Answers to Homework 1.5

Example:

	$\mathbf{ket}\psi = \begin{pmatrix} \frac{1}{\sqrt{3}} \\ \frac{\dot{n}}{\sqrt{3}} \\ 0 \\ -\frac{1}{\sqrt{3}} \end{pmatrix}$	w.r.t. the observable $\Omega = \begin{pmatrix} 0 & 0 & 1 & -\dot{n} \\ 0 & 0 & \dot{n} & -1 \\ 1 & -\dot{n} & 0 & 0 \\ \dot{n} & -1 & 0 & 0 \end{pmatrix}$				
Eigenvalue	Basis	Projector	Prob	Resulting State		
$\sqrt{2}$		$\left(\begin{array}{ccccc} \frac{1}{2} & 0 & \frac{1}{2\sqrt{2}} & -\frac{\dot{\pi}}{2\sqrt{2}} \\ 0 & \frac{1}{2} & \frac{\dot{\pi}}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} \\ \frac{1}{2\sqrt{2}} & -\frac{\dot{\pi}}{2\sqrt{2}} & \frac{1}{2} & 0 \\ \frac{\dot{\pi}}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & 0 & \frac{1}{2} \end{array}\right)$	$\frac{1}{2}$	$\begin{pmatrix} \frac{\underline{n}+\sqrt{2}}{2\sqrt{3}} \\ \frac{2}{\sqrt{3}} \\ \frac{2}{\sqrt{6}} \\ \frac{1}{\sqrt{3}} \\ -\frac{1}{\sqrt{6}} \end{pmatrix}$		
- √2	$\begin{pmatrix} \frac{\dot{n}}{2} \\ \frac{1}{2} \\ 0 \\ \frac{1}{\sqrt{2}} \end{pmatrix}, \begin{pmatrix} -\frac{1}{2} \\ -\frac{\dot{n}}{2} \\ \frac{1}{\sqrt{2}} \\ 0 \end{pmatrix}$	$\left(\begin{array}{ccccc} \frac{1}{2} & 0 & -\frac{1}{2\sqrt{2}} & \frac{\dot{n}}{2\sqrt{2}} \\ 0 & \frac{1}{2} & -\frac{\dot{n}}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} \\ -\frac{1}{2\sqrt{2}} & \frac{\dot{n}}{2\sqrt{2}} & \frac{1}{2} & 0 \\ -\frac{\dot{n}}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & 0 & \frac{1}{2} \end{array}\right)$	$\frac{1}{2}$	$\begin{pmatrix} -\frac{\dot{n} + \sqrt{2}}{2\sqrt{3}} \\ -\frac{-2 \dot{n} + \sqrt{2}}{2\sqrt{6}} \\ -\frac{1}{\sqrt{3}} \\ -\frac{1}{\sqrt{6}} \end{pmatrix}$		

Exercise 1.1:

Measure k	$ \left(\begin{array}{c} \frac{1}{2} \\ \frac{1}{2} \end{array}\right) $		ervabl	$\mathbf{e} \Omega = \begin{pmatrix} 2 & 0 & 0 & \mathbf{\dot{n}} \\ 0 & 2 & 0 & 0 \\ 0 & 0 & 2 & 0 \\ -\mathbf{\dot{n}} & 0 & 0 & 2 \end{pmatrix}$
Eigenvalue	Basis	Projector	Prob	Resulting State
1	$ \left(\begin{array}{c} -\frac{i}{\sqrt{2}}\\ 0\\ 0\\ \frac{1}{\sqrt{2}} \end{array}\right) $	$\left(\begin{array}{ccccc} \frac{1}{2} & 0 & 0 & -\frac{\dot{a}}{2} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ \frac{\dot{a}}{2} & 0 & 0 & \frac{1}{2} \end{array}\right)$	$\frac{1}{4}$	$\left(\begin{array}{c} \frac{1}{2} - \frac{\dot{n}}{2} \\ 0 \\ 0 \\ \frac{1}{2} + \frac{\dot{n}}{2} \end{array}\right)$
2		(0000)	$\frac{1}{2}$	$ \left(\begin{array}{c} 0 \\ \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \\ 0 \end{array}\right) $
3	$ \left(\begin{array}{c} \frac{1}{\sqrt{2}} \\ 0 \\ 0 \\ \frac{1}{\sqrt{2}} \end{array}\right) $	$\left(\begin{array}{cccccc} \frac{1}{2} & 0 & 0 & \frac{\dot{n}}{2} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -\frac{\dot{n}}{2} & 0 & 0 & \frac{1}{2} \end{array}\right)$	$\frac{1}{4}$	$\left(\begin{array}{c} \frac{1}{2} + \frac{\dot{n}}{2} \\ 0 \\ 0 \\ \frac{1}{2} - \frac{\dot{n}}{2} \end{array}\right)$

Exercise 1.2:

	$\mathbf{t}\boldsymbol{\psi} = \begin{pmatrix} \frac{1}{2} \\ \frac{1}{2} \\ \frac{1}{2} \\ \frac{1}{2} \\ \frac{1}{2} \end{pmatrix}$	w.r.t. the obse		$\left(\begin{array}{cccc} 0 & -\frac{\dot{\mathbf{n}}}{2} & \frac{5}{2} & 0 \\ -\frac{3 \dot{\mathbf{n}}}{2} & 0 & 0 & \frac{5}{2} \end{array}\right)$
Eigenvalue	Basis	Projector	Prob	Resulting State
1	$ \left(\begin{array}{c} -\frac{i}{\sqrt{2}}\\ 0\\ 0\\ \frac{1}{\sqrt{2}} \end{array}\right) $	$\left(\begin{array}{ccccc} \frac{1}{2} & 0 & 0 & -\frac{\dot{u}}{2} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ \frac{\dot{u}}{2} & 0 & 0 & \frac{1}{2} \end{array}\right)$	$\frac{1}{4}$	$\left(\begin{array}{c} \frac{1}{2} - \frac{\dot{n}}{2} \\ 0 \\ 0 \\ \frac{1}{2} + \frac{\dot{n}}{2} \end{array}\right)$
2	$\begin{pmatrix} 0 \\ -\frac{\mathbf{i}}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \\ 0 \end{pmatrix}$	$\left(\begin{array}{ccccc} 0 & 0 & 0 & 0 \\ 0 & \frac{1}{2} & -\frac{\dot{\pi}}{2} & 0 \\ 0 & \frac{\dot{\pi}}{2} & \frac{1}{2} & 0 \\ 0 & 0 & 0 & 0 \end{array}\right)$	$\frac{1}{4}$	$\begin{pmatrix} 0 \\ \frac{1}{2} - \frac{\dot{\mathbf{n}}}{2} \\ \frac{1}{2} + \frac{\dot{\mathbf{n}}}{2} \\ 0 \end{pmatrix}$
3	$ \left(\begin{array}{c} 0 \\ \frac{\mathbf{i}}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \\ 0 \end{array}\right) $	$\left(\begin{array}{ccccc} 0 & 0 & 0 & 0 \\ 0 & \frac{1}{2} & \frac{\dot{n}}{2} & 0 \\ 0 & -\frac{\dot{n}}{2} & \frac{1}{2} & 0 \\ 0 & 0 & 0 & 0 \end{array}\right)$	$\frac{1}{4}$	$\begin{pmatrix} 0 \\ \frac{1}{2} + \frac{\dot{\mathbf{n}}}{2} \\ \frac{1}{2} - \frac{\dot{\mathbf{n}}}{2} \\ 0 \end{pmatrix}$
4	$ \left(\begin{array}{c} \frac{\dot{a}}{\sqrt{2}}\\ 0\\ 0\\ \frac{1}{\sqrt{2}} \end{array}\right) $	$\left(\begin{array}{ccccc} \frac{1}{2} & 0 & 0 & \frac{\dot{a}}{2} \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ -\frac{\dot{a}}{2} & 0 & 0 & \frac{1}{2} \end{array}\right)$	$\frac{1}{4}$	$\begin{pmatrix} \frac{1}{2} + \frac{\dot{n}}{2} \\ 0 \\ 0 \\ \frac{1}{2} - \frac{\dot{n}}{2} \end{pmatrix}$