

Ex 4

Parametrisation:

$$R = A(1 - \cos \theta)$$

$$t = B(\theta - \sin \theta)$$

$$A^3 = GM B^2$$

Show that this satisfy

$$\ddot{R} = -\frac{GM}{R^2}$$

$$\frac{dt}{d\theta} = B(1 - \cos \theta) \Rightarrow \left(\frac{1}{d\theta} = \frac{B(1 - \cos \theta)}{dt} \right)^2$$

$$\frac{d^2 t}{d\theta^2} = -B \sin \theta$$

$$B(1 - \cos \theta)^2$$

$$= B(1 + \cos^2 \theta - 2 \cos \theta)$$

$$\frac{1}{d^2 t} = -\frac{1}{B \sin \theta d\theta^2}$$

$$\frac{d^2 R}{dt^2} = -\frac{1}{B \sin \theta} \frac{d^2 R}{d\theta^2}$$

$$= -\frac{1}{B \sin \theta} \frac{d}{d\theta} (A \sin \theta)$$

$$= -\frac{A}{B \tan \theta}$$

nah

try brute forcing it using

$$\frac{1}{dt} = \frac{1}{B(1-\cos \theta) d\theta}$$

$$\frac{d}{dt} \left(\frac{1}{B(1-\cos \theta)} A \sin \theta \right)$$

$$= \frac{1A}{B^2(1-\cos \theta)} \frac{d}{d\theta} \left[\frac{\sin \theta}{(1-\cos \theta)} \right]$$

$$= \frac{A}{B^2(1-\cos \theta)} \frac{1}{(\cos \theta - 1)}$$

$$= \frac{A}{B^2(1-\cos \theta)} \left(-\frac{1}{1-\cos \theta} \right)$$

$$= -\frac{A}{B^2(1-\cos \theta)^2}$$

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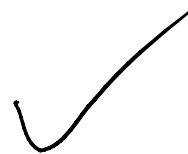
$$= \frac{A}{B^2(1-\cos\theta)} \left(- \frac{1}{1-\cos\theta} \right)$$

$$= - \frac{A}{B^2(1-\cos\theta)^2}$$

$$= - \frac{A}{\frac{A^3}{GM} (1-\cos\theta)^2}$$

$$= - \frac{GM}{(A(1-\cos\theta))^2}$$

$$= - \frac{GM}{R^2}$$



$$A = \frac{R}{(1-\cos\theta)}$$

$$\Rightarrow \ddot{r} = - \frac{GM}{r^2} \left(1 + \frac{\sin \theta}{1 - \cos \theta} \right)$$

