PHYSICS

BOOKS - CENGAGE PHYSICS (HINGLISH)

RAY OPTICS AND OPTICAL INSTRUMENTS

Question Bank

1. The diagram shows a mirror system. If after two reflections the image and the object O coincide with each other, then the value of radius of curvature (in metre) of the concave mirror is (Take $a = 3m$)

'(##CEN_KSR_PHY_JEE_C26_E01_001_Q01##)'

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2. A lens has one surface as concave with $R_1 = 2m$ and the other as convex with

$R_2 = 3m$. The magnitude of focal length (in m) of lens is (If $\mu_r = 1.5$)

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3. The near vision of an average person is $25cm$. To view an object with an angular magnification of 10, what should be the power of the microscope ?

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4. A compound microscope consists of an objective. lens of focal length $2(\sim cm)$ and eyepiece of focal length $6.25cm$ separated by a distance of $15cm$. How far (in cm) from the objective lens should an object be placed in order to obtain the final image at the least distance of distinct vision?

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5. As shown in the figure, one of the faces of the prism of retive angle 30° and retive index

$\mu = \sqrt{2}$, is silvered. At what angle of incidence i (in degrees) the ray must fall on unsilvered surface, sò that after retion and reflection it retrace its path?

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6. The image produced by a concave mirror is one-quarter the size of object. If the object is moved 5cm closer to the mirror, the image will

only be half the size of the object. The focal length of mirror is

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7. A point object O can' move along vertical line AB as shown in the figure. At $t = 0$, the image of the object is visible to D and then the object O is released from rest from point A : The time for which object is visible to D is T. Find T^2. (Given $L = 9.8m$)

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8. A vessel is quarter filled with a liquid of refractive index μ. The remaining parts of the vessel is filled with an immiscible liquid of refractive index $3\mu/2$. The apparent depth of the vessel is 50% of the actual depth. The value of μ is

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9. A point object is placed at a distance of $62cm$ from a concave mirror of focal length $20cm$. A slab of the thickness $6cm$ and retive index $\mu = \frac{3}{2}$ is placed in between the object and the mirror at a distance $1.5\ (cm)$ from the mirror. The distance (in cm) of the final image from the mirror is

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10. The distance between the object and its real' image in convex lens is $90cm$. It has

happened in two positions of the lens whose difference is $30cm$. Then the focal length (in cm) of the lens is

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11. An opaque cylindrical tank with an open top has a diameter of $6.00m$ and is completely filled with water. When the setting sun reaches an angle of 37° above the horizon, sunlight ceases to illuminate any part of the. bottom of the tank. The depth (in metre) of the tank is

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12. O text (is the point object shown in the diagram.)If the mirror starts moving with velocity $\sqrt{3}$m/s, then find velocity (in m/s) of the image.

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13. Find the position (in cm and only magnitude) of the final image of the object for

the arrangement shown.

'(##CEN_KSR_PHY_JEE_C26_E01_013_Q05##)'

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14. Focal length of objective of a compound microscope is $4mm$ and $theima \geq isf$ or $medatadis\tan ceof$ 224mm from it. If angular magnification is 550 , then focal length (in cm) of eyepiece for normal adjustment is

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15. As shown in the figure, light ray P enters slab at an angle 60° with normal and inside the slab, light ray Q suffers total internal reflection. Find the minimum retive index of the slab.

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16. A point object is moving with velocity $6i + j + 2k$ (m/s)in front of a plane mirror

whose refiecting side is xz -planc. If the mirror also moves with a velocity $\hat{i} - \hat{j}$ (m/s), then what is the speed (in m/s) of the image? (Round-off the answer to nearest integer)

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17. A lenśmaker has to đesign an achromatic combination of cffective power $0.5D$. If the two types of glasses tó be used (say A and B) have dispersive powers in the ratio $\omega_A : \omega_B = 3:5$,

then the magnitude of focal length (in cm) of the lens made from glass A is

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18. The optical system consişt of a thin convex lens of focal length $30cm$and a plane mirror $15cm$ behind the lens. An object is placed $15cm$ in front of the lens. The distance (in cm) of final image from the lens is

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19. 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.

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20. In the shown figure, the focal length of equivalent system is $\frac{50x}{13}$. Find the value of x.

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21. A certain prism is found to produce a minimum of 38°. It produces a deviation of 44° when the angle of incident is either 42° or 62°. What is the angle of incidence when it is undergoing minimum deviation?

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22. In the above figure, x is any instantaneous position. The mirror is rotating about z -axis with angular velocity ω 'in anticlockwise direction and the objećt is moving with velocity v along x -axis. If the magnitude of velocity of image is $ac\frac{m}{s}$ at the given instant, then find the value of $\frac{36a}{31}$, (Given: $\theta = 30^\circ, \omega = 1\frac{rad}{s}, v = 1c\frac{m}{s}, x = 1m$)

'(##CEN_KSR_PHY_JEE_C26_E01_022_Q08##)'

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23. For the given figure, the radjus of curvature of each surface is $R = 16cm$. Rays of light parallel to the axis of lens from left of the lens traversing through the lens get focused at distance f from the lens. Find the value of magnitude of f. (μ represents retive index and lens is silvered as shown)

'(##CEN_KSR_PHY_JEE_C26_E01_023_Q09##)'

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24. A pin is placed $10cm$ in front of a convex lens of focal length $20cm$. The lens is made of material having retive index 1.5. The surface of the lens farther away from the pin is silvered and has a radius of curvature $22cm$. Determine the position (in cm and only magnitude) of the final image.

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25. The principal section of a glass prism is an isosceles $\Delta(PQR)$ with $PQ = PR$. The face

PR is silvered. A ray is incident perpendicularly on face PQ and after two reflections it emerges from base QR, normal to it. The angle of the prism is given by $\frac{\pi}{\alpha}(rad)$. Find the value of α.

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26. The observer O sees the distance AB as infinitely large. If retive index of liquid is μ_1 and that of glass is μ_2, then $\frac{\mu_1}{\mu_2}$ is

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27. An object moves with a uniform velocity $u_0 = 5\frac{m}{s}$ along the axis of a concave spherical mirror of focal length $f = -10cm$. If the object is at the centre of curvature C at certain instant, then the magnitude of acceleration of image at this instant is $a\frac{m}{(s)^2}$. Find a.

'(##CEN_KSR_PHY_JEE_C26_E01_027_Q11##)'

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28. Optical axis of a thin equi-convex lens is the x -axis. The co-ordinates of a point object and its image are $(10cm, 1$ cm $)$ and $(100cm, -2cm)$, respectively.

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29. A light ray is incident on a transparent sphere of index = $\sqrt{2}$, at an angle of incidence =45° , What is the deviation of a tiny fraction of the ray, which enters the sphere, undergoes

two internal reflections and then refracts out into air?

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30. A ray of light enters a glass sphere, and after three'total internal reflections it travels into original direction as shown in the figure. If μ is the retive index of sphere, then the relation between μ and β is expressed as $\sin^2 x\beta + \mu^2 \sin^2 \beta = 1$. Find the value of x.

'(##CEN_KSR_PHY_JEE_C26_E01_030_Q12##)'

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31. As shown in the figure, left half of the glass, sphere is surrounded with a medium having retive index 3 and the right half is surrounded with medium having retive index $\sqrt{3}$. A ray is incident on it at an angle of 60°. Find the total deviation' (in degree) as the ray comes out of the sphere.

'(##CEN_KSR_PHY_JEE_C26_E01_031_Q13##)'

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32. An optical fibre of retive index n is surrounded by air. A light ray enters the end of the fibre as shown in the figure. The largest value of ϕ permitted, if the ray incidents on the wall of the fibre at criticál angle for the fibre-air interface, is given by $\sin\left(\frac{\phi}{2}\right) = \left(\frac{xn^2 - 4}{y}\right)^{\frac{1}{2}}$. Find (xy).

'(##CEN_KSR_PHY_JEE_C26_E01_032_Q14##)'

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33. In the figure shown, a point object O is plaiced in air. A spherical boundary of radius of curvature $1.0(\sim m)$ separates various media. AB is the principal axis. The retive index above AB is 1.6 and below AB is 2.0. The separation(in m) between the images formed due to retion at spherical surface is

'(##CEN_KSR_PHY_JEE_C26_E01_033_Q15##)'

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34. A very expensive diamond is polished into a perfect sphere of radius $5cm$. The back surface of the sphere is then covered with silver. If d is the distance of the source of light S from the surface of sphere, then the, image coincides with the source. If the index of retion of diamond is 2.4, then $d =$ ..... $xx5cm$.

'(##CEN_KSR_PHY_JEE_C26_E01_034_Q16##)'

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35. The dispersive power of crown and flint glasses are 0.02 and 0.04, respectively. An achromatic converging lens of focal length $40(\sim cm)$ is made by keeping two lenses, one of crown glass and the other of flint glass, in contact with each other. The magnitude of product of focal lengths (in cm) of the two lenses are

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36. Parallel beam is incident on a thin lens and radii $25cm$ of each of the surfaces as shown. What should be the thickness t of a slab (in cm`) between the lens and the screen so that the final image is formed on the screen?

'(##CEN_KSR_PHY_JEE_C26_E01_036_Q17##)'

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37. A concave mirror of focal length $20cm$ and a convex lens of focal length $10(\sim cm)$ are kept with their optic axis parallel but separated by

$0.5mm$ as shown in the figure.The distance between the lens and the mirror is $10cm$. An object of height $3\ \min$ is placed on the optical axis of the lens at a distance of $15^{\circ}cm$ from the lens. Find the height of the image (in mm) formed by the mirror after retion from the lens.

'(##CEN_KSR_PHY_JEE_C26_E01_037_Q18##)'

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38. In the given figure, ABC is a right angled isosceles prism kept in air. A ray of light is incident on it normally as shown in the figure. Retive index of the prism is varying with time t as $\mu = (1 + 0.4t)$, where t is in seconds. The angular velocity (in $ra\frac{d}{s}\Big)oftheemer \geq ntray, attime$t=1s` is

'(##CEN_KSR_PHY_JEE_C26_E01_038_Q19##)'

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39. A curved thick glass surface is silvered at curved face and is not silvered on plane surface. Object is placed at A as shown in the figure. Consider P (pole of the silyered surface) as origin. If x co-ordinate of final image is 2n cm, then find n.

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40. An equiconvex lens having $\mu = 1.5$ and radius of curvature $10cm$ is.cut into four equal

parts as shown in the diagram. Now two parts are used to form' the image as shown in the diagram Now considering O as origin $(0, 0)$, if x and y co-ordinate of image is (ncm, mcm), then the value of $(n \times m)$ is

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