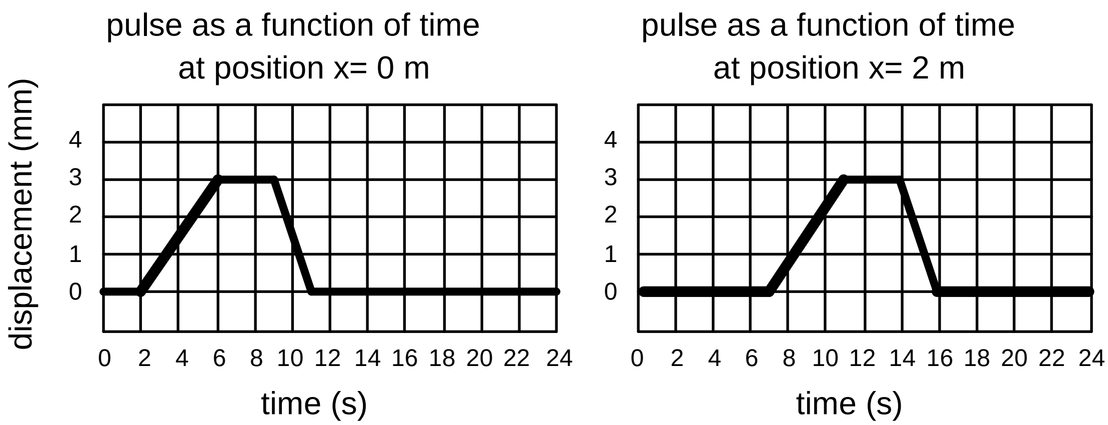
Physics 211 Week 13

Transverse Waves: Pulse on String Solutions

A pulse travels on a string. Its shape does not change. The displacement of the string as a function of time is shown in the figures below at two positions, x = 0 m and x = 2 m. These figures show that the string raises slowly to a height of 3 mm, remains at that height for some time, and lowers quickly back to the equilibrium position.

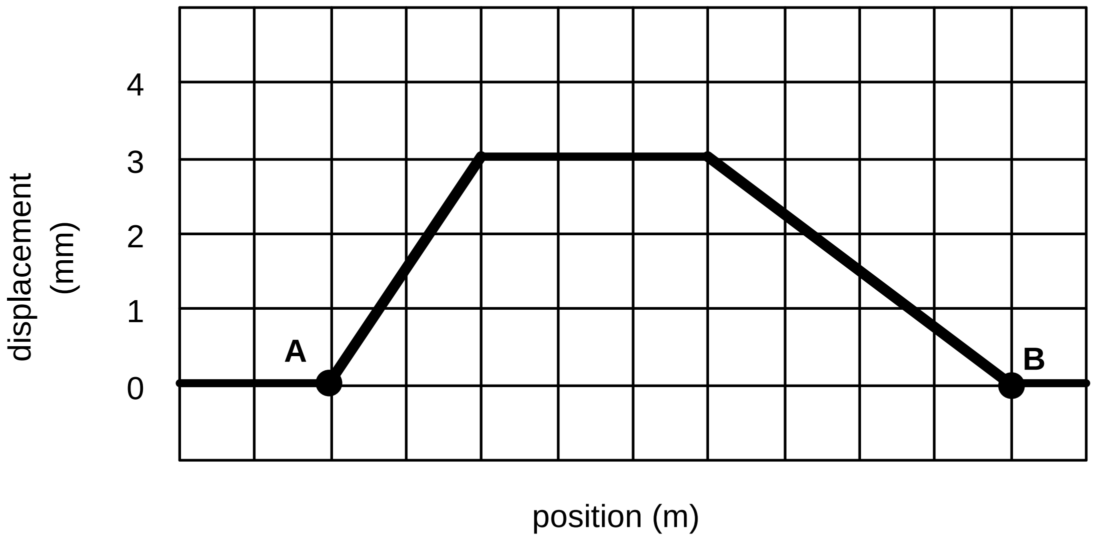


How fast is the pulse traveling along the string?

A strategy: Look at a spot on the wave such as the leading edge at 2 seconds in the plot for x = 0. This spot arrives at x= 2m in t = 7 seconds in the plot at the right. The velocity of this "spot" is thus $V = \Delta x / \Delta t = (2 - 0)/(7-2)= 0.4$ m/s

Another view of the pulse is shown in the figure below, the displacement of the string at t = 0 s. What is the distance between points A and B?

Pulse as a function of position at t= 0 s



We note that when plotted as a displacement versus position plot the wave shape is appears reflected from its appearance when plotted as displacement versus time when the wave is traveling to the right as is the case here. This is easy to understand since if one were at a fixed position to the right of point B, one would first experience a gentle rise from 0 to 3 mm displacement followed by a more abrupt fall from 3 mm to 0 mm. This behavior is consistent with the two displacement versus time plots above.

If we concentrate on the displacement versus time plot at x=0 we see that point B passes x = 0 at 2 seconds while point A passes x=0 at 11 seconds. Hence the wave takes 11 - 2 = 9 seconds to pass through its entire length. Since we established that the wave is traveling with a propagation velocity of 0.4 m/s, points A and B must be separated by **9 s × 0.4 m/s = 3.6 m**.