

# GEOMETRICAL OPTICS QUESTION BANK

## ONE MARK QUESTIONS

1. What is lateral shift?
2. What should be the angle of incidence to have maximum lateral shift?
3. For what angle, lateral shift is minimum?
4. What is Normal shift?
5. What is total internal reflection?
6. Mention an application of total internal reflection.
7. What is an optical fibre?
8. What is dispersion?
9. Write the expression for angle of deviation.
10. What is a pure spectrum?
11. What is an impure spectrum?
12. Write the expression for deviation produced by a thin prism.
13. Define dispersive power.
14. Mention the condition for dispersion without deviation.
15. Which colour has got the maximum angle of deviation?
16. Which colour has got the minimum angle of deviation?
17. If the thickness of the slab is increased what happens to lateral shift?
18. What happens to the normal shift when the thickness of the optical medium is decreased?
19. Write the expression for equivalent focal length of combination of two thin lenses separated by a distance.
20. Which physical quantity is unchanged during refraction of light?
21. Define critical angle.
22. Mention an application of total internal reflection.
23. What is dispersion of light?
24. Write the expression for the deviation produced by a thin prism.
25. Define dispersive power of the material of a prism.
26. What is angular dispersion?
27. Write the condition for dispersion without deviation.
28. Define power of a lens.
29. What is magnification?

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30. Write the relation between power and focal length of a lens.
31. Write the expression for the equivalent focal length of two thin lenses separated by a distance.
32. What is a thin prism?
33. What is the lateral shift produced by a parallel sided glass slab for grazing incidence of light?
34. A thin convex lens of focal length 0.1m & a thin concave lens of focal length 0.1m are placed co-axially in contact. What is the net power of the combination?

### One mark questions from previous papers

35. Mention the condition for dispersion without deviation
36. A thin convex lens of focal length 0.1m and a thin concave lens of focal length 0.1m are placed coaxially on contact. What is the net power of the combination?
37. What is the lateral shift produced by a parallel sided glass slab for grazing incidence of light?
38. Define dispersive power of a medium for a pair of colours.
39. Define power of a lens.
40. What is the principle of an optical fibre?
41. What is a thin prism?
42. Define angular dispersion between two colours for a prism.
43. What is dispersion of light?
44. What is deviation produced by a thin prism of angle  $8^\circ$  & refractive index is 1.5?
45. For what angle of incidence, Snell's law is not valid?

### TWO MARK QUESTIONS

46. Mention the conditions for total internal reflection to occur.
47. Arrive at the relation between critical angle and refractive index.
48. What is an optical fibre? on what principle does it work?
49. Write the ray diagram showing the experimental arrangement for pure spectrum.

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50. What is a pure spectrum? give an example.
51. What is an impure spectrum? give an example.
52. Calculate the refractive index of a pair of media given critical angle as  $40^\circ$ .
53. Calculate the angle of deviation produced by a thin prism of refracting angle  $5^\circ$  and refractive index 1.5.
54. An object is kept at a distance of 0.12m from a convex lens forms an image at a distance of 0.18m. calculate the magnification produced.
55. Two thin convex lenses of focal lengths 0.15m & 0.2m are separated by a distance of 0.6m. Find the effective focal length of the combination.
56. Write the expression for the equivalent focal length of two thin lenses separated by a distance and explain the terms.
57. Arrive at the expression for dispersive power of the material of a prism in terms of angle of deviation.
58. Calculate the critical angle for the material of refractive index 1.5.

### Two mark questions from previous papers

59. Calculate the dispersive power of the material of a thin prism, given the angle of deviation for red and violet as  $11.2^\circ$  and  $11.6^\circ$  respectively.
60. Write an expression for the dispersive power of the material of a prism and explain the symbols.
61. What is a thin prism? Write the expression for deviation produced by a thin prism.
62. Write the expression for the refractive index in terms of A and D for a prism, explain the symbols.
63. Mention any 2 factors on which lateral shift depends.
64. A crown glass prism has refractive indices 1.585 and 1.575 for blue and red colours. Find its dispersive power.
65. What are the conditions for a pair of thin prisms to produce dispersion without deviation?

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66. Write an expression for refractive index of the material of a prism in terms of its angle. Is the expression true for all positions of the prism?
67. Calculate the angle of incidence for a ray of light to have minimum deviation of  $39^{\circ}40'$  in equilateral prism.
68. Write an expression for deviation produced by a thin prism and explain the terms.

### FIVE MARK QUESTIONS

69. What is lateral shift? Derive an expression for lateral shift produced by a parallel sided glass slab for oblique incidence.
70. What is normal shift? Derive the expression for normal shift produced when an object in a denser medium is viewed normally through air.
71. Derive the expression for refractive index in terms of the angle of the prism and angle of minimum deviation.
72. Derive the relation connecting  $n, u, v$  &  $R$  for refraction at a spherical surface concave towards a point object in a denser medium.
73. Derive lens maker's formula.
74. Derive the expression for the effective focal length of two thin lenses in contact.

### Five mark questions from previous papers

75. Derive the relation connecting  $n, u, v$  &  $R$  for refraction at a spherical surface concave towards a point object in a denser medium producing a virtual image.
76. What is lateral shift? Obtain an expression for lateral shift produced by a rectangular glass due to refraction through it.
77. Arrive at lens maker's formula.

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78. What is normal shift? Obtain an expression for the normal shift produced when an object in a denser medium is viewed normally through it.
79. Derive lens maker's formula.
80. Derive an expression for refractive index of the material of a prism in terms of the angle of the prism and angle of minimum deviation.
81. With a diagram explain in brief the TIR. Define critical angle and mention the two conditions for TIR.
82. Derive an expression for lateral shift produced when a ray of light passes through a parallel sided glass slab.
83. Define power of a lens. Write its SI unit. What is meant by linear magnification produced by a lens in a direction perpendicular to its axis? Write the expression for equivalent focal length of coaxial combination of two thin lenses separated by a finite distance and explain the terms.
84. Obtain Lens maker's formula.
85. Obtain an expression for lateral shift produced by a parallel sided glass slab placed in air.

### **Five mark problems from previous papers**

86. A small air bubble is inside a transparent cube of 0.21 m. When viewed from one face it appears to be at a depth of 0.06 m, when viewed from opposite face the bubble appears to be at a depth of 0.08 m. Calculate the actual distance from first face and also the refractive index of the material of the cube.
87. A ray of light travelling in air is incident on a prism and passes through it with a speed of  $2 \times 10^8 \text{ ms}^{-1}$  parallel to its base. If the angle of refraction is equal to half of the angle of incidence, find the angle of the prism? Assume  $C = 3 \times 10^8 \text{ ms}^{-1}$
88. A point source of light is kept at the bottom of a tank containing water ( $n$  for water  $= 4/3$ ) to a depth of 0.5 m. What is the area of the circular patch through which light from the source can emerge out?

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89. A small air bubble is found 0.04 m inside a glass sphere of refractive index 1.5. When viewed normally from outside it is seen at a depth of 0.03 m. Calculate the radius of curvature of glass sphere.
90. A transparent glass cube, of side 20 cm contains a small air bubble. When it is viewed directly from the nearest face it appears to be at 0.05 cm from that face and when it viewed through the opposite face, the air bubble appears to be 7.5 cm from that face. Calculate the position of the bubble from the nearest face and also the refractive index of glass.
91. A glass sphere of radius 15 cm contains a small air bubble at a distance of 6 cm from its centre. When viewed along its diameter from the nearest side, the bubble appears to be 7.5 cm. Calculate the refractive index of glass and the apparent distance of the bubble from the farthest side.
92. An equiconvex lens has a focal length of 0.10 m and the radius of one curved surface is 0.12 m. Find the refractive index of the material of the convex lens.
93. Focal length of convex lens is 0.1 m. A liquid lens is formed between a plane surface and one face of this lens of radius of curvature 0.12m. The converging combination formed is found to have a focal length 0.18 m. Calculate the refractive index of liquid.
94. A ray of light is incident on one of the faces of a parallel sided glass slab of thickness 0.12 m at an angle of incidence  $51^{\circ} 31'$ . Calculate the lateral shift produced given refractive index of glass slab is 1.562.
95. A luminous point object is placed at a depth of 0.5m inside a liquid. A circular patch of light of radius 0.05675 m is formed on the surface. Find the critical angle and refractive index of the liquid.
96. A convex lens of focal length 0.2m of refractive index 1.5 is immersed in water of refractive index 1.33. Calculate the focal length of lens in water.

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97. Find the real position of an air bubble in a glass cube of side 0.3m if the bubble appears to be at a distance of 0.05 m from one face and at 0.15m from the opposite face.
98. A concave lens when placed in air has a focal length of 0.4 m and has a refractive index of  $\frac{3}{2}$ . What will be its focal length when immersed in water of refractive index  $\frac{4}{3}$ ?

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