5) The

quick

brown

fox

jumps

dog

over

lazy

7) 2 weighings. Weigh coin 1 and 2. If 1 and 2 are balanced, weigh 2 and 3. If 2 and 3 are balanced, 4 is the counterfeit. If 2 and 3 aren't balanced, then 4 is the counterfeit. If 1 and 2 aren't balanced, then weigh 1 and 3. If 1 and 3 balance, 2 is the counterfeit. If they don't balance 1 is the counterfeit.

11) 5 comparisons on $[a, b, c, d]$

Compare a to b, then c to d. $(a < b)$ and $(c < d)$. Now compare a to c, the smaller of the two is the smallest of the set. $(a < c)$ So, compare b to c and d to determine the rest of the order.

13)

14

14   11

8   14   9   11

−∞ 8   14 −∞   3 9   −∞ 11

11

8   11

8   −∞   9   11

−∞ 8   −∞ −∞   3 9   −∞ 11

9

8   9

8   −∞   9   −∞

−∞ 8   −∞ −∞   3 9   −∞ −∞

8

8   3

8   −∞   3   −∞

−∞ 8   −∞ −∞   3 −∞   −∞ −∞

→

17

17   17   14

14/   17   13   14

17 4   1 5   13 10   14 6

14

5   14

4   5   13   14

-∞ 4   1 5   13 10   14 6

13

5   13

4   5   13   6

-∞ 4   1 5   13 10   -∞ 6

10

5   10

4   5   10   6

-∞ 4   1 5   -∞ 10   -∞ 6

6

5   6

4   5   -∞   6

-∞ 4   1 5   -∞ -∞   -∞ 6

5

5   5

4   5

-∞ 4   1 5   _ A _   _ A _

4

4

4   1

-∞ 4   1 -∞   _ A _   _ A _
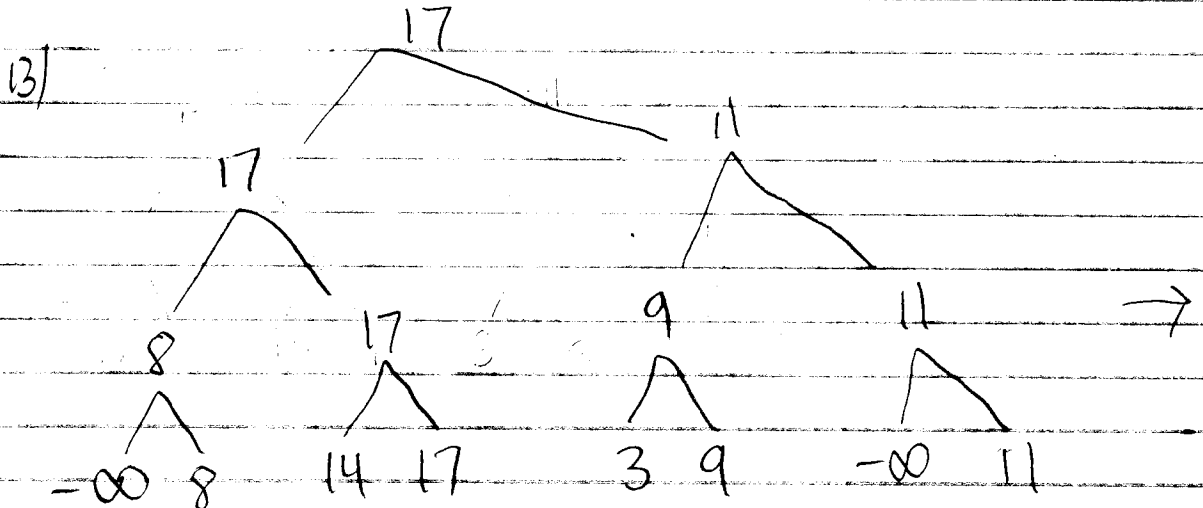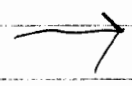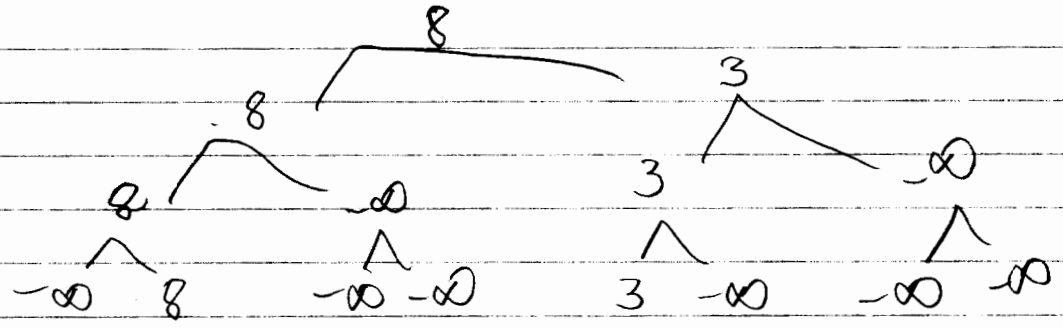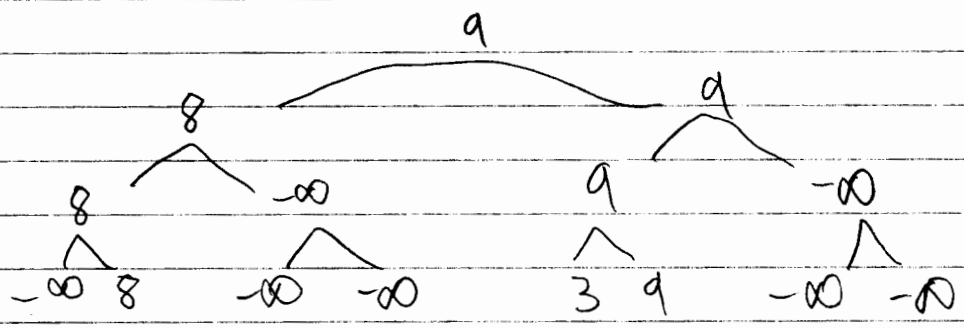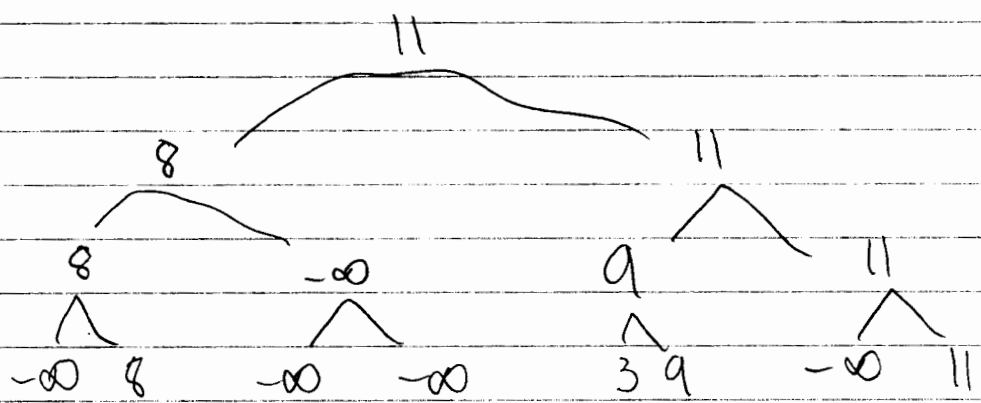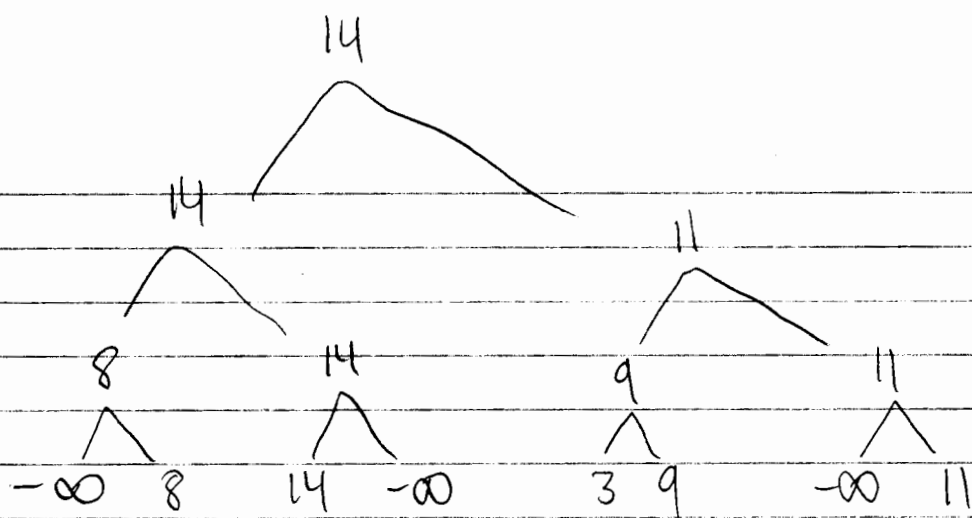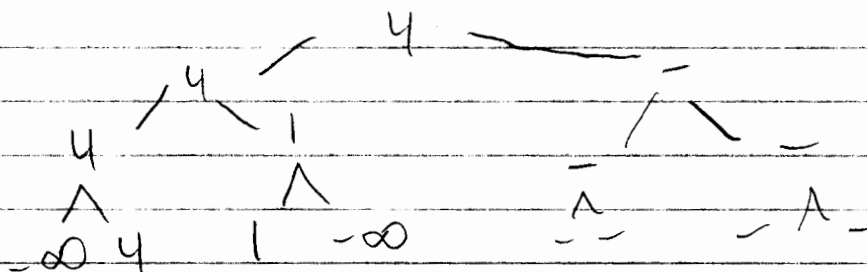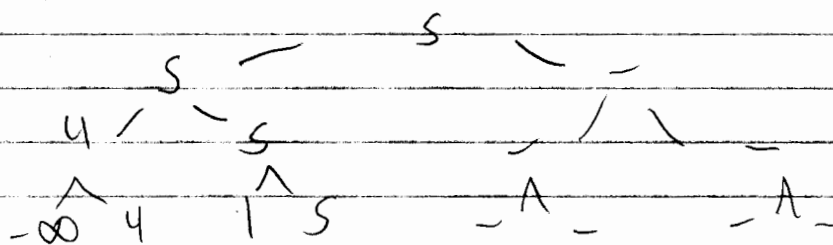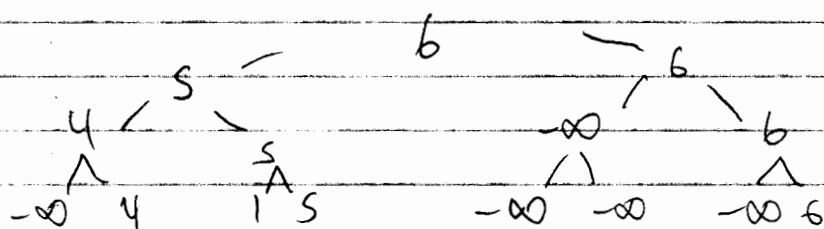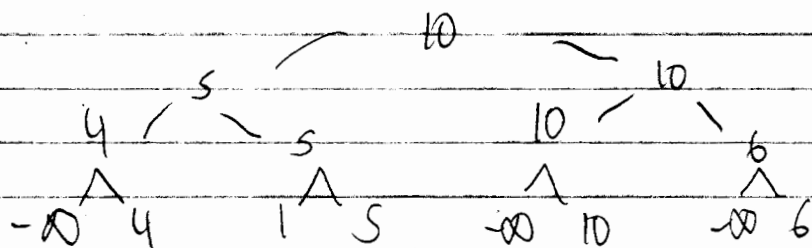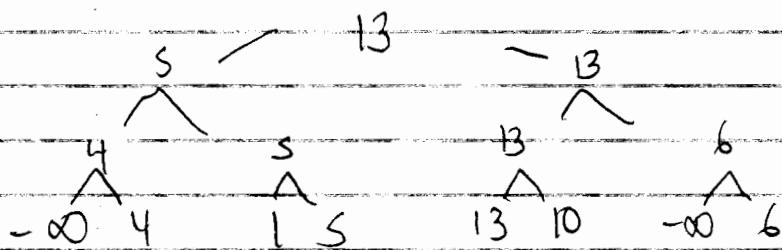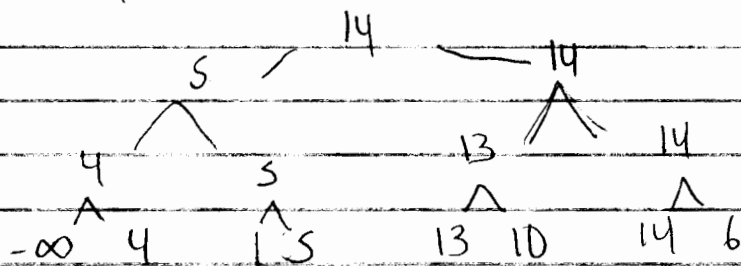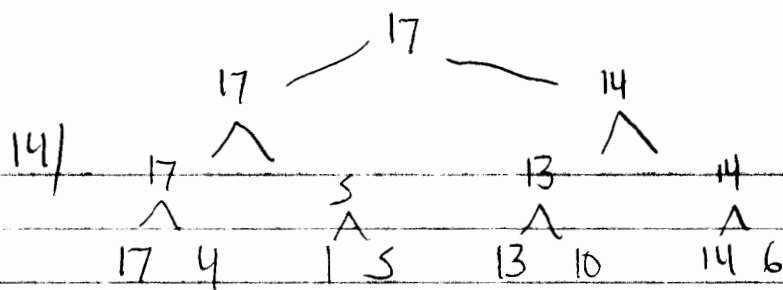
(5) procedure tournament sort $(a_1, \ldots, a_n)$
    $k := \lceil \log n \rceil$
    binary tree of height k
    for $i := 1$ to n
        set the value of the ith leaf to be a_i
        and its label to be itself
    for $i := n+1$ to 2^k
        set the value of the ith leaf to be $-\infty$
        and its label to be itself
    for $i := k-1$ downto 0
        for each vertex v at level i
            set the value of v to the larger of
            the values of its children and its label to
            be the label of the child with the larger
            value
    for $i := 1$ to n
    begin
        $c_i :=$ value at the root
        let v be the label of the root
        set the value of v to be $-\infty$
        while the label at the root is still v
        begin
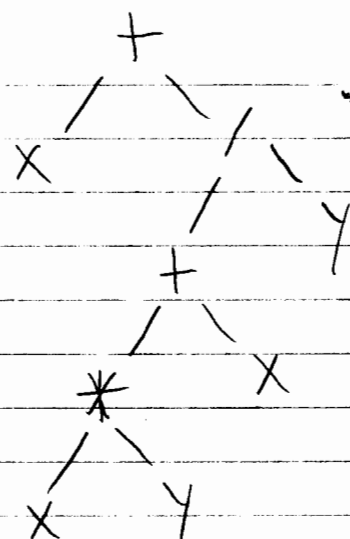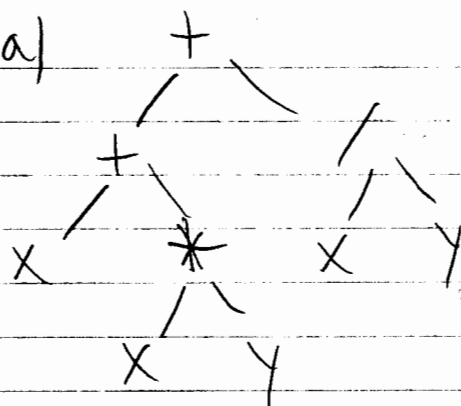 $v := parent(v)$
            set the value of v to the larger
            of the values of its children and
            its label to be the label of the
            child with the larger value
        end
    end $\{c_1, \ldots, c_n$ is the list in nonincreasing order$\}$

6) a)   0 — 3, 3.1, 3.1.2, 3.1.2.2, 3.1.2.1, 3.1.1, 3.2
1, 2
1.1, 1.2, 2.1, 2.2, 2.1.3
1.1.1, 1.1.2, 2.1.1, 2.1.2
2.1.1.1

6) No, need a
2.4.1..... before
2.4.2.....

c)   0 — 4, 3, 3.2, 4.1, 4.1.1
1.1, 1.2, 1.3, 1.4, 2, 3.1
1.2.1, 1.2.2
1.2.2.1

10) d, b, f, e, g, a, c   13) d, f, g, e, b, c, a

16) a)

*
↑ , −
+ , 3 , − , −
x , 2 , y , / , 5
3 , x
3 , x

b) * ↑ + x 2 3 − y − + 3 x 5

c) x 2 + 3 ↑ y 3 x + 5 − − *

d) ((x+2)↑3) * (y − (3+x)) − 5

17) a)

b) (++x * x y / x y)
(+x/+ * x y x y)

c) (xxy * +x y / +)
(xxy * x+y / +)

d) ((x + (x * y)) + (x/y))
(x + (((x * y) + x) / y))