

21. The pulses have the same speed v . Suppose one pulse starts from the left end of the wire at time $t = 0$. Its coordinate at time t is $x_1 = vt$. The other pulse starts from the right end, at $x = L$, where L is the length of the wire, at time $t = 30$ ms. If this time is denoted by t_0 then the coordinate of this wave at time t is $x_2 = L - v(t - t_0)$. They meet when $x_1 = x_2$, or, what is the same, when $vt = L - v(t - t_0)$. We solve for the time they meet: $t = (L + vt_0)/2v$ and the coordinate of the meeting point is $x = vt = (L + vt_0)/2$. Now, we calculate the wave speed:

$$v = \sqrt{\frac{\tau L}{m}} = \sqrt{\frac{(250 \text{ N})(10.0 \text{ m})}{0.100 \text{ kg}}} = 158 \text{ m/s} .$$

Here τ is the tension in the wire and L/m is the linear mass density of the wire. The coordinate of the meeting point is

$$x = \frac{10.0 \text{ m} + (158 \text{ m/s})(30 \times 10^{-3} \text{ s})}{2} = 7.37 \text{ m} .$$

This is the distance from the left end of the wire. The distance from the right end is $L - x = 10 \text{ m} - 7.37 \text{ m} = 2.63 \text{ m}$.