NAME:_____

This quiz contains 4 problems worth 30 points. You may not use books, notes, or a calculator. You have 30 minutes to take the quiz.

Theta Form	Name		Theta Form	Name
$\theta(1)$	Constant		$\theta(n^2)$	Quadratic
$\theta(lg(lg(n)))$	Log log		$\theta(n^3)$	Cubic
$\theta(lg(n))$	Log		$\theta(n^k)$, $k \geq 1$	Polynomial
$\theta(n)$	Linear		$\theta(c^n)$, $c > 1$	Exponential
$\theta(n\ lg(n))$	n log n		$\theta(n!)$	Factorial

Fact from Calc 2:
$1 + a + a^2 + \cdots a^k = \frac{a^{k+1}-1}{a-1}$

1. (3 points) Fill in the blank below in the definition:

   For $f(n)$ and $g(n)$ be functions with domain $\{1, 2, 3, \cdots\}$, we write $f(n) = O(g(n))$

   if _____ for all but finitely many $n \in \mathbb{Z}^+$.

2. (12 points) Select a theta notation from the table for each expression and justify your answer.

   (a) $5 \lg n + 3n^2 + 2n \lg n$

   (b) $3 + 6 + 9 + 12 + \cdots + (3n)$

   (c) $1 + 2 + 4 + 8 + \cdots + 2^n$

3. (8 points) Answer the questions using the algorithm below:

```
i = n
while (i > 1){
   for j = 1 to i
      x = x + 1
   i = ⌊i/2⌋
}
```

   (a) Give an expression (in terms of n) for the exact number of time the statement $x = x+1$ is evaluated.

   (b) Select a theta notation from those in the table for the number of times the statement $x = x + 1$ is evaluated and justify your answer.

4. (7 points) Show that if $f(n) = O(g(n)$, then $g(n) = \Omega(f(n))$.