Chapter 2 Problem 60 [†]

Given
$a = -8\ m/s^2$
$v = 88\ km/h$
Distance 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

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

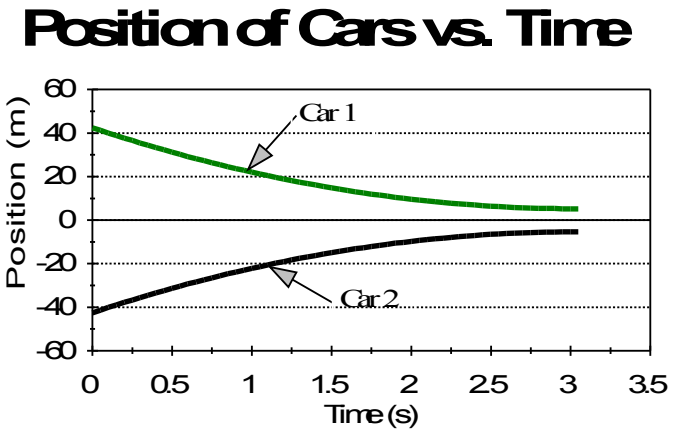
An alternate method would be to use the kinematic equation that relates velocity to position.

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

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.



[†]Problem from Essential University Physics, Wolfson