ICSE CLASS 10 EXAMINATION

PRACTICE QUESTION PAPER

PHYSICS

Chapter 4 : REFRACTION OF LIGHT AT PLANE SURFACES

(Refraction and Refractive Index · Glass Block and Prism · Real and Apparent Depth · Critical Angle and Total Internal Reflection)

Maximum Marks: 40 **Time allowed: One hour**

1. Answers to this Paper must be written on the paper provided separately.

2. You will not be allowed to write during the first 5 minutes. This time is to be spent in reading the question paper.

3. The time given at the head of this Paper is the time allowed for writing the answers.

*4. **Section A** is compulsory. Attempt **all** questions from Section A and **any two** questions from Section B.*

5. The intended marks for questions or parts of questions are given in brackets [ ].

6. Speed of light in air or vacuum $c = 3 \times 10^8$ m s^{-1}. Take sin 42° = 2/3 wherever required. Ray diagrams must be drawn neatly with arrows.

SECTION A (20 Marks)

(Attempt all questions from this Section.)

Question 1

Choose the correct answers to the questions from the given options. *(Do not copy the question, write the correct answers only.)* **[8]**

(i) The absolute refractive index μ of a medium is given by (c = speed of light in vacuum, V = speed in the medium):

(a) V ÷ c (b) c ÷ V

(c) c × V (d) c − V

(ii) When a ray of light passes from air into glass, which of the following does **not** change?

(a) its speed (b) its wavelength

(c) its direction (for oblique incidence) (d) its frequency

(iii) A ray of light travelling in glass (μ = 1.5) is totally reflected at the glass–air surface when the angle of incidence is more than about:

(a) 42° (b) 49°

(c) 60° (d) 90°

(iv) A coin at the bottom of a beaker of water appears raised when seen from above. This is due to:

(a) reflection (b) total internal reflection

(c) refraction (d) dispersion

(v) Assertion (A): A total reflecting prism is preferred to a plane mirror in a periscope.

Reason (R): In total internal reflection the entire incident light is reflected back.

(a) (A) is true and (R) is false.

(b) (A) is false and (R) is true.

(c) Both (A) and (R) are true, and (R) is the correct explanation for (A).

(d) Both (A) and (R) are true, but (R) is not the correct explanation for (A).

(vi) A ray of light is incident normally on the hypotenuse of a right-angled isosceles glass prism (critical angle 42°). The ray is deviated through:

(a) 90° (b) 180°

(c) 60° (d) 0°

(vii) As compared with red light, violet light in a glass prism:

(a) travels faster (b) has smaller refractive index

(c) has larger wavelength (d) is deviated more

(viii) A tank is 12 cm deep and is filled with water (μ = 4/3). When viewed vertically from above, its apparent depth is:

(a) 9 cm (b) 16 cm

(c) 12 cm (d) 8 cm

Question 2

(a) State Snell's law of refraction. What is meant by the statement 'the refractive index of glass is 1.5'? **[2]**

(b) Fig. 1 shows a ray AO incident at an angle of 60° on the top face of a rectangular glass slab of refractive index √3 (= 1.73). **[3]**

(i) Calculate the angle of refraction at O. **[1]**

(ii) Find the angle of emergence at the opposite face, and state how the emergent ray is related to the incident ray AO. **[1]**

(iii) Calculate the speed of light in the glass. **[1]**

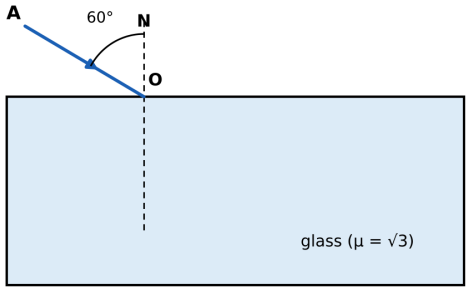


Fig. 1

(c) Which colour of white light travels slowest in glass? Give a reason. **[1]**

Question 3

(a) A ray of light of wavelength 6000 Å in air enters glass of refractive index 1.5. Calculate (i) the frequency of light, (ii) the speed of light in glass, and (iii) the wavelength of light in glass. **[3]**

(b) Fig. 2 shows a point object O lying at the bottom of a tank containing water (μ = 4/3) to a depth of 24 cm. A ray from O is refracted at the surface and reaches the eye of an observer looking vertically down. **[3]**

(i) Explain, in terms of the bending of the ray, why O appears to be nearer to the surface. **[1]**

(ii) Calculate the apparent depth of O. **[1]**

(iii) By how much does O appear to be raised? **[1]**

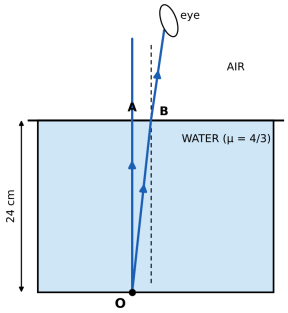


Fig. 2

SECTION B (20 Marks)

(Attempt any two questions from this Section.)

Question 4

(a) A prism has refracting angle 60°. (i) A ray incident at 40° emerges at 62°. Calculate the angle of deviation. (ii) For the same prism the minimum deviation is 38°. Find the angle of incidence at minimum deviation. (iii) In the position of minimum deviation, what is the direction of the refracted ray inside an equilateral prism? **[3]**

(b) Define the critical angle. Derive the relation between the critical angle C and the refractive index μ of a medium with respect to air. **[3]**

(c) Fig. 3 shows an equilateral prism ABC. A ray of light suffers minimum deviation and emerges along QR at an angle of emergence of 48°. **[4]**

(i) Complete the diagram, showing the refracted ray PQ inside the prism and the incident ray OP. Mark the normals and the angles of incidence and emergence. **[2]**

(ii) State the angle of incidence at P and how PQ is directed with respect to BC. **[1]**

(iii) Calculate the angle of minimum deviation. **[1]**

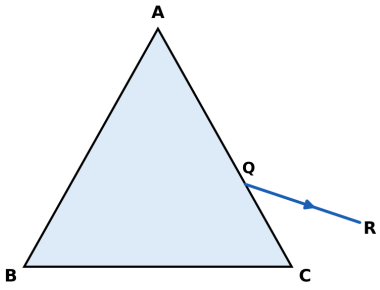


Fig. 3

Question 5

(a) The critical angle for a transparent medium with respect to air is 30°. Calculate (i) the refractive index of the medium, (ii) the speed of light in it, and (iii) state with reason what happens to a ray inside the medium that strikes the medium–air surface at an angle of incidence of 40°. **[3]**

(b) Fig. 4 shows a semicircular glass slab (μ = 1.5, critical angle 42°). Three rays A, B and C of the same colour are directed towards the centre O and strike the straight edge XY at angles of incidence of 30°, 42° and 60° respectively. **[3]**

(i) Complete the paths of the rays A, B and C after they strike XY. Mark the angles wherever necessary. **[2]**

(ii) Name the phenomenon shown by ray C, and explain why the rays enter the slab along the radius without bending. **[1]**

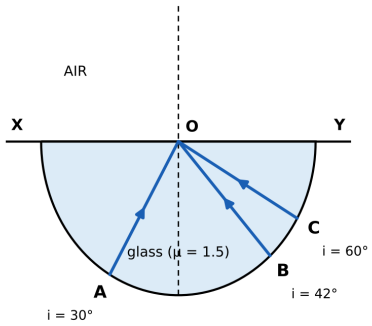


Fig. 4

(c) Fig. 5 shows two rays PQ and P′Q′ falling normally on the face AB of a right-angled isosceles glass prism ABC (critical angle of glass = 42°). **[4]**

(i) What is the angle of incidence at the face AC? **[1]**

(ii) Will the rays suffer total internal reflection at AC? Give a reason. **[1]**

(iii) Complete the paths of both rays till they leave the prism, and state the angle through which the rays are deviated. **[1]**

(iv) Name one optical instrument in which this action of the prism is used. **[1]**

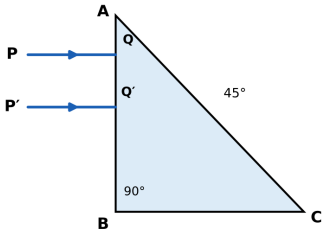


Fig. 5

Question 6

(a) A glass slab of thickness 12 cm and refractive index 1.5 is placed over a printed page. When viewed vertically from above, find (i) the apparent thickness of the slab, (ii) the amount by which the print appears to be raised, and (iii) the colour of light for which the shift is maximum (give a reason). **[3]**

(b) State three differences between total internal reflection and reflection from a plane mirror. **[3]**

(c) Fig. 6 shows an equilateral glass prism ABC (critical angle 42°). A ray PQ is incident normally on the face AB. **[4]**

(i) What is the angle of incidence of the ray inside the prism at the face AC? **[1]**

(ii) Will the ray be totally reflected at AC? Give a reason. **[1]**

(iii) Complete the path of the ray till it emerges into air, marking the points R, S and the emergent ray. **[1]**

(iv) By what angle is the emergent ray deviated from the direction of PQ? **[1]**

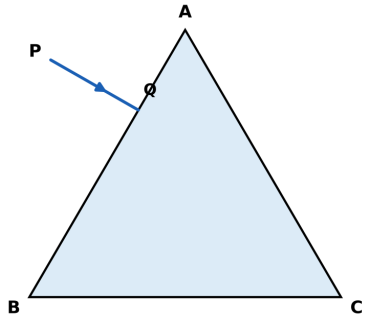


Fig. 6

— End of Question Paper —