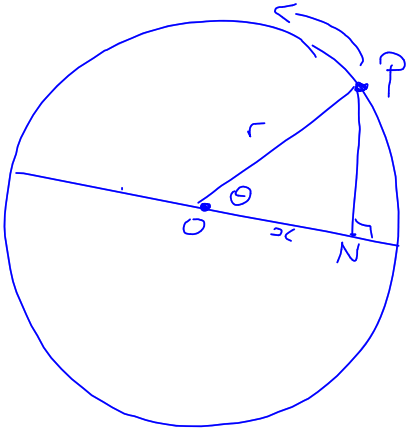


$$\theta = 2\beta$$

$$\frac{d\theta}{dt} = 2 \frac{d\beta}{dt}$$

$$\frac{d\beta}{dt} = \frac{1}{2} \frac{d\theta}{dt}$$

2

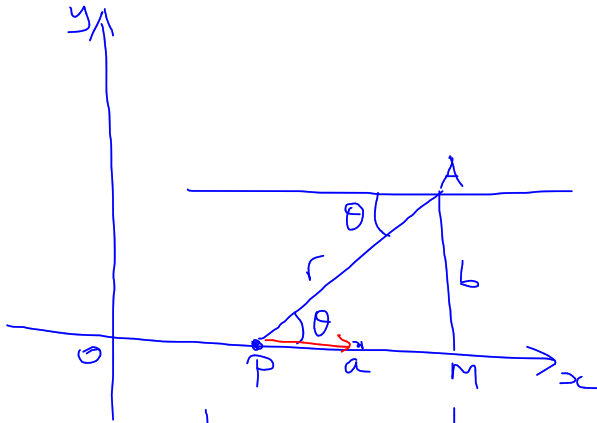


$$ON = r \cos \theta$$

$$\begin{aligned} \dot{ON} &= -r \sin \theta \cdot \frac{d\theta}{dt} \\ &= -r \omega \sin \theta \end{aligned}$$

$$\begin{aligned} \ddot{ON} &= -r \omega \cos \theta \cdot \frac{d\theta}{dt} \\ &= -r \omega^2 \cos \theta \\ &= \underline{\underline{-\omega^2 \cdot ON}} \end{aligned}$$

3/



$$\frac{da}{dt} = -u$$

$$\frac{b}{a} = \tan \theta$$

$$a = b \cot \theta$$

$$\frac{da}{d\theta} = -b \operatorname{cosec}^2 \theta$$

$$\frac{d\theta}{dt} = \frac{da}{dt} \times \frac{d\theta}{da}$$

$$= -u \times \frac{-\sin^2 \theta}{b}$$

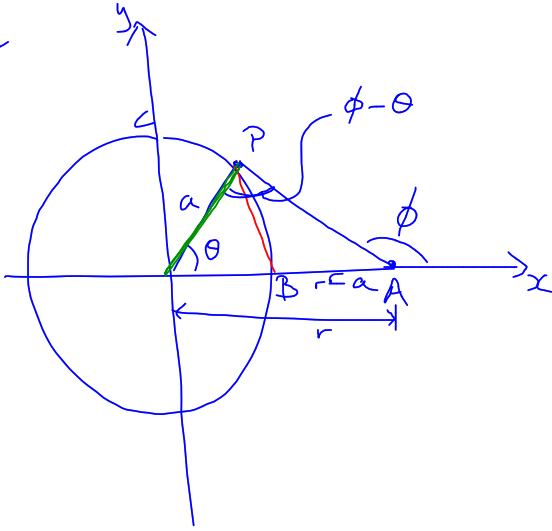
$$= \frac{u}{b} \sin^2 \theta$$

$$= \frac{u}{b} \times \frac{b^2}{r^2}$$

$$= \frac{bu}{r^2}$$

||

4



In $\triangle POA$

$$\frac{r}{\sin(\phi - \theta)} = \frac{a}{\sin(180 - \phi)}$$
$$= \frac{a}{\sin \phi}$$

$$\underline{r \sin \phi = a \sin(\phi - \theta)}$$

$$r \sin \phi = a \sin(\phi - \theta)$$

$$r \cos \phi \cdot \frac{d\phi}{dt} = a \cos(\phi - \theta) \cdot \frac{d(\phi - \theta)}{dt}$$

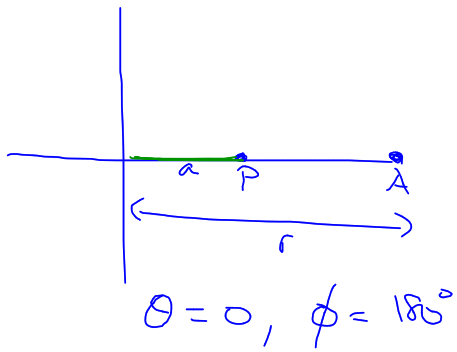
$$= a \cos(\phi - \theta) \left(\frac{d\phi}{dt} - \frac{d\theta}{dt} \right)$$

$$\frac{d\phi}{dt} \left(r \cos \phi - a \cos(\phi - \theta) \right) = -a \cos(\phi - \theta) \cdot \frac{d\theta}{dt}$$

$$\frac{d\phi}{dt} \left(a \cos(\phi - \theta) - r \cos \phi \right) = a \omega \cos(\phi - \theta)$$

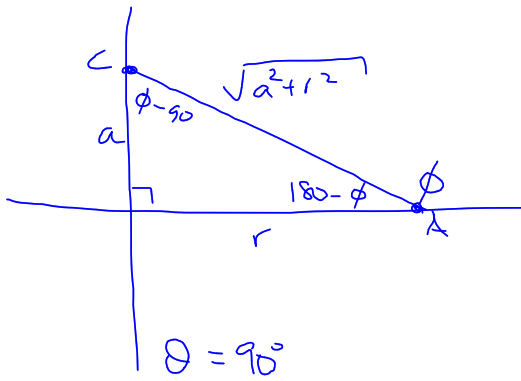
$$\frac{d\phi}{dt} = \frac{a \omega \cos(\phi - \theta)}{a \cos(\phi - \theta) - r \cos \phi}$$

$a + (B(a, 0))$



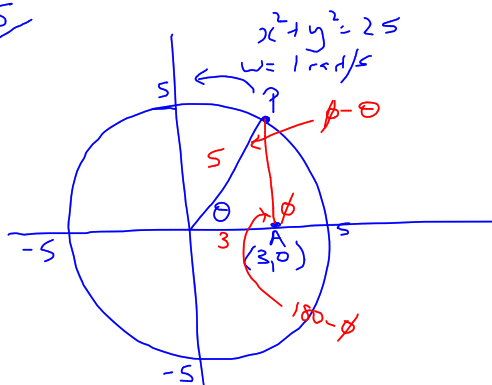
$$\begin{aligned} \frac{d\phi}{dt} &= \frac{a\omega \cos 180^\circ}{a \cos 180^\circ - r \cos 180^\circ} \\ &= \frac{-a\omega}{-a + r} \\ &= \frac{a\omega}{a - r} \end{aligned}$$

at $C(0, a)$



$$\begin{aligned}\frac{d\phi}{dt} &= \frac{a\omega \cos(\phi - \theta)}{a \cos(\phi - \theta) - r \cos \phi} \\ &= \frac{a\omega \times \frac{a}{\sqrt{a^2 + r^2}}}{a \times \frac{a}{\sqrt{a^2 + r^2}} + r \times \frac{r}{\sqrt{a^2 + r^2}}} \\ &= \frac{a^2 \omega}{a^2 + r^2}\end{aligned}$$

5/



$$\frac{\sin(180-\phi)}{5} = \frac{\sin(\phi-\theta)}{3}$$

$$3\sin\phi = 5\sin(\phi-\theta)$$

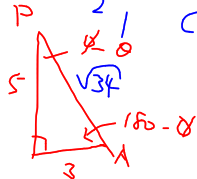
$$3\cos\phi \cdot \frac{d\phi}{dt} = 5\cos(\phi-\theta) \left(\frac{d\phi}{dt} - \frac{d\theta}{dt} \right)$$

$$3\cos\phi \frac{d\phi}{dt} = 5\cos(\phi-\theta) \frac{d\phi}{dt} - 5\cos(\phi-\theta) \frac{d\theta}{dt}$$

$$\frac{d\phi}{dt} = \frac{5\cos(\phi-\theta)}{5\cos(\phi-\theta) - 3\cos\phi} \frac{d\theta}{dt}$$

$$\theta = 0, \quad \frac{d\theta}{dt} = \frac{5}{2}$$

$$\theta = \frac{\pi}{2}, \quad \frac{d\theta}{dt} =$$

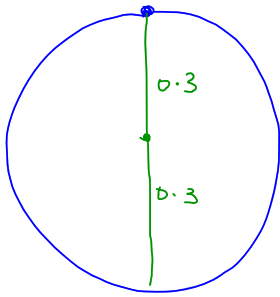


$$5\cos\left(\phi - \frac{\pi}{2}\right)$$

$$5\cos\left(\phi - \frac{\pi}{2}\right) - 3\cos\phi$$

$$= \frac{5\left(\frac{5}{\sqrt{34}}\right)}{5\left(\frac{5}{\sqrt{34}}\right) + 3\left(\frac{3}{\sqrt{34}}\right)} = \frac{25}{34}$$

6/

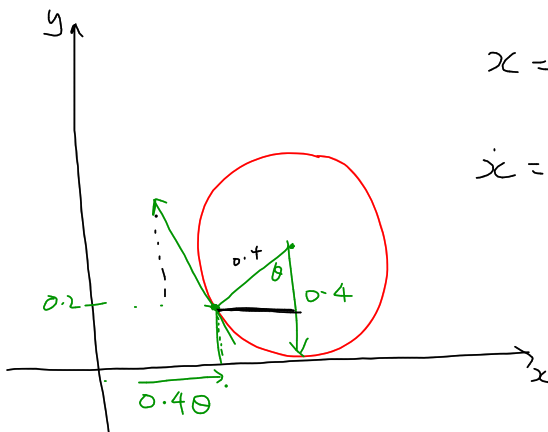


$$\begin{aligned}v &= r\omega \\ &= 0.6 \times \frac{2000}{27} \\ &= \underline{160 \text{ km/h}}\end{aligned}$$

$$\begin{aligned}v &= 80 \text{ km/h} \\ &= \frac{200}{9} \text{ m/s}\end{aligned}$$

$$\begin{aligned}\omega &= \frac{v}{r} \\ &= \frac{2000}{27} \text{ rad/s}\end{aligned}$$

7/



$$x = 0.4\theta - 0.4\sin\theta \quad y = 0.4 - 0.4\cos\theta$$

$$\dot{x} = 0.4(1 - \cos\theta)\omega \quad \dot{y} = 0.4(\sin\theta)\omega$$

$$\tan \alpha = \frac{\dot{y}}{\dot{x}}$$

$$= \frac{.5\sin\theta}{1 - \cos\theta}$$

$$= \frac{\frac{\sqrt{3}}{2}}{1 - \frac{1}{2}}$$

$$= \sqrt{3}$$

$$\alpha = 60^\circ$$

$$v = 60 \text{ cm/h}$$