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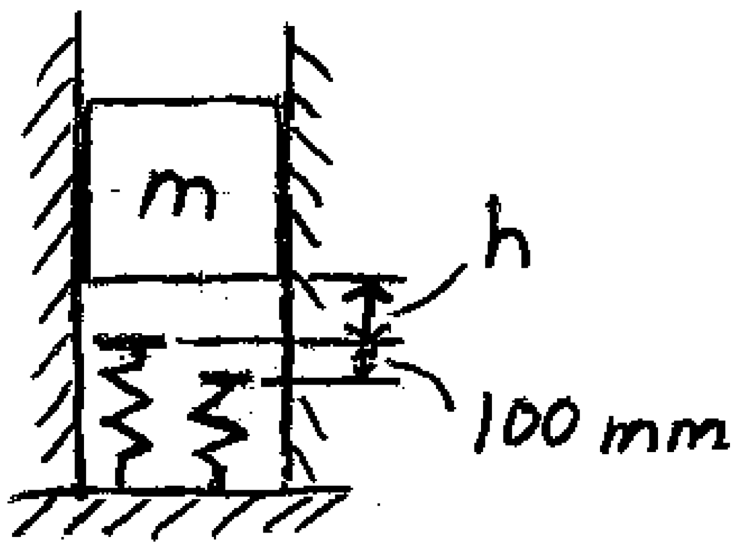
This is a problem involving work and energy.



A block of mass m is released from rest and falls a distance h before contacting the spring on the left, as shown, and then falls further down a distance of 100 mm before contacting a second spring on the right, as shown. The stiffness of the spring on the left is 1000 N/m, and the stiffness of the spring on the right is 2000 N/m. If the maximum compression of the spring on the left is 200 mm, determine the value of h. The mass m = 9 kg.

Solution:

Apply the principle of work and energy:

$$T_1 + \Sigma U_{1-2} = T_2 \quad (1)$$

$$\Sigma U_{1-2} = -\left(\frac{1}{2}k_1 s_{1f}^2 - \frac{1}{2}k_1 s_{1i}^2\right) + -\left(\frac{1}{2}k_2 s_{2f}^2 - \frac{1}{2}k_2 s_{2i}^2\right) + W\Delta d$$

Work done by spring on left, $k_1 = 1000$ N/m

Work done by spring on right, $k_2 = 2000$ N/m

Work done by gravity. This is > 0 because displacement (Δd) of mass, and gravity are in same direction.

$W = mg$, $m = 9\,kg$

The mass is released from rest, so $v_1 = 0 \Rightarrow T_1 = 0$.

For maximum spring compression, $v_2 = 0 \Rightarrow T_2 = 0$.

spring on left: $s_{1i} = 0$, $s_{1f} = \Delta d - h = 0.200\,m$ (2)

spring on right: $s_{2i} = 0$, $s_{2f} = \Delta d - h - 0.100\,m = 0.200m - 0.100\,m$
$= 0.100\,m$

Therefore,

$$\Sigma U_{1-2} = -\left(500(0.200)^2 - 500(0)^2\right) - \left(1000(0.100)^2 - 1000(0)^2\right) + 9(9.8)\Delta d$$

$= 0$, since $T_1 = T_2 = 0$ in equation (1).

Solve for Δd:

$$\Delta d = 0.34\,m$$

From eq. (2) $\Rightarrow$ $h = \Delta d - 0.200m = 0.14\,m$ (answer)