1) **Section 2.3**: 44, 53

2) **Section 2.4**: 35, 38, 46, 72, 76

3) **Section 3.1**: 6, 10, 12, 37, 38

4) Let $O$ be the $n \times n$ zero matrix. If $A$ is a nonzero $n \times n$ matrix and $p$ is a positive integer greater than 1, then we say that $A$ is nilpotent of index $p$ if $A^p = O$, but $A^k \neq O$ for $1 \leq k < p$.

Show that $C = \begin{pmatrix} 0 & 1 & 2 \\ 0 & 0 & 4 \\ 0 & 0 & 0 \end{pmatrix}$ is nilpotent of index 3.

5) Can a nilpotent matrix of index $p$ be invertible? Justify your answer.

6) Suppose that $A \neq B$ are $n \times n$ matrices such that $A^3 = B^3$ and $A^2 B = B^2 A$. Can $A^2 + B^2$ be invertible? 

*Hint:* Consider the product $(A^2 + B^2)(A - B)$.