SHOW ALL WORK!!!!
REPORT ALL NUMBERS TO THREE SIGNIFICANT FIGURES!
Use the conversion constants and data given on the front page.

A car on a circular racetrack passes point A with a speed of 60 mi/hr. It is uniformly accelerated between A and B and has a speed at B of 100 mi/hr. The radius of the track is 800 feet.

12
8
5

(a) Find the inward acceleration at C which is halfway between A and B.
(b) Calculate the magnitude of the TOTAL acceleration at D.
(c) Determine the direction of the total acceleration at D. Express this as an angle measured from the radius vector, and show clearly on a picture how you define this angle.

\[ \text{r} = \frac{V^2}{R} \text{ need } \frac{V_c^2}{R} + A_t \text{ to find } V_c^2 \]

\[ V^2 = V_0^2 + 2a(X-X_0) \text{ between A+B } X-X_0 = \frac{\text{Circumf.}}{2} = \frac{2\pi R}{2} = 2.513 \times 10^3 \text{ ft.} \]

\[ V_B^2 = V_A^2 + 2a_t(X-X_0) \]

\[ V_B = 100 \text{ mi/hr} \cdot \frac{5280 \text{ ft}}{\text{mi}} \cdot \frac{\text{hr}}{3600 \text{ sec}} = 146.7 \text{ ft/s} \]

\[ V_A = 60 \text{ mi/hr} \cdot \frac{5280 \text{ ft}}{\text{mi}} \cdot \frac{\text{hr}}{3600 \text{ sec}} = 88.00 \text{ ft/s} \]

\[ a_t = \frac{V_B^2 - V_A^2}{2(X-X_0)} = 2.74 \text{ ft/s}^2 \]

\[ V_C^2 = V_A^2 + 2a_t(X-X_0) \text{ between A+C, } X-X_0 = \frac{\text{Circumf.}}{4} = 1.257 \times 10^3 \text{ ft.} \]

\[ V_C^2 = (88.00 + 2.74)^2 + 2 \cdot 2.74 \cdot (1.257 \times 10^3 \text{ ft}) = 1.463 \times 10^4 \text{ ft}^2/\text{s}^2 \]

\[ a_r = \frac{V^2}{R} = \frac{1.463 \times 10^4 \text{ ft}^2/\text{s}^2}{800 \text{ ft}} = \frac{18.3 \text{ ft/s}^2}{4.47 \times 10^4 \text{ mi/h}^2} \]
A car on a circular racetrack passes point A with a speed of 60 mi/hr. It is uniformly accelerated between A and B and has a speed at B of 100 mi/hr. The radius of the track is 800 feet.

(a) Find the inward acceleration at C which is halfway between A and B.
(b) Calculate the magnitude of the TOTAL acceleration at D.
(c) Determine the direction of the total acceleration at D. Express this as an angle measured from the radius vector, and show clearly on a picture how you define this angle.

\[ \text{b) total accel. at D} = \vec{a}_r + \vec{a}_t = \vec{\ddot{a}} \]
\[ |\vec{a}_t| = 2.74 \text{ ft/s}^2, \quad |\vec{a}_r| = \frac{V_0^2}{R} \]
\[ V_D^2 = V_A^2 + 2a(x-x_0) \text{ between A+D} \]
\[ V_D^2 = (88,000 \text{ ft/s})^2 + 2 \left( \frac{2.74 \text{ ft/s}^2}{628.3 \text{ ft}} \right) \]
\[ V_D = 14,0 \text{ ft/s} \]
\[ \frac{|\vec{a}_t|}{R} = 14.0 \text{ ft/s}^2 \]
\[ |\vec{\ddot{a}}| = \sqrt{|\vec{a}_r|^2 + |\vec{a}_t|^2} = 14.3 \text{ ft/s}^2 \]

\[ \text{C) direction of } \vec{\ddot{a}}_{\text{tot}} @D \]
\[ \tan \theta = \frac{\vec{a}_t}{\vec{a}_r} \]
\[ \theta = \tan^{-1} \left( \frac{2.74 \text{ ft/s}^2}{14.0 \text{ ft/s}^2} \right) \]
\[ \theta = 11.1^\circ \]