

JAYPEE INSTITUTE OF INFORMATION TECHNOLOGY

NOIDA

TEST-1

Sem 4 CSE

SUBJECT CODE: 10B11 CI411

MAX. MARKS: 15

SUBJECT: FUNDAMENTALS OF ALGORITHM

DURATION: 1.0 HOUR

BRANCH: CSE & IT

SEMESTER: B.Tech IV

N.B. All parts of a question must be written at one place.

Q1. [Marks: 3] Suppose we are sorting an array of ⁸ ~~nine~~ elements using heap sort and we have just finished some heapify operations. The array now looks like this : 16, 14, 15, 10, 12, 5, 27, 28. After the heap is created how many heapify operations have been performed so far for the root of the tree? Justify your answer with all steps.

Q2. [Marks: 5] In a particular neighbourhood the houses are arranged in increasing order of their addresses and they have a special characteristic that the number of residents of first house is lesser than the residents of second house, but the residents of second last house is greater than the residents of last house.

We need to find one such house where the residents are greater than or equal to ^{both} ~~either~~ of the ^{to} neighboring houses.

For example if we were to arrange the number of residents for each house in an array, it would look something like:

House no.:	0	1	2	3	4	5	6	7	8	9	10
Residents:	10	20	<u>30</u>	5	8	<u>92</u>	12	3	19	<u>78</u>	23

House number: 2, 5 or 9 can be selected in above process.

Write an $O(\log n)$ complexity algorithm to find one such house in the above neighborhood. (Hint: the boundary conditions guarantee that there exists the kind of house that we are looking for within the array)

Q3. [Marks: 3] A female rabbit is mature 2 months after birth. Assume that each mature female rabbit produces 1 baby female rabbit per month. If you start out with one baby female rabbit, how many female rabbits will you have in 10 months? Assume that there are enough male rabbits to ensure maximum production, and that no rabbits die. Express the above problem in terms of a recurrence relation.

Q4. Solve the following with any method you find suitable:

a. [Marks: 2] $T(n) = \sqrt{n} T(\sqrt{n}) + 100n$

b. [Marks: 1] $T(n) = 4T(n/2) + n^2$

c. [Marks: 1] State True and False and briefly justify your answer.

$$n^{3x} = O(n^x),$$



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