Assignment 6

1. Tick the correct combination relation(s):
   a) $\psi_1, \psi_2$  
   b) $\psi_1, \psi_2, \psi_3$  
   c) $\psi_1, \psi_2, \psi_3, \psi_4$  
   d) $\psi_1, \psi_2, \psi_3, \psi_4, \psi_4$  

   No. 1 is the correct combination relation.

2. For a particle subjected to the potential $V(x) = \frac{1}{2} m \omega^2 x^2$, where $\omega$ is positive, we expect energy eigenfunctions to have a dispersion of:
   a) True  
   b) False  

   Energy eigenfunctions have a linear dispersion.

3. The commutator bracket $[\hat{H}, \hat{p}]$ will be:
   a) $\hbar$  
   b) $i\hbar$  
   c) $2\hbar$  
   d) $0$  

   $[\hat{H}, \hat{p}] = i\hbar$.

4. The Hamiltonian operator is Hermitian.

   where $H_{total} = H_1 + H_2$ for the subsystem $1$ and $2$.

   The Hamiltonian operator is Hermitian.

5. For the Hamiltonian $\hat{H} = \hat{H}_1 + \hat{H}_2$, the time-evolved state $|\psi(t)\rangle$ of the total state $|\psi(0)\rangle$ is found:
   a) True  
   b) False  

   Time-evolved state $|\psi(t)\rangle$ can be found.

6. Given that $|\Psi\rangle = |z\rangle$, where $z$ is a complex number. The component of the total unperturbed state $|\Psi\rangle$ will be:
   a) $|z\rangle$  
   b) $|\Psi\rangle$  
   c) $\langle z|$  
   d) $\langle z|\Psi\rangle$  

   The component of the total unperturbed state $|\Psi\rangle$ is $|z\rangle$.

7. For a polarization matrix $P = \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}$, the ordinary diagonalizing matrix will be:
   a) $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$  
   b) $\begin{pmatrix} 0 & 1 \\ 1 & 0 \end{pmatrix}$  
   c) $\begin{pmatrix} 0 & 1 \\ 0 & 0 \end{pmatrix}$  
   d) $\begin{pmatrix} 0 & 0 \\ 1 & 0 \end{pmatrix}$  

   The ordinary diagonalizing matrix is $\begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}$.

8. The quantum mechanical operator form of the angular momentum $L_z$ is:
   a) True  
   b) False  

   The quantum mechanical operator form of the angular momentum $L_z$ is $\hat{L}_z$.

9. The Pauli matrices, in the definition of spin-1/2 operators, $\sigma_x, \sigma_y, \sigma_z$ are hermitian and have trace equal to 1.
   a) True  
   b) False  

   The Pauli matrices have trace equal to 1.

10. The eigenvalues of spin-1/2 systems described by $H = g_s B \cdot \sigma$, are:
    a) $g_s B \sigma_z$  
    b) $g_s B \sigma_x$  
    c) $g_s B \sigma_y$  
    d) $g_s B \sigma_z$ and $g_s B \sigma_x$ and $g_s B \sigma_y$.

    The eigenvalues of spin-1/2 systems described by $H = g_s B \cdot \sigma$ are $g_s B \sigma_z$ and $g_s B \sigma_x$ and $g_s B \sigma_y$.

11. A Hamiltonian $\hat{H}$ is Hermitian if:
    a) True  
    b) False  

    A Hamiltonian $\hat{H}$ is Hermitian.

12. The eigenvalues of spin-1/2 systems described by $H = g_s B \cdot \sigma$, are:
    a) $g_s B \sigma_z$  
    b) $g_s B \sigma_x$  
    c) $g_s B \sigma_y$  
    d) $g_s B \sigma_z$ and $g_s B \sigma_x$ and $g_s B \sigma_y$.

    The eigenvalues of spin-1/2 systems described by $H = g_s B \cdot \sigma$ are $g_s B \sigma_z$ and $g_s B \sigma_x$ and $g_s B \sigma_y$. 