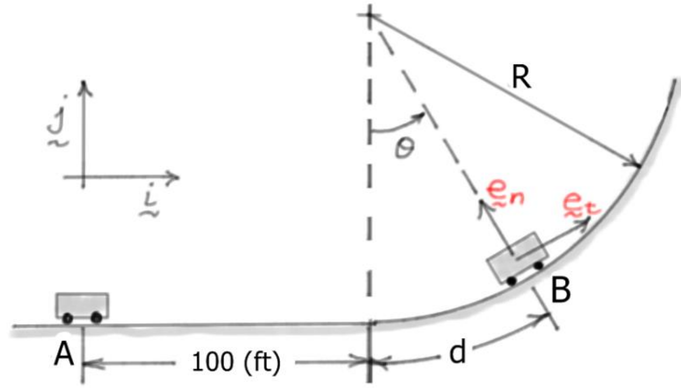
ME 2580 Example #6: (2D Motion, Normal & Tangential Components)



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

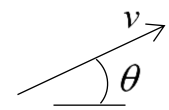
at B: $v = 35$ (mph); $\dot{v} = 15$ (ft/s^2)

Find: $\underset{\sim}{v}_B$ and $\underset{\sim}{a}_B$ in ft/s and ft/s^2 using **_normal_** and **_tangential_** components.

Solution:

Velocity:

$$v = \left[35\frac{\text{mi}}{\text{hr}}\right]\left[\frac{1\text{ hr}}{3600\text{ sec}}\right]\left[\frac{5280\text{ ft}}{1\text{ mi}}\right] \approx 51.\bar{3}\text{ (ft/s)} \quad \Rightarrow \quad \boxed{\underset{\sim}{v}_B = 51.3\,\underset{\sim}{e}_t\text{ (ft/s)}}$$



Acceleration:

$$\boxed{a_t = \dot{v} = 15\text{ (ft/s}^2)} \qquad \boxed{a_n = \frac{v^2}{\rho} = \frac{51.\bar{3}^2}{200} \approx 13.1756 \approx 13.2\text{ (ft/s}^2)}$$

$$\boxed{\underset{\sim}{a}_B = 15\,\underset{\sim}{e}_t + 13.2\,\underset{\sim}{e}_n\text{ (ft/s}^2)} \quad \Rightarrow \quad \boxed{|\underset{\sim}{a}_B| = \sqrt{a_t^2 + a_n^2} \approx 19.9649 \approx 20.0\text{ (ft/s}^2)}$$

Aside: Since the motion at B is **_circular_**,

$$d = R\theta \quad \Rightarrow \quad v = \dot{d} = R\dot{\theta} \quad \Rightarrow \quad \boxed{\dot{\theta} = v/R \approx 0.257\text{ (rad/s)}}$$

$$a_t = \dot{v} = \ddot{d} = R\,\ddot{\theta} \quad \Rightarrow \quad \boxed{\ddot{\theta} = \dot{v}/R \approx 0.075\text{ (rad/s}^2)}$$