Data Structures
Prof. Loftin: Practice Test Problems for Test 2

1. Assume that Stack and Queue are implementations of the corresponding ADTs using Java generics. Consider the following method

```java
public static void problem1(Stack<E> s) {
    Queue<E> q = new Queue<E> ();
    while (! s.empty())
        q.enqueue(s.pop());
    while (! q.empty())
        s.push(q.dequeue());
}
```

(a) Let stack be a stack of Integers containing the data

```
7
10
5
-2
```

How is stack changed (if at all) when problem1(stack) is called? Trace through the method carefully.

(b) If st is any stack, what is the effect of calling problem1(st)? Justify your answer.

2. Trace through the state of the stack s in the following code fragment.

```java
Stack<String> s = new Stack<String> ();
s.push("happy");
s.push("sad");
String st = s.peek();
s.push("numb");
s.push(st+"dle");
s.pop();
st = s.pop();
s.push(st);
```
3. Trace though the state of the queue \( q \) in the following code fragment. (Assume Queue is an implementation of the standard queue interface using Java generics.)

```java
Queue<Integer> q = new Queue<Integer>();
q.enqueue(5);
q.enqueue(7);
q.enqueue(13);
q.dequeue();
Integer t = q.peek();
q.enqueue(12+t);
q.dequeue();
q.enqueue(q.dequeue());
```

4. Evaluate the following postfix expression

\[ 3 \ 5 \ 7 \ 2 \ 8 \ + \ - \ * \ + \ 4 \ - \]

Show your work.

5. Fully parenthesize the following Java expression (using the standard Java rules of precedence of operations and left-right associativity).

\[ x + 3 / ( y * 2 - 4) * w - 1 \]
6. What is the output to the screen?

```java
public class Problem6{
    public static void main (String[] args){
        try{
            for (int i=1; i<=10; i++)
                System.out.println(g(i));
        }
        catch (Exception e){
            System.out.println("Exception caught.");
        }
        int[] ar = new int[10];
        for (int i=0; i<10; i++)
            ar[i] = i*i;
        ar[10] = 500;
        System.out.println("End of main.");
    }
    public static int g(int k){
        return 120/(7-k);
    }
}
```

7. Consider the language whose sentences are given by $\langle W \rangle$

$$\langle W \rangle = \langle W \rangle \ t \mid t \mid \langle W \rangle \ \langle S \rangle$$

$$\langle S \rangle = a \mid b \mid c$$

Write a Java method

```java
public static boolean inW (String s)
```

which determines whether the string s is in the language of $\langle W \rangle$. (Recall that the method call $s.substring(i,j)$ returns the substring of s going from index i to index j-1 inclusive.)

8. Consider an implementation `StackReferenceBased` which implements the `StackInterface`, uses Java generics, and throws a `StackException`. The implementation uses a linked list structure with `top` as the head of the list.

Write the code for the method
public E pop() throws StackException

The class StackException is given by

```java
public class StackException extends RuntimeException{
    public StackException (String s){
        super(s);
    }
}
```