CMPUT 115 Section B2
Term Test 1

January 5, 2001

Instructions:

- This is a closed book, no notes exam.
- Try to put all of your answers in the space provided.
- The backs of pages can be used for rough work.
- Be sure to write your student id number on each internal page.
- Please do not open the exam until you are instructed to do so.
- Good luck.

First Name:

Last Name:

student id: _____

1. [2 Marks] Why won't the following code compile?

```
public class A implements Comparable {
  public A() { }
  public void f() { }
}
```

2. [1 Mark] Why is it valuable to make instance variables private (or protected)?

3. [1 Mark] Are there any drawbacks to making all instance variables private (or protected)?

4. [1 Mark] Name one way that a Vector is better than an Array.

5. [3 Marks] Implement the `addElement` method of the Vector class. There is space on the next page to put your answer.

6. [5 Marks] Implement a method for the Vector class called `removeRange`. This method should take two ints, and it should remove all elements in the range specified by these two ints (that is from its first argument to one less than its second argument). For example if a vector **v** contains the objects:

   [a, b, c, d, e, f],

   then after the call `v.removeRange(2,4)`, **v** should contain:

   [a, b, e, f].

   There is space on the next page to put your answer.

```
public class Vector {
  protected Object elementData[]; // the data
  protected int elementCount;     // # of elements in vector

  public void addElement(Object obj) {
  // post: adds new element to end of possibly extended vector
```

```
  public void removeRange( int start, int end ) {
  // pre:  start and end are valid indexes into this vector
  // post: all elements from start to end-1 have been removed from
  //       this vector.
```

7. [3 Marks] What is the worst-case time complexity of the Vector class's `enusreCapacity` method? Express your answer as a function of n where n is the size of the vector. Explain your answer.

8. [3 Marks] Circle true or false for each of the following:

   a) $n^2 + n = O(n^2)$ T F

   c) $\log_2 n = O(n)$ T F

   b) $n^2 + n = O(n^5)$ T F

9. [2 Marks] Consider the following method.

```
public static int f( int n )
{
  if ( n == 1 ) return 5;
  else if (n%2 == 0) return f(n/2) + f(n-1);
  else return f(n-1);
}
```

   What is returned by the call `f(5)` to the above method? Recall that `%` is the remainder operator (for example: `9%4` is `1`).

10. [2 Marks] Under what circumstances might insertion sort be more efficient than quick sort?

11. [2 Marks] Consider the following sorting algorithm.

```
public void sort( Comparable[] data )
// post: objects in data[] in ascending order
{
  int numSorted = 0;
  while ( numSorted < data.length )
  {
    for ( int i = 1; i < data.length-numSorted; i++ )
    {
      if ( data[i].compareTo(data[i-1]) < 0 )
        swap( i, i-1 );
    }

    numSorted++;
  }
}
```

How many calls to `compareTo` and `swap` are made when `sort` (shown above) is called on an array constructed as follows (there is room for your answers following the code):

```
Comparable[] data = new Comparable[6];
data[0] = new Integer(1);
data[1] = new Integer(16);
data[2] = new Integer(-11);
data[3] = new Integer(34);
data[4] = new Integer(3);
data[5] = new Integer(34);
```

Number of calls to `compareTo`: _____

Number of calls to `swap`: _____