Question			Marks
1	1	**All marks AO1 (knowledge)** Rooted (tree); Where each node has at most two child nodes; **R.** each node has two child nodes	2
1	2	**All marks AO2 (apply)** EIHCYBQ;; If not fully correct award a maximum of 1 mark for any of the following: • Having E followed by I then H • Having Y followed by B then Q • Having C as the 4th output	2

Question			Marks
1	3	**All marks AO2 (apply)**	7

		Stack				
Current	Pos	[0]	[1]	[2]	[3]	OUTPUT
0	0	0				
0	-1					C
	0	4				
	1		1			
1	0					I
	1		3			
	2			2		
2	1					E
3	0					H
4	-1					B
	0	6				
	1		5			
5	0					Y
6	-1					Q

Mark as follows:

1. `Stack[0]` set to `0`, `Pos` set to `0` and `Current` set to `0`
2. `Current` set to `0`, `Pos` set to `-1` and output of `C`
3. `Stack[0]` set to `4` and `Pos` set to `0`
4. `Stack[1]` set to `1`, then `3` and then `5` with no other values after being set to `5`
5. `Stack[2]` set to `2` with no other values after this, `Stack[0]` having a 3rd value of `6` with no other values after this and `Stack[3]` column not used;
6. `Pos` column correct from 4th value (`1`) onwards and `Current` column set to the value `1`, then `2`, `3`, `4`, `5`, `6` with no further values after being set to `6`
7. Correct order in output column for 2nd value onwards (`I`, `E`, `H`, `B`, `Y`, `Q`)

Max 6 if any errors

<table>
<tr><th colspan="2">Question</th><th></th><th>Marks</th></tr>
<tr><td>2</td><td>1</td><td>All marks for AO1 (understanding)

A root (A. start) node; A. there is a parent-child relationship between nodes

Each node has no more than two child nodes; R. has two child nodes</td><td>2</td></tr>
<tr><td>2</td><td>2</td><td>All marks are for AO2 (apply)

<table>
<tr><td>1</td><td>0</td></tr>
<tr><td>2</td><td>-1</td></tr>
<tr><td>3</td><td>True</td></tr>
<tr><td>4</td><td>Current ← Tree[Current].Right</td></tr>
<tr><td>5</td><td>Current ← Tree[Current].Left</td></tr>
<tr><td>6</td><td>False</td></tr>
</table>

Note for examiners: answers are in pseudo-code so accept any reasonable representation (including use of string or integer values for rows 3 and 6).

Mark as follows:

1 mark: row one correct
1 mark: row two correct
1 mark: rows three and six correct
1 mark: rows four and five correct</td><td>4</td></tr>
<tr><td>2</td><td>3</td><td>Mark is for AO1 (knowledge)

$O(\log_2 n)$;

I. missing brackets
I. missing O
I. missing $_2$</td><td>1</td></tr>
<tr><td>2</td><td>4</td><td>Mark is for AO1 (understanding)

Every comparison halves the size of the binary tree to look at; (A. every comparison halves the size of the tree)</td><td>1</td></tr>
</table>

2	**5**	**Mark is for AO1 (understanding)** It does not have exponential (or worse) time complexity; It has a polynomial (or better) time complexity solution; **A.** It can be solved in a reasonable amount of time regardless of the problem/input size; **NE.** can be solved in a reasonable amount of time **Max 1**	**1**
2	**6**	**All marks AO1 (understanding)** Rules/knowledge (about the problem domain); Can be used to find a good/approximate but (probably) not optimal solution to a problem; Can reduce the size of the search/problem space // changing some constraints in the problem; **Max 2**	**2**
2	**7**	**All marks AO1 (knowledge)** As the size of the input/problem increases; the amount of time taken remains the same;	**2**

Question			Marks
3	1	**All marks AO1 (understanding)** Connected; Undirected; **A.** explanations of connected/undirected	**2**