Quantum Mechanics Equations Sheet

Test 1 stuff

(1) **definition of hbar** $\qquad\qquad\qquad\qquad\qquad$ $\hbar = \dfrac{h}{2\pi}$, where h is planck's constant

(2) **uncertainty** $\qquad\qquad\qquad\qquad$ $\sqrt{\langle S_z{}^2 \rangle - \langle S_z \rangle^2} = \Delta S_z$, where ΔS_z is uncertainty

(3) **Completeness Relation** $\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ $\sum_i |u_i\rangle \langle u_i| = 1$

In a discrete basis $\{|u_i\rangle\}$, an operator is represented by the numbers
(4) **Representations of Operators** $\qquad$ to represent operator A in basis $\{|u_i\rangle\}$: $A_{ij} = \langle u_i| A |u_j\rangle$
(5) **Definition of Raising Operator** $\qquad\qquad\qquad\qquad\qquad\qquad$ $S_+ = S_x + iS_y$
(6) **Definition of Lowering Operator** $\qquad\qquad\qquad\qquad\qquad\qquad$ $S_- = S_x - iS_y$
add or subtract the above two equations from each other to obtain for mulas for S_x and S_y respectively

(7) **Rotation Operator** $\qquad\qquad\qquad\qquad\qquad\qquad\qquad$ $R(\phi\mathbf{k}) = e^{-iJ_z\phi/\hbar}$
 (if you want to rotate in another basis, substitute corresponding J operator)

(8) **Components of Raising Operator** $\qquad$ $S_+ |s,m\rangle = \sqrt{s(s+1) - m(m+1)}\hbar |s, m+1\rangle$

Spin $1/2$

(1) **$|+x\rangle$ in terms of z basis** $\qquad\qquad\qquad\qquad$ $|+x\rangle = \dfrac{1}{\sqrt{2}} |+z\rangle + \dfrac{1}{\sqrt{2}} |-z\rangle$

(2) **$|-x\rangle$ in terms of z basis** $\qquad\qquad\qquad\qquad$ $|-x\rangle = \dfrac{1}{\sqrt{2}} |+z\rangle - \dfrac{1}{\sqrt{2}} |-z\rangle$

(3) **$|+y\rangle$ in terms of z basis** $\qquad\qquad\qquad\qquad$ $|+y\rangle = \dfrac{1}{\sqrt{2}} |+z\rangle + \dfrac{i}{\sqrt{2}} |-z\rangle$

(4) **$|-y\rangle$ in terms of z basis** $\qquad\qquad\qquad\qquad$ $|-y\rangle = \dfrac{1}{\sqrt{2}} |+z\rangle + \dfrac{i}{\sqrt{2}} |-z\rangle$

Photon Stuff

(1) **$|R\rangle$ in terms of $|x\rangle$ and $|y\rangle$** $\qquad\qquad\qquad\qquad$ $\dfrac{1}{\sqrt{2}}(|x\rangle + i |y\rangle)$

(2) **$|L\rangle$ in terms of $|x\rangle$ and $|y\rangle$** $\qquad\qquad\qquad\qquad$ $\dfrac{1}{\sqrt{2}}(|x\rangle - i |y\rangle)$