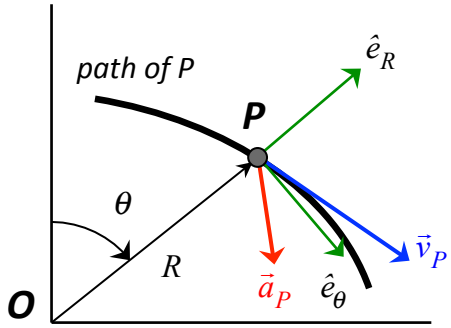
Summary: Particle Kinematics – Polar Description

1. *PROBLEM*: Motion of a point described in polar coordinates, *R* and θ.
2. *FUNDAMENTAL EQUATIONS*:



$$\vec{v}_P = \dot{R}\hat{e}_R + R\dot{\theta}\hat{e}_\theta = velocity\ of\ P$$

$$\vec{a}_P = \left(\ddot{R} - R\dot{\theta}^2\right)\hat{e}_R + \left(R\ddot{\theta} + 2\dot{R}\dot{\theta}\right)\hat{e}_\theta = acceleration\ of\ P$$

where $\hat{e}_R$ and $\hat{e}_\theta$ are the radial and transverse unit vectors.

3. *OBSERVATIONS: In regard to the polar description kinematics, we see*
   - <u>*You*</u> are free to choose the observation point O.
   - $\hat{e}_R$ <u>*always*</u> points OUTWARD from O to P. $\hat{e}_\theta$ is perpendicular to $\hat{e}_R$ and in direction of increasing θ.
   - Polar description is useful for problems with observers or rotations about fixed axes.
   - Do not confuse the unit radial vector $\hat{e}_R$ with the unit normal vector $\hat{e}_n$.