

**14.35. Model:** The vertical mass/spring systems are in simple harmonic motion.

**Visualize:** Please refer to Figure P14.35.

**Solve:** (a) For system A, the maximum speed while traveling in the upward direction corresponds to the maximum positive slope, which is at  $t = 3.0$  s. The frequency of oscillation is 0.25 Hz.

(b) For system B, all the energy is potential energy when the position is at maximum amplitude, which for the first time is at  $t = 1.5$  s. The time period of system B is thus 6.0 s.

(c) Spring/mass A undergoes three oscillations in 12 s, giving it a period  $T_A = 4.0$  s. Spring/mass B undergoes 2 oscillations in 12 s, giving it a period  $T_B = 6.0$  s. We have

$$T_A = 2\pi\sqrt{\frac{m_A}{k_A}} \text{ and } T_B = 2\pi\sqrt{\frac{m_B}{k_B}} \Rightarrow \frac{T_A}{T_B} = \sqrt{\left(\frac{m_A}{m_B}\right)\left(\frac{k_B}{k_A}\right)} = \frac{4.0 \text{ s}}{6.0 \text{ s}} = \frac{2}{3}$$

If  $m_A = m_B$ , then

$$\frac{k_B}{k_A} = \frac{4}{9} \Rightarrow \frac{k_A}{k_B} = \frac{9}{4} = 2.25$$