
Lsg. 6)
a) $Op_1 \circ b_1 = -ik \cdot \cos(kx)/\sqrt{\pi} = 0 \cdot b_1 - ik \cdot b_2; Op_1 \circ b_2 = ik \cdot \sin(kx)/\sqrt{\pi} = ik \cdot b_1 + 0 \cdot b_2;$
$[Op_1] = \begin{pmatrix} 0 & ik \\ -ik & 0 \end{pmatrix}$.
$D_{11} = \int_{-\pi}^{+\pi} dx \cdot \sin(kx)\sqrt{\pi} \cdot -ik\cos(kx)/\sqrt{\pi} = -ik/\pi \cdot \int_{-\pi}^{+\pi} dx \cdot u(x) \cdot g(x) = 0.$
$D_{12} = \int_{-\pi}^{+\pi} dx \cdot \sin(kx)\sqrt{\pi} \cdot ik\sin(kx)/\sqrt{\pi} = ik/\pi \cdot \int_{-\pi}^{+\pi} dx \cdot \sin^2(kx) = ik/\pi \cdot 2\pi \cdot 1/2 = ik.$
b) $Op_2 \cdot b_1 = k^2 \cdot b_1; Op_2 \cdot b_2 = k^2 \cdot b_2; [Op_2] = \begin{pmatrix} k^2 & 0 \\ 0 & k^2 \end{pmatrix}$

Lsg. 7)
$[Op_1]^2 = \begin{pmatrix} 0 & ik \\ -ik & 0 \end{pmatrix} \cdot \begin{pmatrix} 0 & ik \\ -ik & 0 \end{pmatrix} = \begin{pmatrix} +k^2 & 0 \\ 0 & +k^2 \end{pmatrix} = [Op_2].$
$(-i \cdot d/dx)^2 = -1 \cdot d^2/dx^2$. $Op_1^2 = Op_2$ für Operatoren wie für Darstellungsmatrizen.

Lsg. 8)
$m = V \cdot \rho = 4\pi/3 \cdot (d/2)^3 \cdot 1g/cm^3 = \pi/6 \cdot 10^{-18} m^3 \cdot 1g/10^{-6} m^3 = 5 \cdot 10^{-13} g \cdot 1m_e/0.9 \cdot 10^{-27} g =$
$0.575 m_e \cdot 10^{15} = \mathbf{0.6 \cdot 10^{15}}$ au $= \mathbf{5 \cdot 10^{-13} g}$.
$\Delta x = 0.5 \cdot 10^{-6} m \cdot 1$ Bohr$/53 \cdot 10^{-12} m = 9.4 \cdot 10^3$ Bohr $= 10^4$ au;
$\Delta v = 1000\hbar/m/\Delta x = 10^3/0.6 \cdot 10^{15}/10^4 =$
$1.8 \cdot 10^{-16}$ au $= 1.8 \cdot 10^{-16} \cdot 2.188 \cdot 10^6 \cdot 10^6\, \mu m/min * 60 = \mathbf{2.4 \cdot 10^{-2}\, \mu m/min}$.
$kT = 26meV = 0.95$ mHartree $= m/2 \cdot v^2 \rightarrow v = \sqrt{1.9 \cdot 10^{-3}/0.58 \cdot 10^{15}} = 1.8 \cdot 10^{-9}$ au $=$
$1.8 \cdot 10^{-9} \cdot 2.2 \cdot 10^6 \cdot 10^6\, \mu m/min * 60 = \mathbf{2.4 \cdot 10^5\, \mu m/min}$

Lsg. 9)
$\mu = 5D = 5D \cdot 1$ au$/2.54D = 2$ au. $L = 235$ pm $\cdot\, 1$ Bohr$/52.9$ pm $= 4.4$ au.
$\mu = Q \cdot L \rightarrow Q = 2$ au$/4.5$ au $= \mathbf{0.45e}$.

Lsg. 10)
$\lambda = 350nm$; $\tilde{\nu} = 1/\lambda = 1/350 \cdot 10^9 \cdot 10^{-2} cm^{-1} = \mathbf{29 \cdot 10^3 cm^{-1}} \sim 3.5eV \sim \mathbf{342kJ/Mol} \sim$
$0.130\, \mathbf{Hartree}$.