

a) void f1(int n)

{

int i = 2;

while(i < n) { $O(\log n)$

 i = i * i; $O(1)$

}

}

$$T(n) = \sum_{i=2}^n 2^k$$

k	n
1	$2 = 2^1$
2	$4 = 2^2$
3	$8 = 2^3$
4	
⋮	
k	$= 2^k$

$$T(n) = \sum_{i=2}^n 2^{2^n} = \boxed{\Theta(\log(\log(n)))}$$

b.)

```

void f2(int n)
{
    for(int i=1; i <= n; i++){
        if((i % (int)sqrt(n)) == 0){
            for(int k=0; k < pow(1,3); k++){
                // do smthg that takes O(1) of time
            }
        }
    }
}

```

$$T(n) = \sum_{i=1}^n \left(\Theta(1) + O\left(\sum_{k=0}^{i^3} \Theta(1)\right) \right)$$

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

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

$$T(n) = \Theta(n) + \Theta(n^{1/2 \cdot 3/2})$$

$$T(n) = \Theta(n) + \Theta(n^{3/2}) = \boxed{\Theta(n^{3/2})}$$

c.)

```

for (int i=1; i<=n; i++) {
    for (int k=1; k<=n; k++) {
        if (A[k] == i) {
            for (int m=1; m<=n; m=m+m) {
                // do smthng O(1)
                // contents of A() not changed
            }
        }
    }
}

```

Worst case goes in n-times

$m^? = n$

$\Theta(\log n) = n$

$$T(n) = \sum_{i=0}^n \left(\sum_{k=1}^{\log n} 1 + O\left(\sum_{m=1}^{\log n} \Theta(1)\right) \right)$$

$$= \sum_{i=0}^n \Theta(n) + \sum_{i=1}^n \Theta(\log n)$$

$$T(n) = \Theta(n^2) + \Theta(n \log n) = \boxed{\Theta(n^2)}$$

d.)

```

int f(int n)
{
    int *a = new int[10];
    int size = 10;
    for (int i=0; i<n; i++)
    {
        if (i == size)
        {
            int newSize = 3*size/2;
            int *b = new int[newSize];
            for (int j=0; j<size; j++) b[j] = a[j];
            delete[] a;
            a = b;
        }
    }
}

```

```

        size = newSize;
    }
    a[i] = i * i;
}

```

$\sum_{i=1}^n (\Theta(1) + O(\frac{3}{2}))$

10
 $10 \cdot \frac{3}{2}$
 $10 \cdot (\frac{3}{2})^2$
 \vdots
 $10 \cdot (\frac{3}{2})^k$ — times

$$T(n) = \sum_{i=1}^n (\Theta(1) + O(\sum_{j=0}^k (\frac{3}{2})^j))$$

$$= \sum_{i=1}^n \Theta(1) + \overset{\text{constant}}{\text{size}} \cdot 10 \sum_{j=0}^k (\frac{3}{2})^j$$

$$T(n) = \Theta(n) + \Theta(\log n) = \boxed{\Theta(n)}$$

$i < n$
 $10(\frac{3}{2})^k = n$
 $k = f(n)$
 $(\frac{3}{2})^k = \frac{n}{10}$
 $\log_{\frac{3}{2}}(\frac{n}{10}) = k$
 $\therefore \Theta(\log n)$