# of Js int
3 so 3 is
the
remainde

A) void f1(int n){
int i=2;
while(i<n){
//O(1)
i=i*i;
}
}

i increases by i in each iteration:
$i \to ii \to iii \ldots \to n$
$2 \to 2(2) \to 2(2)(2) \ldots \to n$
$1 \quad 2 \quad 3 \quad \ldots \quad x$
$2^x = n$
$\log_2(2^x) = \log_2(n)$
$x = \log_2(n) \to \boxed{\Theta(\log_2(n))}$

B) void f2(int n){
for(int i=1; i<=n; i++){ // runs n times
if((i % (int) sqrt(n)) == 0){ /
for(int k=0; k<pow(i,3); k++){
//O(1)
}
}
}

ex) n=9
for(i=1 → i<=n){// runs 9 times
if(i % √9 == 0) ✓ for i = 3, 6, 9
(triggered 3 times)
}
↑ 3

ex) n=25
for(i=1 → i<=n){ // runs 25 times
if(i % √25 == 0) ✓ for i = 5, 10, 15, 20, 25
(triggered 5 times)
}
↑ 5

Loop 1. size n

Loop 2 : size $\sqrt{n}$

size of n	# of iterations (times $i \% \sqrt{n} == 0$)
1	1 (for $i=1$)
9	3 (for $i = 3, 6, 9$)
25	5 (for $i = 5, 10, 15, 20, 25$)
36	6 (for $i = 6, 12, 18, 24, 30, 36$)

relationship is $\sqrt{n}$ = # of iterations!

1st for loop

$\Theta(n + \sqrt{n} \cdot n^3)$

Loop 3:

each loop runs i^3 times

↑ greatest value of i is n, which would run n^3 times

(for size) $n = 9$	i	# of iterations
	3	$3^3 = 27$
	6	$6^3 = 216$
	9	$9^3 = 729$

$\Theta(n + n^{7/2})$

→ # of loops = $\sqrt{n}$

size of each loop = i^3 w/ $O(n^3)$

c)
```
for( int i= 1; i <=n; i++){      // runs n times
  for( int k=1; k <= n; k++) {   //runs n times
    if (A[k] == i ){             //depends on data (worst case: runs one time!)
      for(int m= 1; m<=n; m=m+m){ // runs n times!
        //O(1)
      }
    }
  }
}
```

1st for loop, 2nd for loop

$\Theta(n \cdot n + n)$

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

$m \to m+m \to m+m+m \to \ldots n$

$m \to 2m \to 3m \to \ldots n$

$1 \to 2 \to 3 \to 4 \ldots n$

$1 \quad 2 \quad 3 \quad 4 \ldots X$ iterations

$X = n$

D)

```
int F(int n){
  int* a = new int[10];
  int size = 10;
  for(int i=0; i<n; i++){ // runs n times
    if(i==size){ // triggered by i>=10
      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;
  }
```

$\theta(K \cdot i)$ — runs i times

$\theta(n + K(i))$ — # of times i is triggered; # of times the 2nd for loop runs

ex) $n = 16$ (n must be greater than 10 in order for the if statement to be triggered!)

for (i=0; i<n) // runs 16 times
 if (i == size) // triggered by i = 10
  newsize = 30/2 = (15)
  for (j=0; j<size) // runs 10 times
  size = 15
 3
 if (i == size) // triggered by i = 15
  newsize = 45/2 = (22)
  for (j=0; j<size) // runs 15 times
  size = 22
 3
}

size of n	# of times if statement triggers
i: 11-15	1
i: 16-33	2
i: 34-49	3
i: 50-73	4

variable size takes on values: 10, 15, 22, 33, 49, 73...