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7.2*a* Insert the following *n* objects, in the order given, into a binary min-heap and place your answer into the following table

5, 3, 9, 7, 2, 4, 6, 1, 8

0	1	2	3	4	5	6	7	8	9

7.2*b* Is the following array-representation of a heap a valid min-heap-as-complete-tree? Why or why not?

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	3	6	9	15	7	35	12	19	31	10	17	42	39	54	13	20	40	30	32

7.2*c* Update the following min-heap-as-complete-tree data structure to demonstrate the state following a pop operation and place your answer in the following table.

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
	2	7	4	12	10	5	9	13	17	19	11	6	21	11	15	14	19	18	20

0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19

7.2*d* The formulas for the parent and two children of a node at index k are $k/2$, $2k$ and $2k + 1$, respectively. This requires that the root of the tree be stored at index $k = 1$. How do these formulas differ if we store the root of the tree at index $k = 0$?

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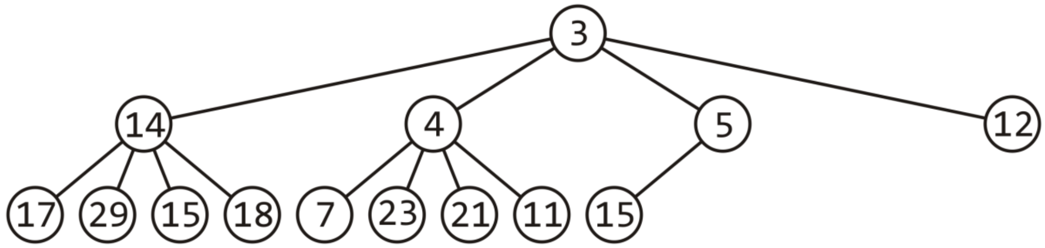
7.2*e* Just like we can represent a complete binary tree using an array, we could similarly represent a complete quaternary tree as an array. For example, we could store



0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
3	14	4	5	12	17	29	15	18	7	23	21	11	15						

Why, in this representation, do we start the index at $k = 0$? Hint: consider the formula used to find both the parent and children of the node at index k.

7.2*f* The quaternary tree in Question 7.2*e* is also a min-heap: each node is less than or equal to all four of its children. Draw the intermediate states of the tree if

1. the value 8 is pushed onto this min-heap,
2. followed by four pops.