Problem Session 1

# Question 1 - Data Types - 10 points

What do the following Java expressions evaluate to? If an expression does not compile or cause and exception at runtime, put an **X** in both columns.

| Expression | Value | Type |
| --- | --- | --- |
| "1" + 2 \* 6 |  |  |
|  |  |  |
| 1 / 2 / 6 |  |  |
|  |  |  |
| Integer.parseInt(12) \* 6 |  |  |
|  |  |  |
| (1 >= 26) || (12 >= 6) |  |  |
|  |  |  |
| (int) 1.26 / (double) 10 |  |  |
|  |  |  |
| 1.2e6 % 1.2e5 |  |  |
|  |  |  |
| 1 <= 2 < 6 |  |  |
|  |  |  |
| Math.min(1.2e6, 1.2e7, 1.2e8) |  |  |
|  |  |  |
| true != false && true > false |  |  |
|  |  |  |
| !!!!!!false |  |  |

# Question 2 - Arrays - 10 points

Consider the following Java code fragment.

int[] a = { 1, 6, 5, 3, 0, 2, 4 };  
int n = a.length;  
  
int [] b = new int[n];  
for (int i = 0; i < n; i++)  
 b[a[i]] = i;  
  
int [] c = new int [n];  
for (int i = 0; i < n; i++)  
 c[i] = a[b[i]];

What are the values of the elements in the array b[] and c[] after the above code fragment is executed? Write your answers in the space below.

a[] = { 1, 6, 5, 3, 0, 2, 4 }

b[] = { \_, \_, \_, \_, \_, \_, \_ }

c[] = { \_, \_, \_, \_, \_, \_, \_ }

# Question 3 - Arrays - 10 points

Determine whether each statement below is true or false. Assume no index is out of bounds. Write either “true” or “false” on each line.

**For Part 8-11**:

int[] a = new int [6];  
int [] b = new int [6];  
int[] c = a;  
c[0] = 3;

| Statement | True or False |
| --- | --- |
| 1. Every element in a new array of integers in initialized to 0. | **true** |
|  |  |
| 3. Every element in a new array of booleans is initialized to true. |  |
|  |  |
| 4. N-1 is the last valid index into an array of size N. |  |
|  |  |
| 5. 0 is the index of the smallest element in an array of size N. |  |
|  |  |
| 6. N-3 is the index of the third-to-last element in an array of size N. |  |
|  |  |
| 7. (int) (Math.random() \* N) is a valid index into an array of size N. |  |
|  |  |
| 8. You can create a new array without using the new keyword. |  |
|  |  |
| 9. Given the array a, b and c as defined above, a == b evaluates to true. |  |
|  |  |
| 10. Given the array a, b and c as defined above, a == c evaluates to true. |  |
|  |  |
| 11. Given the array a, b and c as defined above, a[b[0]] evaluates to 0. |  |
|  |  |
| 12. Given the array a, b and c as defined above, a[b[c[0]]] evaluates to 0. |  |

# Question 4 - Functions - 10 points

Which of the following statements are true for Java functions (static methods). Mark each statement as either true or false.

| true | false | Statement |
| --- | --- | --- |
|  |  | A function can accept more than one argument. |
|  |  |  |
|  |  | You can use double as the return type of a function. |
|  |  |  |
|  |  | A function can call other functions only if those functions are defined in the same .java file. |
|  |  |  |
|  |  | Two functions defined in the same .java file can have the same name only if they have a different number of argument |
|  |  |  |
|  |  | If you pass a (reference to an) array as an argument to a function, the function can not only read the array’s entries, but it can also change them. |

# Question 5 - Functions - 10 points

What do each of the following functions return? Fill in the table below.

Assume that the array x, y and z are defined as follows:

int[] x = new int[5];  
int[] y = {1, 2, 6};  
int[] z = {-10, 0, 10};

public static int f(int[] a) {  
 int t = 0;  
 int n = a.length;  
 for (int i = 0; i < n; i++)  
 t += a[i];  
 return t;  
}

| f(x) | f(y) | f(z) |
| --- | --- | --- |
|  |  |  |

public static int g(int[] a) {  
 int n = a.length;  
 for (int i = 0; i < n; i++)  
 a[i] = a[n-i-1];  
 return f(a);  
}

| g(x) | g(y) | g(z) |
| --- | --- | --- |
|  |  |  |

**NOTE**: The arrays x, y and z are reset to their original values before calling h().

public static int h(int[] a) {  
 int n = a.length;  
 for (int i = 0; i < n; i++)  
 a[i] = f(a);  
 return f(a);  
}

| h(x) | h(y) | h(z) |
| --- | --- | --- |
|  |  |  |

# Question 6 - Arrays - 10 points

Which of the following are properties of arrays in Java?

Mark each statement as either true or false by filling in the table below.

| true | false | Statement |
| --- | --- | --- |
|  |  | After you create and initialize an int[] array, you cannot change its length. |
|  |  |  |
|  |  | If a is an array of type char[] and length 10, then a[0.0] is a valid expression that given its first element. |
|  |  |  |
|  |  | It is possible to declare, create and initialize a String[] array without using the keyword new. |
|  |  |  |
|  |  | If a[] and b[] are two different arrays of the same type and length, then the expression (a == b) evaluates to true if the corresponding array elements are equal, and false otherwise. |
|  |  |  |
|  |  | The elements of an array of type int[] are stored in the computer’s memory (i.e., in consecutive memory locations). |
|  |  |  |
|  |  | It is possible to create and initialize a two-dimensional array a[][] of type double[][] such that (a[0].length != a[1].length) |

# Question 7 - Functions, arrays and pass-by-value - 5 points

Consider the following two functions, which purport to negate the values in an integer array:

public static void negate1(int[] a) {  
 for (int i = 0; i < a.length; i++)  
 a[i] = -a[i];  
}  
  
public static int[] negate2(int[] a) {  
 int[] b = new int[a.length];  
 for (int i = 0; i < a.length; i++)  
 b[i] = -a[i];  
 a = b;  
 return b;  
}

Suppose that an integer array a[] in main is declared and initialized to contain the three integers [1, 2, 3]. What will be the contents in the array referenced by a[] after executing each of the following statements? Answer each part independently.

For each statement on the left, write the letter of the best-matching description on the right. You may use each letter once, more than once, or not at all.

| Statement | Description |
| --- | --- |
| B\_ negate1(a); | A. [1, 2, 3] |
|  |  |
| A\_ negate2(a); | B. [-1, -2, -3] |
|  |  |
| B\_ a = negate2(a); | C. [0, 0, 0] |
|  |  |
| A\_ negate1(negate2(a)); | D. compile-time error or run-time exception |
|  |  |
| B\_ a = negate2(negate2(negate2(a))); |  |

# Question 8 - Properties of types, variables and expressions - 5 points

Which of the following are properties of type, variables and expressions in Java?

Mark each statement as either true or false by filling in the table below.

| true | false | Statement |
| --- | --- | --- |
|  |  | Every variable has a type (such as int, double or String) that is known at compile time. |
|  |  |  |
|  |  | The result of applying one of the arithmetic operators (+, -, \*, /) to two double operands always evaluates to a value of type double(and never produces a run-time exception). |
|  |  |  |
|  |  | If you attempt to use a local variable of type int in an expression before that variable has been assigned a value, Java will substitute the value 0. |
|  |  |  |
|  |  | If a variable is declared and initialized in the body of a for loop, that variable cannot be accessed outside that loop. |
|  |  |  |
|  |  | If you name a variable with all uppercase letters and initialize it to some value, attempting to subsequently change its value would lead to a compile-time error. |