Total Internal Reflection Worksheet

GCSE Physics — Waves

SimpliPhys

Name: _____ Date: _____ Class: _____

Part 1 — Semi-circular Block

Aim

To investigate total internal reflection and find the critical angle for a glass block.

Key Equation

$$\sin c = n_2 / n_1 \quad \text{(where } n_1 > n_2\text{)}$$

Method

1. Open the Total Internal Reflection simulation and select the **Semi-circular Block** tab.
2. Use the **Normal line tool** to draw a normal at the flat face, perpendicular to the surface through the point of incidence.
3. Place the **Protractor** at the point of incidence and align with your normal.
4. Starting at **10°**, slowly increase the angle of incidence.
5. For each angle, record whether the ray is *refracted*, *partially reflected*, or undergoes *total internal reflection*.
6. Identify the **critical angle** — the angle at which the refracted ray disappears.

Results

θ_i (°)	Observation (Refracted / Partially reflected / TIR)
10	
20	
30	
35	
40	
42	
45	
50	
60	
70	

Analysis

1. What is the critical angle for the glass block? State how you identified it.

2. Calculate the expected critical angle using $\sin c = n_2 / n_1$ (glass n = 1.50, air n = 1.00). Show your working.

3. What three conditions must be met for total internal reflection to occur?

4. Describe what happens to the brightness of the reflected ray as the angle of incidence increases toward the critical angle.

5. Explain why a semi-circular block is used rather than a rectangular block for this experiment.

Part 2 — Triangular Prism

Aim

To investigate dispersion and total internal reflection in a triangular prism.

Method

1. Switch to the **Triangular Prism** tab.
2. Set the light type to **White light**.
3. Set the angle of incidence to **45°** and observe the exit rays.
4. Slowly increase the angle to find when total internal reflection occurs.
5. Switch to **Single wavelength** mode and observe how different wavelengths behave.

Results

Angle (°)	Light type	Appearance / Observation

Analysis

1. When white light enters the prism, describe what you see at the exit face. Why does this happen?

> **Hint:** Different wavelengths of light have slightly different refractive indices in glass. This means they bend by different amounts.

2. Which colour of light is refracted the most? Which is refracted the least? Explain why using refractive index.

3. At what angle of incidence does total internal reflection begin inside the prism? Is this the same for all wavelengths?

4. Give two real-world applications of total internal reflection.

5. Explain why a prism can separate white light into a spectrum but a rectangular glass block cannot produce the same effect.