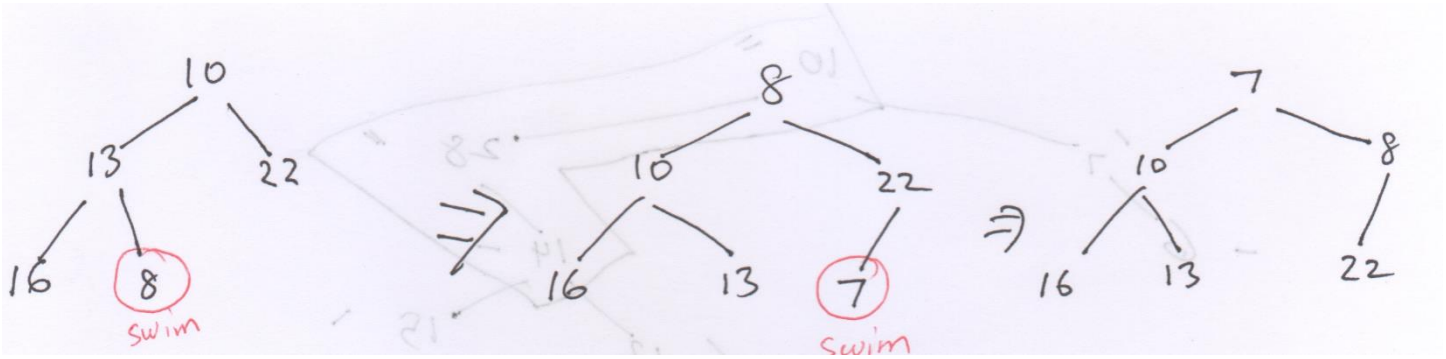
CS210 Data Structures (171) **Name**_____ **ID**_____
Major Exam 2 **Weight 15%** **Time: 50 minutes**

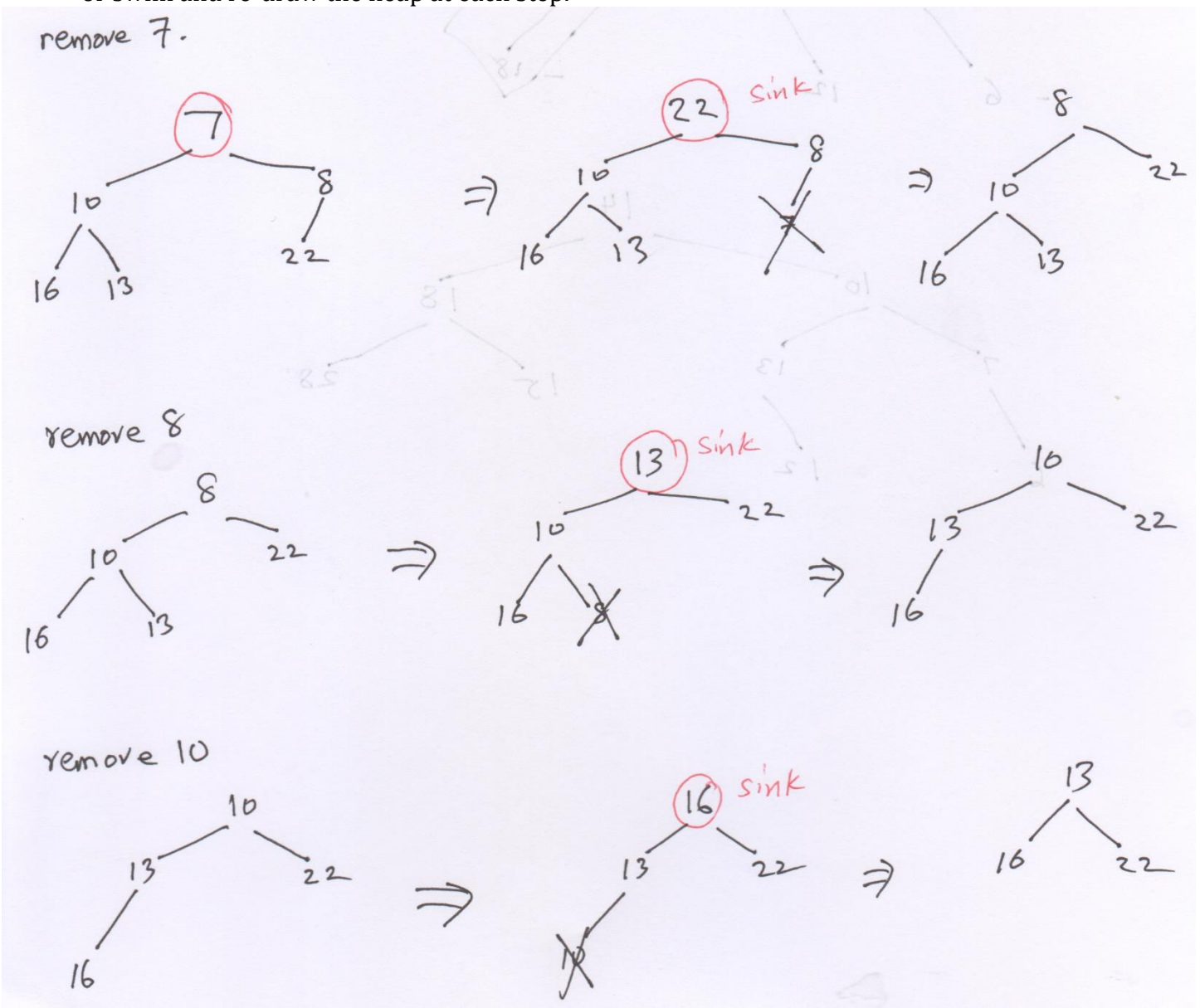
There are six questions in this exam. Answer all questions. Time is of essence, use it wisely!

[CLO-1] Q1. [4] Illustrate trees/heap at each step for the following:

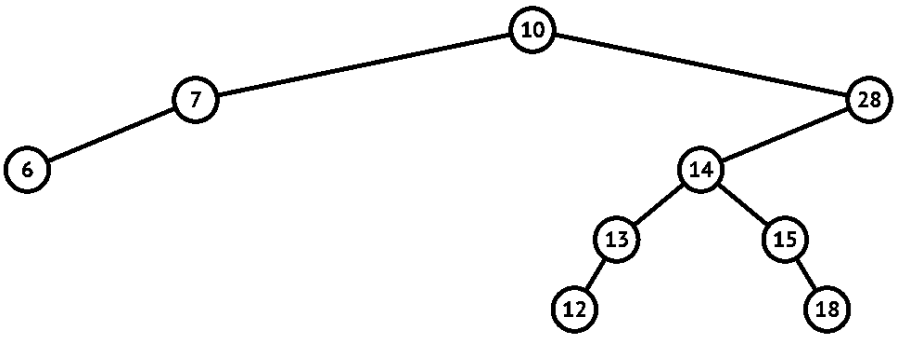
(a) Build a Priority Queue using a min-Binary Heap for the following data
10, 13, 22, 16, 8, 7.

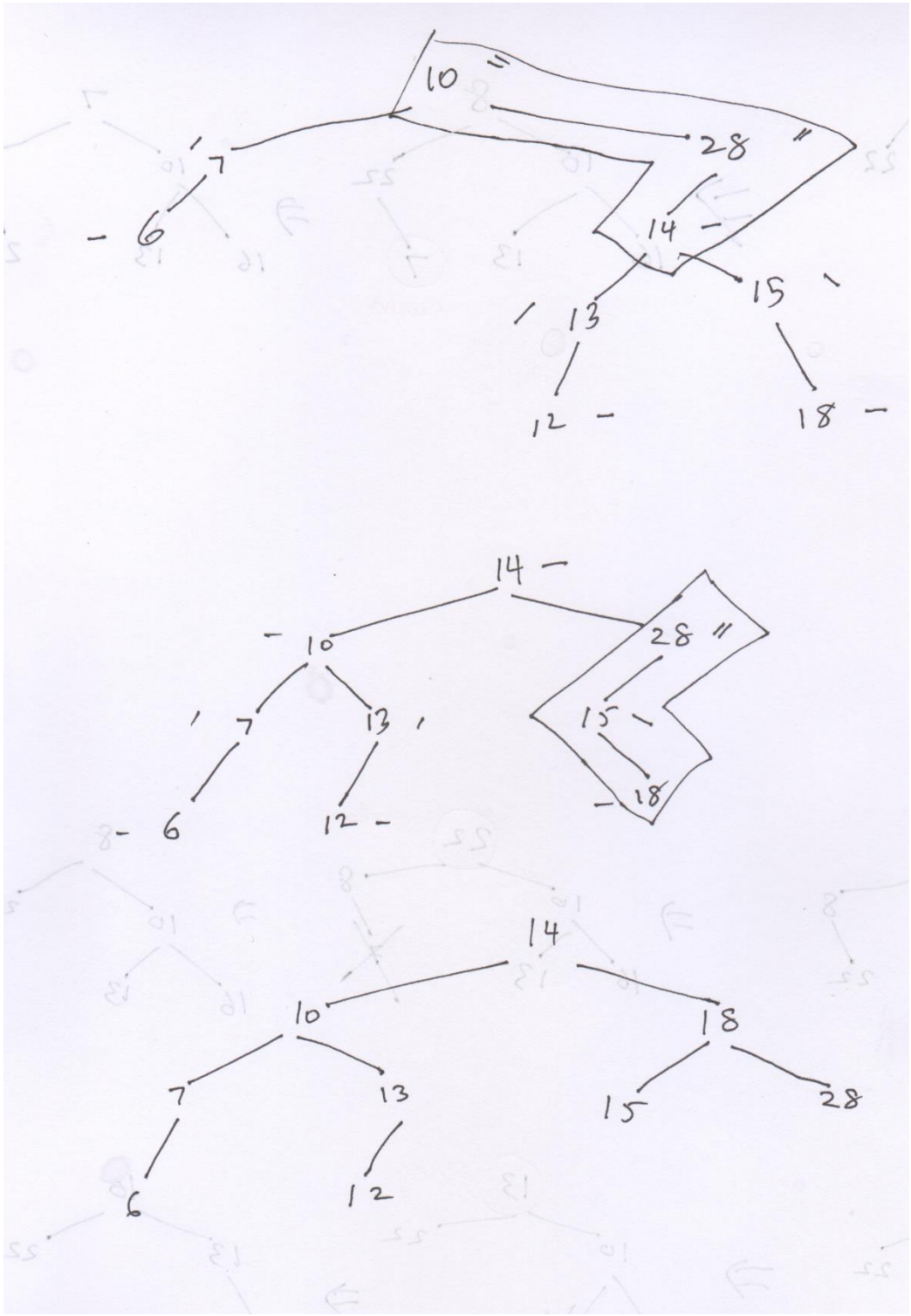


(b) Remove three elements from the above Priority Queue. Highlight which nodes you decide to sink or swim and re-draw the heap at each step.



[CLO-3] Q2. [3] Observe the following Binary Search Tree. Convert this tree to a AVL tree. Re-draw the tree every time you decide to rotate it. Highlight the rotation type (case) for each rotation.





Q3. [2] Write a recursive method **`public boolean isAVL(AVLNode A)`** to check if a tree with root at **`A`** is AVL. Assume all heights are included in the tree.

```
public boolean isAVL(AVLNode A)
{
    //This method is called only after setHeights(A) has been called..

    if(A.height<2)
        return true;
    else if(A.left==null)
        return A.right.height + 1 < 2 ? true : false;
    else if(A.right==null)
        return A.left.height + 1 < 2 ? true : false;
    else if(isAVL(A.left) && isAVL(A.right))
        return Math.abs(A.left.height - A.right.height)<2 ? true : false;
    else
        return false;
}
```

[CLO-2]Q4. [2] Show how the array would be sorted using SelectionSort. Trace all compare and swap operations.

M	I	D	T	E	R	M	E	X	A	M
A	I	D	T	E	R	M	E	X	M	M
	D	I	T	E	R	M	E	X	M	M
		E	T	I	R	M	E	X	M	M
			E	I	R	M	T	X	M	M
				I	R	M	T	X	M	M
					M	R	T	X	M	M
						M	T	X	R	M
							M	X	R	T
								R	X	T
									T	X

[CLO-4] Q5. [2] Consider a hash table of size 7 storing entries with integer keys. Suppose the hash function is h(k) = k mod 7. Insert, in the given order, entries with keys 5, 11, 18, 23, 28, 13, 25 into the hash table using linear probing to resolve collisions. Show all the work and fill the array **A** accordingly.

A

28	13	23	25	11	5	18
0	1	2	3	4	5	6

k	h(k)	Probes
5	5	
11	4	
18	4	11 5
23	2	
28	0	
13	6	18 28
25	4	11 5 18 28 13 23

Q6 [2]. What is the run time (Big Oh notation) for the following operations in given data structures?

- Insertion of a key in Priority Queue implemented using a min-heap __O(log n)_____
- Worst case scenario for Removal of a key in Hash table implemented using Probing _O(n)___
- Number of swap operations using Insertion Sort in a pre-sorted array ___0__-> O(1)_____
- Best case scenario for removal of a node from a BST ____O(1)_____
- Average number of comparisons in selection sort _____$n^2/2$ ->___$O(n^2)$____
- Average number of element swaps in bubble sort ___$O(n^2)$_____

--End of Exam--