3) continued

So

$$GPE(x) \cong mg \cdot R\left(\frac{1}{2}\frac{x^2}{R^2}\right)$$

and the force associated with this quadratic potential is

$$F = -\frac{d(GPE)}{dx} = -mgR \cdot \left(\frac{1}{2R^2}\right)x$$

$$m\left(\frac{d^2x}{dt^2}\right) = -\left(\frac{mg}{R}\right)x$$

$$\rightarrow \quad \frac{d^2x}{dt^2} = -\left(\frac{g}{R}\right)x$$

This is equation for SHM with

$$\omega = \sqrt{\frac{g}{R}} = \sqrt{\frac{9.8\ m/s^2}{0.14\ m}} = 8.36\ \frac{rad}{s}$$

So period is

$$P = \frac{2\pi}{\omega} = 2\pi\sqrt{\frac{R}{g}} = 0.75\ s$$