

(2.3) Use eqns 2.46 and 2.62 to show that

$$\hat{x}_j = \frac{1}{\sqrt{N}} \left(\frac{\hbar}{m} \right)^{\frac{1}{2}} \sum_k \frac{1}{(2\omega_k)^{1/2}} \left(\hat{a}_k \exp(ikja) + \hat{a}_k^\dagger \exp(-ikja) \right) \quad (2.68)$$

$$\hat{x}_j = \frac{1}{\sqrt{N}} \sum_k \tilde{x}_k \exp(ikja) \quad (2.46)$$

$$\hat{x}_k = \sqrt{\frac{\hbar}{2m\omega_k}} \left(\hat{a}_k + \hat{a}_k^\dagger \right) \quad (2.62)$$

FIXME