$R(t) =$

$\langle \cos wt, \sin wt \rangle$

$r(t) = t R(t)$

~~Solve V(t)~~

$v(t) = r'(t)$

$\langle \frac{d}{dt} \cos wt, \frac{d}{dt} \sin wt \rangle$

$$\left\langle \frac{d}{dt} \cos wt, \frac{d}{dt} \sin wt \right\rangle$$

$$= \langle w \sin wt, w \cos wt \rangle$$

$$= R'(t)$$

$$r(t) = t R(t)$$

$$r'(t) = R(t) + t R'(t)$$

$$= \langle \cos wt, \sin wt \rangle$$

$$+ \langle -tw \sin wt, tw \cos wt \rangle$$

$$\langle \cos \omega t - \omega t \sin \omega t,\ \sin \omega t + \omega t \cos \omega t \rangle$$

$$v = r'(t)$$

$$= \frac{d}{dt} t R(t)$$

$$= R(t) + t R'(t$$

$$a = \frac{d}{dt} v(t)$$

pro proposition

$$a = 2v_d + t a_d$$

where $v_d = R'(t)$, $a_d = R''(t)$

$$v(t) = R(t) + tR'(t)$$

$$a(t) = v'(t)$$

$$= R'(t) + R'(t) + tR''(t)$$

$$= 2R'(t) + tR''(t)$$

$$= 2v_d + t\,a_d$$

#

Calculate

$2r(t)$ for $r(t)$

$$r(t) = \langle e^{-t} \cos wt, e^{-t} \sin wt \rangle$$

$v(t) = r'(t)$

$= \langle \frac{d}{dt} e^{-t} \cos \omega t, \frac{d}{dt} e^{-t} \sin \omega t \rangle$

$= \langle -e^{-t} \cos \omega t - \omega e^{-t} \sin \omega t,$

$\quad -e^{-t} \sin \omega t + \omega e^{-t} \cos \omega t \rangle$

2 $v(t)$ is the [illegible]

#

$r(t) = \langle R\cos\omega t, R\sin\omega t\rangle$

(a) find v and show

$v \cdot r = 0$

$v = r'(t)$

$= \langle -\omega R\sin\omega t, \omega R\cos\omega t\rangle$

$$v \cdot r$$

$$= (-\omega R \sin \omega t) R \cos \omega t + (\omega R \cos \omega t) R \sin \omega t$$

$$= 0$$

b) ~~Show~~

We prove $\forall t$,

$$|r(t)| = wR$$

$$T = \frac{2\pi R}{r}, \text{ then}$$

s.t. $T = \dfrac{2\pi}{w}$

$$v = \langle -\omega R \sin \omega t, \omega R \cos \omega t \rangle$$

$$|v(t)|$$

$$= \sqrt{\omega^2 R^2 (\sin^2 \omega t + \cos^2 \omega t)}$$

$$= \omega R \ \#$$

Assuming ω is positive

~~since~~ otherwise the

move clockwise.

particle

(c)

Find $a(t)$.

$$a(t) = v'(t)$$

$$v = (-\omega R \sin \omega t, \omega R \cos \omega t)$$

$$v'(t) = (-\omega^2 R \cos \omega t, -\omega^2 R \sin \omega t)$$

$$= -\omega^2 r(t)$$

$$|v| = \omega R$$

$$\frac{|F|}{m} = |a| = |-\omega^2 r(t)|$$

$$= \omega^2 R$$

$$= \frac{|v|^2}{R} =$$

(b)

$$|F| = \frac{m|v|^2}{R}$$

4.

a) $\alpha = \frac{\pi}{3}$

$r_y'(t) = v_0 \sin\alpha - gt$

local maximum is $t = \frac{v_0 \sin\alpha}{g}$

$= \frac{v_0}{g}$