PHYS 301 – Term 151
Quiz#3-chapter 5
22/10/2015

Name: Key Id#:

A particle at rest is attracted toward a center of force according to the relation $F = -m\frac{k^2}{x^3}$. Calculate the time required for the particle to reach the force center from a distance d.

$$t = \int_d^0 \frac{dx}{\sqrt{\frac{2}{m}(E-U)}}$$ (equation 2.98 in your textbook)

$$F = -m\frac{k^2}{x^3} \Rightarrow U = -\int F\,dx = -m\frac{k^2}{2x^2}$$

$$E = K + U = \text{Constant}$$

$$E = -\frac{m k^2}{2d^2} = 0 + U_{max}$$

$$t = \int_d^0 \frac{dx}{\sqrt{\frac{2}{m}\left(-\frac{mk^2}{2d^2} + \frac{mk^2}{2x^2}\right)}} = -\int_d^0 \frac{dx}{\sqrt{\frac{k^2}{x^2} - \frac{k^2}{d^2}}}$$

$$t = -\frac{d}{k}\int_d^0 \frac{x\,d}{\sqrt{d^2 - x^2}} = \frac{d}{k}\sqrt{d^2 - x^2}\Big|_0^d$$

$$\boxed{t = \frac{d^2}{k}}$$