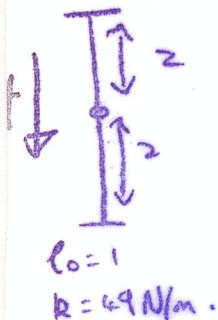
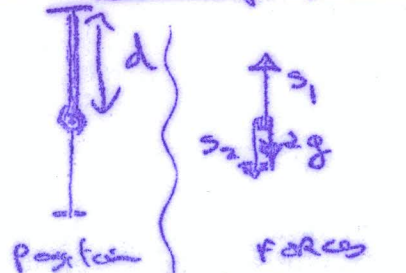


1976 Q3  
Spring Alone



Rest position of Equilibrium.



Hook's Law:

$$s_1 = 49(3-d)$$

$$s_2 = 19.6$$

$$s_1 = s_2 \Rightarrow 49(3-d) = 19.6$$

$$147 - 49d = 19.6$$

$$127.4 = 49d$$

$$d = 2.6$$

$\Rightarrow$  Equil position is 2.2 m below ceiling.

$accel = 0$

NI  $\Rightarrow$

$$s_2 + W - s_1 = 0$$

$$49(3-d) + 2g - 49[d-1] = 0$$

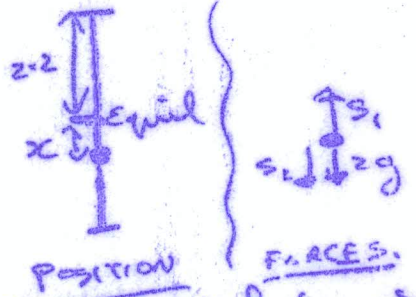
$$147 - 49d + 19.6 - 49d + 49 = 0$$

$$215.6 - 98d = 0$$

$$d = \frac{215.6}{98}$$

$$d = 2.2 \text{ m}$$

Now Show SHM: Typical position  $x$  below Equil, and so  $x+2.2$  below ceiling



Hook's Law  $\Rightarrow$

$$s_1 = 49[(2.2+x)-1] = 49[1.2+x]$$

$$s_2 = 49[(4-(2.2+x))-1] = 49[0.8-x]$$

NI  $\Rightarrow$

$$s_2 + W - s_1 = 2 \text{ accel}$$

$$49[0.8-x] + 2g - 49[1.2+x] = 2 \text{ accel}$$

$$39.2 - 49x + 19.6 - 58.8 - 49x = 2a$$

$$0 - 98x = 2a$$

$$\Rightarrow -49x = a$$

SHM with

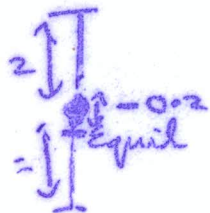
$$W = 7$$

Next need A to find question:

Initially released from rest 2m from Roof.

$$\Rightarrow v=0 \text{ where } x = -0.2$$

$$\Rightarrow A = \pm 0.2$$



Time to reach point 2.3 m below ceiling.  
point is  $x = 0.1 \text{ m}$

Question is: Find Time to travel from  $A = -0.2$  Extreme to  $x = 0.1$

use

$$x = A \cos \omega t$$

$$0.1 = -0.2 \cos \omega t$$

$$\Rightarrow -\frac{1}{2} = \cos \omega t \Rightarrow t = \frac{1}{\omega} \cos^{-1} \frac{1}{2}$$

$$\Rightarrow t = 0.3 \text{ seconds}$$

Speed at (this point  $x = 0.1$ ,  $v = ?$   $v^2 = \omega^2(A^2 - x^2)$   
 $\Rightarrow v = 1.021 \text{ m/s}$

or see Board for "Sine" alternative