3A. A massless spring of force constant 19 nt/meter hangs vertically. A body of mass 0.20 kg is attached to its free end and then released. Assume that the spring was unstretched before the body was released. Find (a) how far below the initial position the body descends, (b) the frequency, and (c) the amplitude of the resulting motion, assumed to be simple harmonic.

\[ mg \quad \text{released from here} \quad \begin{array}{c}
\text{m} \\
\text{F} = 0
\end{array} \]

a) choose potential energy (gravitational) to be zero at the release position - then

\[ 0 = mg(-x) + \frac{1}{2} k x^2, \text{where } x \text{ is the distance below the release pt. at which } v = 0. \]

\[ \therefore x = \frac{2mg}{k} = \frac{(2)(0.20)(9.8 \text{m/s}^2)}{19 \text{nt/m}} = 0.206 \text{m} \]

b) \[ \omega = 2\pi v = \sqrt{\frac{k}{m}} = \sqrt{9.75 \text{m/s}^{-1}} = 1.55 \text{cycle/s} \]

c) the equilibrium pt. \( x_0 \) will be at the pt. where the net force on the mass is zero.

\[ \therefore mg = kx_0 \Rightarrow x_0 = \frac{mg}{k} \]

\[ A = x - x_0 = \frac{2mg}{k} - \frac{mg}{k} = \frac{mg}{k} \]

\[ A = \frac{mg}{k} = 0.103 \text{m} \]

\[ A \text{VG} = 12 \]