

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) **100 0110 0110**
- B. Hexadecimal (base 16) **466**
- C. Octal (base 8) **2146**

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

- A. Which Java data type has only two values? **boolean**
- B. True or false: Any for loop can be converted to an equivalent while loop. **true**
- C. What is the value of the Java expression $(.2 * (10/4))$? **0.4**
- D. What is the value of the Java expression $((.2 * 10)/4)$? **0.5**
- E. What is the value of the Java expression $(.2 * (10/4.0))$? **0.5**

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: 7251	R[2] <- 51	addr of first element (lo)
12: 8350	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: 2423	R[4] <- R[2] - R[3]	15-16 exit loop if hi < lo
16: D41E	if (R[4] > 0) pc <- 1E	
17: A502	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: C015	if (R[0] == 0) pc <- 15	
1E: 0000	halt	
50: 0005		
51: 1234		
52: 5678		
53: 9AA9		
54: 8765		
55: 4321		

The TOY reference card is on the last page of the exam.
 Feel free to tear out the last page in order to use it more easily.

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);  
    }  
}
```

My score will be 9.5 points.
Out of 9 points.
I will get 10 of 9.5 points on this question.

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)` **a**

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

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

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

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

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 **6**

Correct version: **String [] s = new String[N];**

- 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 **9**

Correct version: **for (int i = N - 1; i >= 0; i--)**

- 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 **7**

Correct version: **for (int i = 0; i < N; i++)**

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

N	<i>time</i>
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).

$a = 1.667e-7$

$b = 2$