CLASS XII – PHYSICS (042)
PRACTICE PAPER – CHAPTER 9: RAY OPTICS AND OPTICAL INSTRUMENTS

Academic Session 2026–27

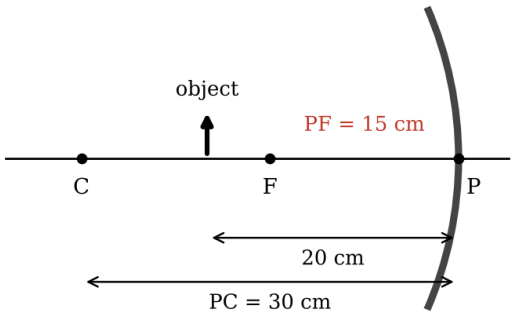
Maximum Marks : 35 **Time Allowed : 1 hour 15 minutes**

General Instructions

(1) There are 18 questions in all. All questions are compulsory.
(2) The question paper has five sections: Section A, B, C, D and E.
(3) Section A (Q.1–9) has seven MCQs and two Assertion–Reasoning questions of 1 mark each. Section B (Q.10–13) has four questions of 2 marks each. Section C (Q.14–16) has three questions of 3 marks each. Section D (Q.17) is one case study based question of 4 marks. Section E (Q.18) is one long answer question of 5 marks.
(4) There is no overall choice. An internal choice is provided in Q.12 (Section B), Q.15 (Section C), Q.17 part (iv) (Section D) and Q.18 (Section E). Attempt only one of the choices in such questions.
(5) Use of calculators is not allowed.
(6) You may use the following values wherever necessary: $c = 3 \times 10^8$ m s^{-1}, $\sqrt{2} = 1.41$, $\sqrt{3} = 1.73$, least distance of distinct vision D = 25 cm. Use the Cartesian sign convention.

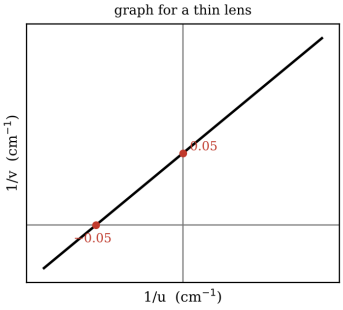
SECTION A (9 × 1 = 9)

1. A small object is placed on the axis of a concave mirror at the position shown, the mirror having its centre of curvature C and focus F as marked. The image formed is **1**



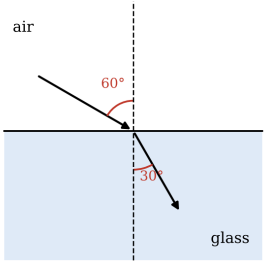
(a) 60 cm behind the mirror, virtual, erect and 3 times the size of the object
(b) 12 cm in front of the mirror, real, inverted and diminished
(c) 60 cm in front of the mirror, real, inverted and 3 times the size of the object
(d) 60 cm in front of the mirror, virtual, inverted and 3 times the size of the object

2. A student plots 1/v against 1/u for a thin lens and obtains the straight line shown, which cuts the two axes at the values marked. The lens is **1**



(a) a convex lens of focal length +20 cm
(b) a concave lens of focal length −20 cm
(c) a convex lens of focal length +5 cm
(d) a concave lens of focal length −5 cm

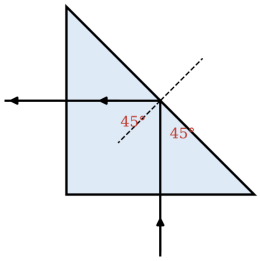
3. A ray of light passes from air into glass, making the angles shown with the normal. The refractive index of the glass is **1**



(a) 1.41
(b) 1.50
(c) 1.73
(d) 2.00

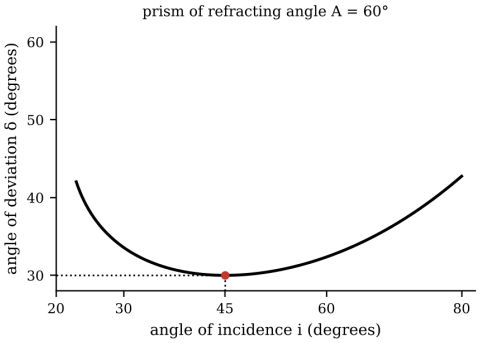
4. A right-angled isosceles prism is to be used to turn a ray of light through 90°, as shown, by total internal reflection at its hypotenuse. The table gives the refractive indices of four media. The prism can be made from **1**

Medium	A (water)	B (crown glass)	C (dense flint glass)	D (diamond)
Refractive index	1.33	1.52	1.62	2.42



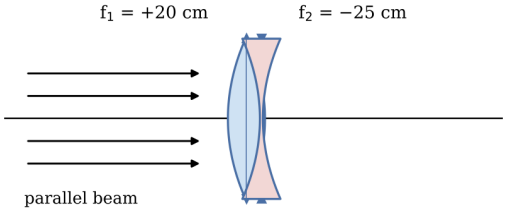
(a) medium A only
(b) media B, C and D only
(c) media A and B only
(d) medium D only

5. The graph shows the variation of the angle of deviation δ with the angle of incidence i for a prism of refracting angle 60°. The refractive index of the material of the prism is **1**



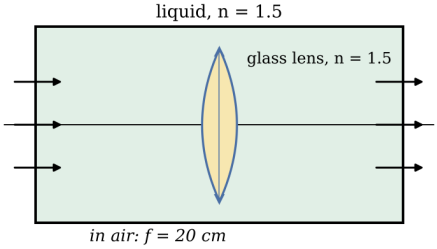
(a) 1.33
(b) 1.50
(c) 1.73
(d) 1.41

6. A convex lens and a concave lens of the focal lengths shown are placed in contact, and a parallel beam of light is incident on them, as shown. The combination behaves as **1**



(a) a converging lens of focal length 100 cm
(b) a diverging lens of focal length 100 cm
(c) a converging lens of focal length 45 cm
(d) a diverging lens of focal length 4.5 cm

7. A double-convex glass lens (n = 1.5) has a focal length of 20 cm in air. It is completely immersed in a liquid of refractive index 1.5, as shown. The focal length of the lens in the liquid is **1**



(a) 20 cm
(b) 40 cm
(c) zero
(d) infinite

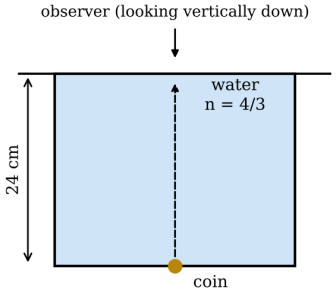
For Questions 8 and 9, a statement of Assertion (A) is followed by a statement of Reason (R). Select the correct answer from the options below.
(a) Both A and R are true and R is the correct explanation of A.
(b) Both A and R are true but R is not the correct explanation of A.
(c) A is true but R is false.
(d) A is false but R is true.

8. **Assertion (A):** A properly cut diamond sparkles brilliantly. **1**
Reason (R): The critical angle for diamond is large, so very little light inside it undergoes total internal reflection.

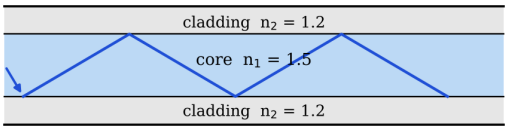
9. **Assertion (A):** A convex lens always behaves as a converging lens, whatever the medium in which it is placed. **1**
Reason (R): The focal length of a lens depends on the radii of curvature of its surfaces.

SECTION B (4 × 2 = 8)

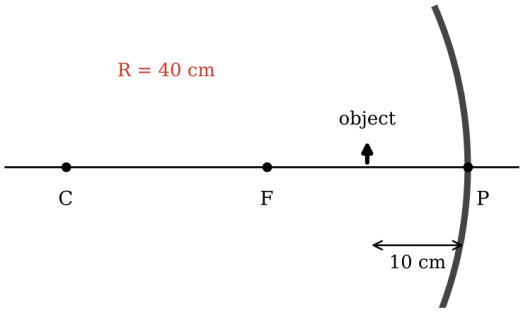
10. A coin lies at the bottom of a tank containing water (refractive index 4/3) to a depth of 24 cm, as shown. For an observer looking vertically down, find the apparent depth of the coin and the distance through which it appears to be raised. **2**



11. A light pipe has a core of refractive index 1.5 surrounded by a cladding of refractive index 1.2, as shown. Find the critical angle at the core–cladding interface (give sin i_c and the approximate value of i_c). State the condition that the ray must satisfy at the interface to be guided along the pipe. **2**



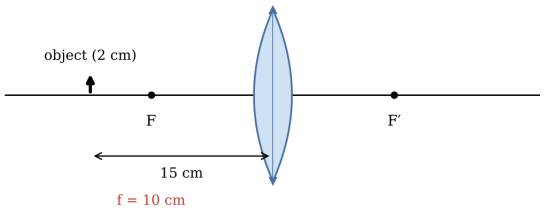
12. **(A)** An object is placed 10 cm in front of a concave mirror of radius of curvature 40 cm, as shown. Find the position of the image and its magnification. State the nature of the image. **2**



OR

(B) Using the mirror equation, show that a convex mirror always forms a virtual, erect and diminished image of a real object, located between its pole and its focus.

13. An object 2 cm tall is placed 15 cm in front of a convex lens of focal length 10 cm, as shown. Find the position of the image and its size. State whether the image is erect or inverted. **2**

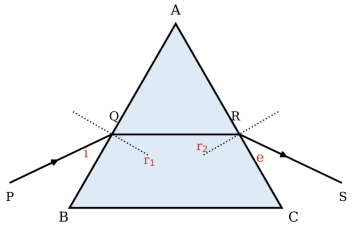


SECTION C (3 × 3 = 9)

14. In an experiment with a convex lens, a student records the three sets of readings given in the table. (a) Find the focal length of the lens from each reading and show that the readings are consistent. (b) Find the magnification for each reading and identify the reading for which the image is of the same size as the object. (c) Find the power of the lens in dioptre. **3**

Reading	Object distance u (cm)	Image distance v (cm)
1	−30	+60
2	−40	+40
3	−60	+30

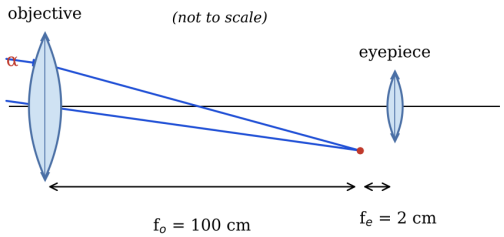
15. **(A)** The figure shows the passage of a ray PQRS through a prism ABC of refracting angle A, the angles of incidence and refraction at the first face being i and r_1 and those at the second face r_2 and e. Show that $r_1 + r_2 = A$ and that the angle of deviation is $\delta = i + e - A$. Hence obtain the expression $n = \sin[(A + D_m)/2] / \sin(A/2)$ for the refractive index of the prism, where D_m is the angle of minimum deviation. **3**



OR

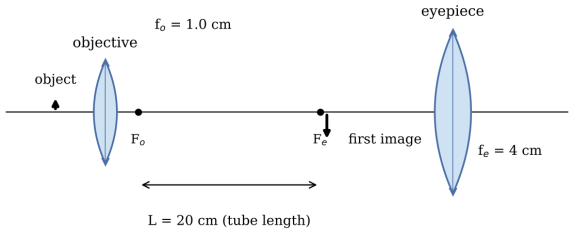
(B) Two thin lenses of focal lengths f_1 and f_2 are placed in contact. Derive the expression $1/f = 1/f_1 + 1/f_2$ for the focal length f of the combination. If the powers of the two lenses are P_1 and P_2, write the power of the combination.

16. A refracting telescope has an objective of focal length 100 cm and an eyepiece of focal length 2 cm, as shown, and is in normal adjustment. (a) Find its magnifying power. (b) Find the length of the telescope tube. (c) Two distant stars are 2′ (two minutes of arc) apart. At what angular separation do they appear through the telescope? **3**



SECTION D (1 × 4 = 4)

17. **Case Study.** A compound microscope uses two convex lenses. The objective, of small focal length, forms an image of the tiny object, and this image is viewed through the eyepiece, which acts as a simple magnifier. In the microscope shown the objective has a focal length f_o = 1.0 cm, the eyepiece has a focal length f_e = 4 cm and the distance between the second focal point of the objective and the first focal point of the eyepiece (the tube length) is L = 20 cm. Take D = 25 cm. Answer the following: **4**



(i) The image formed by the objective is

(a) virtual, erect and diminished (b) real, inverted and magnified (c) virtual, erect and magnified (d) real, erect and magnified

(ii) The magnification produced by the objective, $m_o = L/f_o$, is

(a) 0.05 (b) 5 (c) 20 (d) 200

(iii) The magnifying power of the microscope when the final image is formed at infinity is

(a) 125 (b) 145 (c) 25 (d) 5

(iv) The magnification produced by the eyepiece alone when the final image is formed at the near point is

(a) 6.25 (b) 7.25 (c) 25 (d) 4

OR

(iv) When the final image is formed at infinity, the image formed by the objective lies at a distance from the eyepiece of

(a) 4 cm (b) 8 cm (c) 20 cm (d) 25 cm

SECTION E (1 × 5 = 5)

18. **(A)** Draw a ray diagram for the image of a real object formed by a concave mirror, the object being placed between the centre of curvature and the focus. Using it, derive the mirror equation 1/v + 1/u = 1/f, and the expression for the magnification m = −v/u. (3) **5**

An object 4 cm tall is placed 25 cm in front of a concave mirror of focal length 20 cm. Find the position, nature and size of the image. (2)

OR

(B) Draw a labelled ray diagram for the formation of the image by a compound microscope when the final image is formed at infinity. Obtain the expression for its magnifying power $m = (L/f_o)(D/f_e)$. (3)

A compound microscope has an objective of focal length 1.0 cm, an eyepiece of focal length 5.0 cm and a tube length of 15 cm. Find its magnifying power for the final image at infinity, and the new magnifying power if the eyepiece is replaced by one of focal length 2.5 cm. (2)

— End of Question Paper —