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解答

1.

$$|0\rangle\langle 0| = \begin{pmatrix} 1 & 0 \\ 0 & 0 \end{pmatrix}, \quad (1)$$

$$|1\rangle\langle 1| = \begin{pmatrix} 0 & 0 \\ 0 & 1 \end{pmatrix}, \quad (2)$$

$$|+\rangle\langle +| = \frac{1}{2} \begin{pmatrix} 1 & 1 \\ 1 & 1 \end{pmatrix}, \quad (3)$$

$$|-\rangle\langle -| = \frac{1}{2} \begin{pmatrix} 1 & -1 \\ -1 & 1 \end{pmatrix}, \quad (4)$$

$$|i\rangle\langle i| = \frac{1}{2} \begin{pmatrix} 1 & -i \\ i & 1 \end{pmatrix}, \quad (5)$$

$$|-i\rangle\langle -i| = \frac{1}{2} \begin{pmatrix} 1 & i \\ -i & 1 \end{pmatrix} \quad (6)$$

2.

$$|0\rangle\langle 0| + |1\rangle\langle 1| = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \quad (7)$$

$$|+\rangle\langle +| + |-\rangle\langle -| = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix}, \quad (8)$$

$$|i\rangle\langle i| + |-i\rangle\langle -i| = \begin{pmatrix} 1 & 0 \\ 0 & 1 \end{pmatrix} \quad (9)$$

3.

$$|0\rangle\langle 0|\psi\rangle = \begin{pmatrix} \alpha \\ 0 \end{pmatrix}, \quad (10)$$

$$|1\rangle\langle 1|\psi\rangle = \begin{pmatrix} 0 \\ \beta \end{pmatrix}, \quad (11)$$

$$|+\rangle\langle +|\psi\rangle = \frac{1}{2} \begin{pmatrix} \alpha + \beta \\ \alpha + \beta \end{pmatrix}, \quad (12)$$

$$|-\rangle\langle -|\psi\rangle = \frac{1}{2} \begin{pmatrix} \alpha - \beta \\ -\alpha + \beta \end{pmatrix}, \quad (13)$$

$$|i\rangle\langle i|\psi\rangle = \frac{1}{2} \begin{pmatrix} \alpha - i\beta \\ i\alpha + \beta \end{pmatrix}, \quad (14)$$

$$|-i\rangle\langle -i|\psi\rangle = \frac{1}{2} \begin{pmatrix} \alpha + i\beta \\ -i\alpha + \beta \end{pmatrix}, \quad (15)$$