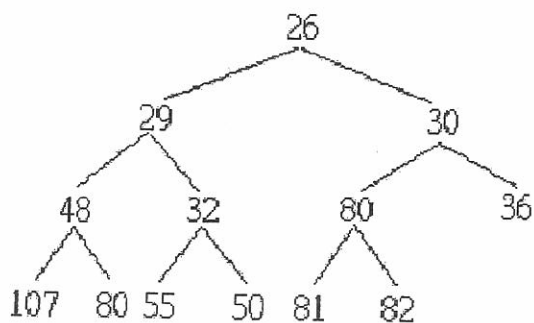


1.  $f(1)=f(2)=1, f(n)=f(n-1)+f(n-2)$ 
  - (a) Please write a *iterative* program to compute  $f(12)$ . (5%)
  - (b) Please write a *recursive* program to compute  $f(15)$ . (5%)
2. (a) Design a data structure and write a program to convert an expression from infix including parentheses to postfix. (b) Use the example below to illustrate your program.  $A + (((B - C) * (D - E) + F) / G) \$ (H - J)$  (20%)
3. Use pointer variables to implement list pointers. (a) Please define the type of a pointer and a node. (b) We assume that struct node and NODEPTR have been declared as (a). A queue is represented as a structure:
 

```

      Struct queue {
          NODEPTR front, rear;
      };
      struct queue q;
      
```

 Please write programs to insert an element into a queue  $\text{insert}(q, x)$  and delete the first element from a queue  $\text{remove}(q)$ . (20%)
4. Suppose  $v$  is an element with one child in a red-black tree. Explain why  $v$  must be black and  $v$ 's child must be red leaf. (15%)
5. Show the resulting heap after each of the following alterations made, consecutively, to the following heap. (20%)



- a.  $\text{add}(28)$ ;
- b.  $\text{add}(27)$ ;
- c.  $\text{removeMin}()$ ;
- d.  $\text{removeMin}()$ ;
- e.  $\text{removeMin}()$ ;

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6. In open addressing, with the quotient-offset collision handler, insert the following keys into a table of size 13: (15%)

20

33

46

22

26

202

140

508

9

Here are the relevant remainders and quotients:

key	key % 13	key / 13
20	7	1
33	7	2
49	10	3
22	9	1
26	0	2
202	7	15
140	10	10
508	1	39
9	9	0