2016 F=ma Exam: Problem 15

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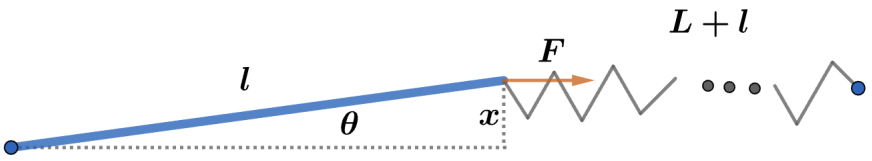
We found in the previous problem that

$$f = \frac{l}{2\pi}\sqrt{\frac{k}{I}}$$



When the spring is moved to the right of the rod, we have a constant spring force $F = -kl$ pointing to the right (using our given assumption $L \gg l$). If we displace the rod by a small angle θ, the restoring torque τ is

$$\tau = Fx = F(l\theta) = -kl^2\theta$$

Applying Newton's 2nd law $\tau = I\alpha$,

$$-kl^2\theta = I\ddot{\theta}$$
$$\ddot{\theta} = -\frac{kl^2}{I}\theta$$

This is the same equation of motion as that followed by the original system so the frequency $f' = f$ is the same as before. Thus, the answer is $\boxed{\text{C}}$.