Instructions Please answer all five questions below. Write clearly and circle your final answers. Show your work for partial credit. The questions will be graded with equal weight. You may use a calculator and one page of notes only. Good luck.

1. Find $2701^{-1} \mod 5541$. 
2. (a) Suppose $x \equiv 1 \mod 11$ and $x \equiv 3 \mod 5$. Find $x \mod 55$.

(b) Do $x \equiv 1 \mod 6$ and $x \equiv 4 \mod 15$ have a common integer solution? If so, find an example. If not, explain why.

(c) Do $x \equiv 8 \mod 21$ and $x \equiv 10 \mod 12$ have a common integer solution? If so, find an example. If not, explain why.

(d) Suppose $x \equiv 1 \mod 2$, $x \equiv 0 \mod 3$, and $x \equiv 2 \mod 5$. Find $x \mod 30$. 
3. Find every possible $2 \times 2$ Hill Cipher matrix which encrypts the plaintext “good” as the ciphertext “OKAY.”
4. (a) Compute $\phi(960)$.

(b) Find $7^{600} \mod 960$