Problem 15.3

$v_{x,\text{bottle}} = v_{\text{truck}}$

A vertical spring stretches .0390 m when a .0100 kg mass is attached. A .0250 kg mass is attached to the spring and allowed to oscillate freely. What is the oscillation's period?

The first bit of information allows us to determine the spring's *spring constant* (the .001 kg mass exerts a gravitational force—that force elongates the spring, and the ratio of the two give the number of *newtons per meter* required to elongate the spring—this is the spring constant, WHICH IS ALWAYS POSITIVE). Determine that:

$$k = \frac{F}{x} = \frac{mg}{x}$$
$$= \frac{\left(1.00\text{x}10^{-2}\ \text{kg}\right)\left(9.80\ \text{m/s}^2\right)}{\left(3.90\text{x}10^{-2}\ \text{m}\right)}$$
$$= 2.51\ \text{N/m}$$

The *period* of an oscillating, ideal spring (i.e., one that follows Hooke's Law and that oscillates with Simple Harmonic Motion) will be derived in class. Without derivation, it is:

$$T = 2\pi\sqrt{\frac{m}{k}}$$
$$= 2\pi\sqrt{\frac{(.0250\ \text{kg})}{(2.51\ \text{N/m})}}$$
$$= .627\ \text{s}$$