PHYSICS

BOOKS - PEARSON IIT JEE FOUNDATION

LIGHT

Example

1. A convex mirror is made by cutting a hollow sphare of radius of curvature 20 cm. Find the

focal length of the mirror.

2. An object is placed at 20 cm from the pole of a concave mirror. It forms real image at a distance of 60 cm from the pole. Find the focal length of the concave mirror.

3. An object is placed at a distance of $10cm$ from a convex mirror of focal length $15cm$. Find the position and nature of the image ?

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4. A concave mirror of focal length 8 cm forms an inverted image of an object placed at a certain distance. If the image is twice as large as object, where is the image formed ?

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5. An object is placed at a distance of 30 cm from a convex lens of focal length 20 cm.

6. An object is placed in front of a convex lens of focal length 12 cm. If the size of the real image formed is half the size of the object, calculate the distance of the object from the lens.

7. Calculate the power of the eye lens of the normal eye, when it is focused at far point and near point, given the diameter of the eye is 2.5 cm. Find the maximum variation in the power of normal eye lens.

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Very Short Answer Type Questions

1. Is the virtual image formed by a concave mirror always magnified ?

2. Define Snell's law of refraction.

3. DISPERSION FORCES

4. Under what conditions, it is possible to obtain a virtual image with the help of a convex lens?

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5. What are primary colours ? Why are they so called ?

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6. How are shadows cast?

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7. What is a mirror formula?

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8. Mention two uses of IR rays.

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9. Red and cyan are called _____ colours.

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10. What are umbra and penumbra?

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11. CONDITIONS OF TOTAL INTERNAL REFLECTION

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12. What is fluoroscence?

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13. Derive lens formula for a concave lens.

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14. What is a spherical mirror, ? Distinguish between a concave mirror and a convex mirror.

15. Define optic centre of a lens.

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16. Define critical angle.

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17. What is a pigment?

18. REFRACTION OF LIGHT

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19. How many images of an object are formed when two plane mirrors are inclined to each other facing each other at an angle of $60°$?

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20. What is meant by scattering of light ?

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21. Define spectrum.

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22. REFRACTIVE INDEX

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23. What is irregular reflection?

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24. Why is a concave mirror called converging mirror ?

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25. Among the different colours of white light, the colour, which undergoes the maximum scattering, is _____ .

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26. Give two uses of uv rays.

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27. What is a rainbow?

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28. Define first principal focal length of a convex lens.

29. A light ray travels from oil to water medium. Does it bend towards the normal or away from the normal ?

30. When an object is placed at infinite distance from a concave mirror, what is the position of the image?

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Short Answer Type Questions

1. What information do we get about sunlight from the formation of a rainbow ?

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2. A concave mirror is made from a hollow sphare of redius 30 cm. If an object 2 cm high is placed at 10 cm from the pole of the mirror, determine (1) the position, (2) nature and (3) size of the image.

3. Why does the sun appear red at sunrise ?

4. Light rays from the sun after reflection at a plane mirror pass throgh a hole in a wall. After some time due to the shift in the position of the sun, the angle of incidence of sun light increases by $10°$. By what angle, should the mirror be rotated, such that the reflected rays continue to pass through the hole in the wall?

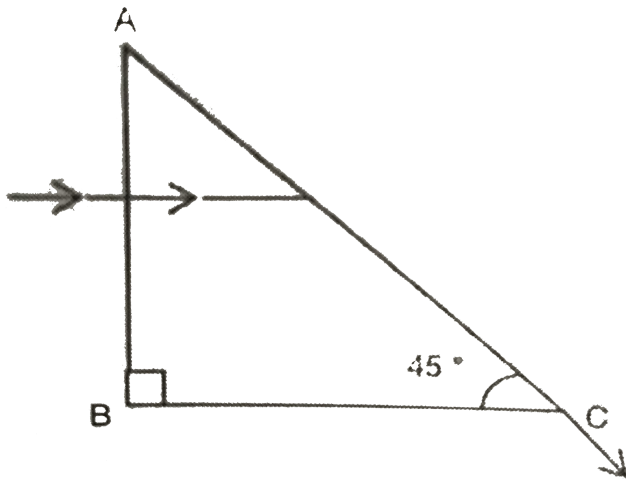**5.** State and explain sign conventions used in spherical mirrors.

6. What is the refractive index of the material of the glass prism shown in the figure, if a ray of light incident normally at the face AB

emerges along the face AC?

7. With the help of a ray diagram, show the formation of an image of an object placed

between principal focus and centre of curvature of a concave mirror.

8. In an optical instrument, a convex lens of focal length 20 cm is used in combination with a concave lens of focal length 40 cm. What is the power of this combination?

9. Define power of a lens and write its unit

10. Write two advantage and two disadvantages of a pin hole camera.

11. Mention differences between light microscope and electron microscope.

12. Two mirrors inclined to each other produce 8 images of an object placed between them. Through how much angle should one of the mirror be rotated to get only two images?

13. What is lateral inversion of images ? Explain with an example.

14. An object is placed on the principal axis of a convex mirror of focal length 15 cm. If the distance of the object from the mirror is 30 cm, where should a plane mirror be placed such that the images produced by the two mirrors coincide?

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Essay Type Questions

1. Prove that focal length of a spherical mirror is equal to half the radius of its curvature.

2. Explain an experiment to determine the focal length of a concave mirror by u-v method.

3. Obtain an expression for mirror formula (either for concave or convex mirror).

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4. What is atmospheric refraction? Explain with an example.

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Level 1

1. Red , green and blue pigments are primary pigments.

2. When an object is placed between two plane mirrors which are inclined at right angle, the number of images formed is four.

    A. True

    B. False

    C.

D.

Answer:

3. The power of a rectangular glass slab is zero

.

A. True

B. False

C.

D.

Answer: 1

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4. Virtual image produced by convex mirror is always smaller in size and located between focus and the pole.

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5. Rainbow is an impure spectrum caused by sunlight.

A. True

B. False

C.

D.

Answer: 1

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6. The rays passing through the optic centre of a thin lens suffers no lateral displacement.

A. True

B. False

C.

D.

Answer: 1

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7. A ray of light passing through centre of curvature of a concave mirror retraces its path on reflection. Why ?

8. When a light ray passes from a denser medium into a rarer medium, the angle of incidence for which the angle of refraction is maximum is called _____

9. _____ mirror is used for obtaining real images.

10. The colour, we observe, when white light passes through yellow and red filters in that order is _____ .

11. The image of an object at infinite distance is formed at _____ of a concave mirror.

12. Power of the lens is the _____ of the focal length .

13. Fog is an example of _____ medium.

14. The refractive index of a medium (2) with respect to medium (1) is x and refractive index of medium (2) with respect to medium (3) is 'y' then what is the refractive to index of the medium (3) with respect to medium (1).

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Column A		Column B
A. Object at infinite distance	( )	a. light
B. Shadow	( )	b. light travels with less velocity
C. Real image	( )	c. dispersion of light
D. Optically denser medium	( )	d. angle of incidence = angle of emergence
E. Elliptical shape of the setting sun	( )	e. convex lens.
F. Angle of minimum deviation	( )	f. concave lens
G. Rainbow	( )	g. parallel beam of light rays
H. Myopia	( )	h. rectilinear propagation
I. Sensation of vision	( )	i. refraction of light

15.

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16. V_V, V_R, V_G are the velocities of violet, red and green light , respectively, in a glass prism.

Which among the following is a correct relation?

A. $V_V = V_R = V_G$

B. $V_V > V_R > V_G$

C. $V_V < V_G < V_R$

D. $V_V < V_R < V_G$

Answer: C

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17. As an object moves towards a convex mirror, the image

    A. magnification increases

    B. moves towards the mirror

    C. Neither (a) nor (b) happens

    D. Both (1) and (2) happen

Answer: D

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18. When a light ray passes from an optically denser medium into an optically rarer medium,

A. its velocity increases

B. frequency requency remains same

C. wavelength increases

D. All the above

Answer: D

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19. Time taken by the sunlight to pass through a window made of glass of 5 mm thickness is _____ s. $\left(\mu_{\text{glass}} = 1.5\right)$

A. 2.5×10^{-11}

B. 0.4×10^{-8}

C. 4×10^{-8}

D. 2.5×10^{-5}

Answer: A

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20. A man at the bottom of a pool wants to signal to a person lying at the edge of the pool. The man should beam his water proof light _____ .

   A. vertically upwards

   B. at an angle to the vertical which is less than the critical angle.

   C. at an angle to vertical which is equal to the critical angle.

D. at an angle to the vertical which is

greater than critical angle.

Answer: C

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21. Choose the correct statement.

A. The final image formed by a terrestrial

telescope is inverted.

B. The final image formed by an

astronomical telescope in erect.

C. The final image of an astronomical

telescope is magnified.

D. Both (a) and (b)

Answer: C

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22. Light appears to travel in straight lines since

A. it passes by the atmosphare

B. its wavelength is very small

C. its velocity is very large

D. it is a form of energy

Answer: B

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23. Choose the correct statement

A. The combination of a convex lens and a concave lens is a concave lens if the focal length of the convex lens is numerically less than that of concave lens .

B. The power of the combination of a concave lens and convex lens is more than the power of individual lenses.

C. The combination of a convex lens and concave lens of equal focal length

behaves as a glass slab.

D. All the above.

Answer: C

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24. The power of two lenses are + 6 D and - 4 D , determine the power of the combination of two lenses.

A. 6D

B. 4D

C. 2D

D. 3D

Answer: C

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25. The angle which the incident ray makes with the mirror is called

A. angle of incidence

B. angle of reflection

C. right angle

D. glancing angle of incidence

Answer: D

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26. A magenta pigment absorbs _____

colours

A. red

B. blue

C. green

D. magenta

Answer: C

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27. A concave mirror is placed on a table with its pole touching the table . The mirror is rotated about its principal axis in clockwise

direction. The image of a person looking straigth into it

A. rotates in clockwise direction

B. rotates in anti-clockwise direction

C. is inverted

D. does not rotate

Answer: D

28. If two plane mirrors are placed with the reflecting surfaces perpendicular to each other, which of the following statement is true?

A. The rays incident on the first mirror and the rays reflected from the second mirror are always parallel.

B. The rays incident on the first mirror and the rays reflected from the second mirror are perpendicular.

C. The angle of deviation lies between

   $90°$ and $180°$.

D. None of the above.

Answer: A

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29. Which of the following statements is true,

if a planet is observed with the help of an

astronmical telescope?

A. The image of the planet is errect.

B. The objective is larger than the eye piece.

C. Eye piece has greater focal length than the objective.

D. Eye piece is of convex lens and the objective is of concave lens.

Answer: B

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30. a convex lens forms a virtual image of an object. What is the position of the object ?

A. between the lens and its focus.

B. at the focus of the lens.

C. between F and 2F.

D. at infinity

Answer: A

31. Law Of Rectilinear Propagation Of Light

A. it passes through the atmosphere.

B. its wavelength is very small.

C. its velocity is very large.

D. it is a form of energy.

Answer: B

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32. When a point source of light is kept near a plane mirror

   A. only the reflected rays close to the normal meet at a point when produced backwards.

   B. only those rays reflected at small angles meet when produced backwards.

   C. light of different colours form images of different sizes.

D. all the reflected rays meet at a point when produced backwards.

Answer: D

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33. Arrange the following steps in a sequential order to determine the focal length of a concave mirror by distant object method.

(A) Place a white screen in front of the mirror and adjust the position of the screen until a

sharp images is formed.

(B) Focus the mirror towards a distant object.

(C) Mount the concave mirror on a mirror stand.

(D) Measure the distance between the screen and the mirror. This gives the focal length.

A. C A B D

B. C B A D

C. B A C D

D. A B D C

Answer: B

34. If μ_v, μ_r, μ_b are refractive indices of violet, red and blue, respectively, in a given medium, then

    A. $\mu_v = \mu_b = \mu_r$

    B. $\mu_v > \mu_b < \mu_r$

    C. $\mu_v > \mu_b > \mu_r$

    D. $\mu_v > \mu_b < \mu_r$

Answer: C

35. A lens behaves as a diverging lens in air and converging lens in water.The refractive index of the material of the lens is _____ .

   A. greater than refractive index of water

   B. equal to refractive index of water

   C. between 1 and refractive index of water

   D. equal to unity

Answer: C

36. Write the following steps in a sequential order to determine the focal length of a concave mirror by using graphical method.

(A) Determine the object distance and image distance, by placing the object a diflerent places in front of convex lens.

(B) Draw a line (OP) which makes an angle 45° with the X-axis.

(C) Mark the values of u on the X -axis and the corresponding values of v on the Y-axis and

join the points to obtain a curve.

(D)Mark the point where the line OP intersects

the curve.

(E) Draw perpendiculars PA and PB to the X-

axis and Y-axis from the point (P).

(F) Draw a graph by taking object distance (u)

on the X-axis and image distance (v) on the Y-

axis.

(G) It is found that the value OA and OB are

equal which is equal to the redius of curvature

and the

focal length f = $\dfrac{\text{Radius of curvature}}{2}$

A. A D B F E C G

B. A B C D F E G

C. A F C B D E G

D. A F C B G E D

Answer: C

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37. When red and green light fall on certain region of a screen simultaneously, the region will look _____ .

A. red

B. blue

C. yellow

D. white

Answer: C

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38. Cameras used in remote sensing make use

of

A. visible light

B. ultraviolet rediation

C. redio waves

D. infrared radiation

Answer: D

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39. The focal length of a normal eye lens is about

A. equal to 2.5

B. > 2.5

C. < 2.5

D. Both (a) and (c).

Answer: D

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40. Which of the statements is true in case of an astronomical telescope?

A. The image of the object is erect when viewed through it.

B. The objective is larger in size than the eye piece.

C. Eye piece ha sgreater focal length than the objective.

D. Eye piece is a convex lens and the objective is a concave lens.

Answer: B

41. The diaphragm in a photographic camera

    A. controls the exposure time of the film.

    B. controls the amount of light entering

       the camera.

    C. varies the focal length of the lens.

    D. prevents internal reflection of light.

Answer: B

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42. When light emitted by a point source of light is passed through a prism, after dispersion, the emerging light would produce on the screen

A. a pure spectrum

B. an impure spectrum

C. a line spectrum

D. None of these

Answer: B

43. On mixing the colours yellow and cyan, the colour obtained is _____ .

A. red

B. blue

C. green

D. black

Answer: C

44. During total internal reflection, the energy of the incident light

    A. is absorbed by the reflecting surface.

    B. is not absorbed by the reflecting surgace.

    C. increases.

    D. None of the above

Answer: B

45. For a given glass prism, as the angle of incidence increases, the angle of emergence _____ .

A. decreases

B. increases

C. remains the same

D. None of the above

Answer: A

Level 2

1. A student with a normal eye observes the reading on a vernier scale using a magnifying glass of focal length 10 cm. What are the minimum and the maximum distances between the scale and the magnifying glass at which he can read the scale when viewing through the magnifying glass ?

▶

2. A light ray incident on a plane mirror gets reflected from it. Another plane mirror is placed such that the reflected ray from the first mirror is incident on it If the reflected ray from the second mirror travels perpendicular to the indecent ray on the first mirror, determine the angle between two plane mirrors.

3. Why do clouds generally look white ?

4. Two plane mirrors X and Y are placed parallel to each other and are separated by a distance of 20 cm. An object is placed between the two mirrors at a distance 5 cm from the mirror X. Find the distance of the first three image formed in the mirror X.

5. An object is placed between two identical convex mirrors X and Y of focal length 15 cm a the midpoint on their common principal axis. If the two mirrors are separated by a distance of 20 cm, determine the distance of the first two images formed in the mirror Y .

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6. A rod of length (f/2) is placed along the axis of a concave mirror of focal length f. If the

near ead of the real image formed by the mirror just touches the far end of the rod, find its magnification.

7. A diver under water sees a bird in air, vertically above him. If the actual, height of the bird above the water surface is 'h' , then does it appear at the same height 'h' to the diver ? Explain giving reasons. If μ_w is the refractive

index of water, find the shift in the bird's position as observed by the diver.

8. A ray of light is incident on a plane mirror placed horizontally. When the mirror is rotated through an angle $30°$ the reflected ray is found to be directed along the vertical. Determine the angle of incidence at the initial position of the mirror.

9. A ray of light is incident at an angle of $60°$ on a prism whose refracting angle is $30°$. The ray emerging out of the prism when produced backward makes an angle of $30°$ with the incident ray produced forward. Find the refractive index of the material of the prism.

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10. A light ray passes from air to denser medium of certain thickness and emerges on

the other side. If emergent ray is parallel to the incident ray, the distance travelly by the ray of light in the denser medium is 6 cm, and the angle of incidence and refraction are $60°$ and $30°$, respectively, find the lateral displacement of the light ray.

11. A postal stamp is placed on a surface and a glass cube of refractive index $\dfrac{3}{2}$ is placed over it. When observed through the glass slab, the

stamp appears at a height of 1.5 cm from the bottom. Another glass cube made of different material nad having the same thickness is placed over the first glass cube. When observed from the top, the stamp now appears to be at a height of 4 cm from the bottom. Determine the refractive index of the second galss cube.

12. A telescope has an objective of focal length 100 cm and eye piece of focal length 6 cm and the least distance of distinct vision is 25 cm. The telescope is focused for distinct vision of an object at a distance 100 m from the objective. What is the distance of separation between objective and eye piece?
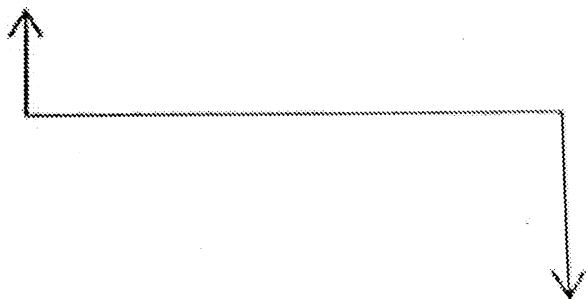
13. Which radiation is used to photograph in smoke or fog? Explain why?

14.

An object and the image obtained from the lens are as given above.

If the distance between the object and the

image is 36 cm and the magnification is -2, find the focal length of the lens and draw the ray diagram to show the position of the lens.
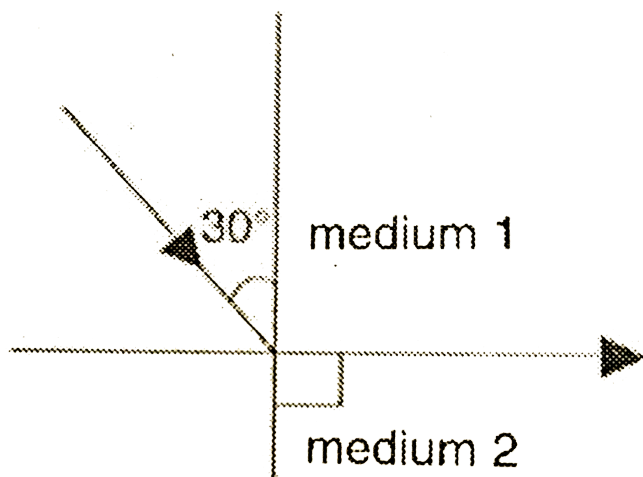
15. Determine the thickness of the glass through which light can pass is 5×10^{-11} seconds (Take $\mu_{\text{glass}} = 1.5$).

16. A light ray travels from a medium 1 to medium 2 as shown in the figure. If the refractive of midium 1 is $2\sqrt{2}$, determine the refractive index of medium 2.

Solution

Angle of incidence, $\theta_1 = 30^\circ$ and angle of refraction, $\theta_2 = 45^\circ$.

Using Snell's law:
$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$$2\sqrt{2}\,\sin 30^\circ = n_2 \sin 45^\circ$$

$$2\sqrt{2} \times \frac{1}{2} = n_2 \times \frac{1}{\sqrt{2}}$$

$$n_2 = \sqrt{2} \times \sqrt{2} = 2$$

17. The power of two lenses are + 6 D and - 4 D , determine the power of the combination of two lenses.

18. The refractive index of a medium (2) with respect to medium (1) is x and refractive index of medium (2) with respect to medium (3) is 'y' then what is the refractive to index of the medium (3) with respect to medium (1).

19. The ciliary muscles can change the focal length of the eye lens. Find the ratio of focal lengths of the eye lens when it is focused on two different objects, one at a distanace of 2 m and the other at a distanc of 1 m. The diameter of normal eye is 2.5 cm.

Level 3

1. A glass slab ABCD is made of two different grades of glass of refractive indices $\dfrac{3}{2}$ and $\dfrac{4}{3}$ of equal thickness, and a ray PQ is incident on the face AB. Trace the ray as it passes through the slab and find the angle of emergence and the angle of deviation, Find the effective refractive index of the slab.

P

60°

Q

A

B

t $\mu = 3/2$

$\mu = 4/3$

D

C
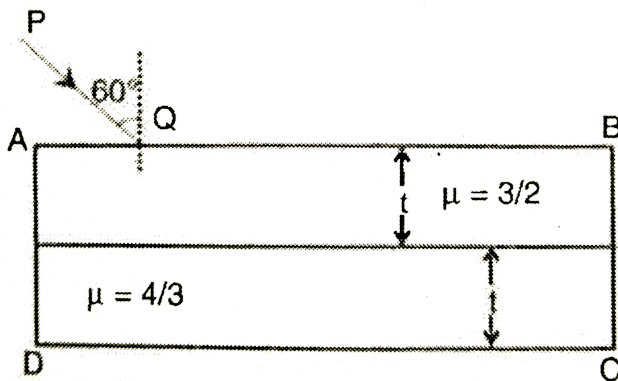
2. The base of a rectangular glass slab of thickness 10 cm and refractive index 1.5 is silvered. A coloured spot inside the glass slab at a distance of 8 cm from the base. Determine the position of the image formed by the mirror as observed from the top.

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3. A boy holds a convex lens 30 cm above the base of an empty vessel. The real image of the

bottom of the vessel is formed 20 cm above the lens. The boy fills a liquid in the vessel up to a depth of 25 cm and finds that the real image of the bottom of the vessel is now 30 cm above the lens. Find the refractive index of the liquid.

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4. A fish under water observes a freely falling stone in air . If the refractive index of water is
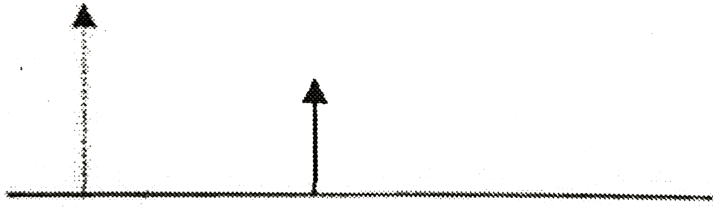
$\frac{4}{3}$, what is the apparent acceleration of the stone as observed by the fish?

5. An object and its image are as shown in the diagram below. If the object image distance is 4 cm and the magnification is 3, find type of the lens used and ratio $u : v : f$. Draw the ray diagram to show the position of the lens and
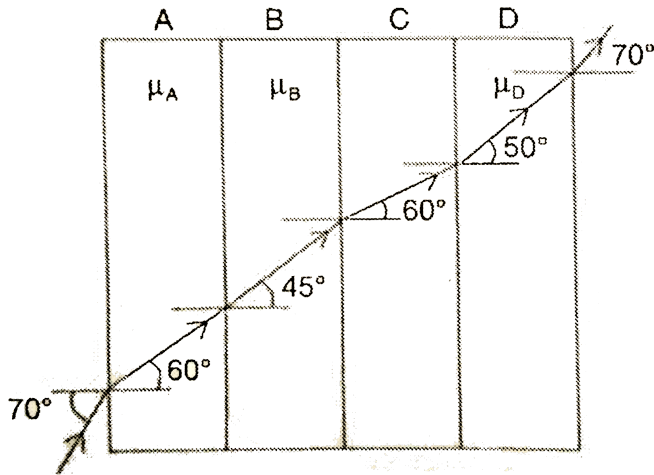
the principal focil.

6. A, B , C and D are four transparent sheets of equal thickness and made of material of refractive indices $\mu_A, \mu_B, \mu_C,$ and μ_D. If a light ray propagates through them as shown in the figure, compare their refractive indices and also find if any of them have the same

refractive index.

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7. A convex lens and a convex mirror are separated by a distance of 10 cm such that the reflecting surface of the mirror faces the lens. The image of an object placed in front of the

convex. Lens at a distance of 20 cm is found to coincide with the object. If the focal length of the convex lens is 15 cm, determine the focal length of the mierror.

8. An object is placed at a distance of 20 cm from a convex mirror of radius of curvature convex cm. At what distance from the object should a plane mirror be placed so that the

images due to the mirror and the plane mirror are on the same plane?

9. In a college hostal , a clever warden in order to know what the students are doing in the room in his absence during night he switched off the light in the corridor and watched the room through a glass partition from the corridor. Explain why the objects in the room are more clearly visible when he switched off

the corridor lights than when there is light in

the corridor.

10. A tree, which is 200 m away from the

pinhole, produces an image of height 1 cm, in

a pinhole camera of width 20 cm. Find the

height of the tree.