$$U(r) \quad = \quad K\left[\left(\frac{\sigma}{r}\right)^{12} - \left(\frac{\sigma}{r}\right)^{6}\right]$$

$$f(x) \quad = \quad f(x_0) \; + \; (x-x_0)\frac{df}{dx}|_{x_0} \; + \; \frac{1}{2}(x-x_0)^2\frac{d^2f}{dx^2}|_{x_0} \; + \; \frac{1}{6}(x-x_0)^3\frac{d^3f}{dx^3}|_{x_0} \; + \; ...$$

$$f(x) \quad = \quad f(x_0) \; + \; \sum_{n=1}^{\infty}\frac{1}{n!}(x-x_0)^n\frac{d^nf}{dx^n}|_{x_0}$$

$$f(x) \quad = \quad f(x_0) \; + \; 0 \; + \; \frac{1}{2}(x-x_0)^2\frac{d^2f}{dx^2}|_{x_0} \; + \; \frac{1}{6}(x-x_0)^3\frac{d^3f}{dx^3}|_{x_0} \; + \; ...$$

$$f(x) \quad \simeq \quad f(x_0) \; + \; \frac{1}{2}(x-x_0)^2\frac{d^2f}{dx^2}|_{x_0} \; + \; ...$$

$$f(x) \quad \simeq \quad f(x_0) \; + \; \left[\frac{1}{2}\frac{d^2f}{dx^2}|_{x_0}\right] \; (x-x_0)^2$$

$$U(x) \quad \simeq \quad U(x_0) \; + \; \left[\frac{1}{2}\frac{\partial^2U}{\partial x^2}|_{x_0}\right] \; (x-x_0)^2$$

$$\text{Force } F(x) \quad = \quad -\frac{\partial U}{\partial x}$$

$$(U(x)-U(x_0)) \quad \simeq \quad \left[\frac{1}{2}\frac{\partial^2U}{\partial x^2}|_{x_0}\right] \; (x-x_0)^2$$

$$\left(\frac{U(x)-U(x_0)}{x-x_0}\right) \quad \simeq \quad \left[\frac{1}{2}\frac{\partial^2U}{\partial x^2}|_{x_0}\right] \; (x-x_0)$$

$$F(x) \quad \simeq \quad -\left[\frac{1}{2}\frac{\partial^2U}{\partial x^2}|_{x_0}\right] \; (x-x_0)$$

$$F(x) \quad \simeq \quad -K(x-x_0)$$

$$F(x) \quad = \quad -Kx$$

$$m\,a(x) \quad = \quad -Kx$$

$$m\,\frac{d^2x}{dt^2} \quad = \quad -Kx$$

$$\frac{d^2x}{dt^2} \quad = \quad -\left(\frac{K}{m}\right)x$$

$$\omega \quad \equiv \quad \sqrt{\frac{K}{m}}$$

$$\frac{d^2x}{dt^2} \quad = \quad -\omega^2 x$$

$$x(t) \quad = \quad A\cos(\omega t + \phi)$$

$$x(t) \quad = \quad A\sin(\omega t) + B\cos(\omega t)$$

$$h(x) \quad = \quad H\left[1 - \cos(\frac{2\pi x}{L})\right]$$

$$m\,\frac{d^2x}{dt^2} \; + \; Kx \quad = \quad 0$$

$$\int \left(m\,\frac{d^2x}{dt^2}\right)dx \; + \; \int (Kx)dx \quad = \quad \int (0)dx$$

$$\int \left(m\,\frac{d^2x}{dt^2}\right)dx \; + \; \frac{1}{2}Kx^2 \quad = \quad C$$

$$mv^2$$

$$\frac{d}{dx}(mv^2) \quad = \quad 2mv\;\frac{dv}{dx}$$

$$2mv\;\frac{dv}{dx} \quad = \quad 2m\;\frac{dx}{dt}\;\frac{dv}{dx}$$

$$2mv\;\frac{dv}{dx} \quad = \quad 2m\;\frac{dx}{dt}\;\frac{dv}{dx} \quad = \quad 2m\;\frac{dv}{dt} \quad = \quad 2m\;\frac{d^2x}{dt^2}$$

$$\frac{1}{2}mv^2 \; + \; \frac{1}{2}Kx^2 \quad = \quad C$$

$$\int \left(m\,\frac{d^2x}{dt^2}\right)dt \; + \; \int (Kx)dt \quad = \quad \int (0)dt$$

$$\int \left(m\,\frac{d^2x}{dt^2}\right)dt \; + \; \int (\text{Force})dt \quad = \quad \int (0)dt$$

$$m\,v \;+\; \int (\text{Force})dt \quad = \quad C$$

$$m(v_f - v_i) \;+\; \int (\text{Force})dt \quad = \quad C$$