Problem H.1.H

Given: A baseball P moves along the path in the vertical xy-plane shown below in the figure in the absence of air resistance. The velocity of P makes an angle of β with respect to the horizontal. The motion of P is monitored by an observer at O who is able to measure the radial distance r from O to P and the angle θ that the line OP makes with the horizontal, as shown in the figure. Note that since the air resistance is to be considered negligible, the acceleration of P is g vertically downward. At the position shown, line OP is vertical ($\theta = 90°$) and $r = 6$ ft.

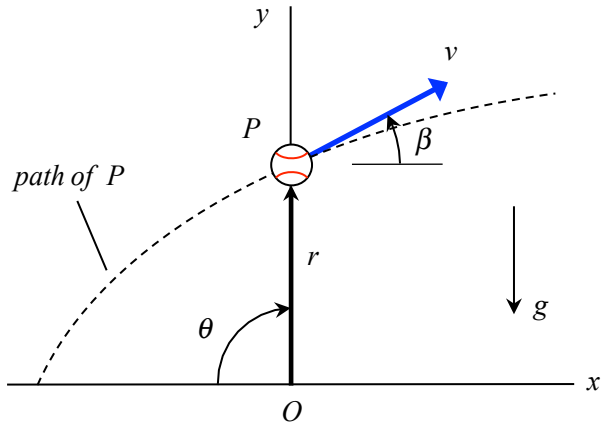
Find: For the position shown:

(a) Make a sketch of P showing the polar unit vectors $\hat{e}_r$ and $\hat{e}_\theta$, and the path unit vectors $\hat{e}_t$ and $\hat{e}_n$.

(b) Determine numerical values for $\dot{r}$, $\dot{\theta}$, $\ddot{r}$ and $\ddot{\theta}$.

(c) Write the path unit vectors $\hat{e}_t$ and $\hat{e}_n$ in terms of $\hat{e}_r$ and $\hat{e}_\theta$ polar unit vectors.

(d) Determine the rate of change of speed of P, $\dot{v}$, and the radius of curvature, ρ, of the path of P at this position.



Use the following parameters in your analysis: $v = 100$ ft/s and $\beta = 36.87°$.

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