1. Find all $2 \times 2$ complex matrices that are simultaneously diagonal, Hermitian, and unitary.

2. Find all $2 \times 2$ real matrices that are simultaneously symmetric and orthogonal.

3. Find all $2 \times 2$ complex matrices that are simultaneously anti-symmetric and unitary.

4. Find the maximum of $2x^2 + 4xy + 5y^2$ subject to $x^2 + y^2 = 1$. 