COE 212 – Engineering Programming

Welcome to Exam I
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Solution

Instructions:

1. This exam is **Closed Book**. Please do not forget to write your name and ID on the first page.
2. You have exactly **115 minutes** to complete the **8** required problems.
3. Read each problem carefully. If something appears ambiguous, please write your assumptions.
4. Do not get bogged-down on any one problem, you will have to work fast to complete this exam.
5. Put your answers in the space provided only. No other spaces will be graded or even looked at.

Good Luck!!

Problem 1: Multiple choice questions (**20 minutes**) [16 points]

For each question, choose the **single** correct answer.

1) Method headers contain **all** of the following **except**:
   a. visibility modifier
   b. name of the method
   c. return type
   d. **none of the above**

2) Every Java file is composed of exactly one
   a. `main` method
   b. **public class declaration**
   c. imported class
   d. instance variable

3) What is the name of the values that a method call statement passes to the method's parameters?
   a. Formal parameters
   b. **Actual parameters**
   c. Values
   d. None of the above

4) What type of methods allows a client of a class to assign values to a private instance variable?
   a. Mutator methods
   b. Setter methods
   c. **Both of the above**
   d. Getter methods

5) How many parameters does a default constructor take?
   a. **0**
   b. 1
   c. A variable number of parameters
   d. none of the above

6) Which of the following does not lead to a Java syntax error?
   a. Mismatched curly braces {}
   b. **An extra blank line in the code**
   c. Missing a semi-colon ;
   d. All of the above

7) What is the output of the following statements?
   ```
   System.out.print("Hello ");
   System.out.println("World");
   ```
   a. **Hello World**
   b. Hello
      World
   c. World
      Hello
   d. None of the above

8) Which of the following is true?
   a. **Methods can be either `public` or `private`**
   b. Information hiding is achieved via the keyword public
   c. The private members of a class are directly accessible to client programs
   d. None of the above is true

9) Which of the following lines will generate a random `int` value in the range of 5 (inclusive) to 20 (inclusive)?
   a. `(int) Math.random() * 5 + 16`
   b. `(int) Math.random() * 16 + 5`
   c. Both of the above
   d. **None of the above**

10) Which of the following refers to the automatic conversion from a primitive type to its corresponding wrapper class?
   a. Aliasing
   b. **Autoboxing**
   c. Unboxing
   d. None of the above

11) Suppose we have a `String` object referenced by a variable called `listing`. Suppose we want a new `String` object that consists of the last 5 characters in `listing`. Which of the following lines of code will achieve this objective?
   a. `String prefix = listing.substring(5);`
   b. `String prefix = listing.substring(length()-5, length()-1);`
   c. `String prefix = listing.substring(length()-5, length());`
   d. **None of the above**

12) Methods that can be called directly through the class name and do not need to have an object instantiated are called
   a. Public methods
   b. Private methods
   c. Instance methods
   d. **None of the above**

13) Of the following types, which one cannot store a number
   a. `int`
   b. `byte`
   c. `String`
   d. **None of the above**

14) A cast is required in which of the following situations?
   a. Storing an `int` in a `double`
   b. Storing a `float` in a `double`
   c. Using the `charAt` method to extract an element of a `String` and storing it in a `char`
   d. **Storing a `float` in an `int`**

15) Since you cannot take the square root of a negative number, you might use which of the following instructions to find the square root of an `int` variable x?
   a. `Math.sqrt(-x);`
   b. `Math.sqrt((int) x);`
   c. `Math.abs(Math.sqrt(x));`
   d. **None of the above**

16) A variable whose scope is the entire class is known as
   a. parameter
   b. **instance variable**
   c. local variable
   d. None of the above

Problem 2: Long True or false questions (**15 minutes**) [12 points]
In the following questions, check **all** the correct answers. There is at least one correct answer per question, but **there may be more**.

1. Which of the following are true:
   a. **Java bytecode files end with the .class extension.**
   b. It is possible to define several classes in a single Java source file.
   c. **The following Java statement: Math.pow(2, 3); would yield a float value of 8.0.**

2. Which of the following are false:
   a. The Java language is strongly typed and case sensitive.
   b. All Java reserved words are lowercase.
   c. **A `final` variable in Java can only be numeric.**

3. Which of the following are false:
   a. **Accessor methods are the only way the value of an object's instance variables can be modified.**
   b. **An accessor method uses void as its return type.**
   c. A mutator method is also known as a 'setter'.

4. Which of the following are true:
   a. Casting a double variable to a long always leads to a loss of information.
   b. **If an uninitialized primitive variable is used, the compiler issues an error message.**
   c. **Instance data defines the state of a class.**

5. Which of the following are false about methods:
   a. **Formal parameters of a method are considered as local variables and cannot have the same name as instance variables.**
   b. **A return statement is required at the end of every setter method.**
   c. public or private can be used as visibility modifiers.

6. Which of the following are true:
   a. **A method can have at most a single return statement.**
   b. Every class definition must include a main method.
   c. **The data types of the actual parameters used when calling a method must match those in the method's parameter list exactly.**

7. Which of the following are false about wrapper classes:
   a. There is a wrapper class for every primitive data type.
   b. **Wrapper classes have the same names as the corresponding data type but the first letter is capitalized.**
   c. Unboxing refers to the automatic conversion of a wrapper class object to the corresponding primitive data type.

Problem 3: Short True or false questions (**10 minutes**) [10 points]

1. A valid Java arithmetic expression with no parentheses is always evaluated from left to right.
Answer: True   **False**

2. Empty parentheses following a method name in a method declaration indicate that the method does not produce any value after performing its task.
Answer: True   **False**

3. Floating-point values that appear in source code are known as floating-point literals and are of type `float` by default.
Answer: True   **False**

4. In a Java program, a method that does not return any value can either have a return type of `void` or have no return type listed at all.
Answer: True   **False**

5. Multiple `System.out.println` statements in a Java program could result in a single line of output.
Answer: True   **False**

6. The output of the statements below is: 4
```
int value = 9;
System.out.println(value / 2 * 1.0);
```
Answer: True   **False**

7. After running the code shown below, the value stored in variable x is: 9
```
int y = 3;
int x = y * y++;
```
Answer: **True**   False

8. The output of the program segment below is: 3 Done
```
String a = "2", b = "1";
System.out.print(
           Integer.parseInt(a)+Double.parseDouble(b));
System.out.println(" Done");
```
Answer: True   **False**

9. If you don't implement the `toString()` method in a class, then using an instance of that class in a `System.out.println()` statement results in a number.
Answer: True   **False**

10. Consider a `String` variable called `str`. The following Java statement: `str.length;` returns the total number of characters stored in `str`.
Answer: True   **False**

Problem 4: Random class (**10 minutes**) [8 points]
For each of the following questions, assume the following declaration:
`Random rand = new Random();`
1) Write statements that assign random integers to the variable n in the following ranges:
   a. $1 \le n \le 2$

   ```
   int n = rand.nextInt(2) + 1;
   ```

   b. $0 \le n \le 9$

   ```
   int n = rand.nextInt(10);
   ```

   c. $1000 \le n \le 1112$

   ```
   int n = rand.nextInt(113) + 1000;
   ```

   d. $-1 \le n \le 1$

   ```
   int n = rand.nextInt(3) - 1;
   ```

   e. $-3 \le n \le 11$

   ```
   int n = rand.nextInt(15) - 3;
   ```

2) For each of the following sets of integers, write a single statement that will display a number at random from the set:
   a. 2, 4, 6, 8, 10.

   ```
   int n = 2 * rand.nextInt(5) + 2;
   ```

   b. 3, 5, 7, 9, 11.

   ```
   int n = 2 * rand.nextInt(5) + 3;
   ```

   c. 6, 10, 14, 18, 22.

   ```
   int n = 4 * rand.nextInt(5) + 6;
   ```

Problem 5: Code analysis (**15 minutes**) [10 points]

1) Assume that an instance of the class called `Confuse1` given below is created and that this instance is used to call the method `doIt()`. What output is produced by this method call?

```
public class Confuse1 {
    private int x = 0;
    public void first(int y) { x = x + y; }
    public void second(int a, int b) {
        x = a- 1 ;
        first(b) ; }
    public void doIt() {
        x = 3;
        int y = 6;
        first(y);
        second(y, x);
        System.out.println("Answer is: "+x);}
} // end class Confuse1
```

   a. Answer is: 4
   b. Answer is: 5
   c. Answer is: 6
   d. Answer is: 11
   e. None of the above

2) Assume that the class called `Confuse2` given below is instantiated and that the instance is printed using a `System.out.println` statement. What output is produced?

```
public class Confuse2 {
    private int x, y;
    public Confuse2() { x = 3 ; y = 6; }
    public void first(int z) {
        x=z; y++; }
    public void second (int s, int t) {
        setXY((y+t),(x-s)) ;}
    public void setXY(int s, int y) {
        x = s; this.y = y; }
    public String toString() {
        first(y);
        second(y, x);
        return "Answer is: " + x + y;
    }
} // end class Confuse1
```

   a. Answer is: 12
   b. Answer is: -12
   c. Answer is: 13-1
   d. Answer is: 1-13
   e. None of the above

Problem 6: Evaluating Java expressions (**15 minutes**) [8 points]

For each of the following code fragments, what is the value of x after the statements are executed?

(1)
```
String s = "Evaluating Java expressions";
char x = s.charAt(s.length() –
          s.substring(4, 12).length());
```
Answer: x= **'r'**

(2)
```
int y = (int) Math.PI*9;
int x = 2*y + (y++);
```
Answer: x= **81**

(3)
```
DecimalFormat fmt = new DecimalFormat("00.###");
double z = 2.1;
z /= 0.5;
String x = fmt.format(z);
x += 24;
```
Answer: x= **04.224**

(4)
```
String s1 = "The exam is fun";
s1.replace('e', 'x');
String x = s1.replace('x', 'E');
```
Answer: x= **"The eEam is fun"**

(5)
```
int x=0;
int y = 1;
y++;
x = x -y;
```
Answer: x= **-2**

(6)
```
int m = 18, n = 4;
x = m/n + m % n;
```
Answer: x= **6**

(7)
```
int n = 4;
double x = 2.5;
x = 5 * x - n / 5;
```
Answer: x= **12.5**

(8)
```
String x = "x";
String y = "z";
x = x.concat(x + "\\y");
```
Answer: x= **"xx\y"**

Problem 7: Miscellaneous (**5 minutes**) [6 points]

For each question, choose the single best answer:

1. Consider the following class declaration:

```
public class SimpleInteger {
   private int i;
   public void setValue(int v){ i = v; }
   public int getVal() { return i; } }
```

   Assuming that x is a properly constructed SimpleInteger, which of the following statements will compile correctly in a client program that uses a SimpleInteger?

   a) **System.out.println(x.getVal());**
   b) System.out.println(x.i);
   c) System.out.println(x.setVal(10));
   d) (a) and (b) only.
   e) (b) only.
   f) (a) and (c) only.

2. Consider the following code segment for a method called calculate.

```
public int calculate(int x) {
    x = x * x; x = x * x; return x; }
```

   A call to calculate(2) will return:
   a) 4
   b) **16**
   c) 8
   d) 9

3. Which of the below statements are legal?
   a) String s = "40";
   b) Integer i = new Integer(40);
   c) Integer i = 40;
   d) String s = new String("40");
   e) **All of the above are legal.**

Problem 8: Coding (25 minutes) [30 points]

Coding Problem 1

Newton's gravitational force between 2 planets is given by:

$$F = G.\frac{M.m}{r^2}$$

Where M is the mass of the first planet, m is the mass of the 2nd planet, r is the distance between them and G is the gravitational constant given by: $G = 6.674 \times 10^{-11}$

Write a JAVA application called Newton that reads the masses of 2 planets from the user as well as their corresponding inter-planetary distance and prints out the gravitational force F between them. F must be rounded to 2 decimal places with the letter N concatenated at the end.

Sample output:
```
Enter mass of planet 1:    225640205684759256
Enter mass of planet 2:    82354240000000063801
Enter distance:            126589
F = 77392114875204475.07N
```

```java
import java.util.Scanner;
import java.text.DecimalFormat;

public class Newton {
    public static void main (String[] args) {
        DecimalFormat fmt = new DecimalFormat("0.##");
        Scanner scan = new Scanner(System.in);
        final double G = 6.674 * Math.pow(10,-11);
        System.out.print("Enter mass of planet 1: ");
        double M = scan.nextDouble();
        System.out.print("Enter mass of planet 2: ");
        double m = scan.nextDouble();
        System.out.print("Enter distance: ");
        double r = scan.nextDouble();
        double F = G * M * m / Math.pow(r,2);
        System.out.println("F = " + fmt.format(F) + "N")
    }
}
```

Coding Problem 2

One light year is equivalent to 9.4605284×10^{15} meters. Write a JAVA program called `LightYear` that reads from the user a distance in meters and prints out its corresponding equivalent in light years.

Sample output:
```
Enter distance: 150000000000
150000000000 meters is: 0.000015855351166 light years
```

```java
import java.util.Scanner;

public class LightYear {
    public static void main (String[] args) {
        Scanner scan = new Scanner(System.in);
        final double l = 9.4605284 * Math.pow(10,15);
        System.out.print("Enter distance: ");
        double d = scan.nextDouble();
        double ly = d/l;
        System.out.println(d + " meters is: " + ly +
                            "light years");
    }
}
```
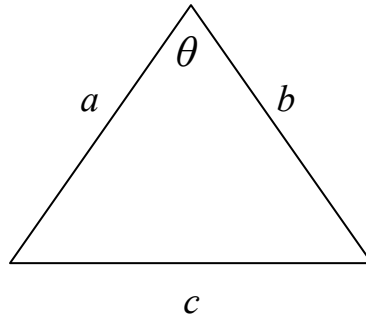
Coding Problem 3

A triangle has three sides as indicated in the figure below. The generalized Pythagoras rule to compute the length of side *c* of the triangle is:

$$c = \sqrt{a^2 + b^2 - 2ab\cos(\theta)}$$

Write a JAVA application that will accept from the user the values of sides *a* and *b* as well as the value of the angle *θ* and print the length of side *c*.

```java
import java.util.Scanner;

public class Triangle {
    public static void main (String[] args) {
        Scanner scan = new Scanner(System.in);
        System.out.print("Enter a: ");
        double a = scan.nextDouble();
        System.out.print("Enter b: ");
        double b = scan.nextDouble();
        System.out.print("Enter the angle: ");
        double t = scan.nextDouble();
        double c = Math.sqrt(a * a + b * b +
                    2 * a * b * Math.cos(t));
        System.out.println("c = " + c);
    }
}
```