Problem 3, Part B

```
void f2(int n)
{
    for(int i=1; i <= n; i++){
        if( (i % (int)sqrt(n)) == 0){ // constantly evaluated Θ(1)
            for(int k=0; k < pow(i,3); k++) {
              /* do something that takes O(1) time */ //Θ(1)
            }
        }
    }
}
```

executes a certain amount of times

iterates through the whole thing

geometric series?

$$T(n) = \sum_{i=1}^{n} \Theta(1) + \sum_{i}^{n} \sum_{i=1}^{n} \Theta(i^p)$$

$$\sum_{k=0}^{n-1} k^i = \frac{k^n - 1}{k-1}$$

$$O(n) + \Theta\left(\frac{n(n-1)}{2}\right)$$

$$\frac{k^{(g(n)-1}}{k-1} = \frac{k+n-1}{1} = \Theta(n)$$

$$O(n) + O(n)$$

$$= \Theta(n^2)$$

Problem 3, Part A

```
void f1(int n)
{
    int i=2; Θ(1)
    while(i < n){ // iterating through UNTIL it is greater than O(n)
        /* do something that takes O(1) time */ Θ(1)
        i = i*i; // constantly is called Θ(1)
    }
}
```

$$\sum_{i=1}^{n} \theta(i^p)$$

$$T(n) = \sum_{i=2}^{n-1} (\Theta(1)) + \Theta(1)$$

$$= \Theta(n) + \Theta(1)$$

$$= \Theta(n)$$

Problem 3, Part D

```
int f (int n)
{
  int *a = new int [10];   Θ(1)
  int size = 10;           //executes Θ(n) times
  for (int i = 0; i < n; i ++)
    {                      Θ(1) //executes one time
      if (i == size)
        {                  Θ(1)
          int newsize = 3*size/2 Θ(1)
          int *b = new int [newsize];
          for (int j = 0; j < size; j ++) b[j] = a[j];   executes Θ(size) times
          delete [] a; Θ(1)
          a = b; Θ(1)
          size = newsize; Θ(1)
        }
      a[i] = i*i;  Θ(1)
    }
}
```

$$T(n) = 3\Theta(1) + \sum_{i=0}^{n-1} (\Theta(1)) + 3\Theta(1) + \sum_{i=0}^{size} (\Theta(1)) +$$

$$4\Theta(1) + \Theta(1)$$

$$= \Theta(n) \cdot \Theta(size) = \Theta(n \cdot size)$$

Problem 3, Part C

```
for(int i=1; i <= n; i++){  //iterates through n times Θ(n)
  for(int k=1; k <= n; k++){ //iterates through n times  Θ(n)
    if( A[k] == i){ Θ(1)
      for(int m=1; m <= n; m=m+m){ // iterates through Θ(log(n)), halving the time for iteration by m + m
        // do something that takes O(1) time // Θ(1)
        // Assume the contents of the A[] array are not changed
      }
    }
  }
}
```

$$T(n) = \sum_{i=0}^{n} \sum_{K=1}^{n} \left(\Theta(1) + \sum_{m=1}^{n} 1 \frac{1}{i} \right)$$

$$T(n) = \Theta(n \times n) \left(\Theta(\log(n)) \right) =$$

$$T(n) = \Theta(n^2 \log(n))$$