Chapter 2 Problem 62 †

Given $a = -8 m/s^2$ v = 88 km/hDistance between cars = 85 m

Solution

Will the cars collide. If not, how far apart will they be when they come to a stop.

First convert the velocity into m/s.

$$v = 88 \ km/h\left(\frac{1 \ h}{3600 \ s}\right)\left(\frac{1000 \ m}{1 \ km}\right) = 24.4 \ m/s$$

Next use the definition of acceleration to find the time for each car to come to a stop.

$$\bar{a} = \frac{\Delta v}{\Delta t}$$
$$\Delta t = \frac{\Delta v}{\bar{a}} = \frac{v_f - v_i}{\bar{a}} = \frac{0 \ m/s - 24.4 \ m/s}{-8.0 \ m/s^2} = 3.05 \ s$$

Assuming they don't collide, each car will travel the following distance

$$x = x_0 + v_0 t + \frac{1}{2}at^2 = 0 \ m + (24.4 \ m/s)(3.05 \ s) + \frac{1}{2}(-8.0 \ m/s^2)(3.05 \ s)^2 = 37.2 \ m$$

An alternate method would be to use the kinematic equation that relates velocity to position.

$$x - x_0 = \frac{v^2 - v_0^2}{2a} = \frac{(0 \ m/s)^2 - (24.4 \ m/s)_0^2}{2(-8.0 \ m/s^2)} = 37.2 \ m$$

When they stop, the distance between the cars is

85 m - 2(37.2 m) = 10.6 m

Plotting the distance between the two cars as a function of time gives.

Position of Cars vs. Time

