3. (25 pts.) An object on a frictionless, horizontal surface is attached to a horizontal spring with spring constant 5.0 N/m. The object is released from rest a distance of $0.7\,\text{m}$ from the origin. When it reaches the origin, it has a speed of $3\,\text{m/s}$. Assume that the equilibrium point is at the origin.

a. (5 pts.) What is the mass of the object?

b. (10 pts.) How long does it take the mass to reach the origin?

c. (10 pts.) Write down an equation giving the position as a function of time. Put in numerical values for all constants. Don't forget to think about the phase!

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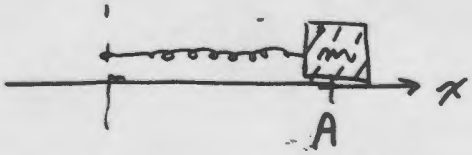
$k = 5.0\ N/m$

$A = 0.7\ m$



(a) conserve energy: initial: $E = \frac{1}{2}kA^2$

final: $E = \frac{1}{2}m v_{max}^2$

$\frac{1}{2}kA^2 = \frac{1}{2}m v_{max}^2$

$\frac{kA^2}{v_{max}^2} = m \rightarrow \boxed{m = 0.272\ kg}$

(b) $t = \frac{1}{4}T$ $\quad T = 2\pi\sqrt{m/k} = 2\pi\sqrt{\frac{0.272}{5}} = 1.466\ s$

$\boxed{t = 0.367\ s}$

(c) $x = A\cos(\omega t + \delta)$ $\quad \omega = \frac{2\pi}{T} = 4.29$

at $t = 0$, $x = A\cos\delta$, $A = 0.7\ m$

$\boxed{x(t) = 0.7\cos(4.29\,t)}$