Clevel

1.

$N+\frac{N}{2}+\frac{N}{4}+\cdots+2+1$

$=N+\frac{N}{2}+\frac{N}{4}+\cdots+16+8+4+2+1$

$=N+\frac{N}{2}+\frac{N}{4}+\cdots+16+8+4+2+1+1-1$

$=N+\frac{N}{2}+\frac{N}{4}+\cdots+16+8+4+4-1$

$\cdots$

$=N+\frac{N}{2}+\frac{N}{4}+\frac{N}{4}-1$

$=2N-1$

$O(2N-1)=O(N)$

2. Every element in values only be calculated once.

$O(N)$

3. $O(\log_2(N))$ $O(\log_3(N))$

$=O\left(\frac{\lg(n)}{\lg 2}\right)$ $O\left(\frac{\lg(n)}{\lg 3}\right)$

$\left(\log_x y=\frac{\log_z y}{\log_z x}\right)$

B level

1. For each fib(n), runtime is runtime of fib(n-1) plus runtime of fib(n-2)

runtime of f(0), f(1) = 1, f(2) = 2, f(3) = 3, f(4) = 5.

i:	0	1	2	3	4	5
runtime:	1	1	2	3	5	8
fib(i):	0	1	1	2	3	5

∴ runtime fib(n+1) for each.

runtime of print_fib = runtime of $\sum_{i=0}^{n-1} fib(i)$

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

$=fib(1)+fib(2)+fib(3)\cdots fib(n)$

$=1+1+2+3+\cdots+fib(n)$

$=fib(3)+fib(3)+\cdots+fib(n)$

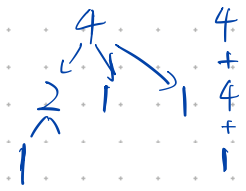
$=2fib(n)$

2. $O(N\cdot fib(N+1))$

3. $O(n^3)$

4. $n=1$, count 1

$n=2$, count $2^2=3$ if $n=4$,



$4\times\log 4+1$ 9

if $N=8$

$8\times\log 8-1$ 23

if n=16: 16 → 8 4 4 $= 16 + 2^3 + 4 + 4 = 57$ $4 \times 2 + 1$ $8 \times 3 - 1$

$16 \times \log 16 - 7$

$16 \times 4 - 7$

$\therefore O(N \cdot \log N)$

Itiuition: function will print N and split itself. The splited part is same size N with original one. The generations ~~that~~ it can split is $\log_2 N$. Every generation print N, ~~totally~~ be $(N \cdot \log N)$.

5. Problem 8

a) $\Theta(N^6)$ $\Theta(2^N)$ $\Theta(N)$

b) T T T T

c) NEI NEI FALSE TRUE NEI

d) $\Theta(N)$

$\Theta\ 2^N$

$\Theta \log N$

$\Theta\ N$

e) N, N^2

f) N, N^3

time to compare in a linkedlist, Length of List is N, each compare cost N time. So one compare cost N^2. $1^2 + 2^2 + 3^2 + 4^2 + \dots N^2 = N^3$

6. Problem 4

a) i+=1

i*=2

i*=N

b) $\Theta(N^2 \cdot \log N)$

$O(N)$

(c) Is this MIHO Museum?

(d) $b_1 \approx 1$ $b_2 \approx 3$