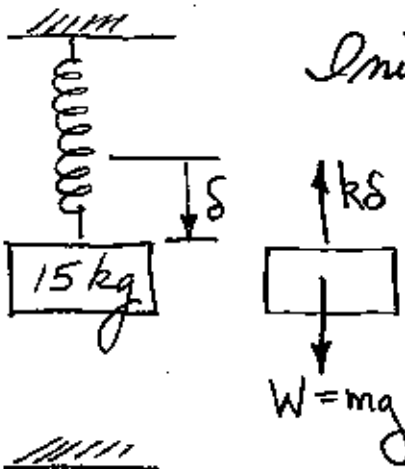
HIBBELER 9th ed. 22-6

1. SPRING IS STRETCHED 200mm by 15-kg block.
2. BLOCK THEN DISPLACED 100mm DOWN FROM EQUIL. and GIVEN A DOWNWARD VELOCITY = 0.75 m/s

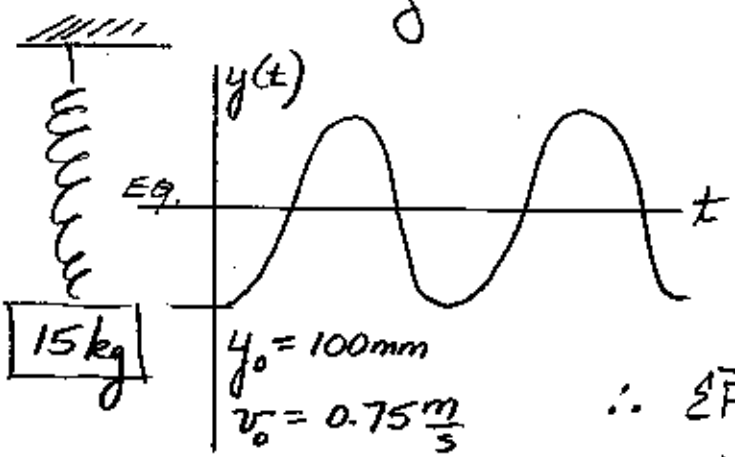
1.) Initial stretch brings system to EQUIL.

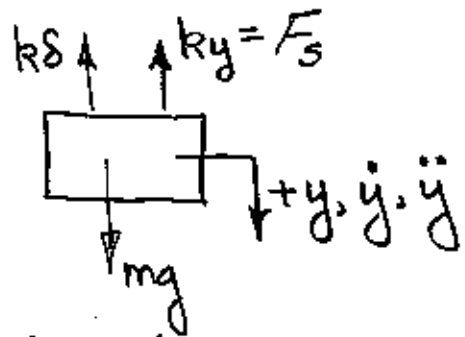
$\therefore k\delta = mg$

$k = \frac{(15\,kg)(9.81\,\frac{m}{s^2})}{.200\,m} = 735.75\,\frac{N}{m}$ STIFFNESS.



2.)





where $k\delta = mg$

$\therefore \Sigma \vec{F}_{on\ mass} = m\vec{a}$

$-ky = m\ddot{y}$

$m\ddot{y} + ky = 0 \Rightarrow mD^2 + k = 0$

$D = \pm\sqrt{\frac{k}{m}}\,\hat{j} = \pm\omega_n\,\hat{j}$

$\omega_n = \sqrt{\frac{735.75\,N/m}{15\,kg}} = 7\,rad/s$

$y(t) = A\sin\omega_n t + B\cos\omega_n t$

$y(t=0) = y_0 = 100mm = \boxed{B = 0.1\,m}$

$\dot{y}(t) = A\omega_n\cos\omega_n t - B\omega_n\sin\omega_n t$

$\dot{y}(t=0) = 0.75\,\frac{m}{s} = A\omega_n \quad \therefore \boxed{A = \frac{0.75\,m/s}{7\,rad/s} = 0.107\,m.}$

$y(t) = 0.107\sin 7t + 0.1\cos 7t$

$\phi = \tan^{-1}\left[\frac{0.1}{0.107}\right] = 43°$