PHYSICS

BOOKS - DISHA PUBLICATION PHYSICS (HINGLISH)

RAY OPTICS AND OPTICAL INSTRUMENTS

Jee Main 5 Years At A Glance

1. A plano convex lens becomes an optical system of 28 cm focal length when its plane surface is silvered and illuminated from left to right as shown in Fig-A. If the same lens is instead silvered on the curved surface and illuminated from other side as in Fig. B, it acts like an optical system of focal length 10 cm. The refractive index of the material of lens is:

A. 1.50

B. 1.55

C. 1.75

D. 1.51

Answer: B

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2. A convergent doublet of separated lens correct for spherical aberration, are separated by $2m$ and has an equivalent focal lenth of $10cm$. Calculate the focal length of its component lenses.

A. 18cm, 20cm

B. 10cm, 12cm

C. 12cm, 14cm

D. 16cm, 18cn

Answer: A

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3. A ray of light is incident at an angle of 60° on one face of a prism of angle 30°. The ray

emerging out of the prism makes an angle of 30° with the incident ray. The emergent ray is

A. 30°

B. 90°

C. 0°

D. 45°

Answer: C

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4. Let the refractive index of a denser medium with respect to a rarer medium be n_{12} and its critical angle be θ_c. At an angle of incidence A when light is travelling from denser medium to rarer medium, a part of the light is reflected and the rest is refracted and the angle between reflected and refracted rays is 90°, Angle A given by -

A. $\dfrac{1}{\tan^{-1}(\sin\theta_C)}$

B. $\dfrac{1}{\tan^{-1}(\sin\theta_C)}$

C. $\cos^{-1}(\sin\theta_C)$

D. $\tan^{-1}(\sin\theta_C)$

Answer: D

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5. In an experiment a convex lens of focal length 15 cm is placed coaxially on an optical bench in front of a convex mirror at a distance of 5 cm from it. It is found that an object and its image coincide, if the object is placed at a

distance of 20 cm from the lens. The focal length of the convex mirror is :

A. 27.5cm

B. 20.0 cm

C. 25.0 cm

D. 30.5 cm

Answer: A

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6. To determine refractive index of glass slab using a travelling microscope, minimum number of readings required are :

A. Two

B. Four

C. Three

D. Five

Answer: C

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7. An observer looks at a distant tree of height 10m with a telescope of magnifying power of 20 . To the observer the tree appears

A. 20 times taller

B. 20 times nearer

C. 10 times taller

D. 10 times nearer

Answer: B

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8. You are asked to design a shaving mirror assuming that a person keeps it $10cm$ from his face and views the magnified image of the face at the closest comfortable distance of $25cm$. The radius of curvature of the mirror would then be:

A. 60 cm

B. $-24cm$

C. $-60cm$

D. 24 cm

Answer: C

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9. A telescope has an objective lens of focal length 150 cm and an eyepiece of focal length 5 cm. If a 50 m tall tower at a distance of 1 km is observed through this telescope in normal setting, the angle formed by the image of the tower is θ, then θ is close to :

A. 30°

B. 15°

C. 60°

D. 1°

Answer: C

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10. A diver looking up through the water sees the outside world contained in a circular horizon. The refractive index of water is $\frac{4}{3}$, and the diver's eyes are 15 cm below the

surface of 3 water. Then the radius of the circle is:

A. $15 \times 3 \times \sqrt{5} cm$

B. $15 \times 3\sqrt{7} cm$

C. $\frac{15 \times \sqrt{7}}{3} cm$

D. $\frac{15 \times 3}{\sqrt{7}} cm$

Answer: D

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11. If the focal length of objective and eye lens are $1.2cm$ and $3cm$ respectively and the object is put $1.25cm$ away from the objective lens and the final image is formed at infinity. The magnifying power of the microscope is

A. 200

B. 100

C. 400

D. 150

Answer: A

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12. A thin convex lens made from crown glass $\left(\mu = \frac{3}{2}\right)$ has focal length f. When it is measured in two different liquids having refractive indices $\frac{4}{3}$ and $\frac{5}{3}$, it has the focal lengths f_1 and f_2 respectively . The correct relation between the focal lengths is ,

A. $f_1 = f_2 < f$

B. $f_1 > f$ and f_2 becomes negative

C. $f_2 > f$ and f_1 becomes negative

D. f_1 and f_2 both become negative

Answer: B

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Exercise 1 Concept Builder Topicwise Topic 1 Plane Mirror Spherical Mirror And Reflection Of Light

1. The light reflected by a plane mirrorr may form a real image

A. if the rays incident on the mirror are diverging

B. if the rays incident on the mirror are converging

C. if the object is placed very close to the mirror

D. under no circumstances

Answer: B

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2. Two plane mirrors are inclined at 70°. A ray incident on one mirror at incidence angle θ after reflection falls on the second mirror and is reflected from there parallel to the first mirror, The value of θ is

A. 50°

B. 45°

C. 30°

D. 55°

Answer: A

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3. A point source of light is placed in front of a plane mirror.

A. all the reflected rays meet at a point when produced backward

B. only the reflected rays close to the normal meet at a point when produced backward.

C. only the reflected rays making a small angle with the mirror, meet at a point when produced backward.

D. light of different colours make different images.

Answer: A

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4. In image formatiion from spherical mirrors, only paraxial rays are considered because they

A. are easy to handle geometrically

B. contain most of the intensity of the incident light

C. form nearly a point image of a point source

D. show minimum dispersion effect

Answer: C

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5. Two mirrors are placed at right angle to each other. A man is standing between them combining his hair. How many images he will see?

A. 2

B. 3

C. 1

D. zero

Answer: B

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6. A concave mirror forms the image of an object on a screen. If the lower half of the mirror is covered with an opaque card, the effect would be

A. image less bright.

B. lower half of the image disappear

C. upper half of the image disappear

D. image blurred.

Answer: A

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7. A man 160 cm height stands in fromt of a plane mirror . His eyes are at a height of 150 cm from the floor. Then the minimum length of the plane mirror for him to see his full length image is -

A. 85 cm

B. 170 cm

C. 80 cm

D. 340 cm

Answer: C

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8. Two plane mirrors are inclined to each other such that a ray of light incident on the first mirror and parallel to the second is reflected from the second mirror parallel to the first

mirror. Determine the angle between the two mirrors:

A. 30°

B. 45°

C. 60°

D. 75°

Answer: C

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9. When a plane mirror is placed horizontally on level ground at a distance of 60 m from the foot of a tower, the top of the tower and its image in the mirror subtend and angle of 90° at the eye. The height of the tower is

A. 30 m

B. 60 m

C. 90 m

D. 120 m

Answer: B

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10. In a concave mirror, an object is placed at a distance d_1 from the focus and the real image is formed aat a distance d_2 from the focus. Then the focal length of the mirror is :

A. $\sqrt{x_1 x_2}$

B. $\frac{x_1 - x_2}{2}$

C. $\frac{x_1 + x_2}{2}$

D. $\sqrt{\frac{x_1}{x_2}}$

Answer: A

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11. A ray of light is incident at 50° on the middle of one of the two mirrorrs arranged at an angle of 60° between them . The ray then touches the second mirrorr, get reflected back to the first mirrorr, making an angle of incidence of

A. 50°

B. 60°

C. 70°

D. 80°

Answer: C

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12. Two plane mirrors are inclined to each other at a certain angle.A ray of light first incident on one of them at an inclination of

10° with the mirror retraces its path after five reflections.The angle between the mirrors is

A. 12°

B. 22°

C. 30°

D. 20°

Answer: D

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13. An infinitely long rod lies along the axis of a concave mirror of focal length f. The near end of the rod is distance $u > f$ from the mirror. Its image will have length

A. $\frac{f^2}{u-f}$

B. $\frac{uf}{u-f}$

C. $\frac{f^2}{u+f}$

D. $\frac{uf}{u+f}$

Answer: A

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14. A ray parallel to principal axis is incident at 30° from normal on concave mirror having radius of curvature R. The point on principal axis where rays are focussed is Q such that PQ

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

B. $\frac{R}{\sqrt{3}}$

C. $\frac{2\sqrt{R}-R}{\sqrt{2}}$

D. $R\left(1-\frac{1}{\sqrt{3}}\right)$

Answer: D

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15. A car is fitted with a convex side-view mirror of focal length 20 cm. A second car 2.8m behind the first car is overtaking the first car at a relative speed of 15 $\frac{m}{s}$. The speed of the image of the second car as seen in the mrror of the first one is:

A. $\frac{1}{15} m/s$

B. $10m/s$

C. $15m/s$

D. $\frac{1}{10}m/s$

Answer: A

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16. Two mirrors, one concave and the other convex, are placed 60 cm apart with their reflecting surfaces facing each other. An object is placed 30 cm from the pole of either of

them on their axis. If the focal lengths of both the mirrors are 15 cm, the position of the image formed by reflection, first at the convex and then at the concave mirror, is:

A. 19.09 cm from the pole of the concave mirror

B. 19.09 cm from the pole of the convex mirror

C. 11.09 cm from the pole of the concave mirror

D. 11.09 cm from the pole of the convex mirror

Answer: A

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17. In Fig. find the total magnification after two successive reflections first on M_1 and on M_2.

A. $+1$

B. -2

C. $+2$

D. -1

Answer: C

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18. A plane mirror is kept parallel to y-axis. A point object is approaching the mirror with velocity $\overrightarrow{u} = \left(10\hat{i} + 10\hat{j}\right) m/s.$ The magnitude of relative velocity of objective w.r.t

image is equal to

A. $20\sqrt{2}m/s$

B. $20m/s$

C. $10\sqrt{2}m/s$

D. $10m/s$

Answer: B

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19. A point object is kept in front of a plane mirror. The plane mirror is doing SHM of ampliture 2cm. The plane mirror moves along the x-axis which is normal to the mirror. The amplitude of the mirror is such that the object is always in front of the mirror. The amplitude of SHM of the image is

A. 0

B. 2 cm

C. 4 cm

D. 1 cm

Answer: C

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Exercise 1 Concept Builder Topicwise Topic 2 Refraction Of Light At Plane Surface And Total Internal Reflection

1. When light is refracted into a medium

A. its wavelength and frequency both increase

B. its wavelength increases but frequency remains unchanged

C. its wavelength decreases and frequency increases

D. its wavelength and frequency both decrease

Answer: B

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2. The ratio of thickness of plates of two transparent medium A and B is 6 : 4. If light takes equal time in passing through them, then refractive index of A with respect to B will be

A. 1.33

B. 1.75

C. 1.4

D. 1.5

Answer: D

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3. The refractive indices of glass and water with respect to air $\frac{1}{2}$ and $\frac{1}{\sqrt{3}}$ respectively. Then the refractive index of are glass with respect to water is

A. $\frac{1}{\sqrt{3}}$

B. $\frac{\sqrt{3}}{2}$

C. $\frac{2}{\sqrt{3}}$

D. 2

Answer: B

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4. The wavelength of a monochromatic light in vacuum is γ. It travels from vacuum to a medium of absolute refractive index μ. The ratio of wavelength of the incident and refracted wave is

A. $\mu^2 : 1$

B. $1:1$

C. $\mu:1$

D. $1:\mu$

Answer: C

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5. A glass slab of thickness $4cm$ contains the same number of waves as $5cm$ of water, when both are traversed by the same

monochromatic light. If the refractive index of water is $4/3,$ then refractive index of glass is

A. $5/3$

B. $5/4$

C. $16/15$

D. 1.5

Answer: A

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6. A ray of light travelling in water is incident on its surface open to air. The angle of incidence is θ, which is less than the critical angle. Then there will be

A. only a reflected ray and no refracted ray

B. only a refracted ray and no reflected ray

C. a reflected ray and a refracted ray and the angle between them would be less than $180^\circ - 2\theta$

D. a reflected ray and a refracted ray and the angle between them would be greater than $180^\circ - 2\theta$

Answer: C

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7. A ray of light is Incident on a glass plate at 60°. The reflected and refracted rays are found to be mutually perpe:ndiwlar. The refractive index of the glass is

A. 0.866

B. 1.5

C. 1.732

D. 2

Answer: C

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8. Total internal reflection can take only if

A. light goes from optically rarer medium (smaller refractive index) to optically denser medium

B. light goes from optically denser medium to rarer medium

C. the refractive indices of the two media are close to different

D. the refractive indices of the two media are widely different

Answer: B

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9. Electromagnetic radiation of frequency n, wavelength λ, travelling with velocity v in air, enters a glass slab of refractive index μ. The frequency, wavelength and velocity of light in the glass slab will be respectively

A. $\frac{n}{\mu}, \frac{\lambda}{\mu}$ and $\frac{v}{\mu}$

B. $n, \frac{\lambda}{\mu}$ and $\frac{v}{\mu}$

C. $n, 2\lambda$ and $\frac{v}{\mu}$

D. $\frac{2n}{\mu}, \frac{\lambda}{\mu}$ and v

Answer: B

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10. A ray of light travelling inside a rectangular glass block of refractive index $\sqrt{2}$ is incident on the glass-air surface at an angle of incidence of 45°. The refractive index of air is one. Under these conditions the ray will

A. emerge into the air without any deviation

B. be reflected back into the glass

C. be absorbed

D. emerge into the air with an angle of refraction equal to 90°

Answer: D

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11. A narrow beam of white light enters slab having parallel faces.

A. the light never splits in different colours

B. the emergent beam is white

C. the light inside the slab is split into different colours

D. the light inside the slab is white

Answer: B

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12. A ray is incident at an angle 60° on a sphere which is made of material having refractive index= $\sqrt{3}$ find angle by which the emergent ray is deviated

A. 30°

B. 15°

C. 45°

D. 60°

Answer: D

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13. A fish looking up through the water sees the outside world contained in a circular horizon. If the refractive index of water is $\frac{4}{3}$ and the fish is 12 cm below the surface, the radius of this circle is cm is

A. $36s\sqrt{5}$

B. $5\sqrt{5}$

C. $36\sqrt{7}$

D. $36\sqrt{7}$

Answer: D

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14. A ray of light passes from vaccum into a medium of refractive index n. If the angle of incidence is twice the angle of refraction, then the angle of incidence is

A. $2\cos^{-1}\left(\frac{\mu}{2}\right)$

B. $\sin^{-1}(\mu)$

C. $\sin^{-1}\left(\frac{m}{2}\right)$

D. $\cos^{-1}\left(\frac{\mu}{2}\right)$

Answer: A

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15. A small coin is resting on the bottom of a beaker filled with liquid. A ray of light from the coin travels upto the surface of the liquid and

moves along its surface. How fast is the light travelling in the liquid?

A. $2.4 \times 10^8 m/s$

B. $3.0 \times 10^8 m/s$

C. $1.2 \times 10^8 m/s$

D. $1.8 \times 10^8 m/s$

Answer: D

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16. Let the x-z plane be the boundary between two transparent media. Medium 1 in $z \geq 0$ has a refractive index of $\sqrt{2}$ and medium 2 with $z < 0$ has a refractive index of $\sqrt{3}$. A ray of light in medium 1 given by the vector $\overrightarrow{A} = 6\sqrt{3}\hat{i} + 8\sqrt{3}\hat{j} - 10\hat{k}$ is incident on the plane of separation. The angle of refraction in medium 2 is:

A. 45°

B. 60°

C. 75°

D. 30°

Answer: A

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17. A transparent solid cylindrical rod has a refractive index of $\frac{2}{\sqrt{3}}$. It is surrounded by air. A light ray is incident at the mid-point of one end of the rod as shown in the figure.

The incident angle θ for which the light ray grazes along the wall of the rod is :

A. $\sin^{-1}(\sqrt{3}/2)$

B. $\sin^{-1}\left(\frac{2}{\sqrt{3}}\right)$

C. $\sin^{-1}\left(\frac{1}{\sqrt{3}}\right)$

D. $\sin^{-1}(1/2)$

Answer: C

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Exercise 1 Concept Builder Topicwise Topic 3 Refraction Of Light At Spherical Surface And Power Of Lens

1. A point object is placed at the centre of a glass sphere of radius 6cm and refractive index 1.5. The distance of virtual image from the surface is

A. `2 cm

B. 4 cm

C. 6 cm

D. 12 cm

Answer: C

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2. A parallel beam of light is incident on the surface of a transparent hemisphere of radius R and refractive index 2.0 as shown in figure. The position of the image formed by refraction at the first surface is:

A. R/2

B. R

C. 2R

D. 3R

Answer: C

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3. A lens made of glass whose index of refraction is 1.60 has a focal length of + 20 cm

in air. Its focal length in water, whose refractive index is 1.33, will be

A. three times longer than in air

B. two times longer than in air

C. same as in air

D. None of these

Answer: A

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4. A convex lens is in contact with a concave lens. The magnitude of the ratio of their powers is $\frac{3}{2}$. Their equivalent focal length is 30 cm. What are their individual focal lengths?

A. $-15, 10$

B. $-10, 15$

C. $75, 50$

D. $-75, 50$

Answer: A

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5. A parallel beam of light is incident on a converging lens parallel to its principal axis. As one moves away from the les on the other side on its principal axis, the intensity of light

A. remains constant

B. continuously increases

C. continuously decreases

D. first increases then decreases

Answer: A

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6. A converging beam of rays in incident on a diverging lens. Having passed through the lens the rays intersect at a point $15cm$ from the lens. If the lens is removed, the point where the rays meet, move $5cm$ closer to the mounting that holds the lens. Find the focal length of the lens.

A. $-10cm$

B. 20 cm

C. $-30cm$

D. 5 cm

Answer: C

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7. A body is located on a wall. Its image of equal size is to be obtained on a parallel wall with the help of a convex leng. The lens is

placed at a distance d ahead of second wall, then the required focal length will be:

A. only $\frac{d}{4}$

B. only $\frac{d}{2}$

C. more than $\frac{d}{4}$ but less than $\frac{d}{2}$

D. less than $\frac{d}{4}$

Answer: B

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8. A luminous object is placed at a distance of $30cm$ from the convex lens of focal length $20cm$. On the other side of the lens, at what distance from the lens a convex mirror of radius of curvature $10cm$ be placed in order to have an upright image of the object coincident with it ?

A. 12 cm

B. 30 cm

C. 50 cm

D. 60 m

Answer: C

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9. A plano-convex lens fits exactly into a plano-concave lens. Their plane surfaces are parallel to each other. If the lenses are made of different material of refractive indices μ_1 and μ_2 and R is the radius of curvature of the

curved surface of the lenses, then focal length of the combination is

A. $\frac{R}{2(\mu_1 - \mu_2)}$

B. $\frac{R}{(\mu_1 - \mu_2)}$

C. $\frac{2R}{(\mu_2 - \mu_1)}$

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

Answer: B

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10. A plano concave lens is placed on a paper on which a flower is drawn. How far above its actual position does the flower appear to be?

A. 10 cm

B. 15 cm

C. 50 cm

D. None of these

Answer: A

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11. A drop of water is placed on a glass plate. A double convex lens having radius of curvature of each surface is 20 cm is placed on it. The focal length of water is $(\mu_W = 4/3))$

A. $-20cm$

B. $60cm$

C. $20cm$

D. $-60cm$

Answer: D

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12. A point object O is placed in front of a glass rod having spherical end of radius of curvature 30 cm. The image would be form

A. 30 cm left

B. in finity

C. 1 cm of the right

D. 18 cm to the left

Answer: A

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13. A spherical surface of radius of curvature R separates air (refractive index 1.0) from glass (refractive index 1.5). The centre of curvature is in the glass. A point object P placed in air is found to have a real image Q in the glass. The

line PQ cuts the surface at a point O, and $PO = OQ$. The distance PO

A. 5R

B. 3R

C. 2R

D. 1.5R

Answer: A

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14. A convex lens of focal length 40 cm is held coaxially 12 cm above a mirror of focal length 18 cm. An object held x cm above the lens gives rise to an image coincident with it. Then x is equal to:

A. 12 cm

B. 15 cm

C. 18 cm

D. 30 cm

Answer: B

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15. A point object is placed at a distance of 20 cm from a thin plano-convex lens of focal length 15 cm. If the plane surface is silvered, the image will form at:

A. 60 cm left of AB

B. 30 cm left of AB

C. 12 cm left of AB

D. 60 cm right to AB

Answer: C

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Exercise 1 Concept Builder Topicwise Topic 4 Prism And Dispersion Of Light

1. The angular dispersion produced by a prism

A. increases if the average refractive index increases

B. increases if the average refractive index decreases

C. remains constant whether the average refractive index increases or decreases

D. has no relation with average refractive index.

Answer: A

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2. A ray PQ incident on the refracting face BA is refracted in the prism BAC as shown in the figure and emerges from the other refracting face AC as RS such that AQ AR. If the angle of prism A=60° and the refractive index of the material of prism is $\sqrt{3}$, then the angle of deviation of the ray is

A. 60°

B. 45°

C. 30°

D. None of these

Answer: A

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3. A ray is ihncident at an angle of incidence ii on one surface of a prism of small angle A and emerge normally from opposite surface. If the refractive index of the material of prism is μ. the angel of incidance I is nearly equal to

A. $\frac{A}{\mu}$

B. $\frac{A}{2\mu}$

C. μA

D. $\frac{\mu A}{2}$

Answer: C

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4. Light of wavelenght $4000A$ is incident at small angle on a prim of apex angle 4° . The prism has $n_v = 1.5$ and $n_r = 1.48$. The angle

of dispersion produced by the prism in this light is:

A. 0.2°

B. 0.08°

C. 0.192°

D. None of these

Answer: D

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5. A light ray is incident perpendicularly to one face of a 90° prism and is totally internally reflected at the glass-air interface. If the angle of reflection is 45°, we conclude that the refractive index n

A. $n > \frac{1}{\sqrt{2}}$

B. $n > \sqrt{2}$

C. $n < \frac{1}{\sqrt{2}}$

D. $n < \sqrt{2}$

Answer: B

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6. A thin prism P with angle 4° and made from glass of refractive index 1.54 is combined with another thin prism P made from glass of refractive index 1.72 to produce dispersion without deviation The angle of prism P is

A. 5.33°

B. 4°

C. 2.6°

D. 3°

Answer: D

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7. There is a prism with refractive index equal to $\sqrt{2}$ and the refracting angle equal to 60°. One of the refracting surfaces of the prism is polished. A beam of monochromatic light will

retrace its path if its angle of incidence over the refracting surface of the prism is

A. $\sin^{-1}(\sqrt{2})$

B. $\sin^{-1}(2\sqrt{3})$

C. $\sin^{-1}\left(\frac{\sqrt{3}}{\sqrt{2}}\right)$

D. $\sin^{-1}\left(\frac{1}{\sqrt{2}}\right)$

Answer: C

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8. A glass prism of refractive index 1.5 is immersed in water $\left(\mu = \frac{4}{3}\right)$. A light beam incident normally on the face AB is totally reflected to reach the face BC if

A. $\frac{2}{3} < \sin\theta < \frac{8}{9}$

B. $\sin\theta \leq \frac{2}{3}$

C. $\cos\theta \geq \frac{8}{9}$

D. $\sin\theta > \frac{8}{9}$

Answer: D

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9. r and r' denote the angles inside an equilateral prism, as usual, in degrees.

Consider that during some time interval from t=0 to t=t, r' varies with time as r'=$10 + t^2$. During this timer will vary as (assume that r and r' are in degree)

A. $50 - t^2$

B. $50 + t^2$

C. $60 - t^2$

D. $60 + t^2$

Answer: A

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Exercise 1 Concept Builder Topicwise Topic 5 Optical Instruments

1. To increase the angular magnification of a simple microscope, one should increase

A. the focal length of the lens

B. the power of the lens

C. the aperture of the lens

D. the object size

Answer: B

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2. A normal eye is not able to see objects closer than 25 cm because

A. the focal length of the eye is 25 cm

B. the distance of the retina from the eye-lens is 25 cm

C. the eye is not able to decrease the distance between the eye-lens and the retina beyond a limit

D. the eye is not able to decrease the focal length beyond a limit

Answer: D

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3. When the length of a microscope tube increases, its magnifying power

A. decreases

B. increases

C. does not change

D. may decreases or increase

Answer: B

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4. The focal length of the objective and the eyepiece of a telescope are 50 cm and 5 cm respectively. If the telescope is focussed for distinct vision on a scale distant 2 m from its objective, then its magnifying power will be :

A. -4

B. -98

C. $+8$

D. -2

Answer: D

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5. The focal lengths of objective lens and eye lens of a Galilean telescope are respectively 30 cm and 3.0 cm. telescope produces virtual, erect image of an object situated far away from it at least distance of distinct vision from the eye lens. In this condition, the magnifying power of the Galilean telescope should be:

A. $+11.2$

B. -11.2

C. -8.8

D. $+8.8$

Answer: D

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Exercise 2 Concept Applicator

1. A bird in air looks at a fish vertically below it and inside water. h_1 is the height of the bird above the surface of water and h_2, the depth

of the fish below the surface of water. If refractive index of water with respect to air be μ, then the distance of the fish as observed by the bird is

A. $h_1 + h_2$

B. $h_1 + \frac{h_2}{\mu}$

C. $\mu h_1 + h_2$

D. $\mu h_1 + \mu h_2$

Answer: B

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2. A concave lens of glass, refractive index 1.5 has both surfaces of same radius of curvature R. On immersion in a medium of refractive index 1.75, it will behave as a

A. convergent lens of focal length 3.5 R

B. convergent lens of focal length 3.0 R

C. divergent lens of focal length 3.5 R

D. divergent lens of focal length 3.0 R

Answer: A

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3. The layered lens as shown is made of two types of transparent materials - one indicated by horizontal lines and the other by vertical lines. The number of images formed of an object will be

A. 1

B. 2

C. 3

D. 6

Answer: B

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4. In the displacement method a conves lens is placed in between an object and a screen. If the magnificaiton in the two position are m_1 and m_(2)(m_(1) $> m_2$), and the distance between the two positions of the lens is x, the focal length of the lens is

A. $\frac{x}{m_1 + m_2}$

B. $\frac{x}{m_1 - m_2}$

C. $\frac{x}{(m_1 + m_2)^2}$

D. $\frac{x}{(m_1 - m_2)^2}$

Answer: B

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5. Light takes t_1 second to travel a distance x cm in vacuum and the same light takes t_2

second to travel 10x cm in medium. The critical angle for the corresponding medium is

A. $\sin^{-1}\left(\frac{10t_2}{t_1 x}\right)$

B. $\sin^{-1}\left(\frac{t_2 x}{10t_1}\right)$

C. $\sin^{-1}\left(\frac{10t_1}{t_2 x}\right)$

D. $\sin^{-1}\left(\frac{t_1 x}{10t_2}\right)$

Answer: C

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6. A thin lens focal length f_1 and its aperture has diameter d. It forms an image of intensity I. Now the central part of the aperture up to diameter $\frac{d}{2}$ is blocked by an opaque paper. The focal length and image intensity will change to

A. $\frac{f}{2}, \frac{1}{2}$

B. $f, \frac{1}{4}$

C. $\frac{3f}{4}, \frac{I}{2}$

D. $f, \frac{3I}{4}$

Answer: D

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7. Two plane mirrors A and B are aligned parallel to each other, as shown in the figure. A light ray is incident at an angle 30° at a point just inside one end of A. The plane of incidence coincides with the plane of the figure. The maximum number of times the ray undergoes reflections (including the first one)

before it emerges out is

A. 28

B. 30

C. 32

D. 34

Answer: B

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8. A ball is dropped from a height of 20 m above the surface of water in a lake. The refractive index of water is 4.3. A fish inside the lake, in the line of fall of the ball, is looking at the ball. At an instant, when the ball is 12.8 m above the water surface, the fish sees the speed of the ball as $\left[Take_g = 10\frac{m}{s^2}.\right]$

A. $9m/s$

B. $12m/s$

C. $16m/s$

D. $21.33 m / s$

Answer: C

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9. The size of the image of an object, which is at infinity, as formed by a convex lens of focal length 30 cm is 2 cm. If a concave lens of focal length 20 cm is placed between the convex lens and the image at a distance of 26 cm from

the convex lens, calculate the new size of the image

A. $d/2$

B. d

C. $2d$

D. $3d$

Answer: B

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10. A parallel beam of light is incident from air at an angle α on the side PQ of a right angled triangular prism of refractive index $n = \sqrt{2}$. Light undergoes total internal reflection in the prism at the face PR when α has a minimum value of 45°. The angle 0 of the prism is

A. 15°

B. 22.5°

C. 30°

D. 45°

Answer: A

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11. The focal length of the objective and the eye piece of a compound microscope are 2.0 cm and 3.0 cm, respectively. The distance between the objective and the eye piece is 15.0 cm. The final image formed by the eye piece is at infinity. The two lenses are thin. The

distance in cm of the object and the image produced by the objective, measured from the objective lens, are respectively

A. 2.4 and 12.0

B. 2.4 and 15.0

C. 2.0 and 12.0

D. 2.0 and 3.0

Answer: A

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12. A vessel of height 2d is half-filled with a liquid of refractive index $\sqrt{2}$ and the other half with a liquid of refractive index n. (The given liquids are immiscible). Then the apparent depth of the inner surface of the bottom of the vessel (neglecting the thickness of the bottom of the vessel) will be

A. $\dfrac{n}{d\left(n+\sqrt{2}\right)}$

B. $\dfrac{d\left(n+\sqrt{2}\right)}{n\sqrt{2}}$

C. $\dfrac{n\sqrt{2}}{d\left(n+\sqrt{2}\right)}$

D. $\frac{nd}{d+\sqrt{2n}}$

Answer: B

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13. A printed page is pressed by a glass of water. The refractive index of the glass and water is 1.5 and 1.33, respectively. If the thickness of the bottom of glass is 1 cm and depth of water is 5 cm, how much the page

will appear to be shifted if viewed from the top?

A. 1.033 cm

B. 3.581 cm

C. 1.3533 cm

D. 1.90 cm

Answer: C

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14. A convex lens, of focal length 30 cm, a concave lens of focal length 120 cm, and a plane mirror are arranged as shown. For an object kept at a distance of 60 cm from the convex lens, the final image, formed by the combination, is a real image, at a distance of:

A. 60 cm from the convex lens

B. 60 cm from the concave lens

C. 70 cm from the convex lens

D. 70 cm from the concave lens

Answer: A

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15. An object is located in a fixed position in front of a screen. Sharp image is obtained on the screen for two positions of a thin lens separated by 10 cm. The size of the images in two situations are in the ratio $3:2$. What is the distance between the screen and the object?

A. 124.5 cm

B. 144.5 cm

C. 65.0 cm

D. 99.0 cm

Answer: D

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16. The image of an illuminated square object is obtained on a screen with the help of a converging lens. The distance of the square

from the lens is 30 cm. The area of the image is 9 times of the square. What is the focal length of the lens ?

A. 36 cm

B. 27 cm

C. 60 cm

D. 30 cm

Answer: D

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17. An object is placed upright on the axis of a thin convex lens at a distance of four focal lengths (4f) from the center of the lens. An inverted image appears at a distance of $4/3$ f on the other side of the lens. What is the ratio of the height of the image of the height of the object?

A. $1/3$

B. $3/4$

C. $4/3$

D. $3/1$

Answer: A

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18. A ray of light is travelling from glass to air. $(\text{Refractive index of glass} = 1.5)$. The angle of incidence is 50°. The deviation of the ray is

A. 0°

B. 80°

C. $50^\circ - \sin^{-1}\left[\frac{\sin 50^\circ}{1.5}\right]$

D. $\sin^{-1}\left[\frac{\sin 506^\circ}{1.5}\right] - 50^\circ$

Answer: B

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19. We wish to make a microscope with the help of two positive lenses both with a focal length of 20 mm each and the object is positioned 25 mm from the objective lens. How far apart the lenses should be so that the final image is formed at infinity?

A. 20mm

B. 100mm

C. 120mm

D. 80mm

Answer: C

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20. A ray of light passes through an equilateral prism (refractive index 1.5) such that angle of incidence is equal to angle of emergence and

the latter is equal to $3/4th$ of the angle of prism. Calculate the angle of deviation.

A. 45°

B. 39°

C. 20°

D. 30°

Answer: D

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21. An achromatic convergent system of focal length $+20cm$ is made of two lenses (in contact) of materials having dispersive powers in the ratio $1:2$.Their focal lengths must be respectively

A. $f_1 = 10cms, f_2 = -20cms$

B. $f_1 = 20cms, f_2 = 10cms$

C. $f_1 = -10cms, f_2 = -20cms$

D. $f_1 = 20cms, f_2 = -20cms$

Answer: A

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22. The magnifying power of a telescope is 9. When it is adjusted for parallel rays the distance between the objective and eyepiece is $20cm$. The focal lengths of lenses are

A. 18 cm, 2cm

B. 11 cm, 9 cm

C. 10 cm, 10 cm

D. 15cm, 5 cm

Answer: A

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23. Consider the situation shown in fig. Water $(\mu = 4/3)$ is filled in a beaker upto a height of 10 cm. A plane mirror is fixed at a height of 5 cm from the surface of water. Distance of image from the mirror after reflection from it of an object O at the bottom of the beaker is

A. 15 cm

B. 12.5 cm

C. 7.5 cm

D. 10 cm

Answer: B

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24. A plastic hemisphere has a radius of curvature of 8 cm and an index of refraction of 1.6. On the axis halfway between the plane

surface and the spherical one (4 cm from each) is a small object O. The distance between the two images when viewed along the axis from the two sides of the hemisphere is approximately

A. 1.0 cm

B. 1.5 cm

C. 3.75 cm

D. 2.5 cm

Answer: D

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25. A point object O is placed on the principal axis of a convex lens of focal length $f = 20cm$ at a distance of 40 cm to the left of it. The diameter of the lens is 10. An eye is placed 60 cm to right of the lens and a distance h below the principal axis. The maximum value of h to see the image is

A. 0

B. 5 cm

C. 2.5 cm

D. 10 cm

Answer: C

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26. A simple telescope, consisting of an objective of focal length $60cm$ and a single eye lens of focal length $5cm$ is focussed on a distant object is such a way that parallel rays comes out from the eye lens. If the object

subtends an angle 2° at the objective, the angular width of the image.

A. 10°

B. 24°

C. 50°

D. $(1/6)^\circ$

Answer: B

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