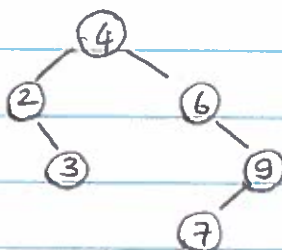
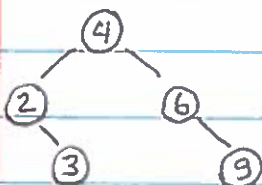
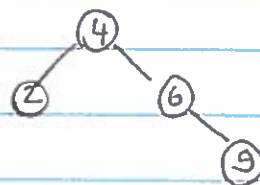
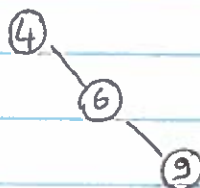
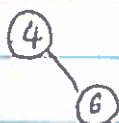


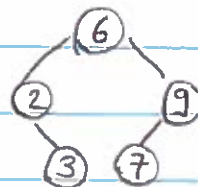
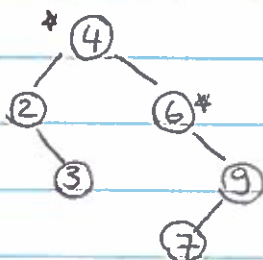
① a) Insert 4, 6, 9, 2, 3, 7 to a BST



b) Delete the root

delete 4

replace with 6



c) Insert 4, 6, 9, 2, 3, 7 to an AVL tree

insert 4 $h=0$ (4) ✓

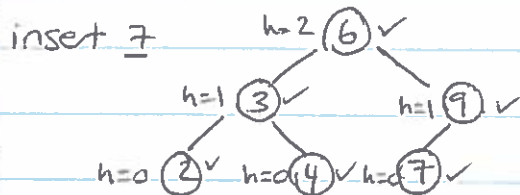
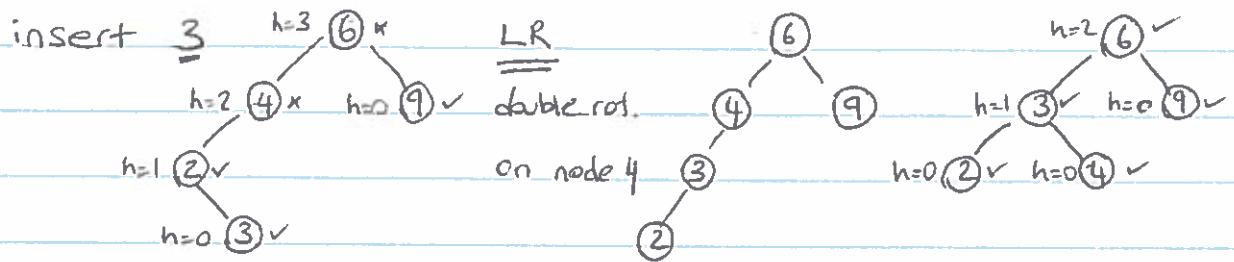
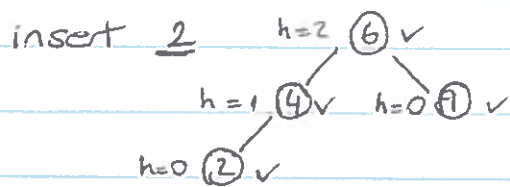
insert 6 $h=1$ (4) ✓
 $h=0$ (6) ✓

insert 9 $h=2$ (4) ✗
 $h=1$ (6) ✓
 $h=0$ (9) ✓

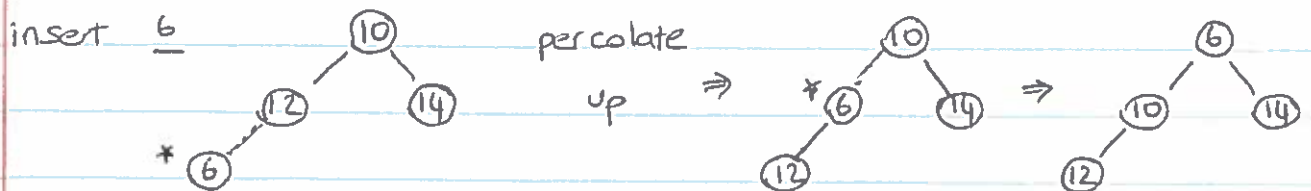
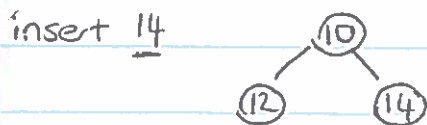
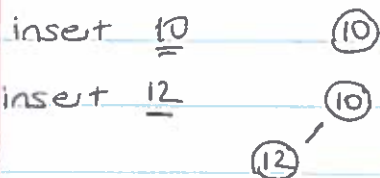
RL

single rot.
on node 4

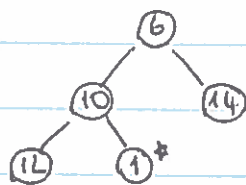
$h=1$ (6) ✓
 $h=0$ (4) ✓ $h=0$ (9) ✓



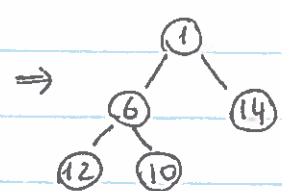
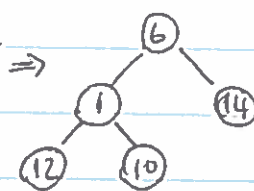
② a) Insert 10, 12, 14, 6, 1 to a binary heap



insert 1



percolate up



0	1	2	3	4	5
X	6	10	14	12	hole

1?

$\lfloor 5/2 \rfloor = 2$, $1 < 10$, percolate up

0	1	2	3	4	5
X	6	hole	14	12	10

1?

$\lfloor 2/2 \rfloor = 1$, $1 < 6$, percolate up

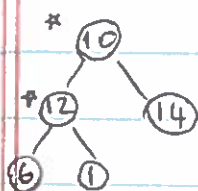
0	1	2	3	4	5
X	1	6	14	12	10

✓

b) buildHeap with 10, 12, 14, 6, 1

$$5/2 = 2$$

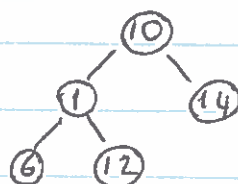
percolate down



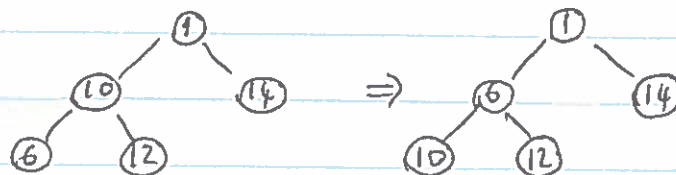
nodes 12 (2nd node)

and 10 (1st node)

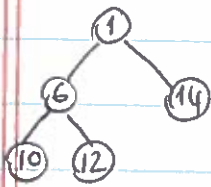
percolate down 12



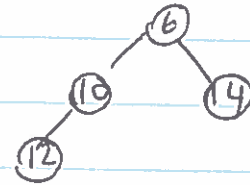
percolate down 10



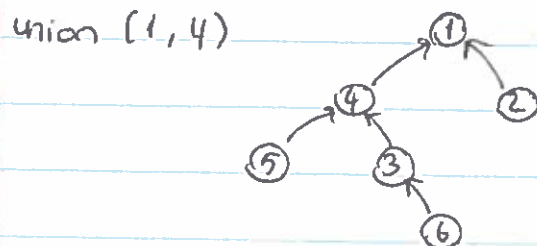
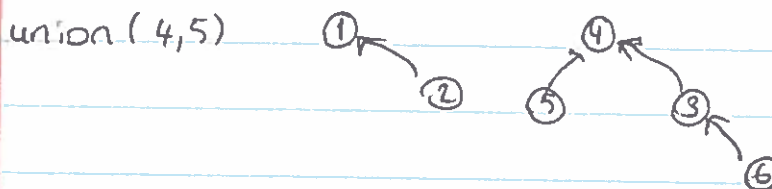
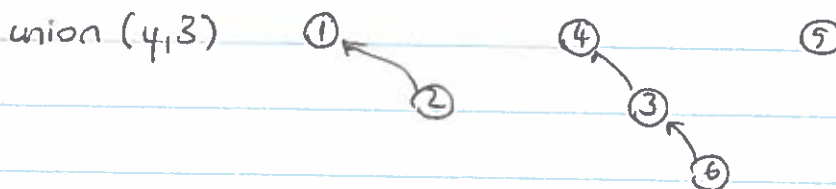
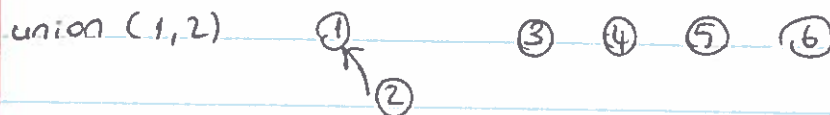
c) delete Min returns 1



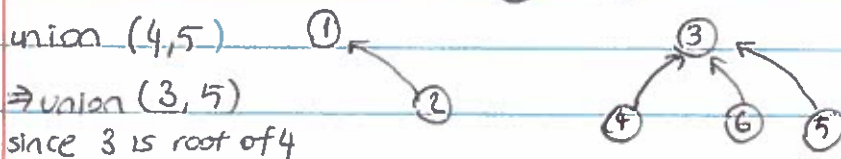
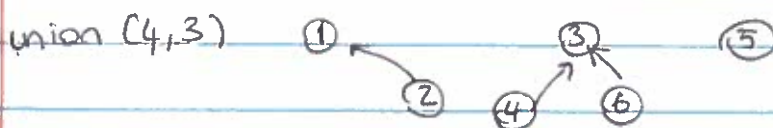
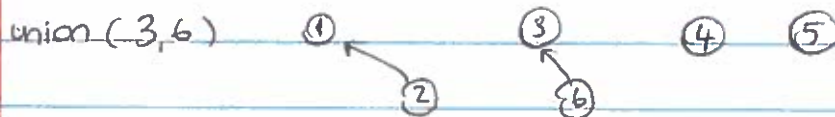
0	1	2	3	4	5
X	1	6	14	10	(12)
X	6	6	14	10	12
X	6	10	14	10	12
X	6	10	14	12	12



3) a) ① ② ③ ④ ⑤ ⑥

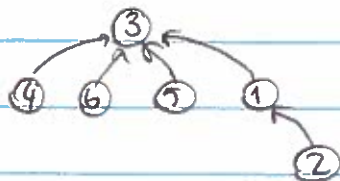


b) ① ② ③ ④ ⑤ ⑥



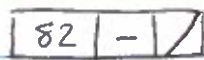
union (1, 4)

$\Rightarrow$ union (1, 3)
 since 3 is root of 4



4) Insert 82, 96, 53, 46, 91 into a B+-tree

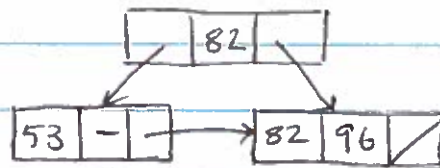
insert 82



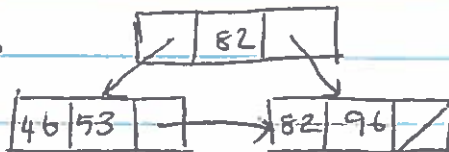
insert 96



insert 53



insert 46



insert 91

