Advanced Placement

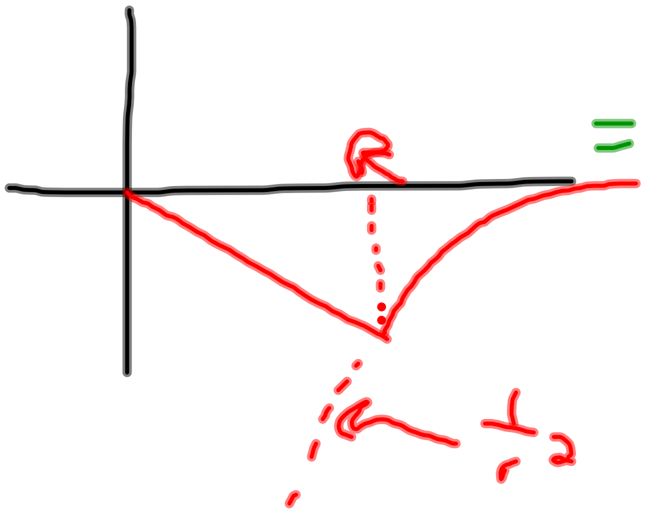
PHYSICS C

2010 Mar 1 Mon

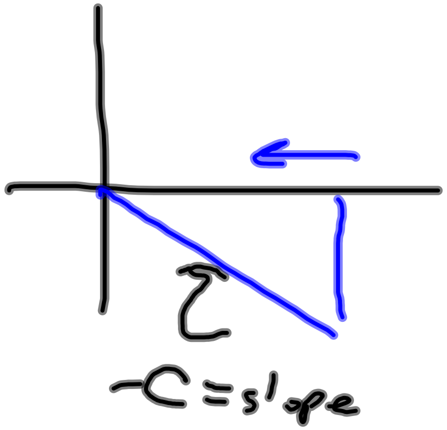
$$F = -G\frac{M_* m}{r^2} \qquad M_* = \rho V(r) = \frac{4}{3}\pi r^3 \rho$$

$$= -\frac{G\frac{4}{3}\pi \rho r^3 m}{r^2}$$

$$= -\left(G\frac{4}{3}\pi \rho m\right) r$$

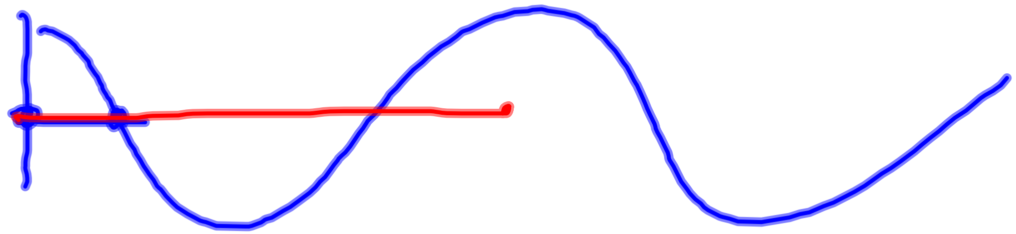


$$F = -Cr = -kx$$



$$W = \frac{1}{2}(+CR)R$$

$$= +\frac{1}{2}CR^2 = \frac{1}{2}mv^2$$

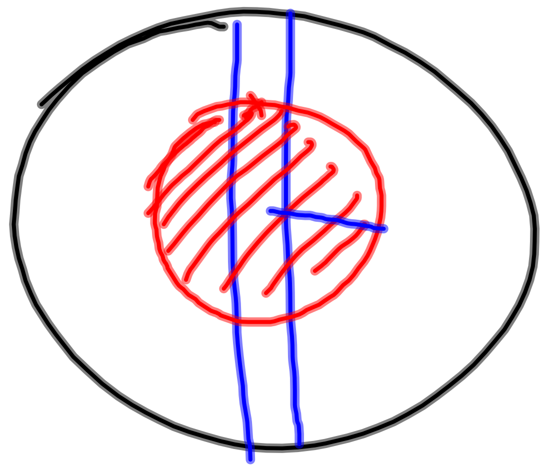


$$t = \frac{1}{4}T = \frac{1}{4}2\pi\sqrt{\frac{m}{k}} = \frac{\pi}{2}\sqrt{\frac{m}{\frac{4}{3}\pi G\rho m}}$$

$$= \frac{\pi}{2}\sqrt{\frac{3}{4\pi G\rho}}$$

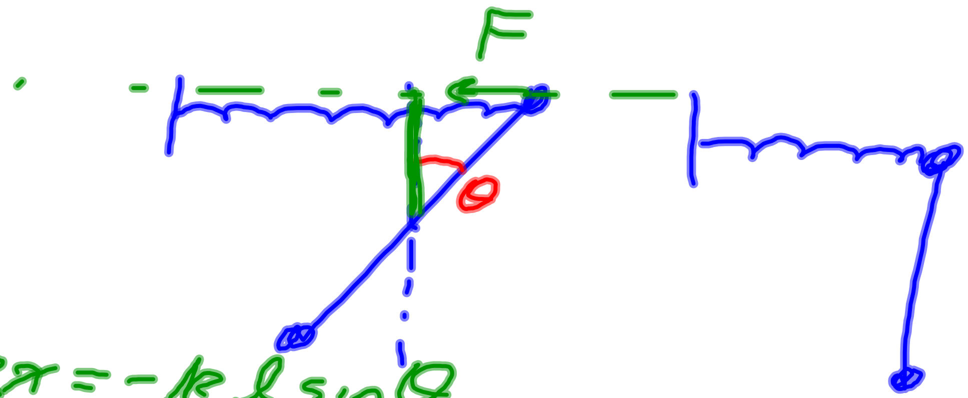
$$= 1300\,s$$

$$v = \omega R$$
$$= \frac{2\pi}{T} R$$



Advanced Placement Physics C

2010 Mar 2 Tue



$$F = -kx = -kl\sin\theta$$

$$\tau \neq rF = r_{\perp}F = (l\cos\theta)(-kl\sin\theta)$$

$$= -kl^2\sin\theta\cos\theta \simeq -kl^2(\theta - \theta^3)(1-\theta^2)$$

$$= -\tfrac{1}{2}kl^2\sin 2\theta \simeq -kl^2\theta$$

$$\sin\theta \simeq \theta - \frac{1}{3!}\theta^3 + \frac{1}{5!}\theta^5 + \ldots$$

$$\cos\theta \approx 1 - \frac{1}{2!}\theta^2 + \frac{1}{4!}\theta^4 + \ldots$$

$$\sin\theta \simeq \theta \qquad \cos\theta \simeq 1 - \frac{1}{2}\theta^2$$

$$\sin\theta\cos\theta \simeq \left(\theta - \frac{1}{3!}\theta^3\right)\left(1 - \frac{1}{2}\theta^2\right)$$

$$\simeq \theta$$

$$\sin 2\theta \simeq (2\theta) - \frac{1}{3!}(2\theta)^3$$

$$\simeq 2\theta$$

$$\tau = -kl^2\theta$$

(b) $\tau = I\alpha$

$$\alpha = \frac{\tau}{I} = \frac{-kl^2\theta}{2ml^2} = -\frac{1}{2}\frac{k}{m}\theta$$

(c) $\alpha = \frac{d^2\theta}{dt^2}$

$$\frac{d^2\theta}{dt^2} = -\frac{k}{2m}\theta$$ like $$\frac{d^2x}{dt^2} = -\frac{k}{m}x$$

$$\frac{d^2\theta}{dt^2} = -\frac{k}{2m}\theta$$ like $$\frac{d^2x}{dt^2} = -\frac{k}{m}x$$

~~$$x = \sqrt{\frac{k}{m}}$$~~

$$x = A\cos\omega t + B\sin\omega t$$

$$\omega = \sqrt{\frac{k}{m}}$$

$$\frac{dx}{dt} = -A\omega\sin\omega t$$

$$\frac{d^2x}{dt^2} = -A\omega(\omega\cos\omega t)$$

$$= -\omega^2(A\cos\omega t)$$

$$= -\omega^2 x$$

$$-\omega^2 x = -\frac{k}{m}x$$

$$\omega^2 = \frac{k}{m}$$

$$\omega = \sqrt{\frac{k}{m}}$$

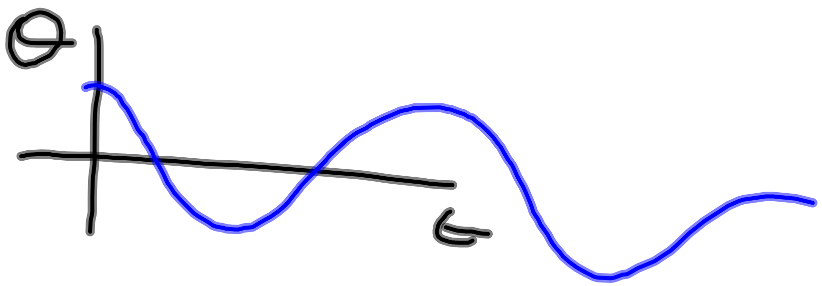
$$\frac{d^2\theta}{dt^2} = -\frac{k}{2m}\theta$$ like $$\frac{d^2x}{dt^2} = -\frac{k}{m}x$$

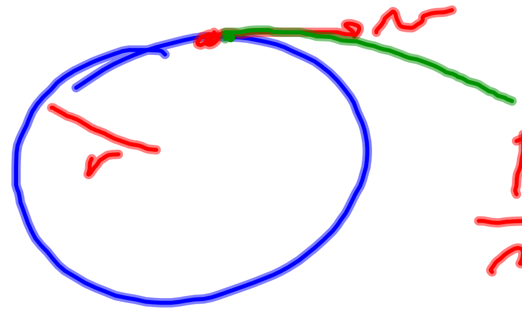
$$\theta = \theta_0 \cos \omega t$$

where $\omega = \sqrt{\frac{k}{2m}}$

$$x = x_{MAX} \cos \omega t$$

where $\omega = \sqrt{\frac{k}{m}}$





$$\frac{F}{m} < \frac{v^2}{r}$$

$$> \frac{v^2}{r}$$