

Question 37066

Walter Light Wave and Percy Photon decide to have a race. Walter runs the entire race in air while Percy slogs his way through crown glass. If Walter beats Percy by $1.34E-6$ s, how long was the race?

A light wave and a photon are essentially the same thing due to the light dualism.

The difference in the travel time is due to the different refraction indices, $n_W = 1$ for air (Walter) and $n_P = 1.52$ for the crown glass (Percy). The speed of a photon in a given medium is $v = \frac{c}{n}$.

We are given information that $t_P - t_W = 1.34 \times 10^{-6}$ s.

If the length of the race is L, the travel times can be calculated as $t = \frac{L}{v} = \frac{Ln}{c}$.

This way the equation for time difference transforms into $\frac{L(n_P - n_W)}{c} = 1.34 \times 10^{-6}$ s.

From this we can work out $L = \frac{(1.34 \times 10^{-6} s) \times c}{(n_P - n_W)}$.

Using the numerical values,

$$L = \frac{(1.34 \times 10^{-6} s) \times 3 \times 10^8 \frac{m}{s}}{(1.52 - 1.00)} \approx 773.08 \text{ m.}$$

Answer: about 773 m.