So, since $\frac{x}{a} << 1$,

$$e^{-\left(\frac{x}{a}\right)^2} \approx 1 - \left(\frac{x}{a}\right)^2 + \frac{1}{2}\left(\frac{x}{a}\right)^4 - \cdots$$

$$\approx 1 - \frac{x^2}{a^2}$$

$$\approx 1$$

In our case, that means the accel on particle in x-dir is approximately

$$\frac{\partial^2 x}{\partial t^2} \cong -\left(\frac{10E}{ma^2}\right) x \left[1 - \frac{x^2}{a^2} + \frac{1}{2}\frac{x^4}{a^4} - \cdots\right]$$

$$\cong -\left(\frac{10E}{ma^2}\right) x \left[1\right]$$

$$\frac{\partial^2 x}{\partial t^2} \cong -\left(\frac{10E}{ma^2}\right) x$$ therefore SHM

c) Frequency of motion given by

$$\frac{\partial^2 x}{\partial t^2} \cong -\omega^2 x$$

$$\rightarrow \omega = \sqrt{\frac{10E}{ma^2}} = \sqrt{\frac{10\left(6\times10^{-11}\ \text{kg}\cdot\frac{\text{m}^2}{\text{s}^2}\right)}{\left(2\times10^{-9}\ \text{kg}\right)\left(3.5\times10^{-4}\ \text{m}\right)^2}}$$

$$\boxed{\omega = 1.56\times10^{3}\ \frac{\text{rad}}{\text{s}}}$$