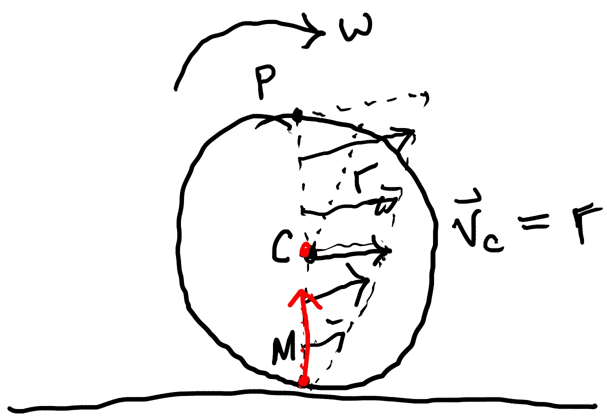
TAM 212

summary: rolling on a flat surface



$\vec{v}_c = r\omega\hat{\imath}$

velocities

$\vec{v}_M = 0$ $\quad$ $\vec{v}_c = r\omega\hat{\imath}$

$\vec{v}_P = 2\vec{v}_c = 2r\omega\hat{\imath}$

constant $\vec{\omega} = -\omega\hat{k}$; $\vec{\alpha} = -\alpha\hat{k} = 0$

rolling is in direction of $\vec{v}_c$

acceleration

$$\vec{a}_c = \frac{d}{dt}\vec{v}_c = 0$$

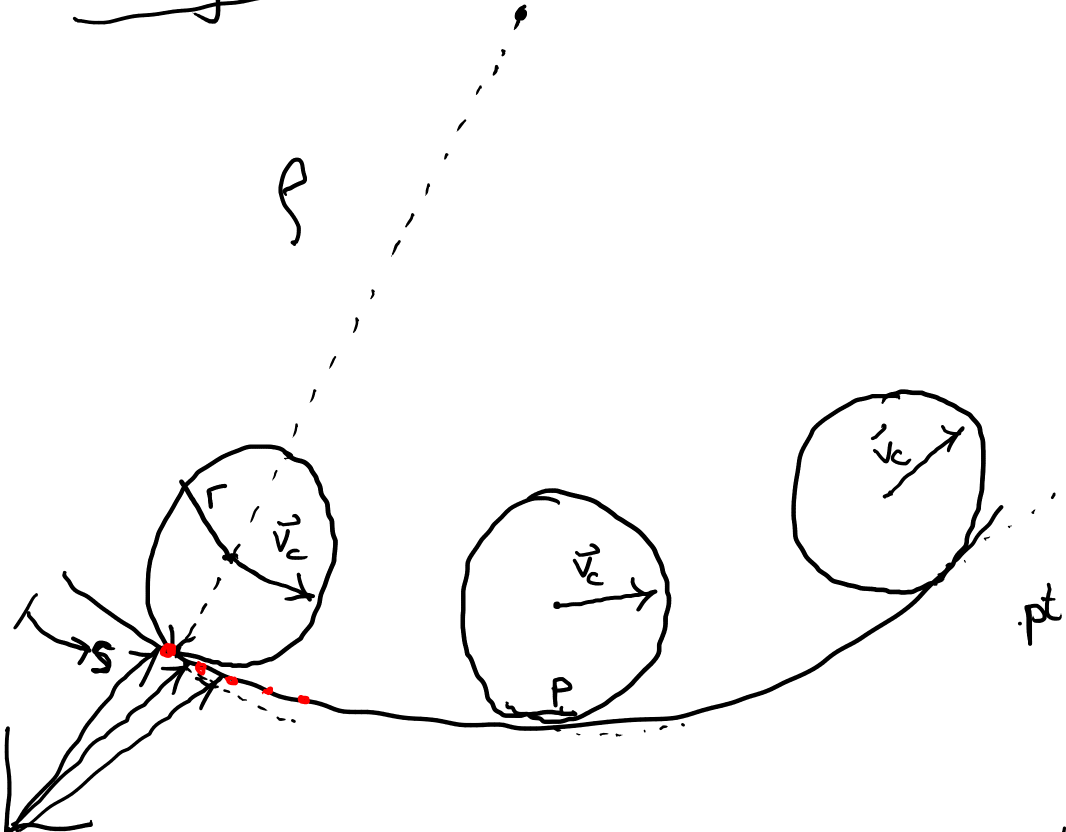
$\vec{a}_M$ = acceleration of the instantaneous center

is it (A) zero

(B) non-zero

$\vec{a}_M = r\omega^2\hat{\jmath}$

Rolling on A Curved Surface



$\vec{\omega} = -\omega \hat{k}$

$\vec{\alpha} = -\alpha \hat{k}$

r = radius of wheel

ρ = radius of curved surface

pt P = point on wheel in contact w/ ground

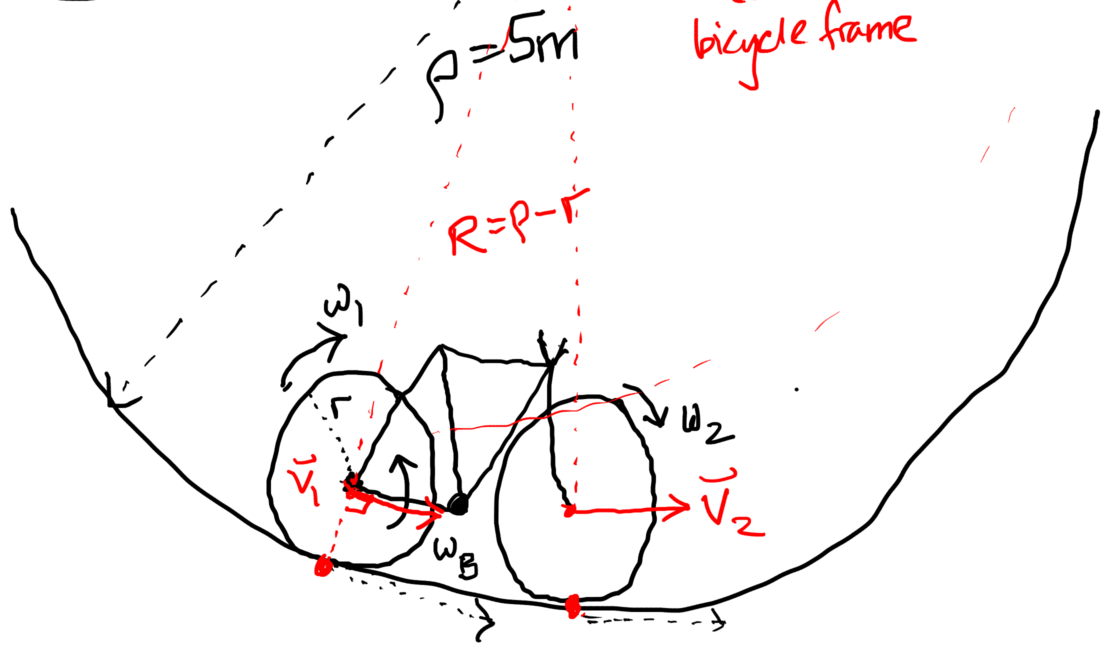
$\vec{r}_M(t)$ = path traced out by instantaneous center M

$$\vec{v}_M(t) = \frac{d\vec{r}_M}{dt} = \dot{s}\,\hat{e}_t$$

$$\vec{a}_M(t) = \frac{d\vec{v}_M}{dt} = \ddot{s}\,\hat{e}_t + \frac{(\dot{s})^2}{\rho}\,\hat{e}_n$$

Recall tangential / normal coordinates

Example:



Bicycle on a Half Pipe

$\rho = 5m$

$r = 0.5\,m$

$$\omega_B = \frac{v_1}{\rho - r}$$

velocities

Find: Relationship between $\omega_1, \omega_2, \omega_B$

$\vec{V}_{c1}, \vec{V}_{c2}, \vec{V}_B$