$\hat{H}\hat{A}$

$$\frac{d}{dt}\hat{A}_H = \left(\frac{\partial \hat{A}}{\partial t}\right)_H + \frac{1}{i\hbar}\left[\hat{A}_H, \hat{H}\right] \tag{1}$$

$H\hbar$
$[\cdot,\cdot]$

$$\frac{d}{dt}\langle\hat{A}\rangle = \left\langle\frac{\partial \hat{A}}{\partial t}\right\rangle + \frac{1}{i\hbar}\langle[\hat{A},\hat{H}]\rangle \tag{2}$$

$$\frac{d}{dt}\langle A\rangle = \left\langle\frac{\partial A}{\partial t}\right\rangle + \langle\{\{A,H\}\}\rangle \tag{3}$$

A
H
$\hat{A}$
$\hat{H}$
$\langle A\rangle$
A
$\langle\hat{A}\rangle$
$\{\{\cdot,\cdot\}\}$

$$\{\{f,g\}\} = \frac{2}{\hbar} f \sin\left[\frac{\hbar}{2}\left(\sum_i \overleftarrow{\partial}_{q_i}\overrightarrow{\partial}_{p_i} - \overleftarrow{\partial}_{p_i}\overrightarrow{\partial}_{q_i}\right)\right] g \tag{4}$$

f
g
$i\{q_i\}\{p_i\}$

$$H = \frac{p^2}{2m} + V(q) \tag{5}$$

m
????

$$\frac{d}{dt}\langle A\rangle = \left\langle\frac{\partial A}{\partial t}\right\rangle + \langle\{A,H\}\rangle + \sum_{k=1}^{\infty}\frac{(-1)^{k+1}\hbar^{2k}}{(2k+1)!2^{2k}}\left\langle A_p^{(2k+1)} V_q^{(2k+1)}\right\rangle \tag{6}$$

$A_p^{(i)} =$
$\partial^i A/\partial p^i$
$V_q^{(i)} =$
$\partial^i V/\partial q^i$

$$\{f,g\} = \frac{\partial f}{\partial q}\frac{\partial g}{\partial p} - \frac{\partial f}{\partial p}\frac{\partial g}{\partial q} \tag{7}$$

$\hbar A$
V
??A
A
q
p

$$\frac{d}{dt}\langle q\rangle = \frac{1}{m}\langle p\rangle \tag{8}$$

$$\frac{d}{dt}\langle p\rangle = -\left\langle V_q^{(1)}\right\rangle \tag{9}$$

??$\langle V_q^{(1)}\rangle$

$$\frac{d}{dt}\left\langle V_q^{(1)}\right\rangle = \frac{1}{m}\left\langle V_q^{(2)} p\right\rangle \tag{10}$$

$\langle V_q^{(2)} p\rangle$

$$\frac{d}{dt}\left\langle V_q^{(2)} p\right\rangle = \frac{\left\langle V_q^{(3)} p^2\right\rangle}{m} - \left\langle V_q^{(1)} V_q^{(2)}\right\rangle \tag{11}$$

????M

1????$M >$
2
$\mu_q =$
$\langle q\rangle \mu_p =$
$\langle p\rangle \sigma_q =$
$\sqrt{\langle (q-\mu_q)^2\rangle}$
$\sigma_p =$
$\sqrt{\langle (p-\mu_p)^2\rangle}$
$\tilde{q} =$
$(q-\mu_q)/\sigma_q$
$\tilde{p} =$
$(p-\mu_p)/\sigma_p$
$\tilde{q}^i\tilde{p}^j$
$q^ip^j\xi_{ij} =$
$\left\langle \tilde{q}^i\tilde{p}^j\right\rangle$
$\xi_{00} =$
$1, \xi_{10} =$
$\xi_{01} =$
0
$\xi_{20} =$
$\xi_{02} =$
1??$\tilde{q}$
V

$$V(\tilde{q}) = \sum_{k=0}^{M} b_k\tilde{q}^k$$

(16)
$b_k =$
$\sum_{l=k}^{M} C_l^k \mu_q^{l-k}\sigma_q^k a_l$
$C_m^n =$
$m!/[n!(m-$
$n)!]$??

$$\frac{d}{dt}\mu_q = \frac{\mu_p}{m}$$

(17)

$$\frac{d}{dt}\mu_q = \frac{\mu_p}{m}$$

(18)

$$\frac{d}{dt}\sigma_q = \frac{\sigma_p\xi_{11}}{m}$$

(19)

$$\frac{d}{dt}\sigma_p = \chi$$

(20)

$$\frac{d}{dt}\xi_{ij} = \alpha\xi_{ij}+\beta\xi_{i-1,j+1}+\gamma\xi_{i,j-1}+\sum_{k=0}^{K}\sum_{j=1}^{M}\eta_{kl}\xi_{i-2k-1+l+l,j-2k-1}$$

(21)
$\{ \alpha =$
$-j\chi/\sigma_p-$
$i\xi_{11}\sigma_p/(m\sigma_q),$
$\beta =$
$i\sigma_p/\left(m\sigma_q\right),$
$\gamma =$
$-j\lambda/\sigma_p,$
$\eta_{kl} =$
$(-1)^{k+1}b_l\hbar^{2k}C_j^{2k+1}A_l^{2k+1}/\left(2^{2k}\sigma_p^{2k+1}\sigma_q^{2k+1}\right),$
$\lambda =$
$-\sum_{k=1}^{M} kb_k\xi_{k-1,0}/\sigma_q,$
$\chi =$
$-\sum_{k=1}^{M} kb_k\xi_{k-1,1}/\sigma_q$
$A_m^n =$
$m!/(m-$
$n)!$
K
$(\min\{j,M\}-$
$1)/2$??$i+$
$j\xi_{ij}$
ξ_{kl}
$i+$
$j+$
$M-$
2
$M >$
2????$N P_N(q,p) P_N(q,p) P_N(q,p)$

$$P_N(q,p) = \sum c_{kl}f_{kl}(q,p)$$