PHYSICS

BOOKS - NEW JYOTHI PHYSICS (TAMIL ENGLISH)

RAY OPTICS AND OPTICAL INSTRUMENTS

Solved Problems

1. Suppose that the lower half of the concave mirror's reflecting surface is covered with an opaque (non-reflective) material. What effect will the have on the image of an object placed in front of the mirror ?

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2. A mobile phone lies along the principal axis of a concave mirror, as shown in figure. Show by suitable diagram, the formation of its

image. Explain why the magnification is not uniform. Will the distortion of image depend on the location of the phone with respect to the mirror ?

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3. An object is placed at (i) 10cm (ii) 5 cm in front of a concave mirror of radius of curvature 15cm. Find the position, nature and magnification of the image in each case.

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4. Suppose while sitting in a parked car, you notice a jogger approaching towards you in the side view mirror of R = 2m. If the jogger is running at a speed of 5 ms^{-1} , how fast the image of the jogger appears to move when the jogger is

(a) 39 m

(b) 29 m

(c) 19m

(d) 9 m aways.

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5. An object is placed at (i) 10cm (ii) 5 cm in front of a concave mirror of radius of curvature 15cm. Find the position, nature and magnification of the image in each case.

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6. The image formed by a convec mirror of focal length 30 cm is a quarter the size of the object what is the distance of the obect from the mirror?

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7. A small candle 2.5 cm height is placed in front of a concave mirror of radius of curvature 36 cm at a distance 27 cm from the concave mirror.

i. At what distance from the mirror should a screen be placed in order to receive a sharp image ?

ii. Describe the nature and size of the image.

iii. If the candle is moved close to the mirror, what will be the position of the screen ?

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8. What kind of a spherical mirror must be used and what must be its radius of curvature in order to get an erect image $\frac{1}{5}$ as large as an object placed 15 cm in front of it ?

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9. Deduce the relation $f^2 =$ ab , where 'a' and 'b' are the distance of an object and its real

image from the principal focus and 'f' its focal length .

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10. The earth takes 24h to rotate once about its axis. How much time does the sun take to shift by 1° when viewed from the earth ?

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11. If the refractive indices of glass and water with respect to air are $\frac{3}{2}$ and $\frac{4}{3}$ respectively, what is the refractive index of glass with respect to water ?

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12. Light from a point source in air falls on a spherical glass surface (n = 1.5 and radius of curvature = 20 cm). The distance of the light

source from the glass surface is 100 cm. At what position the image is formed ?

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13. A magician during a show makes a glass lens with n = 1.47 disappear in a through of liquid. What is the refractive index of the liquid ? Could the liquid be water ?

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14. i. If f = 0.5 m for a glass lens, what is the power of the lens ?

ii. The radii of curvature of the faces of a double convex lens are 10cm and 15cm . Its focal length is 12cm. What is the refractive index of glass ?

iii. A convec lens has 20 cm focal length in air. what is focal length in water ? (Refractive index of air-water = 1.33, refractive index for air-glass = 1.5)

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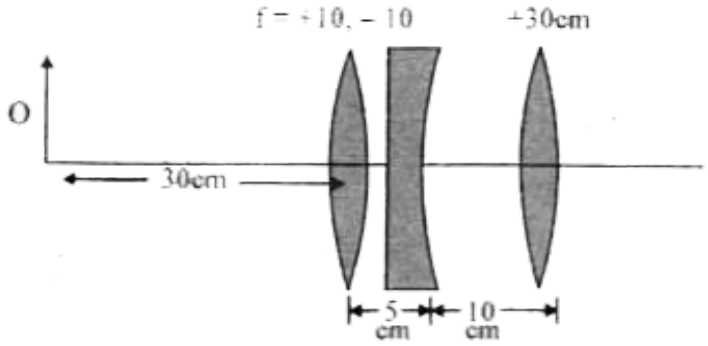
15. Find the position of the image formed by the lens combination given in the figure.



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16. A concave lens of focal length 20 cm is placed at a distance of 35 cm from an object.

Find the position of the image and its magnification.

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17. A convex lens of power 0.04 dioptre produces an image which is double the size of object placed in front of it. Find the position of the object.

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18. Find the dispersive power of a prism, given that $n_v = 1.657$ and $n_R = 1.631$.

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19. What focal length should the reading spectacles have for a person for whom the least distance of distinct vision is 50 cm?

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20. a. The far point of a myopic person is 80cm in front of the eye. What is the power of the lens required to enable him to see very distant object clearly ?

b. In what way does the corrective lens help the above person ? Does the lens magnify very distant objects? Explain carefully.

c. The above person profers to remove his spectacles while reading a book Explain why.

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21. a. The near point of a hypermetropic person is 75 cm from the eye. What is the power of the lens required to enable the person to read clearly a book held at 25 cm from the eye?

b . In what way does the corrective lens help the above person? Does the lens magnify objects held near the eye ?

c. The above person prefers to remove the spectacles with looking at the sky. Explain why

.

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22. Calculate the magnifying power of a magnifying glass of 5 cm focal length, distance of distance vision is= 25 cm .

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23. A small telescope has an objective lens of focal length 140 cm and eyepiece of focal length 5.0 cm. What is the magnifying power of the telescope for viewing distant objects when (a) the telescope is in normal

adjustment and (b) the final image is formed at least distance of distinct vision ?

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24. A reflecting type telescope has a concave reflector radius of curvature 120 cm. Calculate the focal length of eyepiece to secure a magnification of 20 .

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25. The focal length of the objective of an astronomical telescope is 75 cm and that of the eyepiece is 5 cm . If the final image is formed at the least distance of distanct of distinct vision from the eye, calculate the magnifying power of the telescope.

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26. A compound microscope has a magnification of 30. The focal length of its

eyepiece is 5 cm. Assuming the final image to be formed at least distance of distinct vision, calculate the magnification produced by objective .

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Solutions To Exercises From Ncert Text

1. A small candle 2.5 cm in size is placed at 27 cm in front of a concave mirror of radius of corvature 36 cm. At what distance from the

mirror should a screen be placed in order to obtain a sharp image? Describe the nature and size of the image. If the candle is moved closer to the mirror, how would the screen have to be moved ?

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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 as the needle is moved farther from the mirror.

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3. A tank is filled with water to a heigth of 12.5 cm. The apparent depth of a needle lying at the bottom of the tank is measured by a microscope t be 9.4 cm. what is the refractive index of water ? If water is replaced by a liquid of refractive index 1.63 upto the same hight, by

distance would the microscope have to be moved to focus on the needle again?

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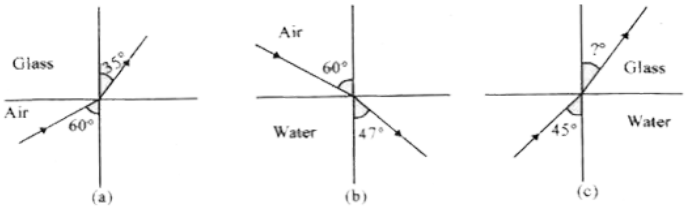
4. Figures (a) and (b) show refraction of a ray in air incident at 60° with the normal to a glass-air and water-air interface, respectively. Predict the angle of a refraction in glass when the angle of incidence in water is 45° with the

normal to a water-glass interface .



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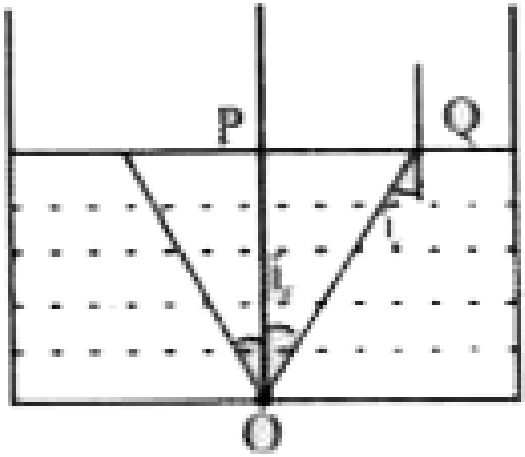
5. A small bulb is placed at the bottom of a tank containing water to a depth of 80cm. What is the area of the surface of water through which light from the bulb can emerge out? Refractive index of water is 1.33 (consider

the bulb to be a point source .)



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6. What is the refractive index of water ?

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7. Double-convex lenses are to be manufactured from a glass of refractive index 1.53, with both faces of the same radius of curvature. What is the radius of curvature required if the focal length is to be 20 cm ?

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8. A beam of light converges at a point P. Nnw a lens is placed in the path of the convergent beam 12cm from P. At what point does the beam converge if the lens is (a) a convex lens

of focal length 20 cm, and (b) a concave lens of focal length 16 cm ?

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

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10. What is the focal length of a convex lens of focal length 30 cm in contact with a concave lens of focal length 20 cm? is the system a converging or a diverging lens ? Ignore thickness of the lenses.

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11. 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 (a) the least distance of distinct vision (25cm), and (b) at infinity? What is the magnifying power of the microscope in each case ?

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12. A person wit a normal near point (25 cm) using a compound microscope with objective of focal length 8.0 mm and an eyepiece of focal length 2.5 cm can bring object placed at

9.0 mm from the objective in sharp focus. What is the separation between the two lenses ? Calculate the magnifying power of the microscope.

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13. A small telescope has an objective lens of focal length 144 cm and 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?

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14. a. A gaint 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 ?

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15. 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 lunar orbit is 3.8×10^8 m.

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16. Use the mirror equation to deduce that

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

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17. b. A convex mirror always produces a virtual image independent of the location of the object.

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18. c. the virtual image produced by a convex mirror is always diminished in size and is located between the focus and the pole.

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19. When an object placed between the pole and focus of a concave mirror the image formed is ------

A. a. real, inverted and small

B. b. real, inverted and same size

C. c. Virtual, inverted and small

D. d. Virtual, erect and enlarged

Answer:

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20. One type of transparent glass has refractive index 1.5. What is the speed of light through thi glass?

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21. Using mirror formula, explain why does a convex mirror always produce a virtual image.

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22. A virtual image. We always say, cannot be caught on a screen. Yet when we 'see' a virtual image, we are obviously bringing it on to the 'screen ' (i.e., the retina) of our eye. Is there a contradiction ?

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23. A diver under water, looks obliquely at a fisherman standing on the bank f a lake.

Would the fisherman look taller or shorter to the diver than what he actually is ?

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24. Does the apparent depth of a tank of water change if viewed obliquely ? if so, does the apparent depth increase or decrease ?

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25. The refractive index of diamond is much greater than the of ordinary glass. is this fact of some use to a diamond cutter ?

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26. The image of a small electric bulb fixed on the wall of a room is to be obtained on the opposite wall 3m away by means of a large convex lens. What is the maximum posible

focal length of the lens required for the purpose ?

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27. A screen is placed 90 cm from an object. The image of the object on the screen is formed by a convex lens at two different locations separated by 20 cm . Determine the focal length of the lens.

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28. a. Determine the 'effective focl length ' of the combination of the two lenses in Exercise 9.10, if they are placed 8.0 cm apart with their principal axes coincident . Does the answer depend on which side of the combination a beam of parallel light is incident? in the notion of effective focal length of this system useful at all ?

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29. An object 1.5 cm is size is placed on the side of the convex lens in the arrangement (a) above. The distance between the object and the convex lens is 40 cm. Detemine the maguificatin produced by the two-lens system an the size of the image.

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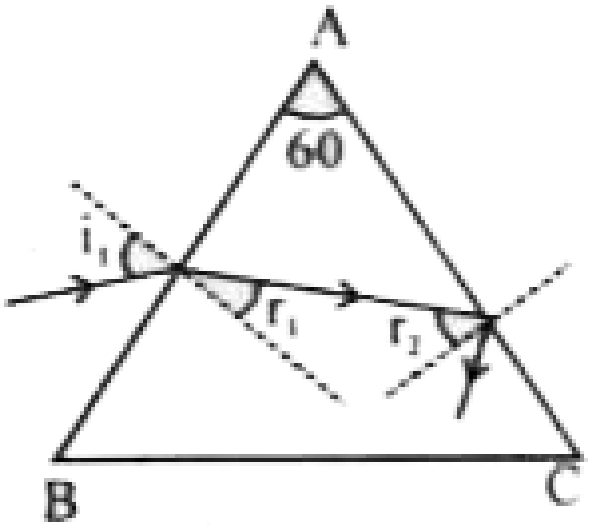
30. At what angle should a ray of light be incident on the face of a prism of refracting

angle 60° so that it just suffers total internal reflection at the other face ? The refractive index of the material of the prism is 1.524



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31. You are given prisms made of crown glass and flint glass with a wide variety of angles. Suggest a combination of prims which will

a. deviate a pencil of white light without much dispersion

b. disperse (and displace) a pencil of white light without much deviation

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32. For a normal eye, the far point is at infinity and the near point of distanct vision is about 25 cm in front of the eye. The cornea of the eye provides a converging power of about 40 dioptres, and the least converging power of the eye-lens behind the cornea is about 20 dioptres. From this rough data estimate the range of accommodation (i.e., the range of converaging power of the eye-lens) of a normal eye.

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33. A myopic person has been using spectacles of power -1.0 dioptre for distance vision. During old age he also needs to use separate reading glass of power +2.0 dioptres. Explain what may have happened.

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34. A person looking at a person wearing a shirt with a pattern comprising vertical and hoziontal lines is able to see the vertical lines

more distinclty than the horizontal ones. What is this defect due to ? How is such a defect of vision corrected?

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35. A man with normal near point (25 cm) reads a book with small print using a magnifying glass : a thin convex lens of focal length 5 cm .

a What is the closest and the farthest distance at which he should keep the lens from the

page so that can read the book when viewing through the magnifying glass ?

b. What is the maximum and the minimum angular magnification (magnifying power) possible using the above simple microscope ?

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36. A card sheet divided into squares each of size 1 mm^3 viewed at a distance of 9 cm through a magnifying glass (a converging lens of focal length 9 cm) held close to the eye.

a. What is the magnification produced by lenas ? How much is the area of each square in the virtual image ?

b. What is the angular magnification (magnifying power) of the lens ?

c. Is the magnification in (a) equal to the magnifying power in (b)? explain.

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37. a. At what distance should the lens be held in Exercise 27 in order to view the squares

distinectly with the maximum possible magnifying power ?

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38. If the object is at (50/7)cm and the image produced is at distinct vision. What is the magnification in this case ?

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39. Is the magnification equal to the magnifying power in this case ? Explain.

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40. What should be the distance between the object in Exercise 28 and the magnifying glass if the virtual image of each square in the figure is to have an area of 6.25 mm^2 Would you be able to see the squares distinctly with your eyes very close to the magnifier?

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41. The angle subtended at the eye by an object is equal to the angle subtended at the eye by the virtual image produced by a magnifying glass. In what sense then does a magnifying glass provide angular magnification ?

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42. In viewing through a magnifying glass, one usually positions one's eyes very close to the lens, does angular magnification change if the eye is moved back?

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43. Magnifying power of a simple microscope is inversely proportional to the focal length of the lens. What then stops us from using a convex lens of smaller and smaller focal length

and achieving greater and greater magnifying power ?

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44. Why must both the objective and the eyepiece of a compound microscope have short focal lengths?

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45. When viewing through a compound microscope, our eyes should be positioned not on the eyepiece, but a short distance away from it for best viewing . why ? How much should be that short distance between the eye and eyepiece?

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46. An angular magnification (magnifying power) of 30x is desired using on objective of

focal length 1.25 cm and an eyepiece of focal length 5cm. How will you set up the compound microscope ?

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47. A small telescope has an objective lens of focal length 140 cm and eyepiece of focal length 5.0 cm. What is the megniftying power of the telescope for viewing distant objects when

(a) the telescope is in normal adjustment (i.e,

when the final image is at infinity)

(b) the final image is formed at the least distance of distinct vision (25cm) ?

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48. For the telescope described in Exercise 32 (a) , whet is the separation between the objective lens and the eyepiece ?

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49. Focal length of the Objective lens is 140 cm. Focal length of the eyepiece is 5cm. 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 ?

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50. A height of a tower formed by a objective lens of a telescope is 4.7 cm. What is the

height of the final image of the tower if it is formed at 25 cm ?

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51. A Cassegrain telescope uses two mirrors. Such a telescope is bult with the mirrors 20mm apart. If the radius of carvature of the large mirror is 220mm and the small mirror is 140 mm, where will the final image of an object at infinity be ?

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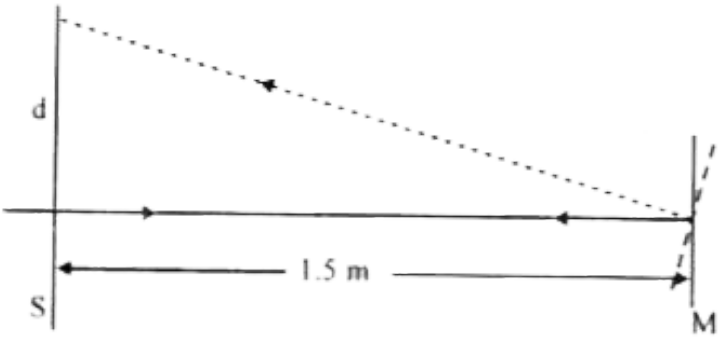
52. Light incident normally on a plane mirror attached to a galanometer coil retraces backwards as shown in figure . A current in the coil produces a deflection of 3.5° of the mirror. What is te displacement of the reflected spot of light on a screen placed 1.5 m away ?



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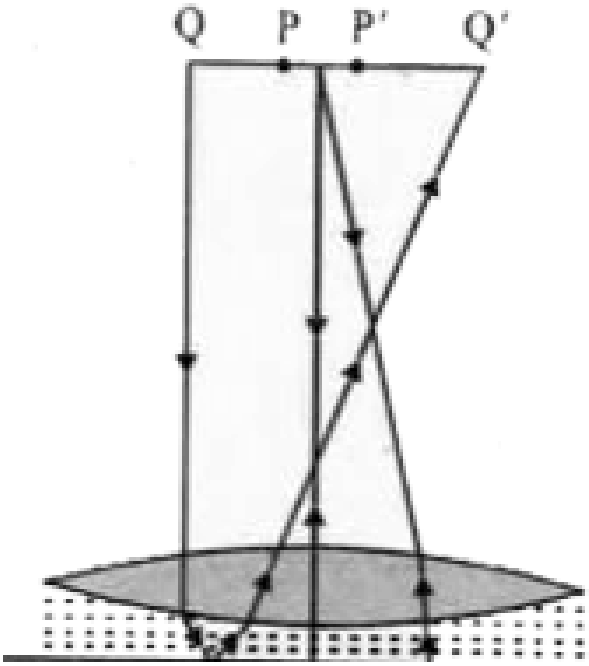
53. Figure shows an equiconvex lens (of refractive index 1.50) in contact with a liquid layer on top of a plane mirror. A small needle with its tip on the principal axis is moved along the axis until its inverted image is found at the position of the needle. The distance of the needle from the lens is measured to be 45.0 cm. The liquid is removed and the experiment is repeated . the new distance is measured to be 30.0 cm. What is the refractive

index of the liquid ?



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Practice Problems For Self Assessment

1. Use the mirror formula to show that for an object between the pole and focus of a concave mirror, the image formed is virtual .

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2. An object is kept in front of a concave mirror of focal length 20 cm. The image formed is three times the size of the object. Calculate the possible distance of the object from the

mirror for

a real image b. virtual image

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3. Find the position of the object for a convex mirror of focal length 20 cm, when the size of the image is half the size of the object.

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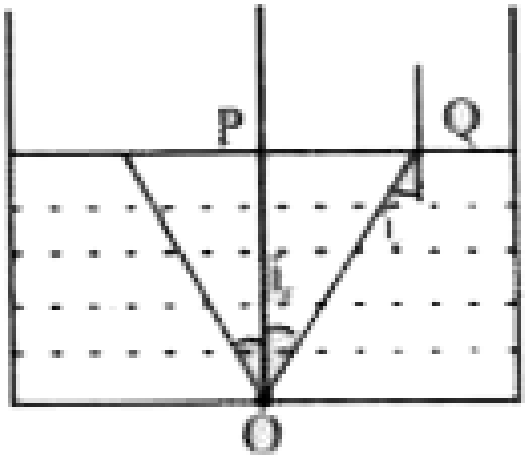
4. A small bulb is placed at the bottom of a tank containing water to a depth of 80cm. What is the area of the surface of water through which light from the bulb can emerge out? Refractive index of water is 1.33 (consider the bulb to be a point source .)



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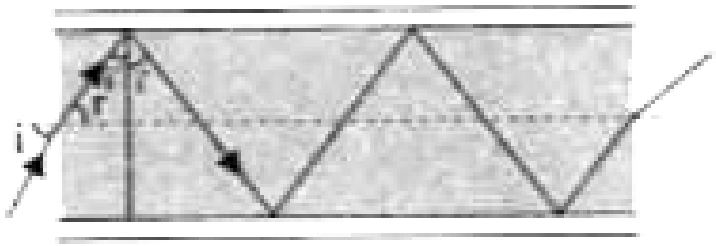
5. a.Figure shows a cross-section of a 'light pipe' made of glass fibre of refractive index 1.68

The outer converting of the pipe is made of a material of refractive index 1.44. What is the range of the angles of the incident rays with the axis of the pipe for which total reflections insides the pipe take place as shown in the figure.

b.What is the answer if there is no outer

converting of the pipe ?



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6. Angle of the prism A = 72° and its refractive index is 1.66 the prism is immersed in a liquid of refractive index 1.33 Find the angle of minimum deviation for a parallel beam of light passing through the prism .

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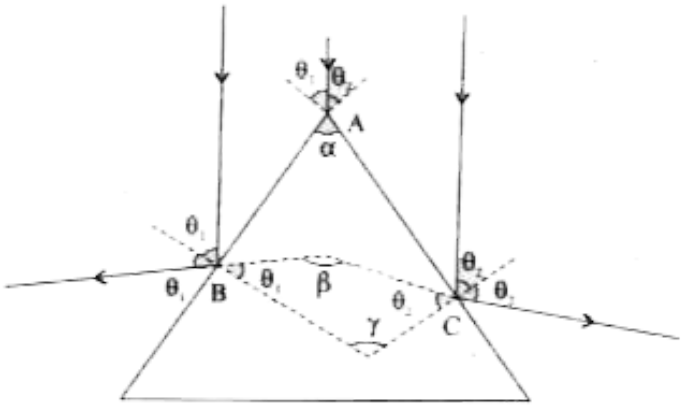
7. The earliest method of measuring refracting angle of a prism is to direct a parallel beams from the 2 faces of the prism as shown. Show that this angular separation is twice the angle of the prism $(\beta = 2\alpha)$.



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8. A parallel beam of light falls normally on the first face of a prism of small anlge A. At the second face it is partly transmitted partly reflected. The reflected beam striking the first face again, emerges out through the first face at an angle of $6^\circ 30'$ with the normal to the first face. The refracted beam is found to hae undergone a deviation of $1^\circ 15'$ from the original direction.

Calculate the refractive index and angle of the glass prism .

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9. A ray of light incident normally on to one face just grazes through the second face of the glass prism of refractive index $\frac{3}{2}$. Calculate the angle of the prism .

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10. An equilateral glass prism has a refractive index of 1.5 Calculate the (a) angle of incidence

for minimum deviation, (b) the minimum deviation, (c) the angle of emergence of the light at the maximum deviation .

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11. A beam of light converges to a point P , A lens is placed in the path of the convergent beams 12 cm from P. At what point does the beam converge if the lens is

a. A convex lens of focal length 20 cm.

b. A concave lens of focal length 16 cm ?

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

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13. a. Determine the 'effective focl length ' of the combination of the two lenses in Exercise

9.10, if they are placed 8.0 cm apart with their principal axes coincident . Does the answer depend on which side of the combination a beam of parallel light is incident? in the notion of effective focal length of this system useful at all ?

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14. A double convex lens is to be made of glass with refractive index. 1.5 One surface is to have twice the radius of curvature of the other

surface and focal length is to be 60 mm. What are the radii ?

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15. A lighted candle and the screen are placed at a fixed distance D apart. Show that the ratio of the two image sizes for two positions of the lens is $\left(\frac{D-d}{D+d}\right)^2$,where d is the distance between the two positions of the candle.

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16. A lens is made with 2 convex faces of same radii of curvature. The refractive index of the lens material is 1.54. What will be the radii of the two convex faces in order to give the lens a focal length of 30 cm ?

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17. A combination of two thin lenses in contact is to be made which has the same focal length for blue and red light. . (Such a combination is known as an ' achromatic doublet '). Show that

the ratio of their focal lengths (for lengths (for yellow light) must be equal in magnitude and opposite in sign to the ratio of the dispersive powers of the material of the two lenses.

b. Use the results in (a) to suggest a way of removing chromatic aberration of the convex lens of focal length 15 cm , made of flint glass. You are given convex and concave lenses (made of crown glass) of various focal lengths. The ratio of the dispersive powers of flint glass to crown glass is about 1.5

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18. For a normal eye, the far point is at infinity and the near point of distanct vision is about 25 cm in front of the eye. The cornea of the eye provides a converging power of about 40 dioptres, and the least converging power of the eye-lens behind the cornnea is about 20 dioptres. from this rough data estimate the range of accommodation (i.e., the range of converging power of the eye-lens) of a normal eye.

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19. In a compound microscope, the objective and eyepiece have focal lengths 0.95 cm and 5 cm respectively and are kept at a distance of 20 cm .the final image is formed at a distance of 25 cm from the eyepiece. Calculate the position of the object and the total magnification .

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20. An amateur astronomer wishes to estimate roughly the size of the Sun using his crude telescope consisting of an objective lens of focal length 200 cm and an eyepiece of focal length 10 cm. By adjusting the distance of the eyepiece from the objective, he obtains an image of the Sun on a screen 40 cm behind the eyepiece. the diameter of the sun's image is measured to be 6.0 cm. What is his estimate of the Sun's size given that the average Earth-sun distance is 1.5×10^{11} m ?

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Evaluation Question And Answers

1. A convex lens is placed in water.

a. Will there be any change in its focal length?

B. Give reason.

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2. a. Which mirror is used as driver's mirror ?

b. Why ?

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3. a. State the law of distances .

b. Using the law deduce that an object between F and 2F a concave mirror produces real image beyond 2F.

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4. What is the cause of refraction of light ?

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5. When does Snell's law of refraction fail ?

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6. A beaker is placed on the top of a coin. The top of the beaker is closed with an opaque body with a small hole. View the coin from an angle , slowly add water through the hole while continuing to view the coin from the same angle. Repeat the procedure using cooking oil.

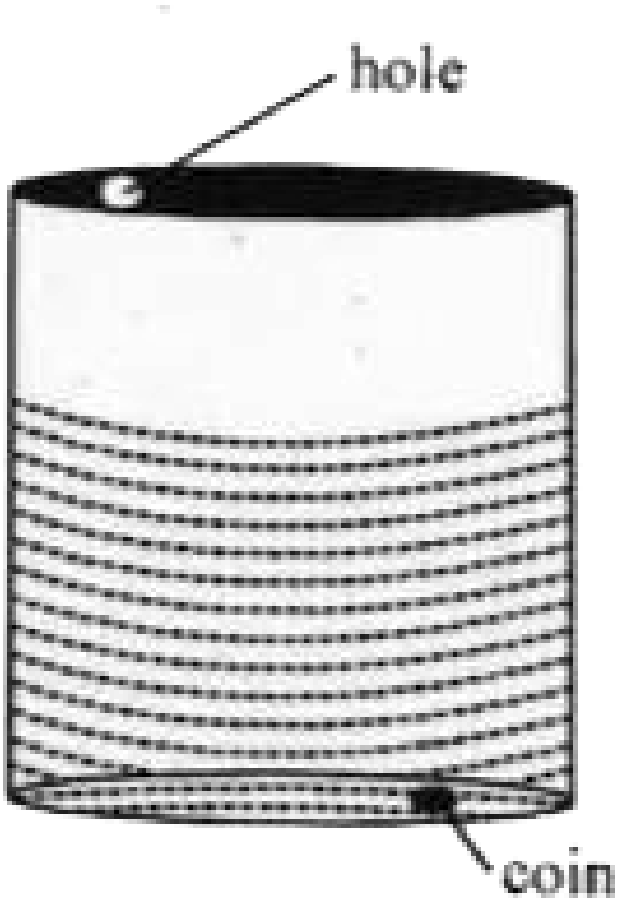
a. What happens when water is continuously added ?

b. What about the heights of water and oil, when con completely disappears ?

c. In which liquid, the coin is concealed best with minimum height? Why?

d. What is the valation between opitieal angle

and refrective index. ?



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7. A beam of light passing from one transparent medium to another obliquely, undergoes an abrupt change in direction. This phenomenon is known as refraction of light.

a. Name the law which satisfies during this refraction.

b. Draw the figure which shows refraction through a parallel sided glass slab. (Ray passing from air)

c. Using the figure obtaind in (b). Show that the incident ray and the emergent ray are parallel to each other.

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8. You are given an equilateral glass prism of refractive index 'n'. A light rays is incident on one of its faces at an angle $'i_1'$.

a. What happens when you increase $'i_l'$ gradually ?

b. What happens if $'i_l'$ is increased beyond a certain value ?

c. Give the graphical representation of variation

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9. a. What is the principle used in optical fibres ?

b. Explain briefly the working principle.

c. What are the uses of optical fibres ?

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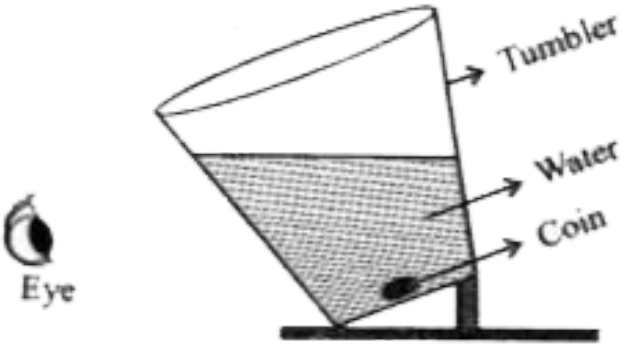
10. If the tumbler is suitably tilted and viewed at a suitable angle.

a. how the coin apprear ?

b. What is due to ?

c. Draw the course of the light ray.



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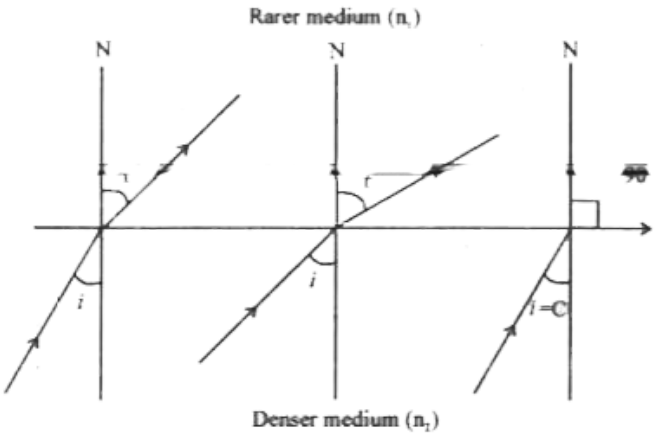

11.

A ray of light passes from denser medium to rarer medium

a. What happens to the refracted ray as the angle of incidence increases from 0° ?

b. What is the importance of the angle C (marked in the figure above)?

c. How is 'C' related to the refractive index 'n' of the medium ? Explain.

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12. A candle is placed in front of a concave lens.

a. Draw the course of the light ray through lens and study the nature of the image formed.

b. If it possible for the concave lens to form a real image ?

c. If possible draw the corresponding ray diagram.

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13. a. What is meant by magnification 'm' ?

b. Give the mathematical relation.

c. How is 'm' related to object distance and image distance ?

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14. The power of a lens is +2D.

a . What do you mean by this ?

b How is power related to its focal length ?

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15. You are given two convex lenses.

a. What is the focal length of the combined lens formed by the lenses put in contact ?

b . What is the advantage in the combination ?

c. if one of the lenses is concave, how will you

find its focal length with the help of lens combination ?

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16. Why do stars twinkle ?

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17. Why does a diamond sparkle with great brilliance?

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18. When a solar spectrum is viewed, we can see a number of dark lines.

a. What are these dark lines called ?

b. How are they formed ?

c. What is their importance ?

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19. $I \propto \frac{1}{\lambda^4}$ where I is the intensity of light and λ its wavelength.

a. Which law does the above expression represent ?

b. Give the law statement form.

c. What conclusion do you draw from this ?

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20. a. What is scattering of light? b. Explain Rayleigh scattering.

c. Why sky appears blue? d. Sky blue extends over a wide region. Why ?

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21. A plano-convex lens fits exactly into a plano-concave lens. Their surfaces are parallel to each other if the lenses are made of different materials. Will the combination act as a lens? If so, what is its focal length? Is it convergent or divergent ?

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22. The teacher shows a thin lens and a thick lens.

a. Which of these lens forms more enlarged image ?

b. Which lens has greater focal length?

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23. a. Is there any difference between fluorescence and phosphorescence ?

b. If so, what is the difference ?

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24. It can be seen that no rainbow is seen during the middle of the day. Give reason.

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25. How could a blue object appear under sodium lamp light ?

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26. A welder wears a mask. Give reason.

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27. Sha went to a doctor and said that he could not see distant objects clearly. Doctor tested and prescribed a lens of power - 0.75 D.

a. what is the eye defect of sha ?

b. Why did the doctor prescribe a lens - 0.75 D ?

c. What type of lens is this ?

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28. Hari asked Prof.Joy, "sir, Why are you using spectacles to read text books etc. " Prof Joy explained. What is the explanation given by Prof.Joy?

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29. A point object at a distance of 36 cm from a convex lens of focal length 10 cm, is moved by 10 cm in 2 sec along principal axis towards the lens. Then image will aslo change its position.

a. Write the law which relates object and image distance from the lens.

b. Find the inwal and final position of the image and calculate average speed of image .

c. A man argues that the image will move uniformly at the same speed as that of object What is your opinion ? Justify.

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30. You may observe that the fish inside the equarium appears to be raised.

a. What is the reason for this phenomenon ?

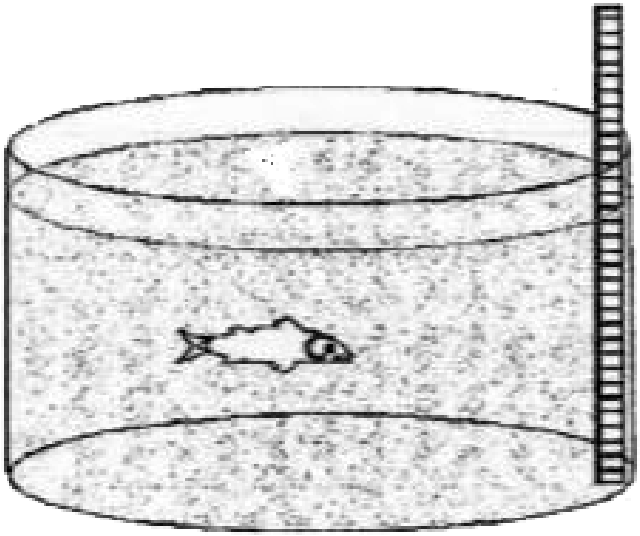
c. What happens to the height of the object , (that vertically stands in the aquarium) when it is observed by the fish ?

i. Becomes taller

ii. becomes smaller

iii. The height does not change

Justify your answer .



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Continuous Evaluation

1. Study or refractive index of liquids and solutions using hollow prism

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2. Measurement of focal length of lenses in contact and correction for their thickness and

study of combination of lenses to reduce chromatic and spherical aberration .

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3. Explain different experimental methods to determine refractive index of glass .

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4. Prepare a chart of refractive index and critical angle of various subtances.

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5. Discuss the application of refraction of light.

Watch Video Solution

6. Discuss the application of total internal reflection.

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7. a. What is the principle used in optical fibres ?

b. Explain briefly the working principle.

c. What are the uses of optical fibres ?

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8. Explain various types of convex and concave lenses.

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9. Obtain the image formation by convex lens and concave lens. Write a note on persistence of vision.

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10. What is persistence of vision?

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11. Write a note on primary colours, secondary colours and complementary colours.

Watch Video Solution

12. Explain the practical applications of spherical mirror.

Watch Video Solution

13. Explain various types of spectra.

Watch Video Solution

14. Mention some types of source of light.

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15. Explain the working of a photographic camera.

Watch Video Solution

16. Compare human eye with a camera.

Watch Video Solution

17. Distintuish between refracting type telescope and reflecting type telescope.

Watch Video Solution

18. Discuss various common defects of vision.

Watch Video Solution

19. Explain the construction and working of a 'Compound Microscope'.

Watch Video Solution

20. Describe the construction and working of an astronomical telescope.

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Previous Year Questions

1. i. Light has several properties like reflection, refraction etc. When light travels from an optically denser medium to a rarer medium ?

a. What happens to the light at the interface ?

b. give a demonstration for total internal reflection.

c. What are the technological applications of total internal reflection in nature? Briefly explain it.

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

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Competitive Exam Corner

1. A 100 W bulb produces an electric field of 2.9 V/m at a point 3m away. If the bulb is replaced by 400 W bulb without disturbing other

conditions. Then the electric field produced at the same point is

A. a. 2.9 V/m

B. 3.5 V/m

C. c. 5V/m

D. d. 5.8 V/m

Answer: D

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2. The focal length of the objective and of the eye- piece of compound microscope are f_0 and f_e respectively. If L is the tube length and d, the least distance of distinct vision, then its angular magnification, when the image is formed at infinity, is

A. a. $\left(1-\frac{L}{f_0}\right)\left(\frac{D}{f_e}\right)$

B. b. $\left(1+\frac{L}{f_0}\right)\left(\frac{D}{f_e}\right)$

C. c. $\frac{L}{f_0}\left(1-\frac{D}{f_0}\right)$

D. d. $\frac{L}{f_0}\left(\frac{D}{f_e}\right)$

Answer:

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3. The velocity of a moving galaxy is 300 kms^{-1} and the apparent change in wavelength of a spectral line emitted from the galaxy is observed as 0.5 nm. Then the actual wavelength of the spectral line is

A. 3000 Å

B. 5000 Å

C. 6000 Å

D. 5500 Å

Answer: B

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4. 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. The focal length f_0 of the

objective and f_e of the eyepiece are respectively

A. 45 cm and 9 cm

B. 50 cm and 10 cm

C. 7.2 cm and 5 cm

D. 30 cm and - 6 cm

Answer: D

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5. If the reflected image formed is magnified and virtual, then the mirror system is

A. concave only

B. convex only

C. plane

D. concave or convex

Answer: A

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6. A vessel of depht 'x' is half filled with oil of refractive index μ_1 and the other half is fillied with water of refractive index μ_2 . The apparent depth of the vessel when viewed from above is

A. $\frac{x(\mu_1+\mu_2)}{2\mu_1\mu_2}$

B. $\frac{x\mu_1\mu_2}{2(\mu_1+\mu_2)}$

C. $\frac{x\mu_1\mu_2}{(\mu_1+\mu_2)}$

D. $\frac{2x(\mu_1+\mu_2)}{\mu_1\mu_2}$

Answer: A

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7. For an angle of incidence θ on an equilateral prism of refractive index $\sqrt{3}$, the ray refracted is parallel to the base inside the prism. The value of θ is

A. 30°

B. 45°

C. 60°

D. 75°

Answer: C

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8. The power of a biconvex lens is 10 dioptre and the radius of corvature of each surface is 10 cm . Then the refractive index of the material of the lens is

A. $\frac{3}{2}$

B. $\frac{4}{3}$

C. $\frac{9}{8}$

D. $\frac{5}{3}$

Answer: A

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9. The focal length of the lens of refractive index $(\mu = 1.5)$ in air is 10 cm. If air is replaced by water of $\mu = \frac{4}{3}$, its focal length is

A. 20 cm

B. 30 cm

C. 40 cm

D. 25 cm

Answer: C

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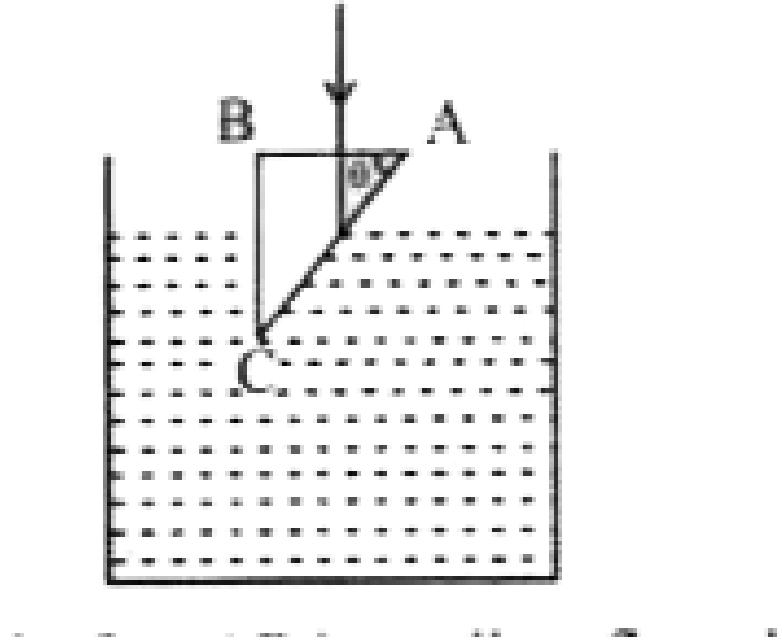
10. A glass prism of refractive index 1.5 is immersed in water $\left(\mu = \frac{4}{3}\right)$. Refer figure.



A light beam incident normally on the face AB is totally freflected to reach the face BC if

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11. A ray of light is incident at 60° on one face of a prism of angle 30° and the emergent ray

makes 30° with the incident ray.the refractive index of the prism is

A. 1.732

B. 1.414

C. 1.5

D. 1.33

Answer: A

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12. An object is kept at a distance of 60 cm from a concave mirror. For getting a magnification of $\frac{1}{2}$, Focal length of the concave mirror required is

A. a. 20 cm

B. b. 40 cm

C. c. -20 cm

D. d. 30 cm

Answer: C

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13. If the speed of light in material A is 1.25 times its speed in material B then the ratio of he refractive indices of these materials is

A. a. 1.5

B. b. 1

C. c. 0.8

D. d. 1.25

Answer: C

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14. The resolving power of a microscope is

A. inversely proportional to numerical aperture

B. directly proportional to wavelength

C. directly proportional to square of the wavelength

D. directly proportional to numerical aperture

Answer: D

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15. The least distance of distance vision of a person is 75 cm. The focal length of the reading spectacles for such a person should be

A. a. 37.5 cm

B. b. 40 cm

C. c. 25 cm

D. d. 50 cm

Answer: A

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16. The focal lengths of the objective and the eyepiece of the telescope are 225 cm and 5 cm respectively. The magnifying power of the telescope will be

A. a. 49

B. b. 54

C. c. 35

D. d. 60

Answer: B

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17. The angle of incidence for an equilateral prism of refractive index $\sqrt{3}$ so that the ray is parallel to the base inside the prism is

A. a. 30°

B. b. 20°

C. c. 60°

D. d. 45°

Answer: C

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18. The sunlight reaches us as white light and not as its compounts because

A. a)air medium is dispersive

B. b)air medium is non-dispersive

C. c)air medium scatters the sunlight

D. d)air medium absorbs the sunlight

Answer: B

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19. The apparent flattening of the sun at sunset and sunrise is due to

A. refraction

B. diffraction

C. total internal reflection

D. interference

Answer: A

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20. Identify the mismatch in the following

A. Myopia - Concave lens

B. For rear view - concave mirror

C. Hypermetropia - convex lens

D. Astigmatism - Cylindrical lens

Answer: B

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21. Two lenses of power 15 and - 3 dioptre are placed in contact. The focal length of the combination is

A. 10 cm

B. 15 cm

C. 12 cm

D. 8.33 cm

Answer:

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22. The speed of light in an isotropic medium depends on

A. a. the nature of the source

B. b. its wavelength

C. c. its direction of propagation

D. d. its intensity

Answer: B

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23. Astigmatism is corrected using

A. cylindrical lens

B. plano-convex lens

C. Plano-concave lens

D. convex lens

Answer: A

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24. An aperture of size a is illuninated by a parallel beam of light of wavelength γ. The distance at which ray optics has a good approximation is

A. a. $\frac{a^2}{\lambda}$

B. b. $\frac{\lambda}{a^2}$

C. c. $\frac{\lambda}{a}$

D. d. $\frac{\lambda^2}{a}$

Answer: A

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25. Identify the wrong sign convention

A. The magnification for virtual image formed by a convex lens is positive

B. The magnification for real image formed by a convex lens is negative

C. The height measured normal to the principal axis upwards is positive

D. The magnification for virtual image formed by a concave lens is nagative

Answer:

26. A ray of light is incident normally on one refracting surface of an equilateral prism . If the refrctive index of a material of the prism is 1.5., then

A. the emergent ray is deviated by 30°

B. the emergent ray is deviated by 60°

C. the emergent ray just graces the second reflecting surface

D. The ray undergoes total internal reflection at second refracting surface

Answer: D

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