

P2.45 Average speed of every point on the train as the first car passes Liz:

$$\frac{\Delta x}{\Delta t} = \frac{8.60 \text{ m}}{1.50 \text{ s}} = 5.73 \text{ m/s.}$$

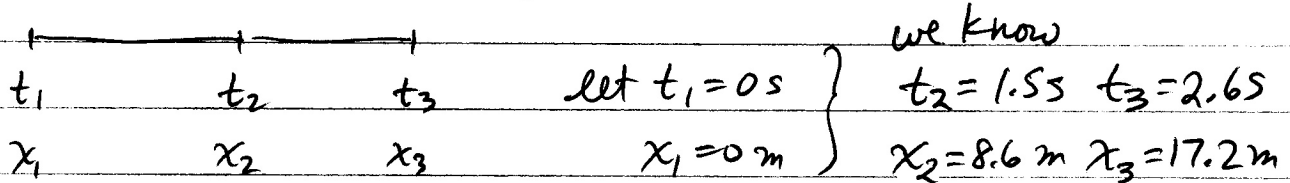
The train has this as its instantaneous speed halfway through the 1.50 s time. Similarly, halfway through the next 1.10 s, the speed of the train is  $\frac{8.60 \text{ m}}{1.10 \text{ s}} = 7.82 \text{ m/s}$ . The time required for the speed to change from 5.73 m/s to 7.82 m/s is

$$\frac{1}{2}(1.50 \text{ s}) + \frac{1}{2}(1.10 \text{ s}) = 1.30 \text{ s}$$

so the acceleration is:  $a_x = \frac{\Delta v_x}{\Delta t} = \frac{7.82 \text{ m/s} - 5.73 \text{ m/s}}{1.30 \text{ s}} = \boxed{1.60 \text{ m/s}^2}$ .

Reynolds  
solution

We can break up the (constant acceleration) motion into two time intervals, bounded by 3 times (and displacements)



Applying the first kinematic equation to the points  $t_2$  and  $t_3$ , we get two equations

$$\left. \begin{array}{l} (1) \quad x_2 = v_1 t_2 + \frac{1}{2} a t_2^2 \\ (2) \quad x_3 = v_1 t_3 + \frac{1}{2} a t_3^2 \end{array} \right\} \begin{array}{l} \text{and there are 2} \\ \text{unknowns: } v_1, a \end{array}$$

solving (1) for  $v_1 = \frac{x_2 - \frac{1}{2} a t_2^2}{t_2}$

and plugging that value in to (2)

$$x_3 = \left( \frac{x_2 - \frac{1}{2} a t_2^2}{t_2} \right) t_3 + \frac{1}{2} a t_3^2$$

Now, we can solve for  $a$

$$a = \frac{2}{t_3 - t_2} \left( \frac{x_3}{t_3} - \frac{x_2}{t_2} \right) = \boxed{1.60 \frac{\text{m}}{\text{s}^2}}$$