

Elementary Dynamics Example #8: (2D Motion, Normal & Tangential Components)

Given: $R = 200$ (ft), $d = 12$ (ft)

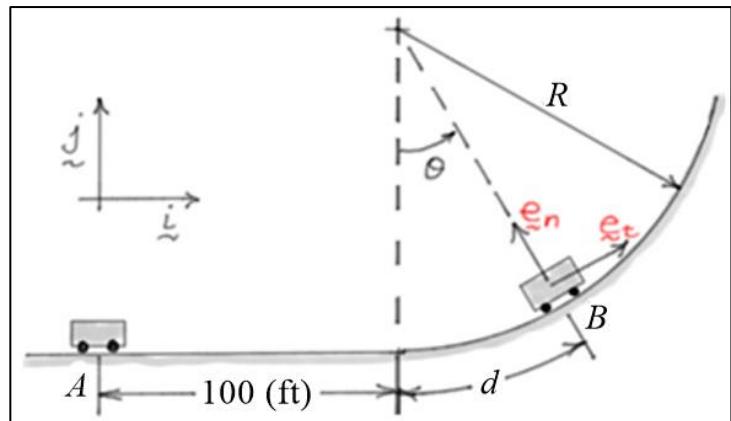
car starts from rest at A ($s = 0$)

car accelerates at a rate of

$\dot{v} = a_t = 0.2 s$ (ft/s²) from A to B

Find: v_B and α_B in ft/s and ft/s² using **normal** and **tangential** components.

Solution:



Velocity:

$$\frac{dv}{dt} = v \frac{dv}{ds} = 0.2 s \Rightarrow \int v dv = \int 0.2 s ds \Rightarrow \frac{1}{2} v^2 = 0.1 s^2 + D \quad (v = 0 \text{ @ } s = 0 \Rightarrow D = 0)$$

$$v(s) = \sqrt{0.2 s^2} = \sqrt{0.2} s \quad (0 \leq s \leq 112) \Rightarrow v_B = (v(s))_{s=112} \approx 50.0879 \approx 50.1 \text{ (ft/s)}$$

$$\Rightarrow v_B = 50.1 e_t \text{ (ft/s)}$$



Acceleration:

$$a_t = (0.2 s)_{s=112} = 22.4 \text{ (ft/s}^2\text{)}$$

$$a_n = \frac{v^2}{\rho} = \frac{(0.2 s^2)_{s=112}}{200} = 12.544 \approx 12.5 \text{ (ft/s}^2\text{)}$$

$$a_B = 22.4 e_t + 12.5 e_n \text{ (ft/s}^2\text{)} \Rightarrow |a_B| = \sqrt{a_t^2 + a_n^2} \approx 25.6732 \approx 25.7 \text{ (ft/s}^2\text{)}$$