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Knowledge is Discipline

BJNP

Learning with the Speed of Mumbai and the Tradition of Kota

Max. Marks: 60 **Date: 03.09.2022**

ABHIMANYU BATCH
PHYSICS : DCT
Topic: Ray Optics

1. What can be the largest distance of an image of a real object from a convex mirror of radius of curvature is 20 cm?

   (a) 10 cm (b) 20 cm (c) Infinity (d) Zero

2. A boy of height 1 m stands in front of a convex mirror. His distance from the mirror is equal to its focal length. The height of his image is

   (a) 0.25 m (b) 0.33 m (c) 0.5 m (d) 0.67 m

3. A concave shaving mirror has a radius of curvature of 35.0 cm. It is positioned so that the (upright) image of a man's face is 2.50 times the size of the face. How far is the mirror from the face?

   (a) 5.25 cm (b) 21.0 cm (c) 10.5 cm (d) 42 cm

4. A rod of length 10 cm lies along the principal axis of a concave mirror of focal length 10 cm in such a way that its end closer to the pole is 20 cm away from the mirror. The length of the image is

   (a) 10 cm (b) 15 cm (c) 2.5 cm (d) 5 cm

5. An object 2 cm high is placed at a distance of 16 cm from a concave mirror, which produces a real image 3 cm high. What is the focal length of the mirro?

   (a) –9.6 cm (b) –3.6 cm (c) –6.3 cm (d) –8.3 cm

6. When an object is kept at a distance of 30 cm from a concave mirror, the image is formed at a distance of 10 cm. If the object is moved with a speed of 9 ms^{-1}, the speed with which image moves is

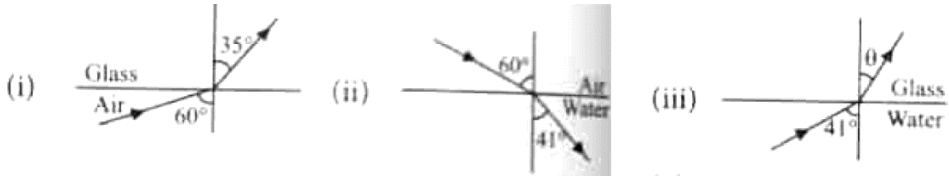
   (a) 10 ms^{-1} (b) 1 ms^{-1} (c) 9 ms^{-1} (d) 0.9 ms^{-1}

7. A microscope is focused on a mark on a piece of paper and then a slab of glass of thickness 3 cm of refractive index 1.5 is placed over the mark. How should the microscope be moved to get the mark in focus again?

   (a) 4.5 cm downward (b) 1 cm downward (c) 2 cm downward (d) 1 cm upward

Space for Rough Work

8. Refraction of light from air to glass and from air to water are shown in figure (i) and figure (ii) below. The value of the angle θ in the case of refraction as shown in figure (iii) will be

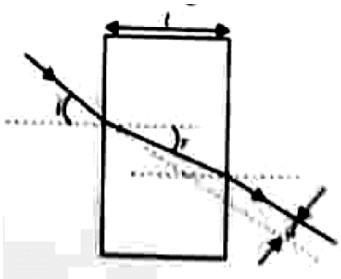


(a) 30° (b) 35° (c) 60° (d) 41°

9. A ray of light strikes a transparent rectangular slab of refractive index $\sqrt{2}$ at an angle of incidence of 45°. The angle between the reflected and refracted rays is

(a) 75° (b) 90° (c) 105° (d) 120°

10. A ray of light is incident on a thick slab of glass of thickness t as shown in the figure. The emergent ray is parallel to the incident ray but displaced sideways by a distance d. If the angles are small then d is



(a) $t\left(1-\frac{i}{r}\right)$ (b) $rt\left(1-\frac{i}{r}\right)$ (c) $t\left(1-\frac{r}{i}\right)$ (d) $t\left(1-\frac{r}{i}\right)$

11. A ray incident at a point at an angle of incidence of 60° enters a glass sphere of refractive index $\sqrt{3}$ and is reflected and refracted at the farther surface of the sphere. The angle between the reflected and refracted rays at this surface is

(a) 50° (b) 60° (c) 90° (d) 40°

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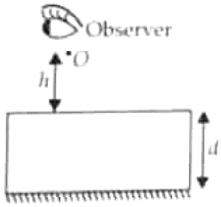
12. The apparent depth of a needle lying at the bottom of the tank, which is filled with water of refractive index 1.33 to a height of 12.5 cm is measured by a microscope to be 9.4 cm. If water is replaced by a liquid of refractive index 1.63 upto the same height. What distance would the microscope have to be moved to focus on the needle again?

(a) 1.73 cm (b) 2.13 cm (c) 1.5 cm (d) 2.9 cm

13. A point luminous object (O) is at a distance h front face of a glass slab of width d and of refractive index μ. On the back face of slab is a reflecting plane mirror. An observer sees the image of object in mirror as shown in figure. Distance of image from front face as seen by observer will be



(a) $h + \frac{2d}{\mu}$ (b) $2h + 2d$ (c) $h + d$ (d) $h + \frac{d}{\mu}$

14. A vessel of depth x is half filled with oil of refractive index μ_1 and the other half is filled 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) $\frac{2x(\mu_1 + \mu_2)}{\mu_1\mu_2}$

15. Three immiscible liquids of densities $d_1 > d_2 > d_3$ and refractive indices $\mu_1 > \mu_2 > \mu_5$ are put in a beaker. The height of each liquid column is h/3. A dot is made at the bottom of the beaker. For near normal vision, find the apparent depth of the dot.

(a) $\frac{h}{6}\left(\frac{1}{\mu_1} + \frac{1}{\mu_2} + \frac{1}{\mu_3}\right)$ (b) $\frac{h}{6}\left(\frac{1}{\mu_1} - \frac{1}{\mu_2} - \frac{1}{\mu_3}\right)$

(c) $\frac{h}{3}\left(\frac{1}{\mu_1} - \frac{1}{\mu_2} - \frac{1}{\mu_3}\right)$ (d) $\frac{h}{3}\left(\frac{1}{\mu_1} + \frac{1}{\mu_2} + \frac{1}{\mu_3}\right)$

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ABHIMANYU BATCH
MATHEMATICS : DCT
Topic: Integration

16. If $\int \frac{2^x - 3^x}{e^x}\,dx = \frac{(2/e)^x}{A} + \frac{(3/e)^x}{B} + c$, then A + B = ……

(a) $\log\left(\frac{2}{3}\right)$ (b) log 6 (c) log 3 – log 2 (d) $\log\left(\frac{3}{4}\right)$

17. If $f'(x) = 2x^3 + 3x^2 + \frac{1}{x}$ and $f(1) = \frac{5}{2}$, then integrating constant = …..

(a) 1 (b) 2 (c) 3 (d) –1

18. If $\int \frac{1}{\cos 2x + \sin^2 x}\,dx = -A \tan x + c$, then A = …..

(a) 1 (b) –2 (c) –1 (d) 2

19. A primitive of cos 4x cos 6x w.r.t. x is …..

(a) $\frac{1}{5}\left[\frac{1}{4}\sin 10x + \sin 2x\right] + c$ (b) $\frac{1}{4}\left[\frac{1}{5}\sin 10x + \sin 2x\right] + c$

(c) $\frac{1}{5}\left[\frac{1}{4}\sin 10x - \sin 2x\right] + c$ (d) $\frac{1}{4}\left[\frac{1}{5}\sin 10x - \sin 2x\right] + c$

20. $\int 2^x . 4^{x+2}\,dx$ = ….

(a) $\frac{\log^{3x+4}}{\log 3} + c$ (b) $\frac{1}{3}.\frac{2^{3x}}{\log 2} + c$ (c) $\frac{1}{3}\log 2 . 2^{3x+4} + c$ (d) $\frac{1}{3}.\frac{2^{3x+4}}{\log 2} + c$

Space for Rough Work

21. If $f(x) = \begin{bmatrix} x & 2 & 3 \\ -1 & 5x & 1 \\ 1 & 2 & x \end{bmatrix}$, then $\int |f(x)|\, dx = \ldots.$

(a) $\frac{5x^4}{4} - \frac{15x^2}{2} - 4x + c$

(b) $\frac{5x^4}{4} + \frac{15x^2}{2} - 4x + c$

(c) $\frac{5x^3}{3} - \frac{15x^2}{5} - 4x + c$

(d) $\frac{5x^3}{3} - \frac{15x^2}{5} - 5x + c$

22. If $\int \sin^2 x\, dx = f(x)$ and $f\left(\frac{\pi}{2}\right) = 0$, then $f(x) = \ldots..$

(a) $\frac{1}{2}\left[x - \frac{1}{2}\sin 2x\right] + \frac{\pi}{4}$

(b) $\frac{1}{2}\left[x - \frac{1}{2}\cos 2x\right] + \frac{\pi}{4}$

(c) $\frac{1}{2}\left[x - \frac{1}{2}\sin 2x\right] - \frac{\pi}{4}$

(d) $\frac{1}{2}\left[x - \frac{1}{2}\cos 2x\right] - \frac{\pi}{4}$

23. If $\int (5x + 3)(x - 1)^{10}\, dx = \frac{5}{12}(x - 1)^A + \frac{8}{11}(x - 1)^B + c$, then $A + B = \ldots.$

(a) 20 (b) 23 (c) 16 (d) 13

24. $\int \sqrt{1 + \sin\frac{x}{2}}\, dx \ldots,\ 0 < x < \frac{\pi}{2}$

(a) $2\left(\sin\frac{x}{4} - \cos\frac{x}{4}\right) + c$

(b) $2\left(\sin\frac{x}{2} + \cos\frac{x}{2}\right) + c$

(c) $4\left(\sin\frac{x}{2} - \cos\frac{x}{2}\right) + c$

(d) $4\left(\sin\frac{x}{4} - \cos\frac{x}{4}\right) + c$

Space for Rough Work

25. If $\int \sin 3x \,.\cos 5x \;dx = P[Q \cos 2x - R \cos 8x] + c$, then $P + Q + R = \ldots.$

(a) $-\frac{3}{2}$ (b) 1 (c) $\frac{3}{2}$ (d) -1

26. If $\int \cos^2\left(\frac{3x}{2}\right) dx = p(x + q \sin 3x) + c$, then $2p + 3q = \ldots..$

(a) 5 (b) 2 (c) -2 (d) 3

27. $\int \sin^4 x \, dx - \int \cos^4 x \;dx = \ldots.$

(a) $\sin x \cos x + c$ (b) $\sin 2x + c$ (c) $-\sin x \cos x + c$ (d) $-\sin 2x + c$

28. If $\int f(x) \;dx = -\frac{1}{3}\cot(3x - 8_) + c$, then $f(x) = \ldots.$

(a) $\text{cosec}\,(3x - 8)$ (b) $\cot^2(3x - 8)$ (c) $\text{cosec}^2(3x - 8)$ (d) $\tan^2(3x - 8)$

29. $\int |f(ax)]^3 \;.\, f'(ax)\, dx =$

(a) $\frac{1}{2}[f(ax)]^3 + c$ (b) $\frac{1}{a}[f(ax)]^4 + c$ (c) $\frac{1}{4}[f(ax)]^4 + c$ (d) $\frac{1}{4a}[f(ax)]^4 + c$

30. If $\int \left[e^{(3-5x)} + \frac{1}{2-3x}\right] dx = pe^{(3-5x)} + q \log(2 - 3x) + c$, then $p + q = \ldots.$

(a) $\frac{8}{15}$ (b) $-\frac{8}{15}$ (c) $\frac{5}{15}$ (d) $\frac{3}{15}$

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1.	(a)	2.	(c)	3.	(c)	4.	(d)	5.	(a)
6.	(b)	7.	(d)	8.	(b)	9.	(c)	10.	(c)
11.	(c)	12.	(a)	13.	(a)	14.	(a)	15.	(d)

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MATHEMATICS : DCT
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16.	(a)	17.	(a)	18.	(c)	19.	(b)	20.	(d)
21.	(a)	22.	(c)	23.	(b)	24.	(d)	25.	(c)
26.	(b)	27.	(c)	28.	(c)	29.	(d)	30.	(b)

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21.	(a)	22.	(c)	23.	(b)	24.	(d)	25.	(c)
26.	(b)	27.	(c)	28.	(c)	29.	(d)	30.	(b)