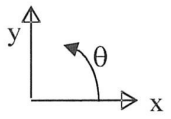
LAST Name (as seen on ROSI): _____ **Tutorial Number:** _____

FIRST Name (as seen on ROSI): _____ **Student Number:** _____

MIE 100S - Quiz number 2b – morning of January 28, 2015: 25 minutes

A particle is moving in a circle of radius 6 meters around the origin, and speeding up at a rate of 4 m/s^2. At time t = 0, the particle is located at (r, θ) = (6 meters, 2 radians), and has a speed of 5 m/s.



(a) At time t = 0, find $\dot{\theta}$ and the x-component of the velocity.

(b) At time t = 3 seconds, determine $\vec{a}$ in r-θ coordinates.

$x = x_o + v_o t + \frac{1}{2} a_o t^2$ $\qquad v = v_o + a_o t$

$\vec{a} = \dot{v}\,\hat{u}_t + v\dot{\theta}\,\hat{u}_n = \dot{v}\,\hat{u}_t + v^2/\rho\,\hat{u}_n$

$\vec{v} = \dot{r}\,\hat{u}_r + r\dot{\theta}\,\hat{u}_\theta$ $\qquad \vec{a} = (\ddot{r} - r\dot{\theta}^2)\,\hat{u}_r + (r\ddot{\theta} + 2\dot{r}\dot{\theta})\,\hat{u}_\theta$

a) $t=0$

$r=6m,\ \dot{r}=0$

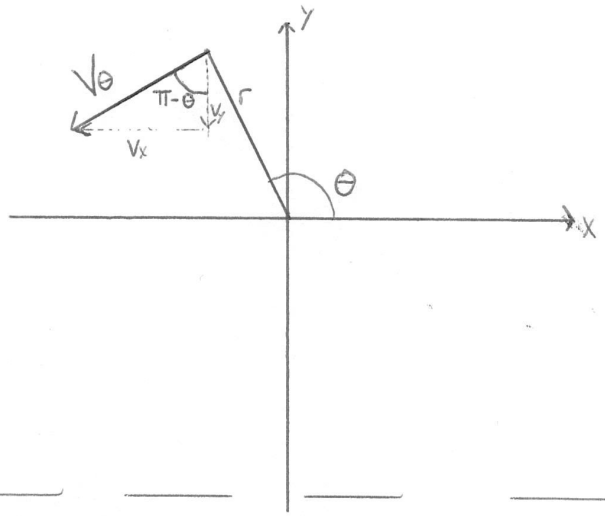
$\theta=2rad,\ \dot{\theta}=?$

$V=5m/s$

$\vec{V} = \dot{r}\hat{u}_r + r\dot{\theta}\hat{u}_\theta$ ($\dot{r}=0$)

$5m/s = 6m \cdot \dot{\theta}$

$\dot{\theta} = \frac{5}{6}\ rad/s \quad (0.833)$



$V_x = -V_\theta \sin(\pi-\theta) = -5\sin(\pi-2)$

$V_x = -4.55\ m/s$

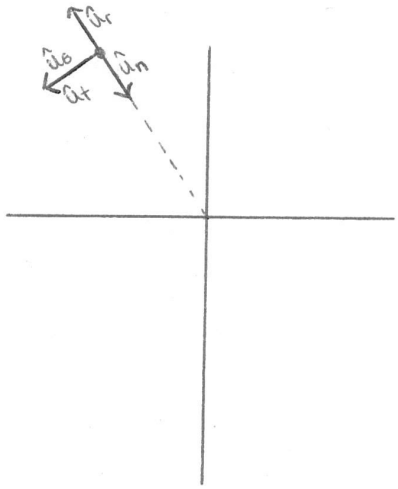
b) $t=3s$

$V = 5m/s + 4m/s^2 \cdot 3s$

$V = 17m/s$

$\dot{V} = 4m/s^2$

$\dot{\theta} = \frac{17}{6}\ rad/s \quad (2.833)$



$\vec{a} = v\dot{\theta}\hat{u}_n + \dot{v}\hat{u}_t$

$= \frac{17^2}{6}\hat{u}_n\ m/s^2 + 4\hat{u}_t\ m/s^2$

$\hat{u}_\theta = \hat{u}_t,\quad \hat{u}_r = -\hat{u}_n$ - because r is constant

$\vec{a} = \left(-\frac{289}{6}\hat{u}_r + 4\hat{u}_\theta\right) m/s^2$

$\downarrow$

-48.167