1. Programs A and B are analyzed and are found to have worst-case running times no greater than 150 N log N and N^2, respectively. Answer the following questions, if possible:

1. Which program has the better guarantee on the running time for large values of N (N > 10 000)?

150 * 10000 lg(10000) = 19 931 568.6

$10\ 000^2$ = 100 000 000

2. Which program has the better guarantee on the running time for small values of N (N < 100)?

150 * 100 lg(100) = 99657.8428

100^2 = 10000

3. Which program will run faster on average for N = 1000?

That is impossible to say as I don't know the algorithm and what the average condition will be.

4. Is it possible that program B will run faster than program A on all possible inputs?

Yes, as it is possible that the execution of program B will always be terminated very early into to loop (i assume there is a loop in it).

2. An algorithm takes 0.5 ms for input size 100. How long will it take for input size 500 if the running time is the following:

1. linear – 2.5 ms
2. O (N log N) – 3.3737125 ms
3. quadratic – 12.5 ms
4. cubic – 62.5 ms

3. An algorithm takes 0.5 ms for input size 100. How large a problem can be solved in 1 min if the running time is the following:

1. linear – 12 000 000
2. O (N log N) –
3. quadratic – 34641
4. cubic – 4932

4. Order the following functions by growth rate, and indicate which, if any, grow at the same rate.:

2/N
37
square root of N
N, 2N/2
2N
N log log N
N log N
$N^{1.5}$
N log (N^2)
N $\log^2$ N
N^2
N^2 log N
N^3