**Given and Required:**

Determine the energy necessary to stretch a spring (with a spring constant of $200\ \frac{\text{lbf}}{\text{in}}$) $4$ inches. Express your answer in $\text{BTU}$.

$$1\ \text{BTU} = 778.169\ \text{ft lbf}$$

**Solution:**

The spring constant is defined as

$$k := 200\ \frac{\text{lbf}}{\text{in}}$$

The length for the spring to be stretch is defined as

$$L := 4\ \text{in}$$

The energy necessary to stretch the spring will be determined by the work required to stretch the spring. The work necessary to stretch a spring is given by

$$W = \int_1^2 F\ \mathrm{d}\,x$$

where $F$ is the force applied to the spring and $dx$ is the distance that the force is applied. The force necessary to stretch the spring is given by Hooke's Law or simple

$$W = \int_1^2 kx\ \mathrm{d}\,x$$

The limits of the integral will be from $0$ to $L$ (or $4\ \text{in}$). This is shown below.

$$W := \int_0^L k \cdot x\ \mathrm{d}\,x = 1600\ \text{in lbf}$$

Knowing the conversion between Btu and in lbf, the energy required in $\text{BTU}$ may be found by a simple unit conversion. However, since this solution is beening done in Smath Solver, Smath Solver can do it for us.

$$\boxed{W = 0.1713\ \text{BTU}}$$