Problem Set 1 on Elementary Quantum Mechanics

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1. Defining three kets as

$$|i\rangle = \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix} \tag{1}$$

$$|j\rangle = \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix} \tag{2}$$

$$|k\rangle = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix} \tag{3}$$

   verify the completeness condition:

$$|i\rangle\langle i| + |j\rangle\langle j| + |k\rangle\langle k| = \hat{I}_{3\times 3} \tag{4}$$

2. Show that a projection operator $\hat{P}$ has the property of *idempotence*:

$$\hat{P}^2 = \hat{P} \tag{5}$$

3. Show that Hermitean operators have eigenvalues that are *real numbers*.

4. Show that Unitary operators have eigenvalues that are *unimodular*.