1)

1. $O(\log(n)) \rightarrow 90000 + \log(\mathrm{n})$
2. $O(n) \rightarrow 50000 \cdot n + 3 \cdot log(n)$
3. $O(n.\log(n)) \rightarrow \log(\mathrm{n}) + \mathrm{n} \cdot \log(\mathrm{n})$
4. $O(n^2) \rightarrow n^2 + n$
5. $O(n^k) \rightarrow n^{\frac{7}{6}} + n^{\frac{5}{6}}$
6. $O(k^n) \rightarrow 4^n + n^{500000}$
7. $O(n!) \rightarrow n! + 2^n$
8. $O(n!) \rightarrow (n+1)! + 20000^n$

4 and 5 can change because of $n^{\frac{7}{6}} + n^{\frac{5}{6}} < n^2 + n$

2)

$$speed\ of\ computer\ C = 4$$
$$speed\ of\ computer\ D = 1$$
$$input\ size\ n = 1000$$

$$f = c.n^2 = t$$
$$\frac{1}{4}.1000^2 = t$$
$$1.n^2 = t$$
$$\frac{1}{4}.1000^2 = 1.n^2$$
$$n = 500$$

3)

Solution is benchmark test.

I write a program with 2 timers. (timerA and timerB)

Run the timerA and program A. The timerA stops when program A finishes. Then start the timerB and run program B. The timerB stops when program B finishes. The timer with small values represents the program which is running faster.

4)

a)

$$\sum_{i=0}^{N-1}\left(\sum_{j=0}^{N-1}1\right)+\sum_{k=0}^{N-1}1 \quad = N^2 + N \rightarrow O(n^2)$$

b)

$$\sum_{i=0}^{N-1}\left(\sum_{j=1}^{\frac{N}{2}}1\right)=\frac{N^2}{2} \quad \rightarrow O(n^2)$$

c)

The inside for loop never works.

$O(0)$

d)

There is no variable.

$10000 * 49 = 490000 \rightarrow O(c)$