Two trains are approaching each other on the same track. The one coming from the left (train A) is traveling at 100.0 km/hr and the one coming from the right (train B) is traveling at 80.0 km/hr. See drawing. When the trains are 3.00 km apart the engineer in train A notices the approaching catastrophe and immediately reverses the wheel rotation in the engine resulting in train A slowing to 2.00 m/s every 3.00 s. Sadly the engineer in train B has suffered a cardiac arrest and his co-engineer is too busy administering CPR to notice the approaching train. Do the two trains collide? You must prove this either way to receive any credit. If the trains do collide, locate where along the track the collision occurs and when the collision occurs after the engineer in train A notices there is a serious problem.

\[ \frac{\Delta v}{\Delta t} = \frac{100.0\text{ km/hr}}{3.00\text{ s}} = 33.3\text{ m/s} \]

\[ v_{0B} = -80\text{ m/s} \]

\[ a_A = \frac{\Delta v}{\Delta t} = -\frac{2.00\text{ m/s}}{3.00\text{ s}} = -0.667\text{ m/s}^2 \]

\[ a_B = 0 \]

At that questioned instant:

For A:

\[ x_A = x_A + v_{0A}t + \frac{1}{2}a_A t^2 \]

\[ x_A = (32.2\text{ m/s})t - (10.000\text{ m/s}^2)t^2 \]

Let's see if there is a meaningful \( t \) for which \( x_A = x_B \)

\[ (32.2\text{ m/s})t - (10.000\text{ m/s}^2)t^2 = 3200 - (22.2\text{ m/s})t \]

\[ -10.000\text{ m/s}^2 t^2 + (32.2\text{ m/s})t - 3200 = 0 \]

\[ t = \frac{-32.2 \pm \sqrt{32.2^2 - 4(-10.000)(-3200)}}{-20.000} \]

\[ t = 180.8 \text{ s} \] (only the positive result makes any sense!)

The trains do collide 180.8 s after the engineer reverses wheels.

The position is:

\[ x_A = (32.2\text{ m/s})(180.8\text{ s}) - \frac{1}{2}(10.000\text{ m/s}^2)(180.8\text{ s})^2 \]

\[ x_A = \approx 80\text{ m} \]

Check this:

\[ x_B = 3200 - (22.2\text{ m/s})(180.8\text{ s}) \]

\[ = \approx 80\text{ m} \]