Physics 111—General Physics: Mechanics and Thermodynamics
Motion with Constant Acceleration

Problem: (*Giancoli, problem 2.23.*) A car slows down from a speed of 25.0 m/s to rest in 5.00 s. How far did it travel in that time? (Assume constant acceleration.)

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Set up the knowns:

$$\begin{aligned} v_i &= 25.0\,\text{m/s} \\ v &= 0 \\ t &= 5.00\,\text{s} \end{aligned}$$

Goal: Find $\Delta x = (x - x_i)$.

First, find the acceleration:

$$\begin{aligned} v &= v_i + at \\ a &= \frac{v - v_i}{t} = \frac{0\,\text{m/s} - 25\,\text{m/s}}{5\,\text{s}} \\ a &= -5.00\,\text{m/s}^2 \end{aligned}$$

Next, find $x - x_i$. There are two ways:

Way #1:

$$\begin{aligned} x &= x_i + v_i t + \frac{1}{2}at^2 \\ x - x_i &= (25\,\text{m/s}) \times (5\,\text{s}) + \frac{1}{2} \times (-5\,\text{m/s}^2) \times (5.0\,\text{s})^2 \\ &= 62.5\,\text{m}. \end{aligned}$$

Way #2:

$$\begin{aligned} v^2 &= v_i^2 + 2a\Delta x \\ 0 &= (25.0\,\text{m/s})^2 + 2 \times (-5.0\,\text{m/s}^2) \times \Delta x \\ 0 &= 625\,\text{m}^2/\text{s}^2 - 10.0\,\text{m/s}^2 \times \Delta x \\ \Delta x &= \frac{625\,\text{m}^2/\text{s}^2}{10.0\,\text{m/s}^2} = 62.5\,\text{m} \end{aligned}$$