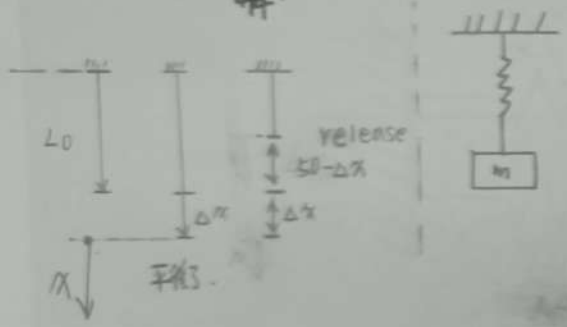
Homework

$k = 800\ N/m$

A spring has a stiffness of 800 N/m. If a 2-kg block is attached to the spring, pushed 50 mm above its equilibrium position, and released from rest, determine the equation that describes the block's motion. Assume that positive displacement is downward.

平衡位置 $x = 0$

解:



平衡: $k\Delta x = mg$

$$\Delta x = \frac{mg}{k} = \frac{2\times 9.81}{800} = 24.525\ mm$$

$$+mg - k(x+\Delta x) = m\ddot{x}$$

$$\Rightarrow m\ddot{x} + kx = 0$$

$$2\ddot{x} + 800x = 0$$

$$\ddot{x} + 400x = 0 \qquad r^2 + 400 = 0$$

$$x = C_1\cos 20t + C_2\sin 20t \quad \Leftarrow \quad r = 0 \pm 20i$$

BC: $t = 0,\ x = -50mm = -0.05,\ C_1 = -0.05$

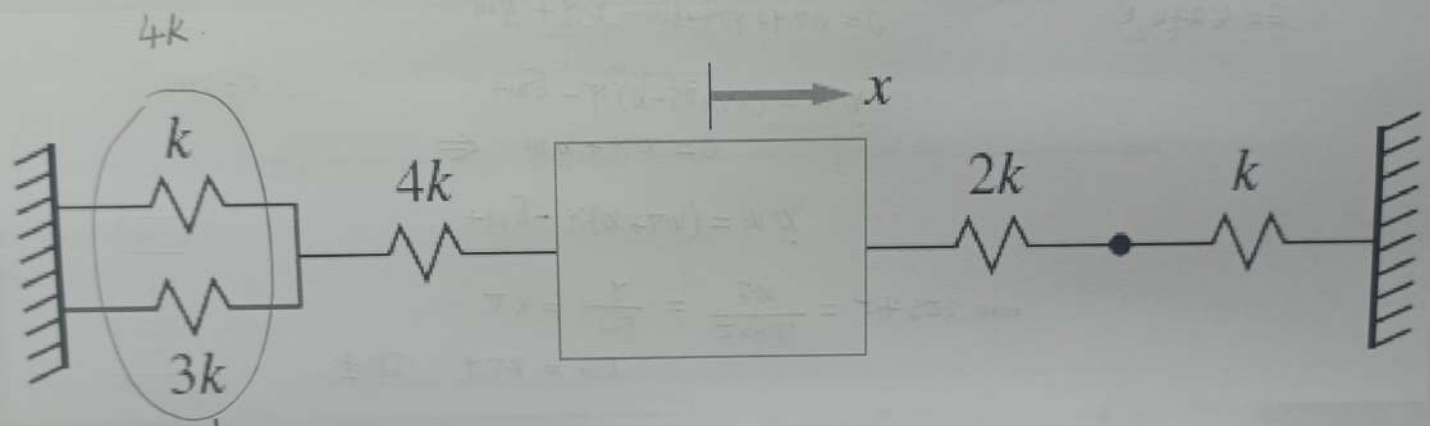
$$\dot{x} = -C_1\sin 20t \cdot 20 + C_2\cos 20t \cdot 20 = 0,\ C_2 = 0$$

$$\therefore\ x = -0.05\cos 20t \quad m \qquad \boxed{ANS}$$

Homework

What is the (equivalent stiffness) of the springs in the system of following Figure?

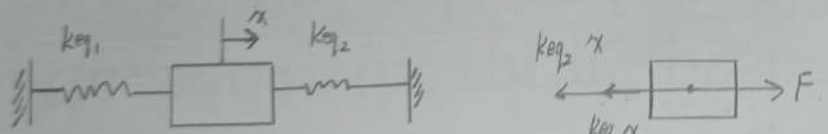
keq



解:

$$k_{eq_1} = \frac{1}{\frac{1}{4k}+\frac{1}{4k}} = 2k$$

$$k_{eq_2} = \frac{1}{\frac{1}{k}+\frac{1}{2k}} = \frac{2}{3}k$$

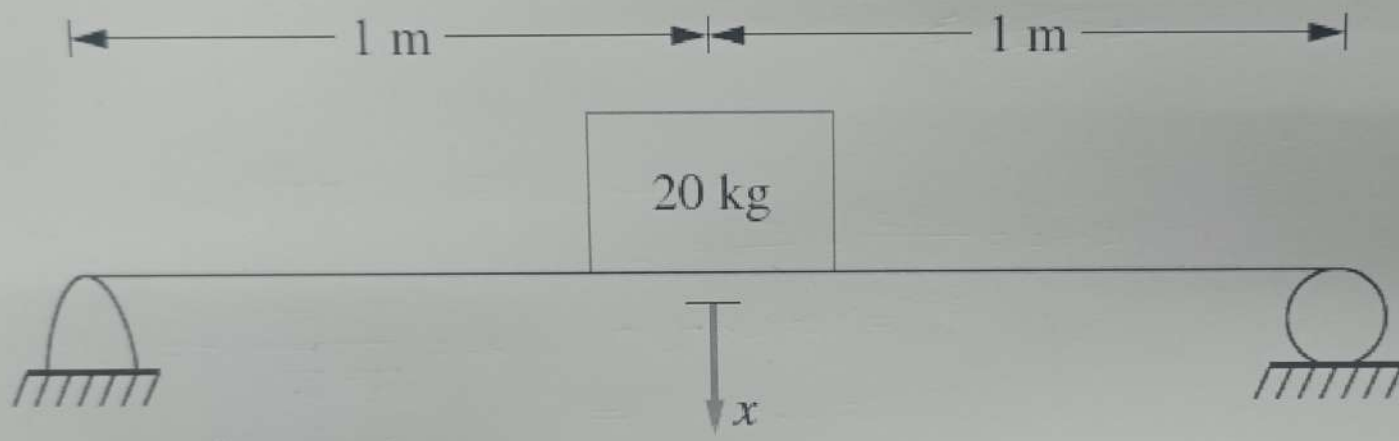


$$F = -(+k_{eq_2}x + k_{eq_1}x) = \frac{8}{3}kx = k_{eq}\cdot x$$

$$k_{eq} = \frac{8}{3}k$$

Homework

Determine the equivalent stiffness of a linear spring when a SDO mass-spring model is used for the systems shown in following Figure through with x being the chosen generalized coordinate.



$E = 200 \times 10^9\ \text{N/m}^2$

$I = 1.15 \times 10^{-4}\ \text{m}^4$

解:

$$x = \frac{L^3}{48EI}F = \frac{F}{k}$$

$$k = \frac{48EI}{L^3} = \frac{48 \times 200 \times 10^9 \times 1.15 \times 10^{-4}}{2^3} = 1.38 \times 10^8\ \text{N/m}$$