70

6) $\hat{\nabla}(\psi \hat{\nabla} \psi^* - \psi^* \hat{\nabla} \psi) = \hat{\nabla}\psi \hat{\nabla}\psi^* + \psi \hat{\Delta} \psi^* - \hat{\nabla}\psi^* \hat{\nabla}\psi - \psi^* \hat{\Delta}\psi =$

$= \psi \hat{\Delta} \psi^* - \psi^* \hat{\Delta} \psi$

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надо представлять не рукописный, а
нормально оформленый вариант
например в
Libreoffice

12) We use them because eigen[...]
operators are real numbe[...]
quantities they express are real too.

Hermitean operator is an operator which
equals its conjugated form
$\hat{A}^+ = \hat{A}$, thus

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$\boxed{\langle \hat{A}\psi | \psi \rangle = \langle \psi | \hat{A}\psi \rangle}$

mis see on?

$\langle \hat{A}\varphi_m | \varphi_n \rangle = \langle \varphi_m | \hat{A}\varphi_n \rangle = a_n \langle \varphi_m | \varphi_n \rangle = a_m^* \langle \varphi_m | \varphi_n \rangle$

$a_n^* = a_n$

$(a_n - a_m)\langle \varphi_m | \varphi_n \rangle = 0$

if $m \neq n \rightarrow$

$\langle \varphi_m | \varphi_n \rangle = 0$

which is an orthonormality definition

21) $U = 0$

20

$-\frac{\hbar^2}{2m}\frac{d^2\psi}{dx^2} = E\psi$

$\frac{d^2\psi}{dx^2} = -k^2\psi, \quad k = \frac{\sqrt{2mE}}{\hbar}$

$\psi = Ae^{ikx} + Be^{-ikx}$

$\psi(x) = \psi(x+L)$

$$Ae^{ik(x+L)} + Be^{-ik(x+L)} = Ae^{ikx} + Be^{-ikx}$$

$$e^{ikL} = e^{-ikL} = 1$$

$$k_n L = 2\pi n \quad , \; n = 0 \ldots \infty$$

$$k_n = \frac{2\pi n}{L}$$

$$\psi(x) = Ae^{ik_n x} \quad , \; B = 0$$

$$\int_0^L |\psi(x)|^2 dx = 1$$

$$|A|^2 \int_0^L 1\, dx = |A|^2 L = 1 \quad , \; A = \frac{1}{\sqrt{L}}$$

Probability density:

$$|\psi_n(x)|^2 = \frac{1}{L}$$

It is not possible to calculate x and p_x exactly and simultaneously due to Heisenberg uncertainty principal:

$$\Delta x \cdot \Delta p_x \geq \frac{\hbar}{2}$$

But it is possible to find the expectation values.

$$\langle x \rangle = \int \Psi^* [x] \Psi \, dx$$

$$\langle p \rangle = \int \Psi^* \left[-i\hbar \left(\frac{\delta}{\delta x}\right)\right] \Psi \, dx$$

26) Assume $\langle A \rangle = \langle B \rangle = 0$, and 15

$[\hat{A}, \hat{B}] = i\hat{C}$

$$J(\alpha) = \int |(\alpha\hat{A} - i\hat{B})\psi|^2 \, dV \geq 0 \qquad \alpha \in R$$

$$J(\alpha) = \int \psi^* (\alpha\hat{A} + i\hat{B})(\alpha\hat{A} - i\hat{B}) \psi \, dV =$$

не понятен переход

$$\int \psi^* (\alpha^2 \hat{A}^2 + \alpha\hat{C} + \hat{B}^2) \psi \, dV$$

$$J(\alpha) = \alpha^2 \langle (\Delta A)^2 \rangle + \alpha \langle C \rangle + \langle (\Delta B)^2 \rangle$$

$$J(\alpha) \geq 0 \qquad D = \langle C \rangle^2 - 4 \langle (\Delta A)^2 \rangle \langle (\Delta B)^2 \rangle$$

$$4 \cdot \langle (\Delta A)^2 \rangle \langle (\Delta B)^2 \rangle \geq \langle C \rangle^2$$

35) 15

$$T(x) = \frac{k'}{k} |C|^2, \quad k' = \frac{\sqrt{2m(E-U)}}{\hbar}, \quad k = \frac{\sqrt{2mE}}{\hbar}$$

$$\lim_{E \to \infty} T(x) = \lim_{E \to \infty} \sqrt{\frac{2m(E-U)}{2mE}} |C|^2 = \lim_{E \to \infty} \sqrt{\frac{E-U}{E}} = 1$$

?