

[40 points] Fill in the blank(s) for questions 1-23. Please write clearly; your answers to these 23 questions must be on the exam, not on a separate paper.

1. The sum of the powers of two ($2^0 + 2^1 + 2^2 + \dots + 2^n$) is equal to $\frac{2^{n+1} - 1}{2 - 1}$.
2. The sum of increasing integers ($1 + 2 + 3 + \dots + n$) is equal to $\frac{n(n+1)}{2}$.
3. $\log_6 b$ is equal to X
4. $\log_b 1$ is equal to O
5. $b^{\log_b a}$ is equal to A
6. A logarithmic algorithm has a time complexity of $O(\log n)$.
7. A quadratic algorithm has a time complexity of $O(n^2)$.
8. A linear algorithm has a time complexity of $O(n)$. $n = \lceil \log(h+1) - \log(1+1) \rceil$
9. A binary tree that has 10,000 internal nodes will have a height between $\log 10000$ and $\log 100000$ ($h \in \mathbb{Z}$). $(\text{Height } 2^10 = 8,192 \text{ and } 2^{11} = 16,384)$.
10. A red-black tree that has 10,000 internal nodes will have a height between $\log 10000$ and $\log 100000$ ($h \in \mathbb{Z}$).
11. An AVL tree that has 10,000 internal nodes will have a height between $\log 10000$ and $\log 100000$ ($h \in \mathbb{Z}$).
12. Post-order traversal of a binary tree means the parent, left child, and right child nodes are “visited” in the following order Left Child, Parent, Right Child, and Parent, Left Child, Right Child.
13. In-order traversal of a binary tree means the parent, left child, and right child nodes are “visited” in the following order Left Child, Parent, Right Child, and Parent, Left Child, Right Child.
14. The maximum depth of any extremal node of a tree T is called the height of T .
15. In a circular, growable array implementation of the Queue ADT, the enqueue and dequeue operations run in and amortized time respectively.
16. In a growable array-based implementation of a Stack ADT, the push operation runs in $O(1)$ time increased by a constant each time it has to be enlarged.
17. In a hash-table implementation of the Dictionary ADT, the insert, find, and remove operations run in and expected time respectively.
18. In an unsorted, growable array implementation of the Dictionary ADT, the insert, find, and remove operations run in and time respectively.
19. In a sorted, growable array implementation of the Dictionary ADT, the insert, find, and remove operations run in and time respectively.

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