NAME:

login ID:
precept:

COS 126 Midterm 1 Written Exam, Fall 2009

This test has 8 questions, weighted as indicated. The exam is closed book, except that you are allowed to use a one page cheatsheet. No calculators or other electronic devices are permitted. Give your answers and show your work in the space provided. *Print your name, login ID, and precept number on this page* (*now*), and write out and sign the Honor Code pledge before turning in the test. You have 50 minutes to complete the test.

"I pledge my honor that I have not violated the Honor Code during this examination."

Signature

1	/6
2	/5
3	/5
4	/5
5	/5
6	/12
7	/12
8	/10
TOTAL	/60

October 22, 2009

1. **Number conversion** (6 points). Give the representation of the decimal number 1126 in the following number systems.

   A. Binary (base 2) ______________________

   B. Hexadecimal (base 16) ______________________

   C. Octal (base 8) ______________________

2. **Short answer** (5 points).

   A. Which Java data type has only two values? ____________

   B. True or false: Any for loop can be converted to an equivalent while loop. ____________

   C. What is the value of the Java expression `(.2 * (10/4))`? ____________

   D. What is the value of the Java expression `((.2 * 10)/4))`? ____________

   E. What is the value of the Java expression `(.2 * (10/4.0))`? ____________

3. **Standard input** (5 points). What are the reasons that a program might take input from standard input rather than from the command line?

   A. To allow inputs that consist of more than one line.

   B. To allow inputs that come from a file.

   C. To allow the program to adapt the inputs it requests, based on prior inputs.

   D. All of the above.

   E. None of the above.

4. **TOY** (5 points). An integer array is stored starting at memory location `51`. The length of the array is stored in memory location `50`. The following (partial) TOY program reverses the array by swapping the first element and the last element, then swapping the second element and the next-to-last element, and so on until the `lo` and `hi` pointers cross.
Fill in the 5 missing instructions in the blanks provided below. You *must* select instructions from the following list.

```
2423 2432 7251 7350 8250 8251 8350 A502 B502 C015 D015
```

```
10: 7101      R[1] <- 01                 R[1] gets constant 1
11: ____      R[2] <- 51                 addr of first element (lo)
12: ____      R[3] <- mem[50]
13: 1323      R[3] <- R[2] + R[3]
14: 2331      R[3] <- R[3] - R[1]        addr of last element (hi)

15: ____                                 15-16 exit loop if hi < lo
16: D41E      if (R[4] > 0) pc <- 1E

17: ____      R[5] <- mem[R[2]]
18: A603      R[6] <- mem[R[3]]
19: B503      mem[R[3]] <- R[5]
1A: B602      mem[R[2]] <- R[6]

1B: 1221      R[2] <- R[2] + R[1]        increment lo pointer
1C: 2331      R[3] <- R[3] - R[1]        decrement hi pointer
1D: ____

1E: 0000      halt

50: 0005
51: 1234
52: 5678
53: 9AA9
54: 8765
55: 4321
```

5. **Functions** (5 points). What does the following program print? Write your answer in the blank space at the bottom of the page, below the code.

```
public class Functions {

   public static void printValues(int v) {
     v = v-1;
     System.out.println("Out of " + v + " points.");
   }


   public static void printValues(double v) {
     System.out.println("My score will be " + v + " points.");
   }

   public static void printValues(int x, double y) {
     System.out.print("I will get " + x + " of ");
     System.out.println(y + " points on this question.");
   }

   public static void printValues(double x, int y) {
     System.out.print("Of all the " + x +  " points, ");
     System.out.println("I will receive " + y + " of them.");
   }

   public static void main(String[] args) {
      // Initialize the variables
      int i = 10;
      double d = 9.5;

      // Call some printing functions
      printValues(d);
      printValues(i);
      printValues(i, d);

   }
}
```

6. **Recursive method** (12 points). Consider the following (recursive) static method.

```
public static char mystery(String s, int n, int m)
{
    if (n == 1) return s.charAt(m);

    char first  = mystery(s, n / 2, m * 2);
    char second = mystery(s, n / 2, m * 2 + 1);

    System.out.print(first + " " + second + " ");

    return first;
}
```

A. Give the return value when this method is called with

```
mystery("abc", 2, 0)
```

____

B. Give the return value when this method is called with

```
mystery("abcd", 3, 1)
```

____

C. What is **printed** when this method is called with

```
mystery("fredpass", 5, 1)
```

____

7. **Debugging** (12 points). Consider the following program, which is supposed to read in integer N from standard input, read N strings from standard input, and print them to standard output in reverse order.

```
 1 public class ReverseInputBuggy
 2 {
 3    public static void main(String[] args)
 4    {
 5       int N = StdIn.readInt();
 6       String s;
 7       for (int i = 1; i < N; i++)
 8          s[i] = StdIn.readString();
 9       for (int i = N; i >= 0; i--)
10          System.out.println(s[i]);
11    }
12 }
```

This program has three bugs.

A. Which bug prevents the program from *compiling* successfully? Identify the line number where the bug appears and give a correct version of this line of code.

   Line number ______

   Correct version:

B. After fixing the first bug, which bug causes the program to *crash*? Identify the line number where the bug appears and give a correct version of this line of code.

   Line number ______

   Correct version:

C. After fixing the first two bugs, which bug causes the program to produce *incorrect output*? Identify the line number where the bug appears and give a correct version of this line of code.

   Line number ______

   Correct version:

8. **Performance** (10 points). The following table gives approximate running times for a program with N inputs, for various values of N.

N	*time*
1000	10 seconds
2000	40 seconds
5000	4 minutes
10,000	16 minutes

Which of the following best describes the likely running time of this program for $N = 100{,}000$?

A. A few minutes

B. A few hours

C. A day

D. A month

E. A few years

Refine a power-law hypothesis to give a formula for the approximate likely running time (in **minutes**) of this program as a function of N. You need to find the exponent (**rounded to** an integer) and the leading constant (use scientific notation).