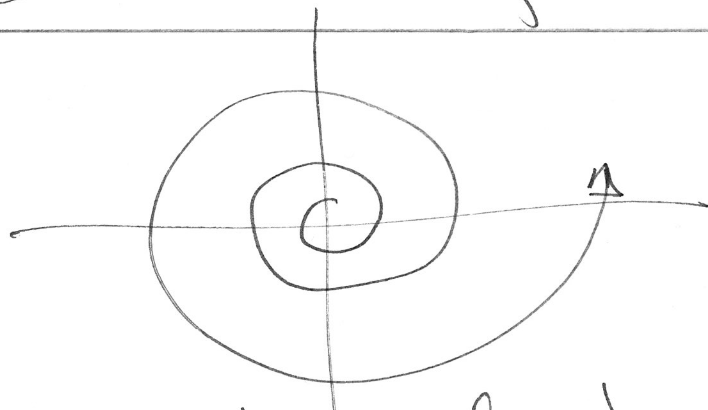
Given:



$r = 10\theta$

$|v| = 2\ m/s$ ← note to self: include $\dot{\theta}$, v_r & v_θ in this.

Req'd

v in polar coord when $\theta = 2\pi$

Assump: $|v| = $ cnst, magical control to get this path.

Strategy $\bar{V}_{polar} = \frac{dr}{dt}\hat{e}_r + r\omega\hat{e}_\theta$ try to find terms

expect that ω will depend on r since v = cnst.

Estimate: when $\theta = 2\pi \Rightarrow r = 20\pi \cong 60\ m \Rightarrow$ circumference

is 360 m. @ $2\ m/s \Rightarrow 180\ s$ to go 6 rad (2π)

$\Rightarrow \omega \sim \frac{6}{180} = .03\ rad/s$ also ⇒ 0 to 60 m in radius

in 180 s $\Rightarrow \frac{dr}{dt} \cong 1/3\ m/s$

Soln $\bar{V}_{polar} = \frac{dr}{dt}\hat{e}_r + r\omega\hat{e}_\theta$ $\quad \frac{d}{dt}(r) = \frac{d}{dt}(10\theta) = 10\frac{d\theta}{dt}$

$= 10\omega$

$$\Rightarrow \bar{V} = 10\omega\,\hat{e}_r + r\omega\,\hat{e}_\theta$$

we know $|\bar{v}| = 2\,m/s = \sqrt{(10\omega)^2 + (r\omega)^2}$

$$\Rightarrow 4\,m^2/s^2 = 100\omega^2 + r^2\omega^2 = (\underline{r}^2 + 100)\,\underline{\omega}^2$$

2 unknowns <u>but</u> @ $\theta = 2\pi$ then $r = 20\pi\,m$

$$\omega^2\Big|_{\theta=2\pi} = \frac{4\,\cancel{m^2}/s^2}{[(20\pi)^2 + 100]\,\cancel{m^2}} = \frac{4}{4048}\,\frac{1}{s^2} = 9.88\cdot 10^{-4}\,\frac{1}{s^2}$$

$$\Rightarrow \omega = 3.14\cdot 10^{-2}\,rad/s = \boxed{31.4\,\frac{mrad}{s} = \omega}$$

$$\Rightarrow \bar{V} = 10^m\left(31.4\,\frac{mrad}{s}\right)\hat{e}_r + 20\pi\,m\cdot 31.4\,\frac{mrad}{s}\,\hat{e}_\theta\,)$$

$$\boxed{\bar{V} = .31\,m/s\,\hat{e}_r + 1.97\,\frac{m}{s}\,\hat{e}_\theta}$$

<u>Discussion</u>: estimates were way closer than I would have expected. I'm aware that my first instinct was to assume $V_\theta = 2\,m/s$ but it <u>was not</u>!