Equations: \[ x = x_0 + v_0 t + \frac{1}{2} a t^2 \quad v = v_0 + a t \]

1) You are driving along a road at 60mph (26.8 m/s). Twenty meters ahead of you (about 4 car lengths) is another car also traveling at 60mph. The car ahead of you starts braking, and decelerates at 5.00 m/s\(^2\) (about half a "g", a pretty fast stop). You are messing with the radio. It takes you a full second and a half to notice that the car is stopping and for you to put your foot on the brake, causing you to also slow down at 5.00 m/s\(^2\).

Solutions accepted for 1.55 OR 15 reaction time.

Partial credit is given if your answer is reasonable or you acknowledge that it is not.

a) (3 pts) How far apart are your cars when you begin braking?

\[
\begin{align*}
A = \text{You} \\
B = \text{Them} \\
( v_0 = 26.8 \text{ m/s} \quad x_0 = 20 \text{ m} \quad a = -5 \text{ m/s}^2 )
\end{align*}
\]

\[
\begin{align*}
X_A &= v_0 t \\
X_B &= x_0 + v_0 t + \frac{1}{2} a t^2 \\
\text{At } t = 1.55 \text{ s, find } X_B - X_A
\end{align*}
\]

\[
\Delta x = \left[ 14.3 \pm 5 \text{ m} \right] \quad \text{or} \quad \left[ 17.5 \text{ m} \right] (t=15)
\]

b) (4 pts) How much time passes between when you start braking and when you hit the other car?

\[
\begin{align*}
X_A &= X_{0A} + V_{0A} t + \frac{1}{2} a t^2 \\
X_{0A} &= 0 \\
V_{0A} &= 26.8 \text{ m/s} \\
a &= -5 \text{ m/s}^2
\end{align*}
\]

\[
\begin{align*}
X_B &= X_{0B} + V_{0B} t + \frac{1}{2} a t^2 \\
X_{0B} &= 20 \text{ m} \\
V_{0B} &= v_0 + a t \\
a &= -5 \text{ m/s}^2
\end{align*}
\]

\[
X_A = X_B \quad \Rightarrow \quad X_{0A} + V_{0A} t + \frac{1}{2} a t^2 = X_{0B} + V_{0B} t + \frac{1}{2} a t^2
\]

\[
t = \frac{X_{0B}}{V_{0A} - V_{0B}}
\]

\[
t = 1.916 \text{ s} \quad (\text{or } 12.5 \text{ s})
\]

c) (3 pts) How fast are each of you going when you collide?

\[
\begin{align*}
&\text{for 1.55 reaction time} \\
&v_A = 26.8 \left. \frac{m}{s} \right| -5 \frac{m}{s} \cdot 1.916 \text{ s} \\
&= 17.22 \text{ m/s} \\
&v_B = 19.3 \frac{m}{s} - 5 \frac{m}{s} \cdot 1.916 \text{ s} \\
&= 9.72 \text{ m/s}
\end{align*}
\]

\[
\begin{align*}
&\text{for 15 reaction time} \\
&v_A = 26.8 \left. \frac{m}{s} \right| -5 \frac{m}{s} \cdot 1.916 \text{ s} \\
&= 19.3 \text{ m/s} \\
&v_B = 21.8 \frac{m}{s} - 5 \frac{m}{s} \cdot 3.55 \text{ s} \\
&= 14.3 \text{ m/s}
\end{align*}
\]