

Answer on Question #69376 – Physics – Mechanics | Relativity

A 10.0-m long wire whose total mass is 39.5 grams is under a tension of 577 N. A pulse is sent down the left end of the wire and 29 ms later a second pulse is sent down the right end of the wire. Where do the pulses first meet?

Solution.

Let us introduce some abbreviations: $L = 10.0\text{ m}$, $M = 39.5\text{ grams} = 0.0395\text{ kg}$, $T = 577\text{ N}$ and $t = 29\text{ ms} = 0.029\text{ s}$.

We can calculate the speed of transverse waves in wire with the following formula:

$$v = \sqrt{T/\rho} = \sqrt{TL/M} \approx 382.2\text{ m/s},$$

where ρ is the linear mass density of wire.

The first pulse managed to propagate the distance

$$x = vt \approx 11.08\text{ m}.$$

So we can see that there are two signals with equal speed moving from the right end of wire to the left end. Because of equal speeds, they meet at a distance $\frac{x-L}{2} \approx 0.54\text{ m}$ from the left end.

Answer: 0.54 m from the left end.

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