36.15 A $100lb_m$ mass rests on 4 springs, each with a spring constant of $15\frac{lb_f}{in}$. The mass is initially displaced from its equilibrium position, then released. What is the resulting period of oscillation?

A. $0.03s$

B. $0.1s$

C. $0.4s$

D. $2.3s$

Refer to the section on Free Vibration. Recognize that the spring constant for springs in parallal add linearly, therefore the total spring constant for the system can be determined as follows.

$$k_{total} = 4\left(k_{spring}\right) = (4)\left(15\frac{lb_f}{in}\right) = 60\frac{lb_f}{in}$$

Find the natural frequency, which is a function of the total spring contant and the mass. The relevant formula may be found by searching undamped natural circular frequency. Note g_c must be included to change lb_m to lb_f for consistency of units. This is not given in the reference handbook and must be inferred by the inconsistency of the units if not addressed. Also note the appearance of radians in the result for this application. Be assured this is valid and expected with analysis of vibrating sytems.

$$\omega_n = \sqrt{\frac{kg_c}{m}} = \sqrt{\frac{\left(60\frac{lb_f}{in}\right)\left(32.2\frac{lb_m \cdot ft}{lb_f \cdot s^2}\right)\left(\frac{12in}{ft}\right)}{100lb_m}} = 15.2\frac{rad}{s}$$

Find the period. The relevant formula may be found by searching undamped natural period of vibration.

$$\tau_n = \frac{2\pi}{\omega_n} = \frac{2\pi\, rad}{15.2\frac{rad}{s}} = 0.4s$$

Answer C