Name: _____

Computer Science 245: Data Structres & Algorithms
Midterm 1 Problems Sheet
Spring 2015

1. Give the $\Theta()$ running time of the following code fragments, in terms of n. Show your work! (Be careful, some of these are tricky!)

(a)
```
for (i=0; i < n; i++)
{
    for (j = n; j > 1;  j--)
        sum++;
    for (j = n; j > 1; j = j - 3)
        sum++
}
```

(b)
```
for (i=1; i < n; i = i + 2)
    for (j = n; j > n / 2; j = j - 2)
        for (k = 1; k < n / 2; k = k * 2)
            sum++;
```

(c)
```
for (i=1; i < n; i++)
{
    for (j = 1; j < i; j++)
        sum++;
    for (j = 1; j < n; j++)
        sum++;
    for (j = 1; j  < n; j = j * 2)
        sum++;
    for (j = 0; j < n; j = j + 2)
        sum++
}
```

2. Consider the following function:

```
int recursive(int n)
{
  if (n <= 1)
      return 1;
   else
      return recursive(n - 1) + recursive(n - 1) + recursive(n - 1);
}
```

(a) What does this function calculate?

(b) Give a recurrence relation $(T(n) = \ldots)$ for this function (be sure to include both base and recursive cases!)

(c) Solve the recurrence relation to get the $\Theta()$ running time of the function, in terms of n. Show your work, using either repeated substitution, the master method, or a recursion tree.

```
int recursive2(int n)
{
  if (n <= 1)
      return n;
   sum = 0;
   for (int i = 0; i < n; i++)
      sum++
   return recursive2(n/3) + recursive2(n/3) + recursve2(n/2)  + sum;
}
```

(a) Give a recurrence relation $(T(n) = \ldots)$ for this function (be sure to include both base and recursive cases!)

(b) Solve the recurrence relation to get the $\Theta()$ running time of the function, in terms of n. Show your work, using either repeated substitution, the master method, or a recursion tree.