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Knowledge is Discipline
BJNP
Learning with the Speed of Mumbai and the Tradition of Kota

Max. Marks: 200 **Date: 04.09.2022**

ABHIMANYU BATCH
PHYSICS : PART TEST
Topic: Ray Optics

1. A tank is filled with water to a height of 15.5 cm. The apparent depth of a needle lying at the bottom of the tank is measured by a microscope to be 8.5 cm. If water is replaced by a liquid of refractive index 1.94 upto the same height, by what distance would the microscope have to the moved to focus on the needle again?

   (a) 1.00 cm (b) 2.37 cm (c) 0.51 cm (d) 3.93 cm

2. For a total internal reflection, which of the following is correct?

   (a) Light travel from rarer to denser medium (b) Light travel from denser to rarer medium

   (c) Light travels in air only (d) Light travels in water only

3. Light travels in two media A and B with speeds 1.8×10^8 ms^{-1} and 2.4×10^8 ms^{-1} respectively. Then the critical angle between them is

   (a) $\sin^{-1}\left(\frac{2}{3}\right)$ (b) $\tan^{-1}\left(\frac{3}{4}\right)$ (c) $\tan^{-1}\left(\frac{2}{3}\right)$ (d) $\sin^{-1}\left(\frac{3}{4}\right)$

4. Critical angle of glass is θ_1 and that of water is θ_2. The critical angle for water and glass surface would be ($\mu_g = 3/2$, $\mu_w = 4/3$)

   (a) less than θ_2 (b) between θ_1 and θ_2

   (c) greater than θ_2 (d) less than θ_1

5. Critical angle for light going from medium (i) to (ii) is θ. The speed of light in medium (i) is v, then the speed of light in medium (ii) is

   (a) $v(1 - \cos\theta)$ (b) $\frac{v}{\sin\theta}$ (c) $\frac{v}{\cos\theta}$ (d) $\frac{v}{(1 - \sin\theta)}$

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6. A ray of light travelling in a transparent medium of refractive index μ, falls on a surface separating the medium from air at an angle of incidence of 45°. For which of the following value of μ the ray can undergo total internal reflection?

(a) $\mu = 1.33$ (b) $\mu = 1.40$ (c) $\mu = 1.50$ (d) $\mu = 1.25$

7. A point source of light is placed at a depth of h below the surface of water of refractive index μ. A floating opaque disc is placed on the surface of water so that light from the source is not visible from the surface. The minimum diameter of the disc is

(a) $\frac{2h}{(\mu^2 - 1)^{1/2}}$ (b) $2h(\mu^2 - 1)^{1/2}$ (c) $\frac{h}{2(\mu^2 - 1)^{1/2}}$ (d) $h(\mu^2 - 1)^{1/2}$

8. Mirage is a phenomenon due to

(a) refraction of light (b) reflection of light

(c) total internal reflection of light (d) diffraction of light

9. From a point source a light falls on a spherical glass surface (μ = 1.5 and radius of curvature = 10 cm). The distance between point source and glass surface is 50 cm. The position of image is

(a) 25 cm (b) 50 cm (c) 100 cm (d) 150 cm

10. An air bubble in a glass sphere (μ = 1.5) is situated at a distance 3 cm from a convex surface of diameter 10 cm. At what distance from the surface will the bubble appear?

(a) 2.5 cm (b) –2.5 cm (c) 5 cm (d) –5 cm

11. A convex refracting surface of radius of curvature 20 cm separates two media of refractive indices 4/3 and 1.60. An object is placed in the first medium (μ = 4/3) at a distance of 200 cm from the refracting surface. The position of the image formed is

(a) 120 cm (b) 240 cm (c) 100 cm (d) 60 cm

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12. Light from a point source in air falls on a spherical glass surface whose radius of curvature and refractive index are 20 cm and 1.5 respectively. If the distance of light source from the glass surface is 100 cm, then at which position image will be formed?

(a) 25 cm (b) 50 cm (c) 100 cm (d) 200 cm

13. A mark placed on the surface of a sphere is viewed through glass from a position directly opposite. If the diameter of the sphere in 10 cm and refractive index of glass is 1.5. The position of the image will be

(a) –20 cm (b) 30 cm (c) 40 cm (d) –10 cm

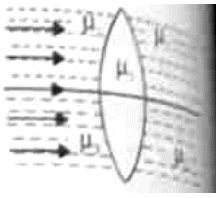
14. A biconvex lens has a focal length 2/3 times the radius of curvature of either surface. The refractive index of the lens material is

(a) 1.75 (b) 1.33 (c) 1.5 (d) 1.0

15. A convex lens of focal length 0.2 m and made of glass (${}^{n}\mu_{g} = 1.5$) is immersed in water (${}^{n}\mu_{w} = 1.50$). Find the change in the focal length of the lens.

(a) 5.8 m (b) 0.58 cm (c) 0.58 m (d) 5.8 cm

16. A double convex lens, made of a material of refractive index μ_1, is placed inside two liquids of refractive indices μ_2 and μ_3 as shown $\mu_2 > \mu_1 > \mu_3$. A wide, parallel beam of light in incident on the lens from the left. The lens will give rise to



(a) a single convergent beam (b) two different convergent beams

(c) two different divergent beams (d) a convergent and a divergent beam

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17. Double convex lenses are to be manufactured from a glass of refractive index 1.55, with both faces of same radius of curvature. What is the radius of curvature required if the focal length is to be 20 cm?

(a) 11 cm (b) 22 cm (c) 7 cm (d) 6 cm

18. What is the refractive index of material of a plane convex lens, if the radius of curvature of the comes surface is 10 cm and focal length of the lens is 30 cm?

(a) $\frac{6}{5}$ (b) $\frac{7}{4}$ (c) $\frac{2}{3}$ (d) $\frac{4}{3}$

19. The radii of curvature of the surface of a double convex lens are 20 cm and 40 cm respectively and its focal length is 20 cm. What is the refractive radius of the material of the lens?

(a) $\frac{5}{2}$ (b) $\frac{4}{3}$ (c) $\frac{5}{3}$ (d) $\frac{4}{5}$

20. A convex lens is dipped in a liquid whose refractive index is equal to the refractive index of the lens. Then its focal length will

(a) become zero (b) become infinite

(c) become small, but non-zero (d) remain unchanged

21. A convergent beam of light passes through a diverging lens of focal length 0.2 m and comes is focus 0.3 m behind the lens. The position of the point at which the beam would converge in the absence of the lens is

(a) 0.12 m (b) 0.6 m (c) 0.3 m (d) 0.15 m

22. Radii of curvature of a converging lens are in the ratio 1 : 2. Its focal length is 6 cm and refractive index is 1.5. Then its radii of curvature are

(a) 9 cm and 18 cm (b) 6 cm and 12 cm (c) 3 cm and 6 cm (d) 4.5 cm and 9 cm

23. A man is trying to start a fire by focusing sunlight on a piece of paper using an equiconvex lens of focal length 10 cm. The diameter of the sun is 1.39×10^4 m and its mean distance from the earth is 1.5×10^{11} m, the diameter of the sun's image on the paper is

(a) 3.1×10^{-4} m (b) 6.5×10^{-5} m (c) 6.5×10^{-4} m (d) 9.2×10^{-4} m

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24. A square card of side length 1 mm a being seen through a magnifying lens of focal length 10 cm. The card is placed at a distance of 9 cm from the lens. The apparent area of the card through the lens is

(a) 1 cm^2 (b) 0.81 cm^2 (c) 0.27 cm^2 (d) 0.60 cm^2

25. A converging lens is used to form an image on a screen. When the upper half of the lens is covered by an opaque screen.

(a) half the image will disappear (b) complete image will disappear

(c) intensity of image will decrease (d) intensity of image will increase

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ABHIMANYU BATCH
MATHEMATICS : PART TEST
Topic: Integration

26. If $\int \frac{1}{3x+5}\,dx = p \log(qx + r) + C$, then $p - q + r = \ldots..$

(a) $\frac{15}{3}$ (b) $\frac{8}{3}$ (c) $\frac{9}{3}$ (d) $\frac{7}{3}$

27. If $\int \frac{2x^2 + 3x + 4}{x+1}\,dx = x[f(x)] + 3 \log|g(x)| + c$, then $f(x) \cdot g(x) = \ldots.$

(a) $(x+1)^2$ (b) $x(x+1)^2$ (c) $(x-1)^2$ (d) $x(x-1)^2$

28. $\int \frac{1}{x + 7x^{-3/3}}\,dx = \ldots..$

(a) $\log|x^{3/2} + 7| + c$ (b) $\frac{5}{2}\log|x^{3/2} + 7| + c$ (c) $\log|x^{3/2} + 7| + c$ (d) $\frac{2}{5}\log|x^{5/2} + 7| + c$

29. $\int \frac{2\sin x - \cos x}{2\cos x + \sin x}\,dx = \ldots.$

(a) $\log|\sin x + 2\cos x| + c$ (b) $\frac{1}{2}\log|\sin x + 2\cos x| + c$

(c) $2\log|\sin x + 2\cos x| + c$ (d) $\log\left|\frac{1}{\sin x + 2\cos x}\right| + c$

30. $\int \frac{[\tan^{-1}(2x+3)]^{3/2}}{4x^2 + 12x + 10}\,dx = \ldots.$

(a) $\frac{1}{5}[\tan^{-1}(2x+3)]^{5/2} + c$ (b) $\frac{2}{5}[\tan^{-1}(2x+3)]^{5/2} + c$

(c) $\frac{1}{10}[\tan^{-1}(2x+3)]^{5/2} + c$ (d) $\frac{1}{5}[\tan^{-1}(2x+3)]^{5/2} + c$

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31. If $\int \tan^{-1} x \,.\, (x^2 + 1)^{-1}\, dx = A(\tan^{-1} x)^B + c$, then $A + B = \ldots.$

(a) 0 (b) -1 (c) 1 (d) $\frac{5}{2}$

32. $\int \tan^6 x \,.\sec^2 x\, dx = A \tan^7 x + c$, then $A = \ldots.$

(a) 7 (b) $\frac{1}{7}$ (c) -7 (d) $-\frac{1}{7}$

33. If $\int \frac{x+1}{x(x + \log x)^{10}}\, dx = \frac{p}{(x + \log x)^9} + c$, then $p = \ldots..$

(a) 9 (b) -9 (c) $\frac{1}{9}$ (d) $-\frac{1}{9}$

34. If $\int \frac{f(x)}{[\log(x + \sqrt{1 + x^2})]^{2/3}}\, dx = 3.\sqrt[3]{\log(x + \sqrt{1 + x^2})} + c$, then $f(x) = \ldots.$

(a) $-\frac{1}{\sqrt{1 + x^2}}$ (b) $x + \sqrt{1 + x^2}$ (c) $\frac{1}{\sqrt{1 + x^2}}$ (d) $\frac{2}{\sqrt{1 + x^2}}$

35. If $\int \frac{\sec \,.\, \operatorname{cosec} x}{\log(\cot x)}\, dx = -\log |f(x)| + c$, then $f(x) = \ldots.$

(a) $\log(\cot x)$ (b) $\log(\tan x)$ (c) $\sec x$ (d) $\operatorname{cosec} x$

36. $\int \frac{x+1}{\sqrt{3x + 2}}\, dx = \ldots.$

(a) $(3x + 2)^{3/2} + \sqrt{3x + 2} + c$ (b) $\frac{2}{9}\left[\frac{1}{3}(3x + 2)^{33/2} + \sqrt{3x + 2}\right] + c$

(c) $\frac{2}{9}[(3x + 2)^{3/2} + \sqrt{3x + 2}] + c$ (d) $\frac{1}{9}\left[\frac{1}{3}(3x + 2)^{3/2} - \sqrt{3x + 2}\right] + c$

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37. If $\int \frac{4x-6}{\sqrt{x^2-3x+7}}\,dx = p\sqrt{x^2-3x+7} + c$, then p = …..

(a) 1 (b) 3 (c) 2 (d) 4

38. If $\int x^5\sqrt{x^2+a^2}\,dx = p(x^2+a^2)^{7/2} + q(x^2+a^2)^{5/2} + r(x^2+a^2)^{3/2} + c$, then p + q + r = …..

(a) $\frac{15+42a^2+a^4}{105}$ (b) $\frac{1}{7}+\frac{2}{5}a^2+\frac{a^4}{3}$ (c) $\frac{1}{7}-\frac{2}{5}a^2-\frac{a^4}{3}$ (d) $\frac{1}{7}-\frac{2}{5}a^2+\frac{a^4}{3}$

39. If $\int x^2e^{x^3}\cos(e^{x^3})\,dx = k\sin(e^{x^2}) + c$, then k = …..

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

40. If $\int \sec(x^{101}).x^{100}dx = \frac{1}{101}\log|f(x)| + c$, then f(x) = ….

(a) $\cot\left(\frac{\pi}{4}+\frac{x^{101}}{2}\right)$ (b) $\sec\left(\frac{\pi}{4}+\frac{x^{101}}{2}\right)$ (c) $\tan\left(\frac{\pi}{4}+\frac{x^{101}}{2}\right)$ (d) $\frac{\pi}{4}+\frac{x^{101}}{2}$

41. If $\int \sqrt{x+1}\,(2x+1)\,dx = p(x+1)^{5/2} + q(x+1)^{3/2} + c$, then p + q = ….

(a) $\frac{22}{15}$ (b) $\frac{10}{15}$ (c) $\frac{2}{15}$ (d) $\frac{12}{15}$

42. If $\int \frac{\sin(x-a)}{\sin(x+a)}\,dx = Ax - B\log|\sin(x+a)| + c$, then A + B = ….

(a) cos 2a + sin 2a (b) cos 2a – sin 2a (c) sin 2a – cos 2a (d) 2 cos 2a

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43. $\int \frac{1}{\cos(x+a)\cos(x+b)}\,dx =$

(a) $\sin(b-a)\log\left|\frac{\sec(x+b)}{\sec(x+a)}\right| + c$ (b) $\cos(b-a)\log\left|\frac{\sec(x+b)}{\sec(x+a)}\right| + c$

(c) $\text{cosec}\,(b-a)\log|\sec(x+b)| + c$ (d) $\text{cosec}\,(b-a)\log\left|\frac{\sec(x+b)}{\sec(x+a)}\right| + c$

44. If $\int \frac{2\tan x + 3}{3\tan x + 4}\,dx = Ax + B\log|3\sin x + 4\cos x| + c$, then A = …. and B = …..

(a) $-\frac{18}{25}, \frac{1}{25}$ (b) $-\frac{18}{25}, -\frac{1}{25}$ (c) $\frac{18}{25}, -\frac{1}{25}$ (d) $\frac{18}{25}, \frac{1}{25}$

45. If $\int \frac{1}{3e^x + 2e^{-x}}\,dx = \frac{1}{a}\tan^{-1}\left(\frac{e^x}{b}\right) + c$, then ab = ….

(a) 2 (b) 3 (c) $\sqrt{3}$ (d) $\sqrt{2}$

46. If $\int \frac{1}{\sqrt{15 + 4x - 4x^2}}\,dx = A\sin^{-1}\left(\frac{2x-1}{B}\right) + c$, then A . B = …..

(a) 1 (b) –1 (c) –2 (d) 2

47. If $\int \frac{\cos x}{\sqrt{\cos 2x}}\,dx = A\sin^{-1}(B\sin x) + c$, then A . B = ….

(a) 2 (b) 1 (c) 0 (d) $2\sqrt{2}$

48. $\int \frac{\sin x}{\sqrt{1 - \cos^2 x}}\,dx =$ ….

(a) x + c (b) – x + c (c) $x^2 + c$ (d) $-x^2 + c$

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49. If $\int \frac{3x+1}{\sqrt{5-2x-x^2}}\,dx = p\sqrt{5-2x-x^2} + q\sin^{-1}\left(\frac{x+1}{r}\right) + c$, then $\frac{p+q}{r} = \ldots.$

(a) $\frac{5}{\sqrt{6}}$ (b) $\frac{7}{\sqrt{6}}$ (c) $\frac{-5}{\sqrt{6}}$ (d) $\frac{-7}{\sqrt{6}}$

50. If $\int \sqrt{\frac{2x-5}{x+3}}\,dx = \sqrt{2x^2+x-15} - \frac{11}{p}\log\left|\frac{4x+1}{q} + \sqrt{\frac{2x^2+x-15}{r}}\right| + c$, then $p + qr = \ldots.$

(a) $2\sqrt{2}$ (b) $8\sqrt{2}$ (c) $6\sqrt{2}$ (d) $5\sqrt{2}$

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ABHIMANYU BATCH
PHYSICS : PART TEST ANSWER KEY
Topic: Ray Optics

1.	(c)	2.	(b)	3.	(d)	4.	(c)	5.	(b)
6.	(c)	7.	(a)	8.	(c)	9.	(b)	10.	(b)
11.	(b)	12.	(c)	13.	(a)	14.	(a)	15.	(c)
16.	(d)	17.	(b)	18.	(d)	19.	(c)	20.	(b)
21.	(a)	22.	(d)	23.	(d)	24.	(a)	25.	(c)

MATHEMATICS : PART TEST ANSWER KEY
Topic: Integration

26.	(d)	27.	(a)	28.	(d)	29.	(d)	30.	(a)
31.	(d)	32.	(b)	33.	(d)	34.	(c)	35.	(a)
36.	(b)	37.	(d)	38.	(d)	39.	(c)	40.	(c)
41.	(c)	42.	(a)	43.	(d)	44.	(d)	45.	(a)
46.	(d)	47.	(b)	48.	(a)	49.	(c)	50.	(c)