You will submit your solution to this assignment to the Curator System (as `HW2`). Your solution must be either a plain text file (e.g., NotePad) or a MS Word document; submissions in other formats will not be graded.

Except as noted, credit will only be given if you show relevant work.

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1. [20 points] Using the rules given in the course notes, perform an exact count complexity analysis, for the worst case, of the body of the following function. (Take `list.length` to be N.)

```
int part(int[] list, int barrierIdx) {

   int barrier, maxIdx, temp;

   barrier = list[barrierIdx];                 // 1
   maxIdx  = list.length - 1;                  // 2

   temp = list[barrierIdx];                    // 3
   list[barrierIdx] = list[maxIdx];            // 4
   list[maxIdx] = temp;                        // 5

   barrierIdx = 0;                             // 6

   for (int i = 0; i < maxIdx; i++) {          // 7
      if ( list[i] < barrier ) {               // 8
         temp = list[barrierIdx];              // 9
         list[barrierIdx] = list[i];           //10
         list[i] = temp;                       //11
         barrierIdx++;                         //12
      }
   }
   temp = list[maxIdx];                        //13
   list[maxIdx] = list[barrierIdx];            //14
   list[barrierIdx] = temp;                    //15

   return barrierIdx;                          //16
}
```

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2. [40 points] For each part, determine the simplest possible function g(n) such that the given function is $\Theta(g)$. No justification is necessary.

   a) $a(n) = 3 + 14n + 47n^2$

   b) $b(n) = 14n^2 + 3n\log n$

   Hint: the last three take a little analysis.

   c) $c(n) = n^{0.9} + \log n$

   d) $d(n) = 3n^2 \log n + n^3$

   e) $e(n) = 3n\log^2 n + 3n^2 \log n$

3. [20 points] An equivalent definition of Θ is:

> Suppose that $f(n)$ and $g(n)$ are non-negative functions of N.
> Then $f(n)$ is $\Theta(g(n))$ if there exist positive constants C_1, C_2 and N such that, for all $n \geq N$, $C_1 g(n) \leq f(n) \leq C_2 g(n)$.

Use the alternate definition given above to prove the following statement:

> Suppose that $f(n)$, $g(n)$, r(n) and $s(n)$ are non-negative functions of N, such that $f(n)$ is $\Theta(r(n))$ and $g(n)$ is $\Theta(s(n))$.
> Then the function $f(n) + g(n)$ is $\Theta(r(n) + s(n))$.

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4. [20 points] Suppose that executing an algorithm on input of size N requires executing T(N) = N log N + 16N instructions. How long would it take to execute this algorithm on hardware capable of carrying out 2^{24} instructions per second if N = 2^{30}? (Give your answer in hours, minutes and seconds, to the nearest second.)