15A

A cart attached to a spring with constant 3.24 N/m vibrates such that its position is given by the function $x = (5.00 \text{ cm}) \cos (3.60t \text{ rad/s})$. (a) During the first cycle, for $0 < t < 1.75$ s, at what value of t is the system's potential energy changing most rapidly into kinetic energy? (b) What is the maximum rate of energy transformation?

15B

A particle of mass m slides without friction inside a hemispherical bowl of radius R. Show that if the particle starts from rest with a small displacement from equilibrium, it moves in simple harmonic motion with an angular frequency equal to that of a simple pendulum of length R. That is, $\omega = \sqrt{g/R}$.

15C

A pendulum of length L and mass M has a spring of force constant k connected to it at a distance h below its point of suspension (Fig. P15.47). Find the frequency of vibration of the system for small values of the amplitude (small θ). Assume the vertical suspension rod of length L is rigid, but ignore its mass.
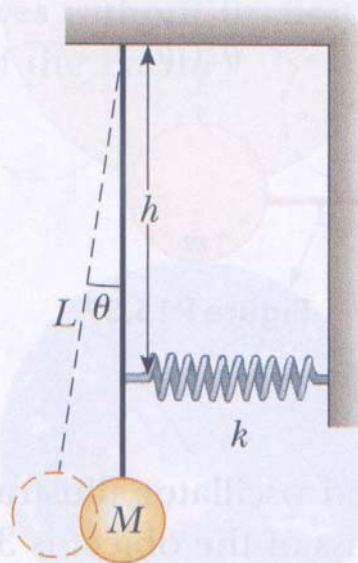

Figure P15.47