05.) Calculate

$$\sum_{i=0}^{1}\sum_{j=0}^{1} |\hat{i}X\hat{j}|$$

$$|0X0| + |0X1| + |1X0| + |1X1|$$

$|0\rangle$ and $|1\rangle$ are orthogonal state

we know

$$|0X0| = \begin{pmatrix}1\\0\end{pmatrix}(10) = \begin{pmatrix}1 & 0\\0 & 0\end{pmatrix}$$

$$|0X1| = \begin{pmatrix}0 & 1\\0 & 0\end{pmatrix}$$

$$|1X1| = \begin{pmatrix}0 & 0\\0 & 1\end{pmatrix}$$

$$|1X0| = \begin{pmatrix}0 & 0\\1 & 0\end{pmatrix}$$

$$\sum_{i=0}^{1}\sum_{j=0}^{1} |\hat{i}X\hat{j}| = \begin{pmatrix}1 & 1\\1 & 1\end{pmatrix}$$