CSE HW01

1.)

	1 second	1 minute	1 hour	1 day	1 month
$2\log_2 n$	$\mathbf{2^{500,000}}$	$2^{3.0E7}$	$2^{3.6E10}$	$2^{8.64E10}$	$2^{5.92E12}$
2n+1000	499500	29999500	1799999500	4.31999995E10	1.296E12
n^4+n	100	391	1533	4421	13737
n^4	32	88	245	562	1269

2.) $2n^2+7n$ $f(n) \in \Theta(n^2)$

$f(n)=2n^2+7n$

$g(n)=n^2$

$2n^2+7n \le c1*n^2$ for all $n \ge k$ and $2n^2+7n \ge c2*n^2$ for all $n \ge k$

let k=1

$2n^2/n^2+7n/n^2 \le c1$ for all $n \ge 1$ and $2n^2/n^2+7n/n^2 \ge c2$ for all $n \ge 1$

simplify

$2+7/n \le c1$ for all $n \ge 1$ and $2+7/n \ge c2$ for all $n \ge 1$

As n approaches infinity, 7/n approaches 0. Therefore, the max value of 7/n would be as n>=1 is 7.

$9 \le c1$ for all $n \ge 1$ and $9 \ge c2$ for all $n \ge 1$

Therefore $2n^2+7n$ is $\Theta(n^2)$

3.) $\Theta(n)$ means $f_1(n)$ can be represented as the polynomial C_1n+C_2

$O(n^3)$ means $f_2(n)$ can be represented as the polynomial $C_3n^3+C_4n^2+C_5n+C_6$

Therefore, $\Theta(n)+O(n^3)$ can represent

$f(n)=f_1(n)+f_2(n)$

$f(n)=(c_1n+c_2)+(c_3n^3+c_4n^2+c_5n+c_6)$

can be rewritten as

$f(n)=c_3n^3+c_4n^2+(c_5+c_1)n+(c_2+c_6)$

f(n) represents a polynomial equation equivalent to $O(n^3)$. Therefore $\Theta(n)+O(n^3)$ is in $O(n^2)$

4.) let f(n)=1

$f(n)=0(n^3)$ (RHS) however, f(n) is not in $\Theta(n)+O(n^3)$ (LHS). There is no integer k such that for all n>=k or constant c that is positive so,

$$f(n)=1 \ge c1*n$$

f(n) is not in $\Theta(n)+O(n^3)$ (LHS). Therefore, $\Theta(n)+O(n^3) \neq O(n^3)$

5.) $\lim_{n\to\inf}\frac{n^{n+1}}{(n+1)^n} = \infty$

for any C>0, k>0 such that $\frac{n^{n+1}}{(n+1)^n}$>C for all n>k is true which proves n^{n+1} is not in $O((n+1)^n)$. This also proves that n^{n+1} is not in $\Theta((n+1)^n)$.