

SOLUTIONS MIDTERM PHY 4936 (Fall 2011)

PROBLEM 1

1.1 The Lagrangian is

$$L = \frac{1}{2}m\dot{x}^2 - \frac{1}{2}kx^2 .$$

1.2 Euler-Lagrange equation

$$\begin{aligned} \frac{d}{dt} \frac{\partial L}{\partial \dot{x}} &= \frac{\partial L}{\partial x} \\ m \ddot{x} &= -kx \\ \ddot{x} &= -\frac{k}{m}x = -\omega^2 x \end{aligned}$$

1.3 Solution:

$$x(t) = x_0 \cos(\omega t) + \frac{\dot{x}_0}{\omega} \sin(\omega t) .$$