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PHYSICS

BOOKS - OSWAAL PUBLICATION PHYSICS (KANNADA ENGLISH)

RAY OPTICS AND OPTICAL INSTRUMENTS

Topic 1 Very Short Answer Type Questions

1. How is the power of lens related to its focal length ?

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2. Define critical angle for a pair of media.

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3. Which theory of light predicts the velocity of light in denser medium to be more than in a

rarer medium?

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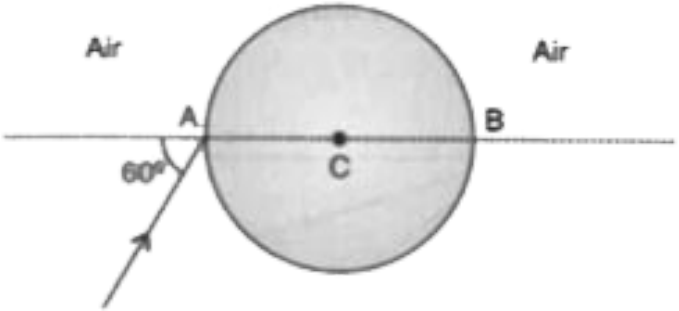
4. A ray of light falls on a transparent sphere sphere with centre C as shown in the figure. The ray emerges from the sphere parallel to the line AB. Find the angle of refraction at A, if refractive index of the material of the sphere

is $\sqrt{3}$.



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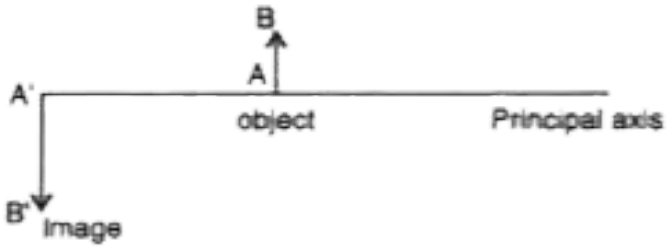
5. Redraw the diagram given below and mark the position of the centre of curvature of the

spherical mirror used in the given set up.



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6. A convex lens is placed in contact with with a plane mirror . A point object at a distance of 20cm on the axis of this combination has its image coinciding with itself. What is the focal length of the lens?

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7. A biconvex lens made of a transparent material of refractive index 1.33. Will the lens behave as a converging or a diverging lens ? Give reason.

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8. The relation between the refractive index and the critical angle of a medium is

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9. If the wavelength of light incident on a convex lens is increased, how will its focal length change?

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10. Under what condition does a biconvex lens of glass having a certain refractive index act as a plan glass sheet when immersed in a liquid?

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11. For the same value of angle of incidence, the angles of refraction in three media A,B and C are $15^\circ, 25^\circ$ and 35° respectively. In which medium would the velocity of light be minimum ?

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12. A glass lens of refractive index 1.45 disappears when immersed in a liquid. What is the value of refractive index of the liquid ?

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13. A converging lens is kept coaxially in contact with a diverging lens, both the lenses being of equal focal lengths. What is the focal length of the combination?

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14. When light travels from a rarer to a denser medium, the speed decreases. Does this

decrease in speed imply a decrease in the energy carried by the light wave ? Justify your answer.

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15. Convex mirror is commonly used as rear view mirror in vehicles. Why?

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Topic 1 Short Answer Type Questions 1

1. Draw the ray diagram to construct a real inverted image by a concave mirror.

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2. Define critical angle. Write two conditions for total internal reflection.

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3. Draw the diagram in each case to show the position and nature of the image formed when the object is placed.

(i) At the centre of curvature of a concave mirror.

(ii) In front of convex lens.

(iii) Between the pole P and focus F of a concave mirror.

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4. Write the conditions for observing a rainbow Show, by drawing suitable diagrams, how one understands the formation of a rainbow.

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5. (a) A mobile phone lies along the principal axis of a concave mirror. Show, with the help of a suitable diagram, the formation of its image. Explain why magnification is not uniform ?

(b) Suppose the lower half of the concave mirror's reflecting surface is covered with an opaque material. What effect this will have on the image of the object ? Explain.

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6. The relation between the refractive index and the critical angle of a medium is

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7. A convex lens of focal length 25 cm is placed coaxially in contact with a concave lens of focal length 20 cm. Determine the power of the combination. Will the system be converging or diverging in nature?

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8. A small bulb is placed at the bottom of a tank containing water to a depth of 80cm. What is the area of the surface of water

through which light from the bulb can emerge out? Refractive index of water is 1.33. (Consider the bulb to be a point source.)

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9. A convex lens is place over a plane mirror. A pin is now positioned so that there is no parallax between the pin and its image formed by this lens-mirror combination . How can this observation be used to find the focal length of

the convex lens? Give appropriate reasons in support of your answer.

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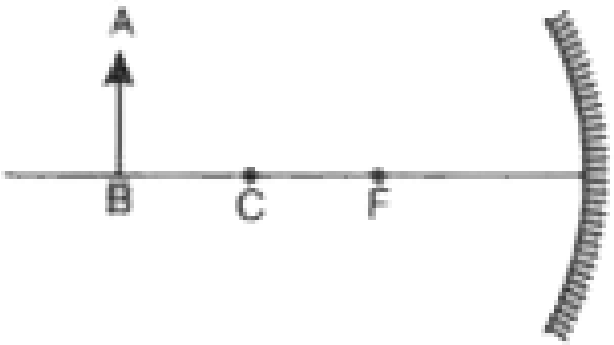
10. An object AB is kept in front of a concave mirror as shown in the figure.



(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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11. The radii of curvatur of the faces of a double convex lens are 10cm and 15 cm. If focal length of the lens is 12 cm, find the refractive index of the material of the lens.

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Topic 1 Short Answer Type Questions 2

1. Derive the relation $f = R/2$ in the case of a concave mirror.

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2. A point object O is kept at a distance of 30cm from a convex lenx of power $+4$ D towards its left. It is observed that when a convex mirror is kept on the right side at a distance of 50cm from the convex lens,

theimage of the object O formed by the lens-mirror combination coincides with the object itself. Calculate the focal length of the convex mirror.

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3. A convex lens of focal length 20cm is places coaxially with a convex mirror of radius of curvature 20cm. The two are kept at 15 cm from each other. A point object lies 60cm in front of the convex lens. Draw a ray diagram to

show the formation of the image by the combination. Determine the nature and position of the image formed.

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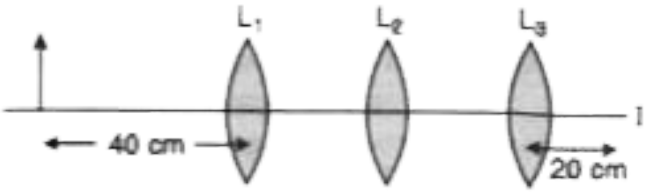
4. Your are given three lenses L_1, L_2 and L_3 each of focal length 20cm. An object is kept at 40cm in front of L_1 as shown. The final real image is formed at the focus I of L_3. Find the

separation between L_1 and L_2 and L_3.



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5. A convex lens made up of glass of refractive index 1.5 is dipped, in turn, in (i) a medium of refractive in dex 1.65, (ii) a medium of refractive index 1.33.

(a) Will it behave as a converging or a diverging lens in the two cases ?

(b) How will its focal length change in the two media ?

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6. Use the mirror equation to show that

(a) An object placed between f and 2f of a concave mirror produces a real image beyond 2f.

(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 an enlarged image.

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Topic 1 Long Answer Type Questions

1. Derive the expression for refractive index of the material of the prism in terms of angle of the prism and angle of minimum deviation.

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2. Derive the expression for refractive index of the material of the prism in terms of angle of the prism and angle of minimum deviation.

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3. Derive the expression for lateral shift produced when a ray of light passes through a parallel sided slab.

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4. Define normal shift. Obtain an expression for normal shift when an object in a denser medium is viewed from a rarer medium.

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5. Draw a ray diagram showing the formation of the image by a point object on the principal axis of a spherical convex surface separating two media of refractive indices n_1 and n_2, when a point source is kept in rarer medium of

refractive index n_1. Derive the relation between object and image distance in terms of refractive index of the medium and radium of curvature of the surface.

Hence obtain the expression for lens-maker's formula in the case of thin convex lens.

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6. (a) A point object is placed in front of a double convex lens (of refractive index $n = n_2/n_1$ with respect to air) with its

spherical faces of radii of curvature R_1 and R_2 . Show the path of rays due to refraction at first and subsequently at the second surface to obtain the formation of the real image of the object.

Hence obtain the lens-maker's formula for a thin lens.

A double convex lens having both faces of the same radius of curvature has refractive index 1.55. Find out the radius of curvature of the lens required to get the focal length of 20cm.

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7. (a) Obtain Lens Maker's formula using the expression

$$\frac{n_2}{v} - \frac{n_1}{u} = \frac{(n_2 - n_1)}{R}$$

Here the ray of light propagating from a rarer medium of refractive index (n_1) to a denser medium of refractive index (n_2) is incident on the convex side of spherical refracting surface of radius of curvature R.

(b) Draw a ray diagram to show the image formation by a concave mirror when the object is kept between its focus and the pole.

Using this diagram , derive the magnification formula for the image formed.

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Topic 1 Numerical Problems

1. A convex lens of focal length 0.24 m and of refractive index 1.5 is completely immersed in water of refractive 1.33. Find the changes in the focal length of the lens.

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2. An object of size 3.0cm is placed 14cm in front of a concave lens of focal length 21cm. Describe the image produced by the lens. What happens if the object is moved further away from the lens?

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3. A Plano-convex lens of radius of curvature 0.1m is kept over a plane glass plate with curved surface of the lens touching it. The gap

between the glass plate and the curved surface of the lens is filled with a liquid. If the combined focal length of the combination is 0.4m, calculate the refractive index of the material of the liquid. Given R.I. of the material of the lens is 1.5.

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4. Calculate the refractive index of the material of the lens using the given data.

Trial	Distance between the object and the screen D m	Shift in the position of the lens S m
1	0.9	0.3
2	0.85	0.21

Radius of curvature of the first surface $R_1 = 0.2m$ Radius of curvature of the second surface $R_2 = 0.2m$.

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5. A convex lens of focal length 0.5m in air has a refractive index of 1.5.What will be its focal length when immersed in water of refractive index 1.33 ?

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6. A glass of refraction index 1.5 and radius -.1 m has a small bubbl inside at a distance of 0.01 m from the centre. Where will the mark appear to the observer when viewed along the diameter containing the bubble?

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7. Calculate the refractive index of the material of the lens using the following data.

Trial No.	D	S
1	0.85 m	0.206 m
2	0.98 m	0.300 m

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8. Using the following data calculate the refractive index of the material of the convex lens.

Radii of curvature of both the surface are 0.2m

.

Data recorded in the shift method to determine the focal length of the convex lens are a follows :

Trial No.	D	S
1	0.82 m	0.128 m
2	0.9 m	0.3 m

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9. A glass sphere of refractive index 1.5 has a diameter of 0.2m. A parallel beam is incident

on the sphere. Where is it brought to focus by the sphere ?

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Topic 2 Very Short Answer Type Questions

1. What is dispersion of light?

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2. What is the thin prism?

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3. Dispersive power of prism material is

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4. How is angle of incidence related to the angle of minimum deviation?

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Topic 2 Short Answer Type Questions I

1. What is the thin prism?

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2. Draw the ray diagram to show the refraction of light through a prism.

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3. Draw the ray diagram to show the refraction of light through a prism.

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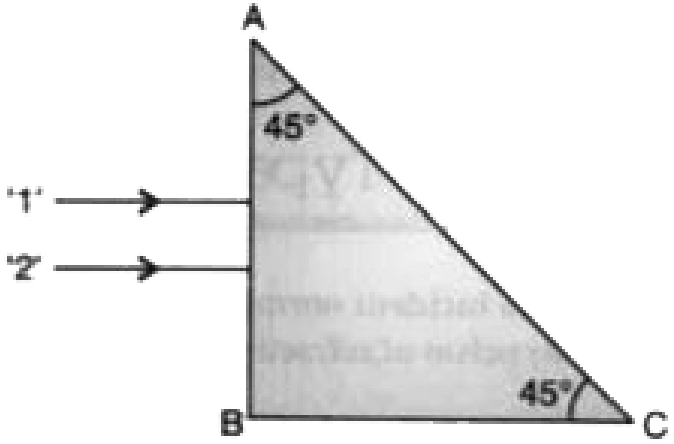
4. Two monochromatic rays of light are incident normally on the face AB of an isosceles right-angled prism ABC. The refractive indices of the glass prism for the two rays '1' and '2' are respectively 1.35 and 1.45. Trace the path of these rays after

entering through the prism.



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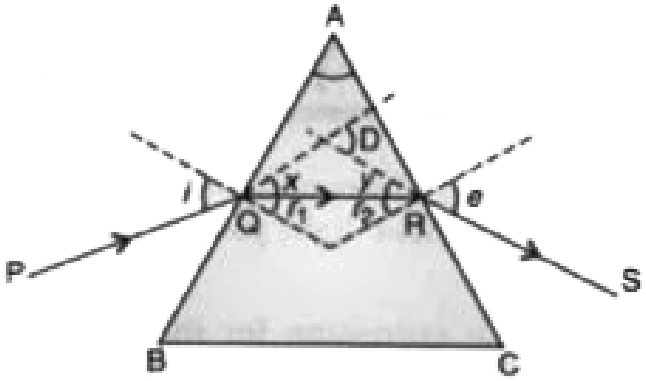
5. Figure shows a ray of light passing through a prism. If the refracted ray QR is parallel to the base BC, show that (i) $r_1 = r_2 = A/2$, (ii) angle of minimum deviation, D or

$D_m = 2i - A.$



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6. A ray of light, incident on an equilateral glass prism $\mu_g = \sqrt{3})$ moves parallel to the base line of the prims inside it. Find the angle of incidence for this ray.

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7. Explain why the colour of the sky is blue (Cyan).

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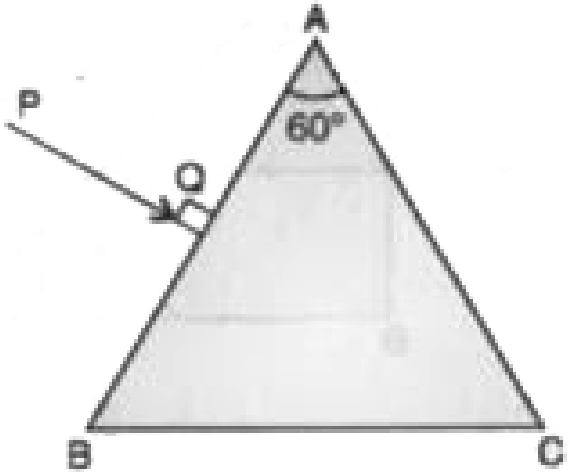
Topic 2 Short Answer Type Questions Ii

1. A ray PQ is incident normally on the face AB of a triangular prism of refracting angle of 60°, mae of a transparent material of

refractive index $\frac{\sqrt{3}}{2}$, as shown in the figure. Trace the path of the ray as it passes through the prism. Also calculate the angle of emergence and angle of deviation.



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Topic 2 Long Answer Type Questions

1. Derive the expression for refractive index of the material of the prism in terms of angle of the prism and angle of minimum deviation.

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Topic 3 Very Short Answer Type Questions

1. Write the expression for magnifying power of a telescope in terms of focal lengths.

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2. Name the type of lens used to correct

(i) Myopia

(ii) Hypermietropia

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3. To increase magnifying power of a telescope, we should increase

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Topic 3 Short Answer Type Questions I

1. Draw the ray diagram of image formation in case of compound microscope

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2. Give the expression for limit of resolution of a microscope along with the meaning of the symbols used.

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3. Calculate the limit of resolution of a telescope given that the diameter of the objective is 1.5 m and wavelength of the light used is 555 nm.

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4. Calculate the resolving power of a microscope, whose limit of resolution is $2.4 \times 10^{-4} m.$

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5. Draw a schematic diagram of a reflecting telescope (Construction). Write its two advantage over a refracting telescope.

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6. Two convex lenses of same focal length but of aperture A_1 and $(A_2 < A_1)$, are used as the objective lenses in two astronomical telescopes having identical eyepieces. What is the ratio of their resolving power? Which

telescope will you prefer and why ? Give reason.

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Topic 3 Short Answer Type Questions Ii

1. Draw a labelled ray diagram showing the formation of a final image by a compound microscope at the least distance of distinct vision.

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2. (i) Draw a neat labelled ray diagram of a compound microscope. Explain briefly its working.

(ii) Why must both the objective and the eye-piece of a compound microscope have short focal lengths ?

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Topic 3 Long Answer Type Questions

1. (a) Draw a neat labelled ray diagram showing the image formation of a distant object by a refracting telescope.

Deduce the expression for its magnifying power when the final image is formed at infinity.

(b) The sum of focal lengths of the two lenses of a refracting telescope is 105 cm. The focal length of one lens is 20 times that of the other. Determine the total magnification of the telescope when the final image is formed at infinity.

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2. (a) Draw a labelled ray diagram of an astronomical telescope to show the image formation of a distant object. Write the main consideration required in selecting the objective and eyepiece lenses in order to have large magnifying power an dhigh resolution of the telescope.

(b) A compound microscope has an objective of focal length 1.25cm and eyepiece of focal lenth 5 cm. A small object is kept at 2.5 cm

from the objective. If the final image formed is at infinity, find the distance between the objective and the eyepiece.

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3. (a) Define magnifying power of a telescope.

(b) Write its expression. A small telescope has an objective lens of focal length 150 cm and an eye piece of focal length 5 cm. If this telescope is used to view a 100m high tower $3x10^5$cm

away , find the height of the final image when it is formed 25 cam away from the eye piece.

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4. How is the working of a telescope different from that of a microscope ? The focal lengths of the objective and eyepiece of a microscope are 1.25 cm and 5 cm respectively. Find the position of the object relative to the objective in order to obtain anangular magnificatio of 30 in normal adjustment.

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5. Draw a ray diagram to show the working of a compound microscope . Deduce an expression for the total magnification when the final is formed at the near point .

In a compound microscope, an object is place at a distance of 1.5cm from the objective of focal length 1.25cm. If the eye piece has a focal length of 5cm and the final image is formed at the near point, estimate the magnifying power of the microscope.

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Topic 3 Numerical Problems

1. The total magnification produced by a compound microscope is 20. The magnification produced by the eye piece is 5. The microscope is focussed on a certain object. The distance between the objective and eyepiece is observed to be 14cm.

If the least distance of distinct vision is 20cm,

calculate the focal length of the objective and the eye piece.

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2. (a) A giant refracting telescope at an observatory has an objective lens of focal length 15m. If an eyepiece of focal length 1.0cm 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 $3.48 \times 10^6 m$, and the radius of lunar orbit is $3.8 \times 10^8 m$.

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3. A compound microscope uses an orjective lens of focal length 4 cm and eyepiece lens of focal Length 10cm. 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 mircroscope.

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