3.2 Light refraction and sound

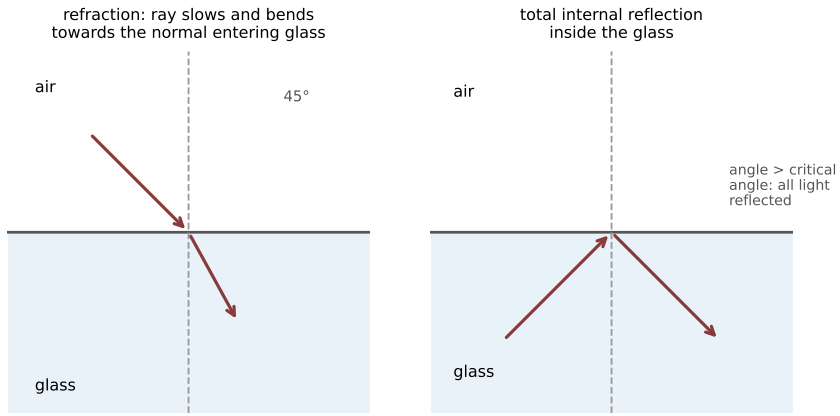
Name: _____ Class: _____ Date: _____ **Total: 23 marks**

Objective

Cover light and (P) sound (3.14–3.29P): reflection, refraction and ray diagrams, refractive index, critical angle and total internal reflection in fibres and prisms; sound as a longitudinal wave, hearing range, oscilloscope traces, pitch and loudness. Original IGCSE-level practice.

1 Key knowledge and worked examples

■ n, c and TIR



$$n = \frac{\sin i}{\sin r} \qquad \sin c = \frac{1}{n}$$

Worked check. Light hits a glass block (n = 1.5) at 45°: $\sin r = \sin 45°/1.5 = 0.707/1.5 = 0.471$, $r \approx 28°$ – bent towards the normal. Critical angle $\sin c = 1/1.5$, $c \approx 41.8°$.

■ (P) Sound on the screen

Loudness ↑ → amplitude ↑; pitch ↑ → frequency ↑. Oscilloscope: louder = taller trace; higher pitch = more cycles across the screen.

2 Practice

2.1 State the law of reflection. [1]

2.2 Which way does light bend entering glass from air, and why? [2]

2.3 Calculate the refractive index if sin i = 0.866 and sin r = 0.5. [2]

2.4 State the two conditions needed for total internal reflection. [2]

2.5 (P) State what raises the pitch of a sound and what raises its loudness. [2]

3 Exam-style questions

3.1 Light travels from air into water (n = 1.33) at an incident angle of 40°. Calculate the angle of refraction. [3]

3.2 Explain how an optical fibre uses total internal reflection to carry information, and why the light must strike the fibre wall above the critical angle. [3]

3.3 (P) Describe how to measure the speed of sound in air using an echo method, stating the measurements taken and the calculation. [4]

3.4 (P) An oscilloscope shows a sound trace with 4 complete waves across the screen; the time base is 5 ms per division and the screen is 10 divisions wide. Calculate the frequency, and describe the trace if the sound becomes louder at the same pitch. [4]