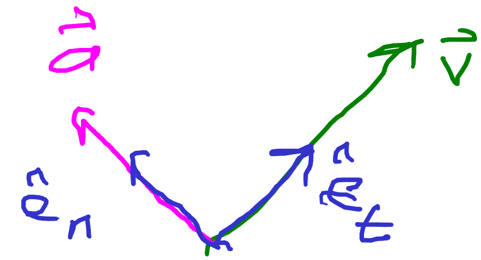
Recap

Tangential/normal in 3D

$\hat{e}_t = \hat{v}$ tang.

$\hat{e}_n = \dfrac{\dot{\hat{e}}_t}{\|\dot{\hat{e}}_t\|}$ normal

$\hat{e}_b = \hat{e}_t \times \hat{e}_n$ binormal



$\cancel{\hat{e}_n = \dfrac{\vec{a}}{\|\vec{a}\|} = \dfrac{\dot{\vec{v}}}{\|\dot{\vec{v}}\|}}$

$\vec{v}$ is always tangent to the path

A. True

B. False

$\dot{s}$ is the speed

A. True

B. False

$\ddot{s}$ is the acceleration

A. True

B. False

$\ddot{s}$ is the magnitude of the acceleration

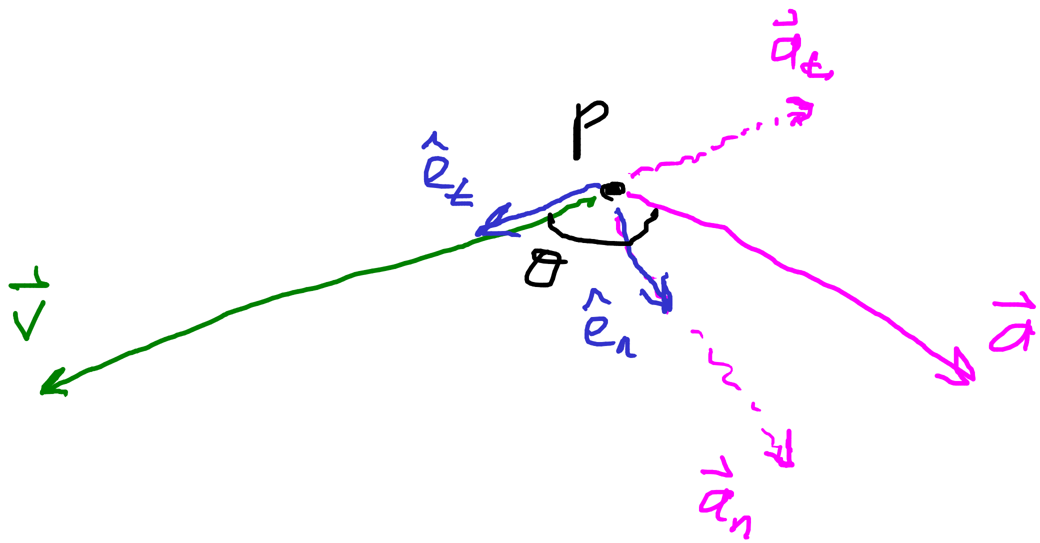
A. True

B. False

Velocity & acceleration in T/N

$$\vec{V} = \dot{s}\,\hat{e}_t$$

$$\vec{a} = \ddot{s}\,\hat{e}_t + \frac{\dot{s}^2}{\rho}\,\hat{e}_n$$

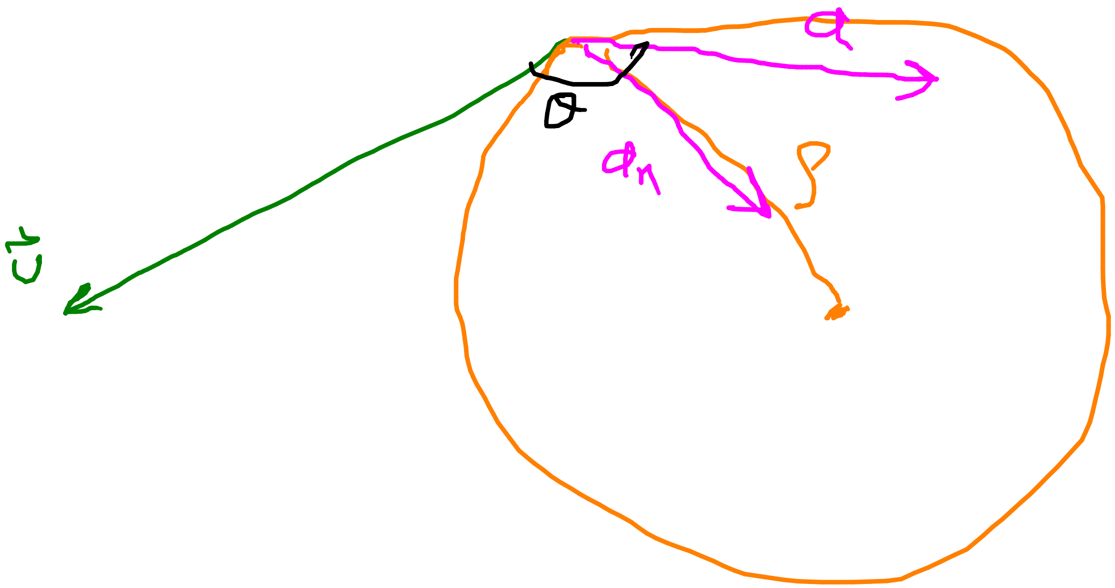


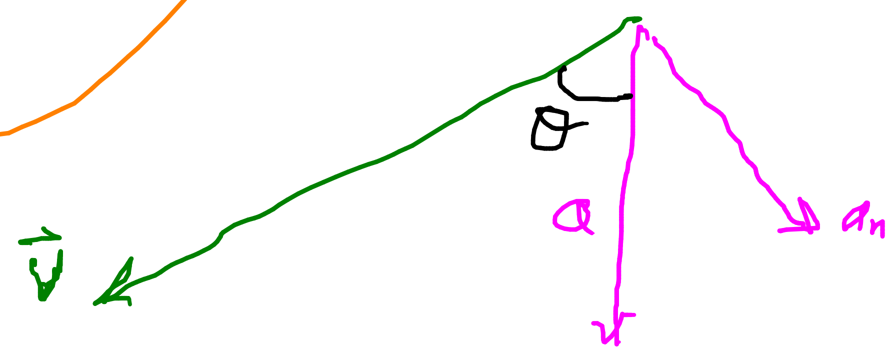
Ex

given ρ, v, a want to find θ = angle $\vec{v}$, $\vec{a}$

$$\frac{v^2}{\rho} = \frac{\dot{s}^2}{\rho} = a_n = a \sin\theta$$

cannot be uniquely solved.





Chain rule: $q = q(g)$

$\dot{q} = q' \dot{g}$ where $\dot{} = \frac{d}{dt}$

$' = \frac{d}{dg}$

A. True

B. False

$q = q(g)$

$\dot{q} = \frac{d}{dt} q(g(t))$

$= \frac{dq}{\partial g}(g(t)) \frac{dg}{dt}(t)$

$= q' \dot{g}$

$q = q(g(t), t)$

$\dot{q} = \frac{\partial q}{\partial g} \dot{g} + \frac{\partial q}{\partial t}$

Chain rule: $u = u(w)$

$\dot{} = \frac{d}{dt}$

$' = \frac{d}{dw}$

What is $\ddot{u}$?

A. $u' \ddot{w}$

B. $u'' \ddot{w} + u' \dot{w}^2$

C. $u'' \ddot{w}$

D. $\dot{w}^2 u'' + \ddot{w} u'$

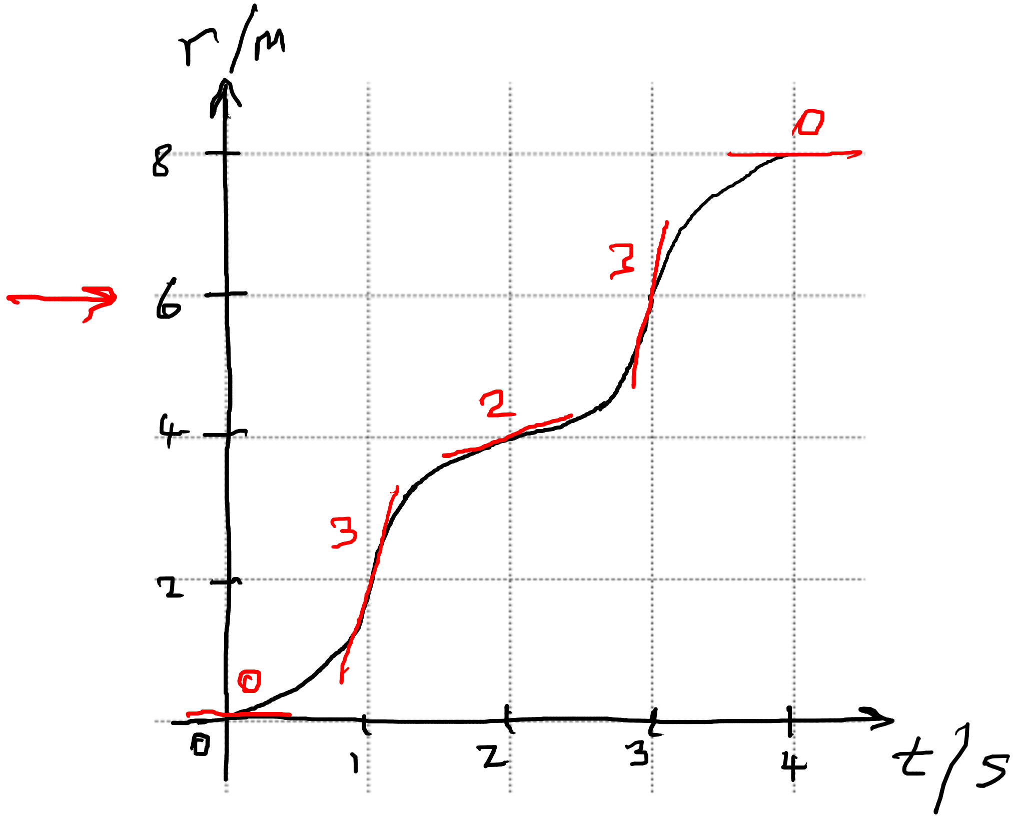
E. none of the above

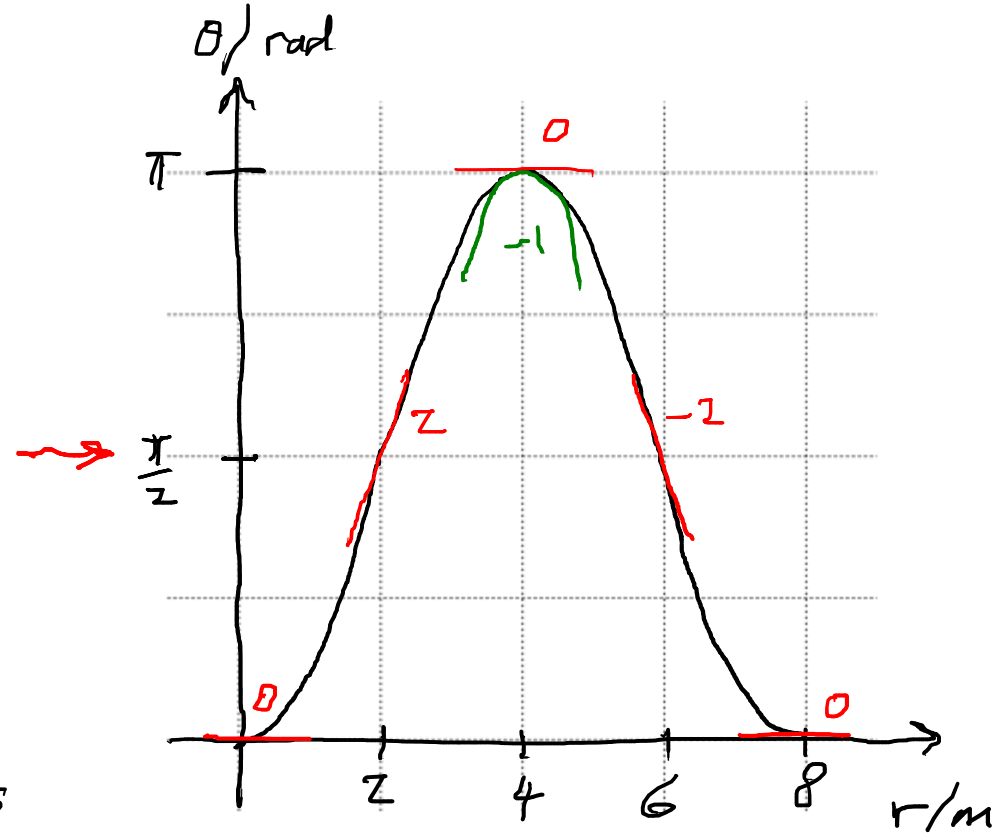
$$[u'' \ddot{w}] = \frac{U}{W^2} \frac{W}{s^2}$$

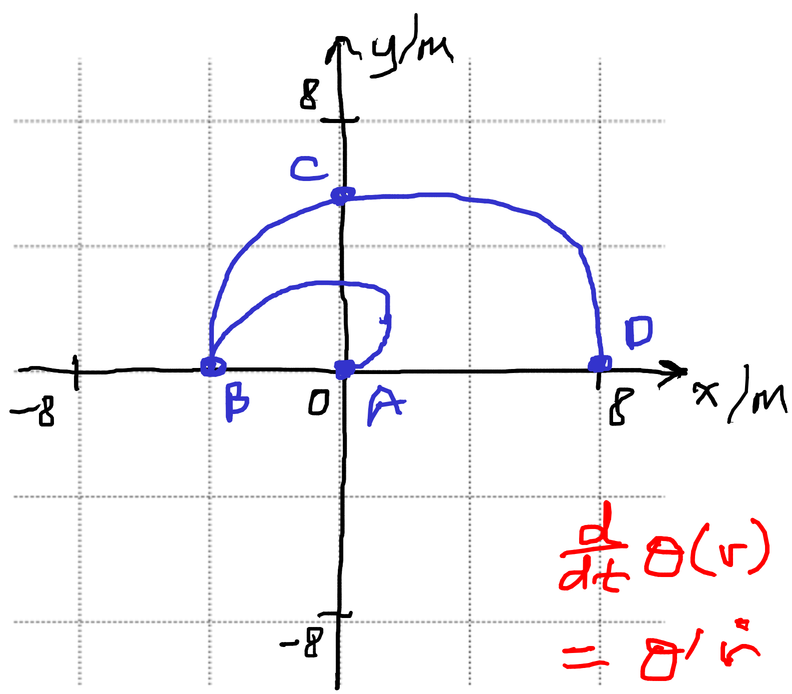
$$= \frac{U}{W s^2}$$

Today: - finish problem from last lecture
- graphical path problem
- torsion of a path

Next time: - rigid bodies







$\frac{d}{dt}\theta(r)$

$= \theta' \dot{r}$

At C, $\dot{\theta} =$

A. 6 rad/s

B. 2 rad/s

C. 0 rad/s

D. −2 rad/s

E. −6 rad/s

$\theta = \frac{\pi}{2}$

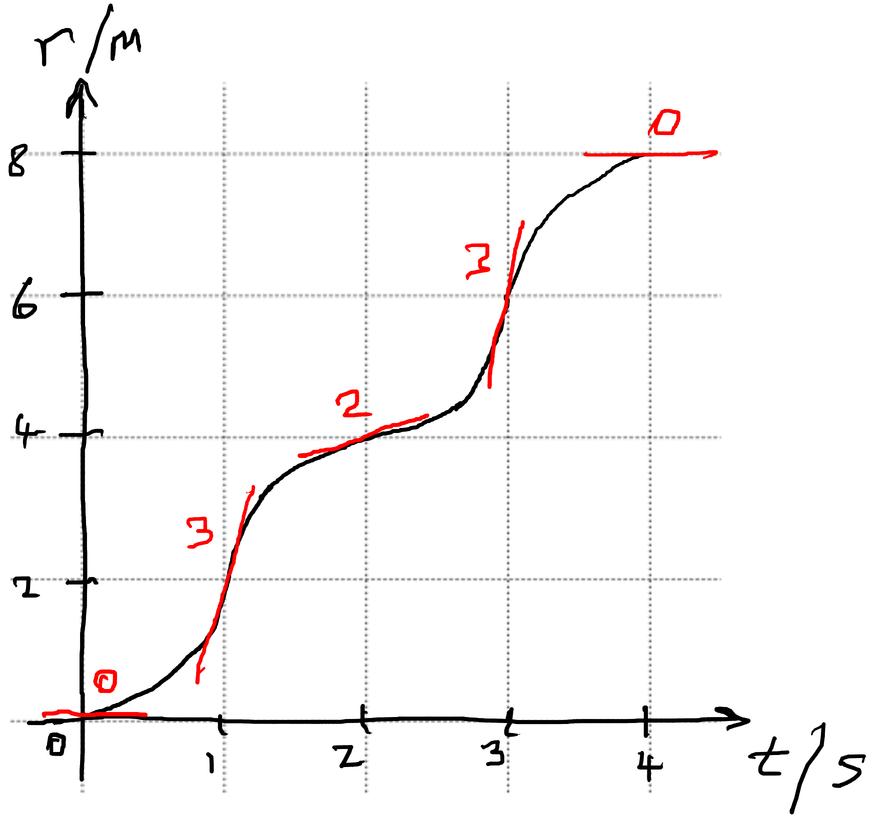
$r = 6$

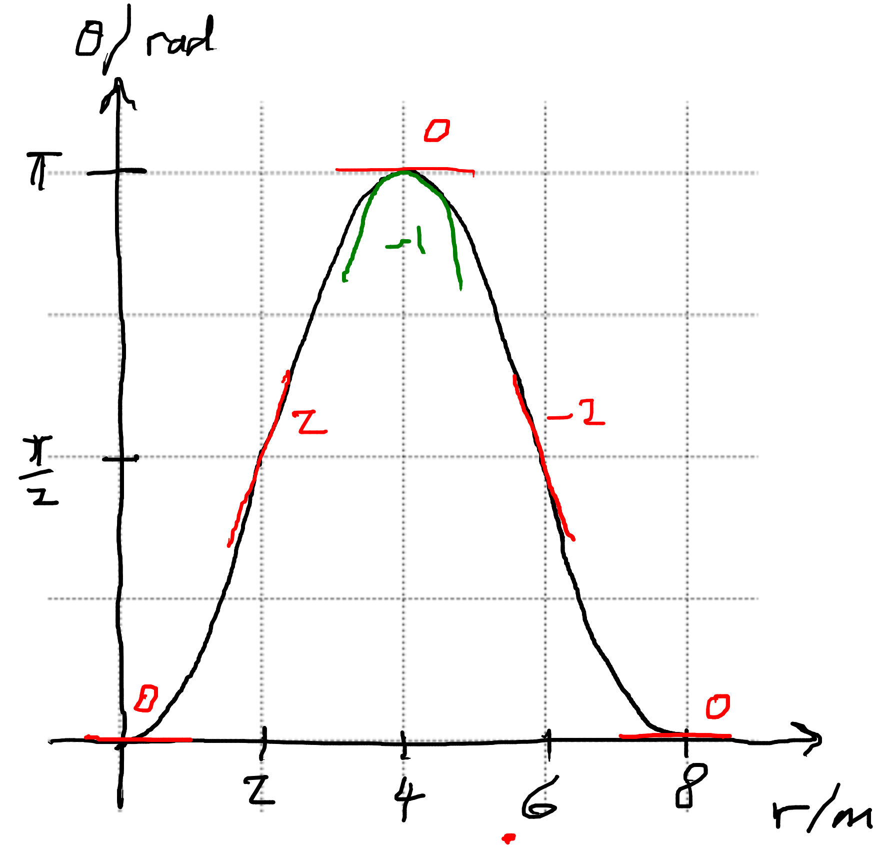
$t = 3$

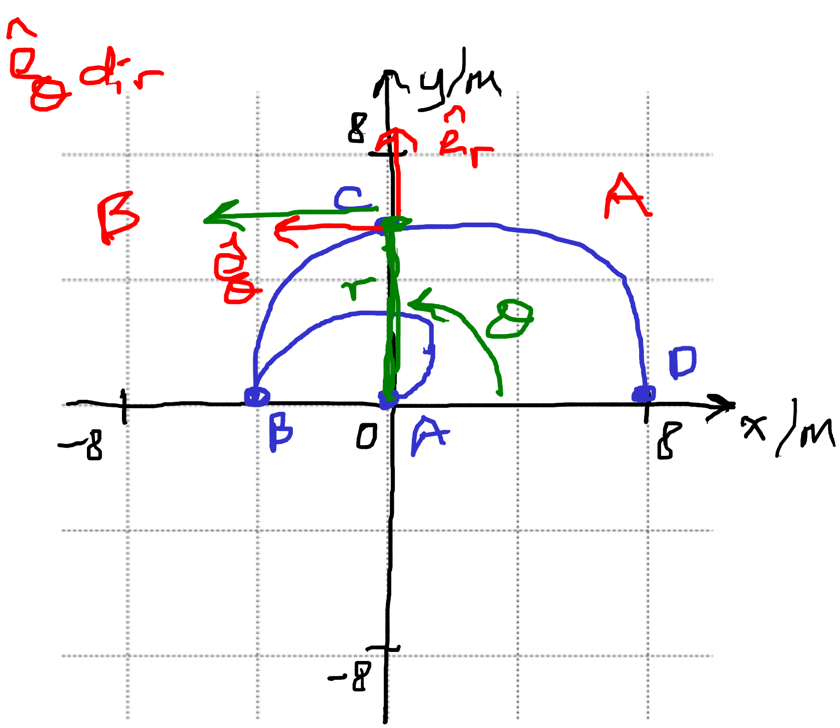
$\dot{r} = 3$

$\theta'(r) = -2$

$\dot{\theta} = \theta' \dot{r} = (-2)3 = -6$





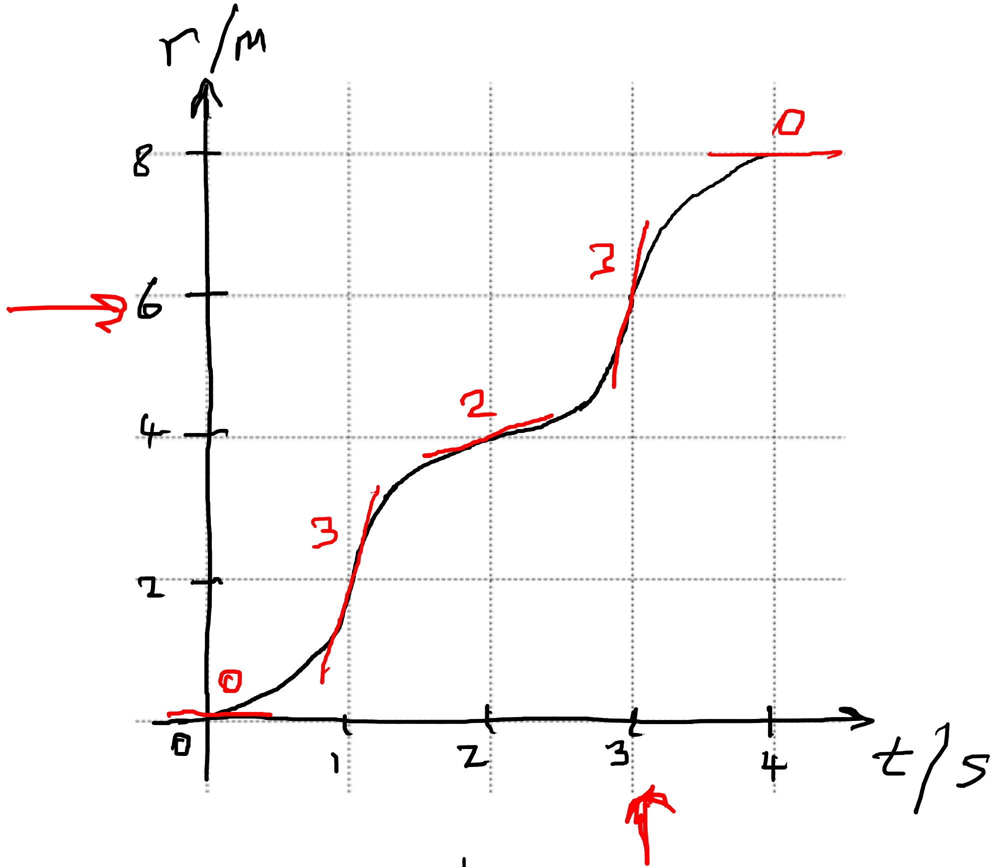


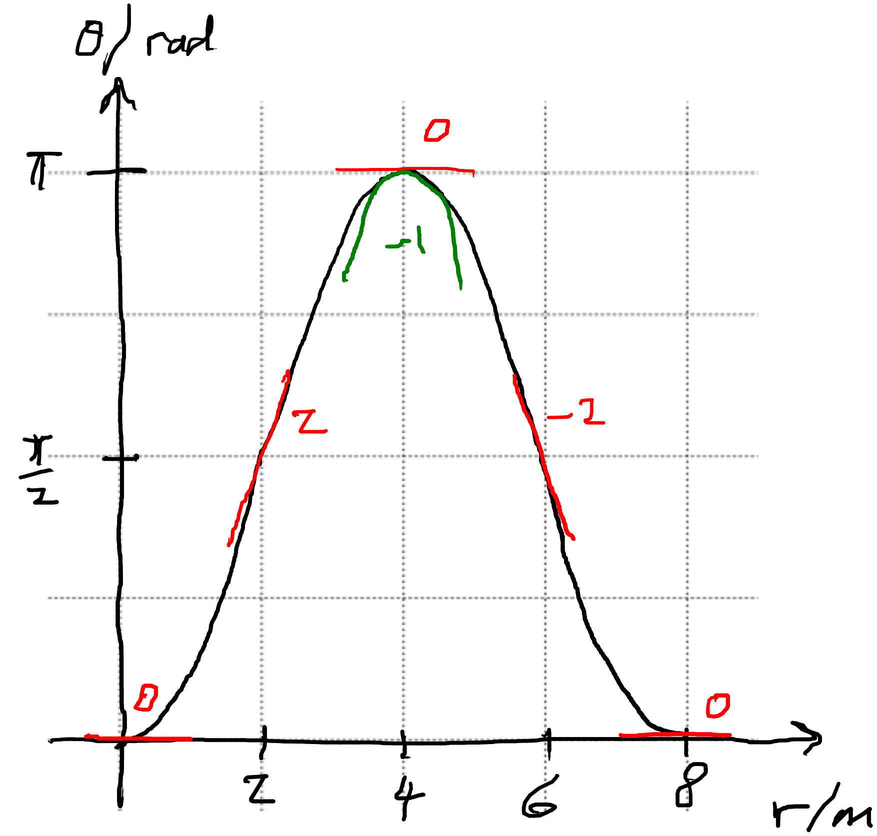
$-r\dot{\theta}$

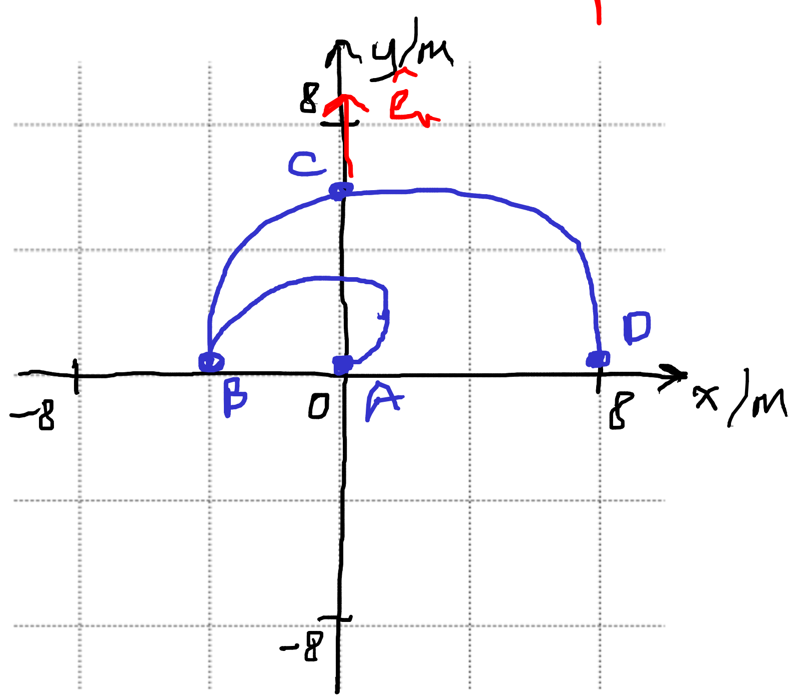
A + C, $\vec{v} = \underline{\boxed{}}\,\hat{c} + \underline{}\,\hat{j}$

A. 36
B. 3
C. 0
D. −3
E. −36

A. $\hat{e}_r$
B. $-\hat{e}_r$
C. $\hat{e}_\theta$
D. $-\hat{e}_\theta$
E. NOTA







At C,

$\vec{v} = \underline{\qquad}\,\hat{i} + \overset{\hat{r}}{\underline{\qquad}}\,\hat{j}$

A. 6

B 3

C. 0

D. -3

E. -6

$\vec{v} = \dot{r}\,\hat{e}_r + r\dot{\theta}\,\hat{e}_\theta$

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