# PROBLEM

Let $H(p,q) = K(p) + U(q)$ be the total energy of the system.

The kinetic energy $K(p) = \sum_i \frac{p_i^2}{2m}$ is quadratic in $p$. This means that we can apply Euler's theorem on homogeneous functions:

$$\frac{\partial H}{\partial m} = \frac{\partial K(p)}{\partial m} + \frac{\partial U(q)}{\partial m} = -\frac{K(p)}{m}$$

(m is the external parameter.)

From eq 15.11 we can then claim that

since $\overline{\frac{\partial E(p,q;\lambda)}{\partial \lambda}} = \left(\frac{\partial F}{\partial \lambda}\right)_{T,V}$ then,

$$K = -m\left(\frac{\partial F}{\partial m}\right)_{T,V}.$$

[When we know F from experiments this method is useful since we sidestep the integral way of computing $\langle K \rangle$.]