3. [2]



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WORKSHEET-9

TIME: 15 min

MAX. MARKS: 15

TOPIC: 9.7 OPTICAL INSTRUMENTS

Name: _____ Roll No.: _____ Date: _____

ANSWER THE FOLLOWING

- Q.No. 1–2 carry 1 mark each and Q.No. 3–6 carry 2 marks each.

1. For a relaxed eye, the magnifying power of a microscope is [1]

(a) $(v_0/u_0) \times (D/f_e)$ **(b)** $(v_0/u_0) \times (f_e/D)$
(c) $(u_0/v_0) \times (D/f_e)$ **(d)** $(u_0/v_0) \times (-D/f_e)$

2. If the focal length of the objective lens is increased, then the magnifying power of [1]

(a) microscope will increase but that of telescope will decrease
(b) microscope and telescope both will increase
(c) microscope and telescope both will decrease
(d) microscope will decrease but that of telescope will increase

3. Four lenses of focal length ±15 cm and ±150 cm are available for making a telescope. To produce the largest magnification, the focal length of the eyepiece should be [2]

(a) +15 cm **(b)** +150 cm **(c)** −150 cm **(d)** −15 cm

4. The magnifying power of a telescope is 9. When it is adjusted for parallel rays, the distance between the objective and eyepiece is 20 cm. The focal lengths of the lenses are [2]

(a) 11 cm, 9 cm **(b)** 10 cm, 10 cm **(c)** 15 cm, 5 cm **(d)** 18 cm, 2 cm

5. You are given the following three lenses. Which two lenses will you use as an eyepiece and as an objective to construct an astronomical telescope? Give a reason. [2]

Lenses	Power (D)	Aperture (cm)
L_1	3	8
L_2	6	1
L_3	10	1

6. Does the magnifying power of a microscope depend on the colour of the light used? Justify your answer. [2]

7. State the condition under which a large magnification can be achieved in an astronomical telescope.

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WORKSHEET-10

TIME: 15 min

MAX. MARKS: 10

TOPIC: 9.7 OPTICAL INSTRUMENTS

Name: _____ Roll No.: _____ Date: _____

ANSWER THE FOLLOWING

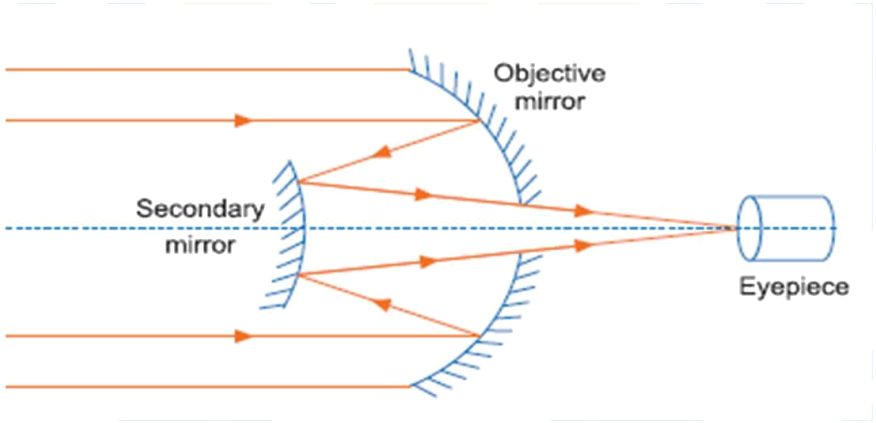
- Marks are indicated against each question.

1. **(a)** A giant refracting telescope at an observatory has an objective lens of focal length 15 m. If an eyepiece of focal length 1.0 cm is used, what is the angular magnification of the telescope? **(b)** If this telescope is used to view the moon, what is the diameter of the image of the moon formed by the objective lens? The diameter of the moon is 3.48×10^6 m and the radius of the lunar orbit is 3.8×10^8 m. [2]

2. A compound microscope consists of an objective lens of focal length 2.0 cm and an eyepiece of focal length 6.25 cm separated by a distance of 15 cm. How far from the objective should an object be placed in order to obtain the final image at **(i)** the least distance of distinct vision (D = 25 cm) and **(ii)** infinity? What is the magnifying power of the microscope in each case? [2]

3. A small telescope has an objective lens of focal length 144 cm and an eyepiece of focal length 6.0 cm. What is the magnifying power of the telescope? What is the separation between the objective and the eyepiece? [3]

4. A Cassegrain telescope uses two mirrors as shown in the figure. Such a telescope is built with the mirrors 20 mm apart. If the radius of curvature of the large mirror is 220 mm and of the small mirror is 140 mm, where will the final image of an object at infinity be? [3]



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WORKSHEET-11

TIME: 15 min

MAX. MARKS: 10

TOPIC: 9.7 OPTICAL INSTRUMENTS

Name: _____ Roll No.: _____ Date: _____

ANSWER THE FOLLOWING

- Marks are indicated against each question.

1. An astronomical telescope has an angular magnification of magnitude 5 for distant objects. The separation between the objective and the eyepiece is 36 cm and the final image is formed at infinity. Calculate the focal length of the objective and the focal length of the eyepiece. [1]

2. A small telescope has an objective lens of focal length 150 cm and an eyepiece of focal length 5 cm. What is the magnifying power of the telescope for viewing distant objects in normal adjustment? If this telescope is used to view a 100 m tall tower 3 km away, what is the height of the image of the tower formed by the objective lens? [3]

3. A compound microscope uses an objective lens of focal length 4 cm and an eyepiece lens of focal length 10 cm. An object is placed at 6 cm from the objective lens. Calculate the magnifying power of the compound microscope. Also calculate the length of the microscope. [3]

4. The total magnification produced by a compound microscope is 20. The magnification produced by the eyepiece is 5. The microscope is focussed on a certain object. The distance between the objective and eyepiece is observed to be 14 cm. If the least distance of distinct vision is 20 cm, calculate the focal length of the objective and the eyepiece. [3]

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