1. (1 point) Express the function $n^3/1000 - 100n^2 - 100n + 3$ in terms of $\Theta$–notation.

2. (1 point) Express the function $25n^2 + 100n\lg n + 20n - 5$ in terms of $\Theta$–notation.

3. (5 points) Some functions are listed in the following table. Assume an algorithm to solve a problem takes $f(n)$ microseconds. Time $t$ is a parameter of time interval. For each function $f(n)$ and time $t$, determine the largest size $n$ of a problem that can be solved in time $t$. Fill the values in the table.

   For example, an algorithm to solve a problem takes $f(n)=n^2$ microseconds, then the largest size $n_{max}$ of the problem that can be solved in 1 minute will have:
   $n^2 \leq 60 \times 1000000$  (60 seconds per minute, $10^6$ microseconds per second)

   ➔ $n \leq 7745.97$ ➔ $n_{max} = 7745$

| time $t$ \ $f(n)$ | 1 second | 1 minute | 1 hour |
|---|---|---|---|
| $\lg n$ | | | |
| $n$ | | | |
| $n^2$ | | 7745 | |
| $n^3$ | | | |
| $2^n$ | | | |
| $n!$ | | | |

   What pattern can you observe from above table? _____

   _____

   _____

   _____

4. (3 points) Given a sorted array of integers $A$ and another integer $x$, describe an efficient algorithm to determine whether or not there exist two elements in $A$ whose sum is exactly $x$. Analyze your algorithm regarding the best case and worst case. (Hint: an algorithm you have learned so far is useful in this exercise.)