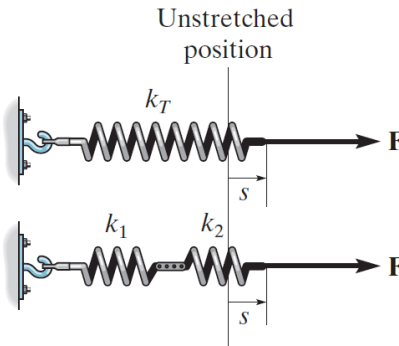


Problem 3-17

Determine the stiffness k_T of the single spring such that the force \mathbf{F} will stretch it by the same amount s as the force \mathbf{F} stretches the two springs. Express k_T in terms of stiffness k_1 and k_2 of the two springs.



Prob. 3-17

Solution

Suppose the force \mathbf{F} is applied to the two springs in series. Both of them will be stretched a different distance because they have different spring constants.

$$s_1 = \frac{F}{k_1} \quad s_2 = \frac{F}{k_2}$$

These two distances sum to s .

$$s = s_1 + s_2 \tag{1}$$

If we want to replace these two springs with one that moves the same distance s under the same force F , then its spring constant will be

$$k_T = \frac{F}{s}.$$

Solve for s and plug the formulas for s_1 and s_2 into equation (1).

$$\frac{F}{k_T} = \frac{F}{k_1} + \frac{F}{k_2}$$

Therefore, dividing both sides by F ,

$$\frac{1}{k_T} = \frac{1}{k_1} + \frac{1}{k_2}.$$