Thinking about springs

At equilibrium,

\[ F_s = F_s \]

\[ -k(2cm) = -k(4cm) \]

Use magnitude: \[ |F_s| = |kx| \]
Basic Spring Calculations

\[ F_s = kx \]
\[ f = mg = 2.5(9.8) = 24.5 \text{N} \]

a) \[ \sum F_y = m\ddot{y} = 0 \]
\[ F_s - F_g = 0 \]
\[ F_s = F_g = 24.5 \text{N} \]

b) \[ x = 2.76 \text{cm} = 0.0276 \text{m} \]
\[ |F_s| = 24.5 \text{ N} = kx = k(0.0276) \]
\[ k = 887.7 \text{ N/m} \]

\[ F_s = -kx \]
\[ x = 3 \text{ cm} = 0.08 \text{ m} \]
\[ F_s = -(887.7 \text{ N/m})(0.08 \text{ m}) \]
\[ F_s = -71 \text{ N} \]
Acceleration with displacement/springs as a harmonic oscillator:

\[ \Sigma F_x = ma_x \]
\[ -F_s = ma_x \]
\[ -kx = ma_x \]
\[ a_x = -\frac{kx}{m} \]
Converting spring energy!

\[ E_{\text{tot}} = KE + PE_g + PE_s \]

\[ \frac{1}{2}mv^2 \quad \downarrow \quad \frac{mgh}{h=0} \quad \frac{1}{2}kx^2 \]

\[ P_{E_g} = P_{E_s} = 0 \text{ J} \]

A) \( v = 0 \); \( x = A \)  
\[ \frac{1}{2}m(A)^2 \quad \frac{1}{2}kA^2 \Rightarrow \text{All } PE_s \]

B) \( v = \text{neg.}; \ x = 0 \)  
\[ \neq \text{All KE} \quad \frac{1}{2}k(0) \Rightarrow \text{maximum movement.} \]

C) \( v = 0; \ x = -A \)  
\[ \Rightarrow \text{All } PE_s \]

D) \( v = \text{positive}; \ x = 0 \)  
\[ \text{All KE} \]