Problem 2

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ω = (1 + I)/√2;

A8 = Table[ω^(i*j)/√8, {i, 0, 7}, {j, 0, 7}]; vec2 = Transpose[{{0, 0, 1, 0, 0, 0, 0, 0}}];

MatrixForm[A8]

MatrixForm[vec2]

MatrixForm[A8.vec2]
```

Out[•]//MatrixForm=

$$\begin{pmatrix} \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} \\ \frac{1}{2\sqrt{2}} & \frac{1}{4}+\frac{i}{4} & \frac{i}{2\sqrt{2}} & -\frac{1}{4}+\frac{i}{4} & -\frac{1}{2\sqrt{2}} & -\frac{1}{4}-\frac{i}{4} & -\frac{i}{2\sqrt{2}} & \frac{1}{4}-\frac{i}{4} \\ \frac{1}{2\sqrt{2}} & \frac{i}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & -\frac{i}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{i}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & -\frac{i}{2\sqrt{2}} \\ \frac{1}{2\sqrt{2}} & -\frac{1}{4}+\frac{i}{4} & -\frac{i}{2\sqrt{2}} & \frac{1}{4}+\frac{i}{4} & -\frac{1}{2\sqrt{2}} & \frac{1}{4}-\frac{i}{4} & \frac{i}{2\sqrt{2}} & -\frac{1}{4}-\frac{i}{4} \\ \frac{1}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} \\ \frac{1}{2\sqrt{2}} & -\frac{1}{4}-\frac{i}{4} & \frac{i}{2\sqrt{2}} & \frac{1}{4}-\frac{i}{4} & -\frac{1}{2\sqrt{2}} & \frac{1}{4}+\frac{i}{4} & -\frac{i}{2\sqrt{2}} & -\frac{1}{4}+\frac{i}{4} \\ \frac{1}{2\sqrt{2}} & -\frac{i}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & \frac{i}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & -\frac{i}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & \frac{i}{2\sqrt{2}} \\ \frac{1}{2\sqrt{2}} & \frac{1}{4}-\frac{i}{4} & -\frac{i}{2\sqrt{2}} & -\frac{1}{4}-\frac{i}{4} & -\frac{1}{2\sqrt{2}} & -\frac{1}{4}+\frac{i}{4} & \frac{i}{2\sqrt{2}} & \frac{1}{4}+\frac{i}{4} \end{pmatrix}$$

Out[•]//MatrixForm=

$$\begin{pmatrix} 0 \\ 0 \\ 1 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{pmatrix}$$

Out[•]//MatrixForm=

$$\begin{pmatrix} \frac{1}{2\sqrt{2}} \\ \frac{i}{2\sqrt{2}} \\ -\frac{1}{2\sqrt{2}} \\ -\frac{i}{2\sqrt{2}} \\ \frac{1}{2\sqrt{2}} \\ \frac{i}{2\sqrt{2}} \\ -\frac{1}{2\sqrt{2}} \\ -\frac{i}{2\sqrt{2}} \end{pmatrix}$$

In[ ]:=

```
Adagger8 = ConjugateTranspose[A8]; vec7wave = Transpose[
  {{1/(2 * Sqrt[2]), (1 - I)/4, -I/(2 * Sqrt[2]), (-1 - I)/4, -1/(2 * Sqrt[2]), (-1 + I)/4, I/(2 * Sqrt[2]), (1 + I)/4}}];
MatrixForm[Adagger8]
MatrixForm[vec7wave]
MatrixForm[Adagger8.vec7wave]
```

Out[ ]//MatrixForm=

$$\begin{pmatrix} \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} \\ \frac{1}{2\sqrt{2}} & \frac{1}{4}-\frac{i}{4} & -\frac{i}{2\sqrt{2}} & -\frac{1}{4}-\frac{i}{4} & -\frac{1}{2\sqrt{2}} & -\frac{1}{4}+\frac{i}{4} & \frac{i}{2\sqrt{2}} & \frac{1}{4}+\frac{i}{4} \\ \frac{1}{2\sqrt{2}} & -\frac{i}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & \frac{i}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & -\frac{i}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & \frac{i}{2\sqrt{2}} \\ \frac{1}{2\sqrt{2}} & -\frac{1}{4}-\frac{i}{4} & \frac{i}{2\sqrt{2}} & \frac{1}{4}-\frac{i}{4} & -\frac{1}{2\sqrt{2}} & \frac{1}{4}+\frac{i}{4} & -\frac{i}{2\sqrt{2}} & -\frac{1}{4}+\frac{i}{4} \\ \frac{1}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} \\ \frac{1}{2\sqrt{2}} & -\frac{1}{4}+\frac{i}{4} & -\frac{i}{2\sqrt{2}} & \frac{1}{4}+\frac{i}{4} & -\frac{1}{2\sqrt{2}} & \frac{1}{4}-\frac{i}{4} & \frac{i}{2\sqrt{2}} & -\frac{1}{4}-\frac{i}{4} \\ \frac{1}{2\sqrt{2}} & \frac{i}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & -\frac{i}{2\sqrt{2}} & \frac{1}{2\sqrt{2}} & \frac{i}{2\sqrt{2}} & -\frac{1}{2\sqrt{2}} & -\frac{i}{2\sqrt{2}} \\ \frac{1}{2\sqrt{2}} & \frac{1}{4}+\frac{i}{4} & \frac{i}{2\sqrt{2}} & -\frac{1}{4}+\frac{i}{4} & -\frac{1}{2\sqrt{2}} & -\frac{1}{4}-\frac{i}{4} & -\frac{i}{2\sqrt{2}} & \frac{1}{4}-\frac{i}{4} \end{pmatrix}$$

Out[ ]//MatrixForm=

$$\begin{pmatrix} \frac{1}{2\sqrt{2}} \\ \frac{1}{4}-\frac{i}{4} \\ -\frac{i}{2\sqrt{2}} \\ -\frac{1}{4}-\frac{i}{4} \\ -\frac{1}{2\sqrt{2}} \\ -\frac{1}{4}+\frac{i}{4} \\ \frac{i}{2\sqrt{2}} \\ \frac{1}{4}+\frac{i}{4} \end{pmatrix}$$

Out[ ]//MatrixForm=

$$\begin{pmatrix} 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \\ 1 \end{pmatrix}$$