

$$V[\chi] = \frac{1}{2m} \left( \frac{\hbar}{\alpha} \right)^2 \left\{ 2TD(0) - \frac{1}{\hbar^2} \int_0^T dt \left[ m^2 [\ddot{\chi}(t)]^2 - 2mk[\dot{\chi}(t)]^2 + k^2[\chi(t)]^2 \right] \right\}$$

$$= \frac{T\hbar^2}{m\alpha^2} D(0) - \frac{m}{2\alpha^2} \int_0^T dt \left[ [\ddot{\chi}(t)]^2 - 2\frac{k}{m} [\dot{\chi}(t)]^2 + \frac{k^2}{m^2} [\chi(t)]^2 \right]$$