2022 Ph H2 Q11

Section: Particles and Waves

Topic: Refraction of Light

A triangular glass prism (n=1.47) in a plastic tank. (a) Calculate angle θ of refraction at exit. (b) Find critical angle. (c) Tank filled with vegetable oil (n=1.47): state exit point.

Worked solution

(a) Angle θ

Snell's law: $n_{glass} \sin 37° = n_{air} \sin\theta$
$1.47 \times \sin 37° = \sin\theta$
$= 0.885$
$\theta = 62.2°$

Answer: θ ≈ 35.5°

(b) Critical angle

$\sin c = n_2/n_1 = 1.00/1.47 = 0.680$
$c = 42.9°$

Answer: 42.8°

(c) When the tank is filled with oil (n=1.47), the refractive index of oil equals that of glass. There is no refraction at the glass–oil boundary. The ray travels straight through and leaves at point T.

Final answers

(a) θ ≈ 35.5°

(b) c ≈ 42.8°

(c) Ray exits at point T

Revision tips

- Snell’s law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$.
- Critical angle: $\sin c = n_2/n_1$ ($n_1 > n_2$).
- If two media have equal n, no refraction occurs.
- Draw diagrams carefully when tracing rays through prisms.
- Remember: larger n → ray bends towards the normal.