# 2020A F=ma Exam: Problem 23

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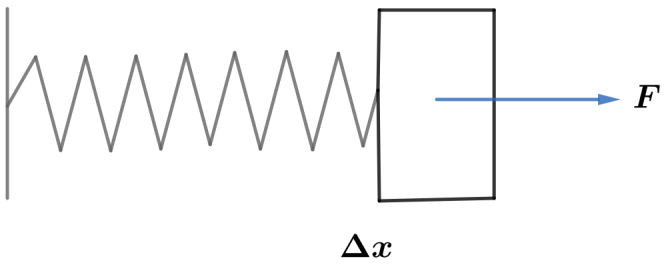


Theory:

$$F = -kx$$
$$k = \frac{F}{\Delta x}$$

Recall when two uncorrelated quantities are multiplied, the relative uncertainties add in quadrature. Also, recall the relative uncertainty gets multiplied by $|n|$ when you raise to the $n$th power. Thus,

$$\frac{\delta k_S}{k} = \sqrt{\left(\frac{\delta F}{F}\right)^2 + \left(\frac{\delta \Delta x}{\Delta x}\right)^2}$$

If $F$ is increased by a factor of 5, then $\Delta x$ is also increased by a factor of 5. Since by assumption the absolute uncertainties are constant, we have

$$\frac{\delta k_T}{k} = \sqrt{\left(\frac{\delta F}{5F}\right)^2 + \left(\frac{\delta \Delta x}{5\Delta x}\right)^2} = \frac{1}{5}\frac{\delta k_S}{k}$$

Hence,

$$\delta k_T = 0.2\,\delta k_S$$

so the answer is $\boxed{\text{C}}$.