NAME: SID:

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**Problem 1:** For each piece of pseudo-code below, give its asymptotic running time as a function of $n$. Express this running time using the $\Theta()$ notation. (You don't need to give any justification.)

| Pseudo-code | Running time |
|---|---|
| **for** $i \leftarrow 1$ **to** $2n$ **do**<br>    **for** $j \leftarrow 1$ **to** $i$ **do**<br>        $x \leftarrow 2x + 7$ | |
| $j \leftarrow 1$<br>**while** $j < n$ **do**<br>        $x \leftarrow 2x + 7$<br>        $j \leftarrow j + 2$ | |
| **for** $i \leftarrow 1$ **to** $n$ **do**<br>    $j \leftarrow 1$<br>    **while** $j < n$<br>        $x \leftarrow 2x + 7$<br>        $j \leftarrow 3j$ | |
| **for** $i \leftarrow n/2$ **to** $n$ **do**<br>    $x \leftarrow 2x + 7$<br>**for** $j \leftarrow 1$ **to** $3n$ **do**<br>    $x \leftarrow 2x + 7$ | |

Note 1: "$\leftarrow$" denotes the assignment statement. The scope of and nesting loops is indicated by the indentation.

**Problem 2:** (a) State Euclid's Algorithm.

(b) Use Euclid's Algorithm to compute the greatest common divisor of 323 and 456. Show your work. (No guessing, you must follow Euclid's algorithm.)

**Problem 3:** (a) Compute $5^{40} \operatorname{rem} 13$. Show your work.

(b) Compute $5^{-1} \pmod{11}$. Show your work.