#1 A a.) bound, unbound +2 $\qquad$ 52 PTS

b.) energy → quantized, continuous For unbound ψ's not normalizable +3

B.) a.) its eigenvalues That are not changed upon remeasuring a system +2

b.) it be an eigenfunction +2

c.) Energy +1

d.) they change for the same system +2

2.) $[\hat{S}^2, S_z] = \alpha\left[\begin{pmatrix}1&0\\0&1\end{pmatrix}\begin{pmatrix}1&0\\0&-1\end{pmatrix} - \begin{pmatrix}1&0\\0&-1\end{pmatrix}\begin{pmatrix}1&0\\0&1\end{pmatrix}\right] \to 0$ yes +3

$[S_y, S_x] = \beta\left[\begin{pmatrix}0&-i\\i&0\end{pmatrix}\begin{pmatrix}0&1\\1&0\end{pmatrix} - \begin{pmatrix}0&1\\1&0\end{pmatrix}\begin{pmatrix}0&-i\\i&0\end{pmatrix}\right]$

$\beta\left[\begin{pmatrix}-i&0\\0&i\end{pmatrix} - \begin{pmatrix}i&-i\\0&-i\end{pmatrix}\right] \neq 0 = \begin{pmatrix}-2i&i\\0&2\end{pmatrix}\beta$ No +3

$[\hat{S}_y, \hat{S}_z] = \delta\left[\begin{pmatrix}0&-i\\i&0\end{pmatrix}\begin{pmatrix}1&0\\0&-1\end{pmatrix} - \begin{pmatrix}1&0\\0&-1\end{pmatrix}\begin{pmatrix}0&-i\\i&0\end{pmatrix}\right]$

$= \delta\left[\begin{pmatrix}0&i\\i&0\end{pmatrix} - \begin{pmatrix}0&-i\\-i&0\end{pmatrix}\right] = \begin{pmatrix}0&2i\\2i&0\end{pmatrix}\delta$ no +3

$[\hat{S}_x, \hat{S}_z] = \delta\left[\begin{pmatrix}0&1\\1&0\end{pmatrix}\begin{pmatrix}1&0\\0&-1\end{pmatrix} - \begin{pmatrix}1&0\\0&-1\end{pmatrix}\begin{pmatrix}0&1\\1&0\end{pmatrix}\right]$ +3

$= \delta\left[\begin{pmatrix}0&-1\\1&0\end{pmatrix} - \begin{pmatrix}0&1\\-1&0\end{pmatrix}\right] = \delta\begin{pmatrix}0&-2\\-2&0\end{pmatrix}$ No

3. $\hat{S}^2, S_x$, All +2

$S_x \quad \begin{vmatrix} -\lambda & \frac{\hbar}{2} \\ \frac{\hbar}{2} & -\lambda \end{vmatrix} = 0 \qquad \lambda^2 - \frac{\hbar^2}{4} = 0 \qquad \lambda = \pm \frac{\hbar}{2}$ +3

$\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix} \begin{pmatrix} a \\ b \end{pmatrix} = \pm \begin{pmatrix} a \\ b \end{pmatrix}$ $\quad b = \pm a$, $a = \pm b$ +3

$\lambda_+ = \frac{1}{\sqrt{2}} \begin{pmatrix} 1 \\ 1 \end{pmatrix} \qquad \lambda_- = \begin{pmatrix} 1 \\ -1 \end{pmatrix} \frac{1}{\sqrt{2}}$ +3 +1

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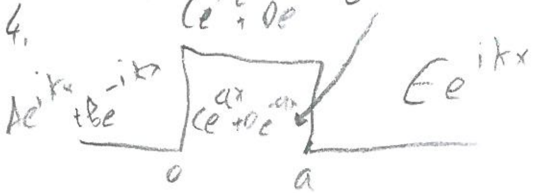
4. $Ce^{iqa} + De^{-iqa}$ $E < V$



$A + B = C + D \qquad x = 0$

$ik(A - B) = q(C - D)$

$Ce^{\alpha a} + De^{-\alpha a} = Ee^{ika} \qquad x = a$

$\alpha(Ce^{\alpha a} - De^{-\alpha a}) = ikEe^{ika}$

+4

$E > V$

$A + B = C + D$

$ik(A - B) = iq(C - D)$

$Ce^{iqa} + De^{-iqa} = Ee^{ika}$

$iq(Ce^{iqa} - De^{iqa}) = ikEe^{ika}$

+4

$n=1 \quad n+1=2 \quad n-1=0$

$2xH_1 - 2H_0$

$4x^2 - 2y$ +2

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6. $\hat{x} = \left(\frac{\hbar}{2m\omega}\right)^{1/2}(\hat{a}_+ + \hat{a}_-)$

$\left(\frac{\hbar}{2m\omega}\right)^{1/2}\langle\psi_2|(\hat{a}_+ + \hat{a}_-)|\psi_2\rangle = \langle x\rangle$

$a_-\psi_2 \propto \psi_1 \quad \langle\psi_2|\psi_1\rangle = 0$

$a_+\psi_2 \propto \psi_3 \quad \langle\psi_2|\psi_3\rangle = 0$

$= 0$

$\hat{x}^2 = \frac{\hbar}{2m\omega}\langle\psi_2|a_+^2 + \overbrace{a_+a_- + a_-a_+}^{n+n+1} + a_-^2|\psi_2\rangle$

$\langle\psi_2|\psi_4\rangle \qquad \langle\psi_2|\psi_0\rangle$

$0 \qquad 0$

$= (2n+1)\frac{\hbar}{2m\omega}$

↑ +6