Using Canonical eq"s of
Hamiltonian mechanics

$$H = \frac{1}{2} kx^2 + \frac{p^2}{2m}$$

$$\frac{\partial H}{\partial x} = -\frac{dp}{dt}$$
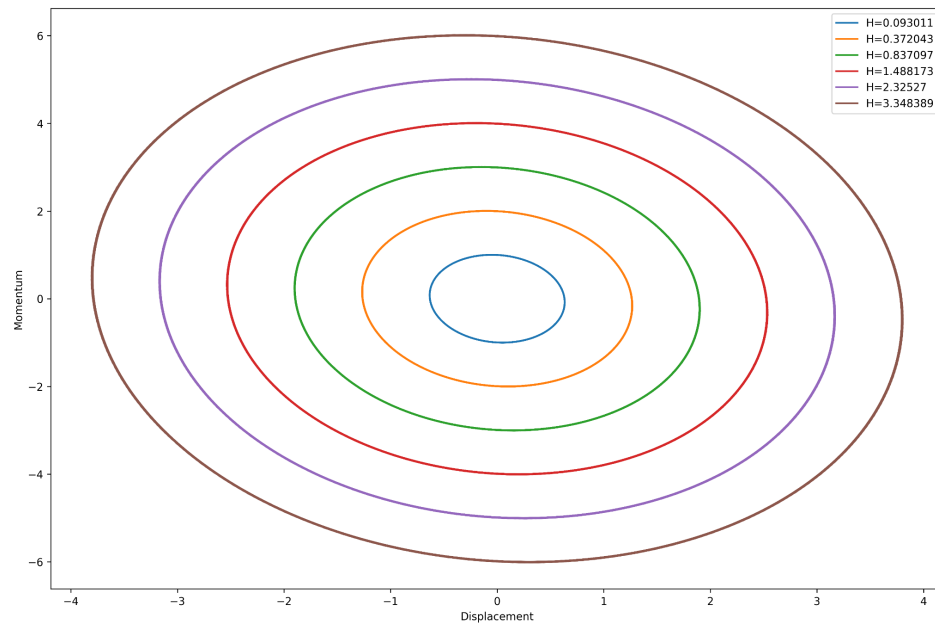
$$\frac{dp}{dt} = -\frac{\partial H}{\partial x} = -kx \qquad \text{——} ①$$

$$\frac{dx}{dt} = \frac{\partial H}{\partial p} = \frac{p}{m} \qquad \text{——} ②$$

So
$$\begin{cases} \dfrac{dp}{dt} = -kx \\[4mm] \dfrac{dx}{dt} = \dfrac{p}{m} \end{cases}$$

Time Evolution P and X

Mean Square Displacement with time