Grade 11 Physics, Explained

Unit 16 · Refraction through Prisms

HARDER PRACTICE QUESTIONS

Full marks 30

Write your answers on separate paper. Show your working. The prisms are of glass and stand in air unless the question says otherwise.

1 Spot the error [3]

Find the mistake in the working and correct it.

Ayushma measured the minimum deviation of an equilateral prism as 42° and wrote: "$\mu = \sin(A + \delta_m) \div \sin A = \sin 102° \div \sin 60° = 0.978 \div 0.866 = \mathbf{1.13}$. The glass is hardly denser than water."

2 Reading a graph [4]

Kritika traced rays through a 60° prism and measured the deviation for each angle of incidence.

i	30°	35°	40°	45°	50°	55°	60°	70°
δ	47.5°	41.0°	38.5°	37.5°	37.0°	38.0°	39.0°	43.0°

i. Estimate the angle of minimum deviation, and from it the refractive index of the glass.

ii. For the ray at i = 40°, find the angle of emergence.

iii. Use the reversibility of light to name another angle of incidence that should give the same deviation as i = 40°. Does her table agree?

iv. Why is it hard to tell, from her table, exactly at which angle the minimum falls?

3 Least and most [4]

For a 60° prism of refractive index 1.5, find the smallest angle of incidence for which light comes out of the second face at all. What happens to light falling at a smaller angle?

4 A real setting [3]

An eye doctor prescribes a prism of 3 prism diopters for Saugat's spectacles (one prism diopter turns light by 1 cm at a distance of 1 m). The glass has a refractive index of 1.52. Find the deviation in degrees and the refracting angle the thin prism must have.

5 Design it [3]

A thin prism of crown glass ($\mu = 1.52$) has an angle of 5°. Diya wants to put a thin prism of flint glass ($\mu = 1.62$) behind it, turned the other way, so that a ray passes through the pair with no deviation at all. What angle must the flint prism have?

6 Predict, then explain [3]

Write your prediction first, then explain it.

Two thin glass sheets are glued into a hollow prism, which is sealed with only air inside and held under water. A ray passes through it. Predict which way the ray is turned: towards the base or towards the refracting edge. Explain.

7 What if? [3]

For a thin prism, $\delta = (\mu - 1)A$. Use it to say how the deviation of a thin glass prism changes, and why, in each case:

i. the prism is made of glass of larger refractive index;
ii. the prism is put in water;
iii. violet light is used instead of red.

8 Correct the misconceptions [3]

The paragraph has three mistakes. Write each mistake and correct it.

Rohan wrote: "The deviation of a prism is greatest when the ray passes through it symmetrically. At that point the angle of incidence equals the angle of the prism. A thin prism deviates a ray by an amount that depends strongly on the angle of incidence."

9 Think [2]

Two prisms have the same refracting angle, 60°. Prism P gives a minimum deviation of 37° and prism Q one of 47°. Without working out μ, say which glass has the larger refractive index, and which has the smaller critical angle. Explain.

10 Make your own [2]

Write a problem about a prism of refractive index 1.5 whose answer is "the refracting angle must be 56.3°". Solve it to show that it works.