HW 8-1 Soln)

For the quantum harmonic oscillator,

$$E_n = n\hbar\omega_o = n\hbar\sqrt{\frac{C}{m}} \ ,$$

where C is the 'spring constant' (k in mechanics). Then,

$$\Delta E = \hbar\sqrt{\frac{C}{m}} = \hbar\sqrt{\frac{C}{m}}\,1.06\times10^{-34}\sqrt{\frac{60}{2}} = 5.8\times10^{-34}\ \text{J} \ .$$

From Newtonian mechanics, the energy of such an oscillator with amplitude 0.3 meters is

$$E = \frac{1}{2}CA^2 = \frac{1}{2}60\ (0.3^2) = 2.7\,J \ .$$

The per cent difference at that stage is

$$\frac{5.8\times10^{-34}}{2.7}\times100\% = 2\times10^{-32}\ \% \ .$$