2018A F=ma Exam: Problem 24

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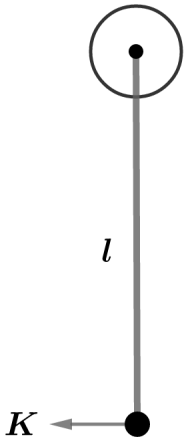

Initially, increasing K corresponds to increasing the amplitude of oscillations for a simple pendulum. Without deriving the exact period of a pendulum, note that its equation of motion is

$$ml\frac{d^2\theta}{dt^2} = -mg\sin\theta$$

usually approximated as

$$ml\frac{d^2\theta}{dt^2} = -mg\theta$$

for simple harmonic motion. Since θ is larger than $\sin\theta$, the actual restoring force becomes smaller relative to the force assumed in SHM as θ increases. Hence, the period increases with amplitude until $\theta = \pi$ when it diverges ($\sin\pi = 0$).

Once the mass has enough energy to swing through a full circle, we have vertical circular motion. Increasing K increases v at all points along the circle so the period will decrease. Thus, the answer is $\boxed{\text{E}}$.