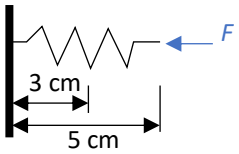
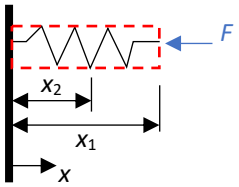
Determine the work required to compress a linear spring with spring constant of 100 N/m from an initial deflection of 5 cm to a final deflection of 3 cm. Calculate the work on the spring using the "$\boldsymbol{F}\cdot d\boldsymbol{s}$" approach.



SOLUTION:



The work required to compress the spring (the system) is,

$$W_{on\ sys} = \int \boldsymbol{F}_{on\ sys} \cdot d\boldsymbol{s} = \int_{x=x_1}^{x=x_2} \underbrace{-kx\hat{\boldsymbol{\imath}}}_{=\boldsymbol{F}_{on\ sys}} \cdot \underbrace{dx\hat{\boldsymbol{\imath}}}_{=d\boldsymbol{s}} = -\frac{1}{2}k\int_{x_1}^{x_2} x dx = -\frac{1}{2}k(x_2^2 - x_1^2)$$ (*k* is a constant). (1)

Using the given data,

k = 100 N/m,

x_1 = 5 cm,

x_2 = 3 cm,

=> $\boxed{W_{on\ sys} = 0.08\ \text{J}}$.