

$$R(t) =$$

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

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

~~$$\text{So I've } V(t)$$~~

$$V(t) = r'(t)$$

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

$$\left\langle \frac{d}{dt} \cos wt, \frac{1}{t} \sin wt \right\rangle$$

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

$$= R'(t)$$

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

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

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

$$+ \langle -t w \sin wt, t w \cos wt \rangle$$

$$\langle \cos wz - wz \sin wz, \sin wz + wz \cos wz \rangle$$

$$V = f'(u)$$

$$= \frac{d}{dz} z R(z)$$

$$= R(z) + z R'(z)$$

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

no position

$$a = 2v_d + t a_d$$

$$\text{where } v_d = R'(t), \quad a_d = R''(t)$$

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

$$u(t) = V'(t)$$

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

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

$$= 2V_d + t a_d$$

Calculate

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

~~~~~  $r(t)$

$$= \left( e^{-t} \cos wt \right.$$

$$\left. , e^{-t} \sin wt \right)$$

$$V(t) = r'(t)$$

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

$$= \left\langle -e^{-t} \cos wt - w e^{-t} \sin wt \right.$$

$$\left. , -e^{-t} \sin wt + w e^{-t} \cos wt \right\rangle$$

2  $V(t)$  is the norm



$$r(z) \in \langle R^{\cos wz}, R^{\sin wz} \rangle$$

(a) find  $v$  and show

$$v \cdot r = 0$$

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$$v = r'(z)$$

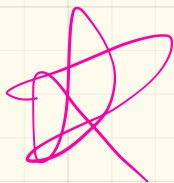
$$\in \langle R^{\sin wz}, w R^{\cos wz} \rangle$$

$$V \cdot r$$

$$= (-wR \sin wt) R \cos wt +$$

$$(wR \cos wt) R \sin wt$$

$$= 0$$



b) ~~show~~

We prove  $\forall z$ ,

$$|v(z)| \leq wR$$

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

$$\text{s.t. } T = \frac{2z}{w}$$

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

$$|V(t)|$$

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

$$= \omega R$$

Notice  $\omega$  is positive  
~~since~~ otherwise the  
 particle moves clockwise. ~~(A)~~

(c)

Find  $a(\varphi)$ .

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$$a(\varphi) = V'(z)$$

$$V = (-\omega R \sin \omega z, \omega R \cos \omega z)$$

$$\begin{aligned} V'(\varphi) &= (-\omega^2 R \cos \omega z, -\omega^2 R \sin \omega z) \\ &= -\omega^2 r(z) \end{aligned}$$

$$|v| = wR$$

$$\frac{|f|}{w} (a) = | -w^2 r w |$$

$$= w^2 R$$

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

$$\text{so, } |f| = \frac{m|v|^2}{R}$$

4.

$$a) \alpha = \frac{Z}{J}$$

$$r_y'(t) = V_0 \sin \alpha - gt$$

$$\text{local maximum is } t = \frac{V_0 \sin \alpha}{g}$$
$$= \frac{V_0}{g}$$