SET – 1B

Stacks and Queues

1. Compute the postfix equivalent of the following infix arithmetic expression where a+b*c+d*e↑f; where ↑ represents exponentiation. Assume normal operator precedence.

2. Suppose one character at a time comes as an input from a string of letters. There is an option either to (i) print the incoming letter or to (ii) put the incoming letter on to a stack. Also a letter from top of the stack can be popped out at any time and printed. The total number of total distinct words that can be formed out of a string of three letters in this fashion, is

    (A)
    (B)
    (C)
    (D)

3. The following sequence of operations is performed on a stack :

    PUSH (10), PUSH (20), POP, PUSH (10), PUSH (20), POP, POP, POP, PUSH (20), POP.

    The sequence of values popped out is:

    A. 20, 10, 20, 10, 20
    B. 20, 20, 10, 10, 20
    C. 10, 20,20,10,20
    D. 20,20,10,20,10
    E. None of the above

4. A stack is use to pass parameters to procedures in a procedure call.

    (a) If a procedure P has two parameters as described in procedure definition:
        procedure P(var x: integer; y: integer);

    and if P is called by:

        P(a,b)

    State precisely in a sentence what is pushed onto stack for parameters a and b.

    In the generated code for the body of procedure P, how will the addressing of formal parameters y and y differ?

5. Which of the following permutation can be obtained in the output (in the same order) using a stack assuming that the input is the sequence1, 2, 3, 4, 5 in that order?

    (A) 3, 4, 5, 1, 2
    (B) 3, 4, 5, 2, 1
    (C) 1, 5, 2, 3, 4
    (D) 5, 4, 3, 1, 2

6.

The postfix expression for the infix expression

A + B*(C+D)/F + D*E is

    (a) AB+CD+*F/D+E*
    (b) ABCD+*F/DE*++
    (c) A*B+CD/F*DE++
  (d) A+*BCD/F*DE++

7.   Consider the following statements.

      i First-in-first-out types of computations are efficiently supported by STACKS.
      ii Implementing LISTS on linked lists is more efficient than implementing LISTS on an array for almost all the basic LIST operations.
      iii Implementing QUEUES on a circular is more efficient than implementing QUEUES
      iv Last-in-first-out QUEUES type of computations are efficiently supported by QUEUES.
      Which of the following is correct?

    (A) (ii) and (iii) are true   (B) (i) and (ii) are true

    (C) (iii) and (iv) are true   (D) (ii) and (iv) are true

8.   Compute the postfix equivalent of the following infix expression.

    $3 * \log (x + 1) - a/2$

9.   A queue Q containing n items and an empty stack S are given. It is required to transfer all the items from the queue to the stack, so that the item at the front of the queue is on the top of the stack, and the order of all the other items is preserved. Show this how this can be done in O(n) time using only a constant amount of additional storage. Note that the only operations which can be performed on the queue and stack are Delete, Insert, Push and Pop. Do not assume any implementation of the queue or stack.

10.   Which of the following is essential for converting an infix expression to the postfix form efficiently?

    (A) An operator stack   (B) An operand stack

    (C) An operand stack and an operator stack   (D) A parse tree

11.   A priority queue Q is used to implement a stack S that stores characters. PUSH(C) is implemented as INSERT(Q, C, K) where K is an appropriate integer key chosen by the implementation. POP is implemented as DELETEMIN(Q). For a sequence of operations, the keys chosen are in

    (A) non-increasing order   (B) non-decreasing order

    (C) strictly increasing order   (D) strictly decreasing order

12.   Suppose a stack implementation supports, in addition to PUSH and POP, an operation REVERSE, which reverses the order of the elements on the stack.

    (a) To implement a queue using the above stack implementation, show how to implement ENQUEUE using a single operation and DEQUEUE using a sequence of 3 operations   (2)

    (b) The following postfix expression, containing single digit operands and arithmetic operators + and *, is evaluated using a stack.
        5 2 * 3 4 + 5 2 * * +

Show the contents of the stack

    i   After evaluating 5 2 * 3 4 +
    ii After evaluating 5 2 * 3 4 + 5 2
    iii At the end of evaluation

13.   What is the minimum number of stacks of size n required to implement a queue of size n?
    A. One
    B. Two
    C. Three
    D. Four

14.   Let S be a stack of size $n \geq 1$. Starting with the empty stack, suppose we Push the first n natural numbers in sequence, and then perform n Pop operations. Assume that Push and POP operations take X seconds each, and Y seconds elapse between the end of one such stack operation and the start of the next operation. For $m \geq 1$, define the stack-life of m as the time elapsed from the end of Push(m) to the start of the Pop operation that removes m from S. The average stack-life of an element of this stack is

    (A) n(X + Y)
    (B) 3Y + 2X
    (C) N(X + Y) – X
    (D) Y + 2X

15.   The following sequence of operations is performed on a stack :

PUSH (10), PUSH (20), POP, PUSH (10), PUSH (20), POP, POP, POP, PUSH (20), POP.

The sequence of values popped out is:

    F.   20, 10, 20, 10, 20
    G.   20, 20, 10, 10, 20
    H.   10, 20,20,10,20
    I.   20,20,10,20,10
    J.   None of the above

16.   Consider three pegs A, B, C and four disks of different sizes. Initially, the four disks are stacked on peg A, in order of decreasing size. The task is to move all the disks from peg A to peg C with the help of peg B. the moves are to be made under the following constraints:

    [i]   In each step, exactly one disk is moved from one peg to another.
    [ii] A disk cannot be placed on another disk of smaller size. If we denote the movement of a disk from one peg to another by y → y, where y, y are A, B or C, then represent the sequence of the minimum number of moves to accomplish this as a binary tree with node labels of the form (y → y) such that the in-order traversal of the tree gives the correct sequence of the moves..

If there are n disks, derive the formula for the total number of moves required in terms of n

17.   A stack is use to pass parameters to procedures in a procedure call.

    (b) If a procedure P has two parameters as described in procedure definition:
          procedure P(var x: integer; y: integer);

      and if P is called by:

          P(a,b)

State precisely in a sentence what is pushed onto stack for parameters a and b.

In the generated code for the body of procedure P, how will the addressing of formal parameters y and y differ?

18. Which of the following permutation can be obtained in the output (in the same order) using a stack assuming that the input is the sequence1, 2, 3, 4, 5 in that order?

   (E) 3, 4, 5, 1, 2
   (F) 3, 4, 5, 2, 1
   (G) 1, 5, 2, 3, 4
   (H) 5, 4, 3, 1, 2

19. Consider the following C program:

```
#include<stdio.h>

#define EOF -1

void push(int);              /* Push the argument on the stack */

int pop(void);               /* pop the top of the stack */

void flagError();

int main( )

{          int c, m, n, r;


               while ((c = getchar( )) != EOF)

               {          if (isdigit(c))

                                   push (c)

                          else if (c = = '+') || (c = = '*'))

                              {          m = pop( );

                                         n = pop( );

                                         are = (c = = '+') ? n + m :  n*m;

                                         push(r);

                              }

                          else if (c != ' ')

                                   flagError( );

                   }

                   printf("%c", pop( ));

        }
```

What is the output of the program for the following input?

5 2 * 3 3 2 + * +

(A) 15 (B) 25   (C) 30 (D) 150

20.   Suppose you are given an implementation of a queue of integers. The operations that can be performed on the
      queue are:

isEmpty(Q)   –   returns true if the queue is empty, false otherwise.

delete(Q)   – deletes the element at the front of the queue and   returns its value.

insert(Q, i)   – inserts the integer i at the rear of the queue.

Consider the following function:

void f(queue Q)

{

        int i;

        if(!isEmpty (Q)) {

                i = delete(Q);

                f(Q)

                insert(Q, i);

        }

}

What operation is performed by the above function f?

(A) Leaves the queue Q unchanged
(B) Reverse the order of elements in the queue Q
(C) Deletes the element at the front of the queue Q and inserts it at the rear keeping the other elements in
     the same order
(D) Empties the queue Q.

21.   Let w be the minimum weight among all edge weights in an undirected connected graph. Let e be a specific edge of
      weight w. Which of the following is **FALSE**?

(A) There is a minimum spanning tree containing e.
(B) If e is not in a minimum spanning tree T, then in the cycle formed by adding e to T, all edges have the
     same weight.
(C) Every minimum spanning tree has an edge of weight w.
(D) e is present in every minimum spanning tree.

22. Consider the following C function:

```
int  f(int n)
    {
      static int are = 0;
      If (n < = 0) return 1;
      If (n > 3)
            { r = n;
              return f (n – 2) + 2;
            }
      return f(n – 1) + r;
    }
```

What is the value of f(5)?

(A) 3   (B) 7   (C) 9   (D) 18

23. The following postfix expression with single digit operands is evaluated using a stack:

8 2 3 ^ / 2 3 * + 5 1 * -

Note that ^ is the exponentiation operator. The top two elements of the stack after the first *is evaluated are:

(A) 6, 1   (B) 5, 7   (C) 3, 2   (D) 1, 5

24. An implementation of queue Q, using stacks S1 and S2 is given below:

```
void insert (Q, x) {
        push (S1, x);
}
void delete (Q) {
        if (stack-empty (S2)) then
                if (stack-empty (S1)) then {
                        print ( " Q is empty" );
                        return;
                }
                else while (! (stack-empty (S1))) then {
```

x = pop (S1);

push (S2, x);

}

x = pop (S2);

}

Let *n* insert and *m (≤ n)* delete operations be performed in an arbitrary order on an empty queue Q. let *x* and *y* be the number of push and pop operations performed respectively in the process. Which one of the following is true for all *m* and *n*?

(A) $n + m \leq x < 2n$ and $2m \leq y \leq n + m$ (B) $n + m \leq x < 2n$ and $2m \leq y \leq 2n$

(C) $2m \leq x < 2n$ and $2m \leq y \leq n + m$ (D) $2m \leq x < 2n$ and $2m \leq y \leq 2n$

25. A function f defined on stacks of integers satisfies the following properties.

f(φ) = 0 and

f(push(**S**, i) = max(f(**S**), 0) + i for all stacks **S** and integers i.

If a stack **S** contains the integers 2, -3, 2, -1, 2 in order from bottom to top, what is f(**S**)?

(A) 6   (B) 4   (C) 3   (D) 2

26. Assume that the operators +, -, × are left associative and ^ is right associative. The order of precedence (from highest to lowest) is ^, ×, +, -. The postfix expression corresponding to the infix expression a+b×c-d^e^f is

(A) abc×+def ^ ^ -
(B) abc×+de ^ f ^ -
(C) ab+c×d-e ^f ^
(D) -+a×bc ^ ^ def

27. The best data structure to check whether an arithmetic expression has balanced parenthesis is a

(A) Queue
(B) Stack
(C) Tree
(D) List