4. Relevant information: track = \( d_e = 1 \text{ km} = 1000 \text{ m} \)

Car 2, \( v_0 = 40 \text{ mph} \) (constant)

Car 1, acceleration \( |\vec{a}_1| \) and 250 mph top

What do we want to find? - minimum time to race for each

Car 1: \( 0 \rightarrow v_0 = 0 \) ....

Car 2: \( 0 \rightarrow v_0 = 40 \) .... \( v_f = 40 \)

Conversions: \( 40 \text{ mi} \cdot \frac{1609 \text{ m}}{\text{mi}} \cdot \frac{1 \text{ hr}}{\text{hr}} = \frac{17.9 \text{ m/s}}{3600 \text{ s}} \)

\( 60 \text{ mi/hr} \cdot \frac{1609 \text{ m}}{\text{mi}} \cdot \frac{1 \text{ hr}}{3600 \text{ s}} = 26.8 \text{ m/s} \)

250 \text{ mi/hr} \cdot \frac{1609 \text{ m}}{\text{mi}} \cdot \frac{1 \text{ hr}}{3600 \text{ s}} = 111.7 \text{ m/s} \)

Car 2: travels 1000 m at \( 17.9 \text{ m/s} \)

\( d = v \cdot t \)

\( 1000 \text{ m} = 17.9 \cdot t \rightarrow t = 55.9 \text{ s} \)

Car 1: \( a = \frac{\Delta v}{\Delta t} \) (since \( a \) constant!)

\( \frac{26.8 \text{ m/s} - 0 \text{ m/s}}{4 \text{ s}} = 6.7 \text{ m/s}^2 \)

Split car 1, into accelerating portion and constant portion

\( v_f = v_0 + a \cdot t \rightarrow 111.7 = 0 + 6.7 \cdot t \rightarrow t = 16.7 \text{ s} \)

distance covered: \( x = x_0 + v_0 t + \frac{1}{2} a t^2 \)
\( x = 0 + 0 + \frac{1}{2} \cdot 6.7 \cdot 16.7^2 = 934 \text{ m} \)

distance remaining: \( 1000 \text{ m} - 934 \text{ m} = 66 \text{ m} \)
remaining $66 \text{ m}$ are at constant speed
\[ V = 250 \text{ mph} = 111.7 \text{ m/s} \]

\[ \text{time for second leg: } 66 \text{ m} = 111.7 \text{ m/s} \cdot t \]
\[ \rightarrow t = 0.6 \text{ s} \]

\[ \text{total time for car 1: } \]
\[ \text{time accelerating } + \text{ time constant} \]
\[ = 16.7 \text{ s} + 0.6 \text{ s} = 17.3 \text{ s} \]

So no, car 2 will not win.
\[ \text{time for car 1} = 17.3 \text{ s} \]
\[ \text{time for car 2} = 55.9 \text{ s} \]

Can you think of another way to solve this problem?

**BONUS! Problem 1.**

\[ v_0 = 15.0 \text{ m/s} \]

\[ \square \text{-cannon} \]

a) position of bowling ball:
\[ y = y_0 + v_0 t + \frac{1}{2} a t^2 \]
\[ y = 0 + 15.0 \cdot t + \frac{1}{2} (-9.8) t^2 \]
\[ y = 15.0 t - \frac{1}{2} (9.8) t^2 \]

velocity equation:
\[ v_f = v_0 + at \rightarrow v(t) = 15 - (9.8) t \]

b) time to hit ground. hits ground when $y = 0$
\[ 0 = 15t - \frac{1}{2} (9.8) t^2 \]
\[ t(15 - (\frac{1}{2})(9.8)t) = 0 \]
\[ t = 0, 3.06 \text{ s} \]
So I'll have about 3 seconds to get out!
NEXT SESSION:
SUNDAY 6:10 pm
Physics B51
See you there!