```
temp.setNext(head.getNext());
var = head.getItem();
head = head.getNext();
return var;
}
```

(A) Return data from the end of the list
(B) Returns the data and deletes the node at the end of the list
(C) Returns the data from the beginning of the list
(D) Returns the data and deletes the node from the beginning of the list

29. Which of the following is not TRUE about a circular linked list?
    (A) Every node has a successor
    (B) Time complexity of inserting a new node at the head of the list is O(1)
    (C) Time complexity for deleting the last node is O(n)
    (D) None of the mentioned

5 Trees

1. Which of the following is a false statement about Binary Trees
   (A) Every binary tree is either complete or full.
   (B) Every complete binary tree is also a full binary tree.
   (C) Every full binary tree is also a complete binary tree.
   (D) No binary tree is both complete and full.

2. The maximum number of binary trees that can be formed with three unlabeled nodes is:
   (A) 10
   (B) 5
   (C) 6
   (D) 12

3. The number of leaf nodes in a rooted tree of n nodes, with each node having 0 or 3 children is:
   (A) $\frac{n}{2}$
   (B) $\frac{(n-1)}{3}$
   (C) $\frac{(n-1)}{2}$
   (D) $\frac{(2n+1)}{3}$

4. The maximum possible height of a weight-balanced tree with n nodes is best described by:
   (A) $\log_2 n$

(B) $\log_{4/3} n$
(C) $\log_3 n$
(D) $\log_{3/2} n$

5. A complete $n-ary$ tree is a tree in which each node has n children or no children. Let I be the number of internal nodes and L be the number of leaves in a complete $n-ary$ tree. If $L = 81$, and $I = 16$, what is the value of n?
(A) 6
(B) 7
(C) 11
(D) 5

6. The maximum number of nodes in a binary tree of height h is:
(A) 2^{h-1}
(B) $2^{h-1} + 1$
(C) $2^{h+1} - 1$
(D) $2^{h+1} + 1$

7. A scheme for storing binary trees in an array X is as follows. Indexing of X starts at 0. the root is stored at X[0]. For a node stored at X[i], the left child, if any, is stored in X[2i+1] and the right child, if any, in X[2i+2]. To store a binary tree completely (at worst) with n nodes minimum size of X should be.
(A) $\log_2 n$
(B) n
(C) $2^n + 1$
(D $2^n - 1$

8. For a given BST, postorder traversal produces the following sequence of keys:
17,19,15,57, 38,92,98,99,95,89,71.
For the same tree inorder traversal can be given as follows:
15,17,19,38,57,71,89,92,95,98,99

Which one of the following sequences of keys can be the result of an pre-order traversal of the tree?
(A) 71,38,17,19,15,57,89,95,92,99,98
(B)71,38,15,19,17,57,89,92,95,99,98
(C) 71,38,15,17,19,57,89,95,92,98,99
(D) 71,38,15,19,17,57,89,95,92,99,98
(E) Not possible

9. Level of a node is distance from root to that node. For example, level of root is 1 and levels of left and right children of root is 2. The maximum number of nodes on level i of a binary tree is
In the following answers, the operator '^' indicates power.
(A) $2^i - 1$
(B) 2^i
(C) 2^{i+1}
(D) $2^{\frac{(i+1)}{2}}$

10. In a complete k-ary tree, every internal node has exactly k children or no child. The number of leaves in such a tree with n internal nodes is:
(A) nk
(B) (n - 1)k+ 1
(C) n(k - 1) + 1
(D) n(k - 1)

11. Which of the following pair of tree traversal can be said sufficient to construct a binary tree uniquely?
(A) Postorder is enough
(B) Preorder, Postorder
(C) Postorder, Inorder
(D) Preorder is enough

12. A Disadvantage of using array for representation of binary trees is?
(A) difficulty in knowing children nodes of a node
(B) difficult in finding the parent of a node
(C) have to know the maximum number of nodes possible before creation of trees
(D) difficult to implement

13. What is the address of parent for a node 'n' of a complete binary tree in an array representation:
(A) $\lfloor(\frac{n-1}{2})\rfloor$
(B) $\lceil(\frac{n-1}{2})\rceil$
(C) $\frac{n-1}{2}$
(D) $\frac{n}{2}$

14. In a situation of writing a binary tree into a file with memory storage efficiency in mind, is array representation of tree is good ?
(A) yes because we are overcoming the need of pointers and so space efficiency
(B) yes because array values are indexable
(C) No it is not efficient in case of sparse trees and remaIning cases it is

fine
(D) No linked list representation of tree is only fine

15. What is the time complexity to find k^{th} smallest element in a Minheap with n nodes?
(A) $O(kLogn)$
(B) $O(n^2)$
(C) $O(nlogn)$
(C) $O(Logn)$
(D) $O(n)$
(E) $O(1)$

16. What is the time complexity to find k^th smallest element in a Maxheap with n nodes?
(A) $O(kLogn)$
(B) $O(n^2)$
(C) $O(nlogn)$
(C) $O(Logn)$
(D) $O(n)$
(E) $O(1)$

17. What is the time complexity of building a Heap from a given array of integers:
(A) $O(nLogn)$
(B) $O(n^2)$
(C) $O(Logn)$
(D) $O(n)$
(E) $O(1)$

18. In a binary tree, the number of internal nodes of degree 1 is 15, and the number of internal nodes of degree 2 is 19. The number of leaf nodes in the binary tree is
(A) 11
(B) 21
(C) 31
(D) 41

19. In a binary tree, if P is an inorder successor of Q then which of the following is true?
(A) P has no right child
(B) P has no left child
(C) P has no children

(D) Q has no children

20. Following are array representations of various binary max-heaps.
(I) 25,14,16,13,10,8,12,2,9
(II) 25,22,16,13,20,18,14,1,2
(III) 25,14,16,10,12,15,11,5,8
(IV) 25,14,12,16,10,8,15,11,9
Which one of the above represent/s binary max-heap/s?
(A) (I) only.
(B) (I),(II) only.
(C) (II),(III) only.
(D) (I),(IV) only.
(E) (I),(III) only.

21. Maximum and minimum number of nodes in a binary tree of height 7 respectively, are:
(A) 63 and 6
(B) 64 and 5
(C) 255 and 8
(D) 127 and 7

22. A binary tree has 30 leaves. The number of nodes in tree having two children is:

(A) 33
(B) 27
(C) 29
(D) 31

23. The number of edges from the root to the node is called
(A) Height
(B) Depth
(C) Length
(D) Euler Path
(E) Radius

24. Property of a red-black tree is:
(A) Every node is either red or black.
(B) Every leaf is black.
(C) If a node is red, then both its children are black.
(D) Every simple path from a node to a descendant leaf contains the same number of black nodes.

(E) All of the above
(F) None of the above

25. Following are operations which can be performed with Red-black trees.
(I) Insertion of element
(II) Deletion of element
(III) Sorting elements
(IV) Searching predecessor
(V) Deleting successor
Which of the following set of operations can be performed in $O(logn)$ time?
(A) (I) only
(B) (I),(II),(III) only.
(C) (I),(II),(III),(IV) only.
(D) (I),(II),(IV),(V) only.

26. Consider the following area of applications:
(I) Dynamic sets
(II) Heaps
(III) Maps
(IV) Sorting
(V) Dictionaries
(VI) Sequences

Which of the following collections of applications belongs to weight-balanced trees:
(A) (I),(III),(VI) only
(B) (I),(II),(III) only.
(C) (I),(IV),(V),(VI) only.
(D) (I),(III),(V),(VI) only.

27. For a given BST, preorder traversal produces the following sequence of keys:
10,8,2,5,9,28,39,31,41
For the same tree postorder traversal can be given as follows:
5,2,9,8,31,41,39,28,10

Which one of the following sequences of keys can be the result of an in-order traversal of the tree?
(A) 2,8,5,10,9,28,31,39,41
(B) 2,5,8,9,11,28,30,39,41
(C) 2,5,8,9,10,27,31,40,41
(D) 2,5,8,9,10,28,31,39,41

(E) Not possible

28. Which of the following statements explain true difference/s between linked list representation of binary trees and array representation of binary trees ?
(A) Random accessing is possible with liked list while not with array
(B) Random accessing is possible with array while not with linked list
(C) Extra memory for a pointer is needed with every element in the list while array needs constant space.
(D) Random access is not possible in linked list and extra memory with every element is required while array allows random access to its elements and no extra memory except that for storing elements is needed.

29. What is the worst case time complexity for searching, insertion and deletion operations in a general Binary Search Tree?
(A) O(Logn) for search, and O(n) for insert and delete
(B) O(Logn) for all
(C) O(Logn) for search and insert, and O(n) for delete
(D) O(n) for all

30. While storing all elements of an array of integers of size N each element can be stored by following $\lfloor \frac{n-1}{2} \rfloor$ with root at index 0. The time complexity to construct such a binary tree this way is:
(A) O(n^2)
(B) O(n log n)
(C) O (n log log n)
(D) O(n)
(E) O(logn)

31. A binary tree has four types of nodes as n_1, n_2, n_3 and n_4 with degrees as 1, 2, 3 and zero, respectively where the degree of a node is defined as the number edges going through the node. n_3 can be expressed as:
(A) $n_1 + n_2 + n_4 - 1$
(B) $n_1 - 2$
(C) $[((n_1 + n_2 + n_4)/2)]$
(D) $n_2 + n_4 - 1$

32. How many structurally different binary trees are possible with 7 nodes:
(A) 529
(B) 1729
(C) 3432
(D) 429

(E) 1529

33. What is the minimum number of nodes in a height balanced binary tree with height 3?
(A) 4
(B) 10
(C) 6
(D) 7
(E) 5

34. Which of the following is/are (an) advantage/s of trees?
(A) Hierarchical structure
(B) O(1) insertion/deletion of elements.
(C) Routing algorithms
(D) Easy random access
(E) Compact storage
(F) Faster search
(G) Useful in lexical analysis
(H) Useful in web addressing

35. Consider a full binary tree with n internal nodes, internal path length i, and external path length e. The internal path length of a full binary tree is the sum, taken over all nodes of the tree, of the depth of each node. Similarly, the external path length is the sum, taken over all leaves of the tree, of the depth of each leaf. Which of the following is correct for the full binary tree?
(A) $e = i + n$
(B) $e = i + 2n$
(C) $e = 2^i + n$
(D) $e = 2^n + i$

36. Suppose you are given a binary tree with n nodes, such that each node has exactly either zero or two children. The maximum possible height of this tree is:
(A) $\frac{n+1}{2}$
(B) $\frac{n-1}{2}$
(C) $\frac{n}{2} - 1$
(D) $\frac{n-1}{2} + 1$

37. The complexity to find number (say k) of keys, which lie between given two keys in a dense pack binary search tree with n integer elements in it can be given by:

(A) O(klogn)
(B) O(n)
(C) O((n+k)logn)
(D) O(k)

38. Which of the following recurrence relations represents appropriately the number of different binary search trees on n distinct elements:
(A) T(n) = $\sum_{k=1}^{n} T(n-k+1) * T(k+1)$

(B) T(n) = $\sum_{k=1}^{n} T(n-1) * T(k-1)$

(C) T(n) = $\sum_{k=1}^{n} (T(n-k) + T(k-1))$

(D) T(n) = $\sum_{k=1}^{n} T(n-k) * T(k-1)$

39. In an empty BST following elements are inserted in such a fashion that tree has the maximum height possible:
12, 31, 74, 5, 16, 7, 10, 56
How many ways can it be done?

(A) 1
(B) 63
(C) 64
(D) 128
(E) 256

40. A BST contains following elements in the path while searching an element 91, not necessarily in that order:
17, 23, 119, 44, 10, 65, 210, 455, 235, 308.
How many different such paths, containing all these keys such that search returns the index of key 91 successfully, are possible:
(A) 120
(B) 264
(C) 256
(D) 252
(E) 265

41. A BST contains all keys with smaller key values to the left of its root while all keys with greater key values to the right of its root. Assuming we are given a BST which is unlabeled. If there are N nodes in this tree, how many ways are there to insert these elements in this tree:
(A) $\frac{n*(n-1)}{2}$

(B) 1
(C) n!
(D) $\binom{2n}{n}\frac{1}{(n+1)}$
(E) 2^n

42. Is it possible to generate a unique BST 'T', based on a given postorder traversal of the same tree. If yes explain the method along with the complexity of your proposed algorithm.

43. It is known that all keys in a given BST contains values between 1 and 200. The element we are looking for is 89.
Which of the following traversals of nodes in this BST does show a valid path to search the node with key-value 89?
(A) 180, 39, 46, 58, 141, 110, 102, 108, 81.
(B) 197, 150, 1, 55, 80, 79, 88, 100, 90.
(C) 140, 10, 30, 60, 138, 126, 119, 115, 110, 62.
(D) 159, 33, 78, 64, 68, 86, 98, 90.

44. A Binary Search Tree stores values in the range 7 to 777. Consider the following sequence of keys.
I. 80, 537, 702, 539, 285, 676, 605
II. 57, 90, 121, 195, 242, 381, 472, 591, 692, 770
III. 130, 248, 520, 586, 645, 670, 665
IV. 775, 1, 507, 595, 683, 690, 665, 659

Suppose the BST has been unsuccessfully searched for key 660. Which all of the above sequences list nodes in the order in which we could have encountered them in the search?
(A) II and IV only.
(B) I and III only.
(C) III only.
(D) III and IV only
(E) None of the above.

45. A binary search tree is used to locate the number 43. Which of the following probe sequences are possible and which are not? Explain your answer/s.
(A) 61 52 14 17 40 43
(B) 1 2 3 50 40 60 43
(C) 4 10 65 31 48 37 43
(D) 10 81 61 52 14 41 43
(E) 11 17 77 27 66 18 43