

1.4 DATA TYPES & STRUCTURES · 1.4.2

Trees & traversals — Mark scheme

30 marks · spec 1.4.2(b)(c)

AO key: AO1 = knowledge · AO2 = application. Accept any valid alternative. Do not award the same point twice.

Q	ANSWER	AO	MARKS
1(a)	Root = the single node at the top of the tree (1); leaf = a node with no children (1). (2)	AO1	2
1(b)	Each node has at most two children. (1)	AO1	1
1(c)	For every node, all values in the left subtree are smaller (1) and all values in the right subtree are larger (1). (2)	AO1	2
1(d)	Any one: a tree has a root / a hierarchy · a tree has no cycles (a graph may) · a graph's nodes can connect freely. (1)	AO1	1

Q	ANSWER	AO	MARKS
2(a)	<pre> graph TD 42 --> 23 42 --> 67 23 --> 12 23 --> 30 12 --> 9 30 --> 35 67 --> 55 </pre> 1 mark per correct level (42 / 23,67 / 12,30,55 / 9,35), max 3. (3)	AO2	3
2(b)	Pre-order: 42, 23, 12, 9, 30, 35, 67, 55. All correct (2); mostly correct (1). (2)	AO2	2
2(c)	In-order: 9, 12, 23, 30, 35, 42, 55, 67. All correct (2); mostly correct (1). (2)	AO2	2
2(d)	The values in ascending (sorted) order. (1)	AO1	1

Q	ANSWER	AO	MARKS
3(a)	Post-order: 9, 12, 35, 30, 23, 55, 67, 42. All correct (2); mostly correct (1). (2)	AO2	2
3(b)	<pre> Line 1: inOrder(node.left) (1); (close if) (1); print line: print(node.data) (1); line 3: inOrder(node.right) (1). (4) procedure inOrder(node) if node.left ≠ null then inOrder(node.left) print(node.data) if node.right ≠ null then inOrder(node.right) endprocedure </pre>	AO2	4

Q	ANSWER	AO	MARKS
4(a)	Breadth-first / level order: 42, 23, 67, 12, 30, 55, 9, 35 . All correct (2); mostly correct (1). (2)	AO2	2
4(b)	A queue. (1)	AO1	1
4(c)	Each value goes the same way, so the tree becomes an unbalanced chain (1); searching then degrades to a slow sequential/linear search rather than halving the tree (1). (2)	AO2	2

Q	ANSWER	AO	MARKS
5(a)	Start at the root 42; $35 < 42 \rightarrow$ go left to 23 (1); $35 > 23 \rightarrow$ go right to 30 (1); $35 > 30 \rightarrow$ go right to 35 $\rightarrow$ found (1). (3)	AO2	3
5(b)	Each comparison discards half the remaining tree (1); so far fewer comparisons than checking every item of an unsorted list one by one (1). (2)	AO2	2

Total for paper: 30 marks