Problem 1 – Introduction to computers, programming and Java
(Readings: book: Chapter 1, part 1 of the online lecture notes)

a) What is a computer program?
sequence of instructions written to perform a specified task

b) List main components of any computer
CPU, main memory (RAM), storage devices (HDD), input-output devices (keyboard, mouse, monitor, etc), communication devices (network interface, etc.)

c) How binary numbers are stored in memory?
electronic switches

d) How many bytes (minimum) do we need to store the information about person’s year of birth?
2 bytes, but if you really want it, you can probably come up with smart way to encode this with 1 byte,

e) What is a CPU register?
A small amount of memory inside CPU, to execute some instruction the data (e.g. operands of the addition instructions) should be loaded into the registers first.

f) What is a data type?
The data type allows the computer program to use the appropriate encoding (interpretation) scheme to interpret the number stored in the variable. It determines the possible values for that type; the operations that can be done on values of that type; the meaning of the data; and the way values of that type can be stored

g) Which commands do we need to type in order to compile and run a Java program?
If our program is called program.java
> javac program.java
> java program

h) What is the meaning of this operator in Java: !=
Not equal
i) What can we use as an identifier in a Java program?
   Identifier can contain letters (lower and uppercase), digits, underscore and $. It cannot start with a digit and it cannot be one of the reserved words (e.g. true, if, for, class etc)

j) Is this a valid Java statement? If not, why?
   double a = 1.0;
   5 = a + 3;

   No, left part of the assignment should be a variable.

k) Convert the given binary number (a number in a system with base 2) to a hexadecimal number (a number in a system with base 16): 10011111₂ = X₁₆

   9F

Problem 2 – Java expressions
(Focus on operations precedence p.116, type casting Chapters: 2.15, 2.17.3)

For each row of the table, state whether the statement is correct or has an error. If there is an error, describe it. If there is no error, give the value stored by the assignment statement. Evaluate each statement with the original values of the variables. The first row has been completed for you. (Assume each row to be independent, that results of some row don’t affect other rows, so you should use original values of variables for each question).

Original values of the variables:
int i1 = -2, i2 = 3;
long L1 = 2, L2 = 10;
boolean b = false;
double d1 = 2.5, d2 = 3;
char c1 = 'a', c2 = 'z';
String s1 = "a", s2 = "z";

<table>
<thead>
<tr>
<th>Statement</th>
<th>Error?</th>
<th>Reason of Error or value assigned or returned (and type of result)</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 = c1 &gt;= c2 - 20 ? 10 : 15;</td>
<td>No</td>
<td>15 long</td>
</tr>
<tr>
<td>d1 = (int)d1 * d2;</td>
<td>No</td>
<td>6.0 double</td>
</tr>
<tr>
<td>b = d1 &gt; L1</td>
<td></td>
<td>s1.length() == 2;</td>
</tr>
<tr>
<td>s1 = s1 + c1 + L1 + i1;</td>
<td>No</td>
<td>&quot;aa2-2&quot;</td>
</tr>
<tr>
<td>s2 = s2 - c2;</td>
<td>Yes</td>
<td>- operation is not defined for strings</td>
</tr>
<tr>
<td>s1 += s1;</td>
<td>No</td>
<td>&quot;22&quot;</td>
</tr>
<tr>
<td>il = L2 / (int)L1;</td>
<td>Yes</td>
<td>type casting is performed before division. Long / int will convert denominator back to Long and the result will be Long. And we cannot assign long to int variable because it is not safe.</td>
</tr>
</tbody>
</table>
Problem 3 – Trace program

Look at the following Java program:

```java
class Exam1 {
    public static void main(String[] args) {
        java.util.Scanner in = new java.util.Scanner(System.in);
        String str = in.nextLine();
        String str1 = str.substring(0, str.length() / 2);
        String str2 = str.substring((str.length() + 1)/2, str.length());
        if (str1.equals(str2))
            System.out.println("Yes");
        else
            System.out.println("No");
    }
}
```

Trace the execution of the program for the following inputs:
1) test string
result: No

2) abcabc
result: Yes

3) testtest
result: Yes

What does the program accomplish?

It checks if the first half of the string equals the second part of the string.
Problem 4 – Triangle

Write a program that asks user to enter 3 numbers: lengths of the sides of a triangle and checks if such a triangle exists (and outputs the corresponding message).

**Hint:** The triangle inequality states that for any triangle, the sum of the lengths of any two sides must be greater than the length of the remaining side.

```java
public class Problem4 {
    public static void main(String[] args) {
        java.util.Scanner in = new java.util.Scanner(System.in);

        double side1 = in.nextDouble();
        double side2 = in.nextDouble();
        double side3 = in.nextDouble();

        if (side1 < side2+side3 && side2 < side1+side3 && side3 < side1+side2)
            System.out.print(“Triangle exists!”);
        else
            System.out.print(“Triangle exists!”);
    }
}
```
Problem 5 – Guess what

Write a program, that generates a random number of 1 to 100 and asks user to guess this number. A user should guess until he finds the number (or he enters a negative number as a guess, which means that he gives up). For each guess the program should print "No", if the guess is too far away from the number, "Close" if the guess is close to the number (by close we mean the absolute value of the difference is less than 10) or “Yes” if the guess is correct.

To generate a random number you can use the Math.random() method, which generates a floating point number from 0 to 1(exclusive). You can then transform it to a number from 1 to 100. This line is written for you.

```java
public class Problem5 {
    public static void main(String[] args) {
        java.util.Scanner in = new java.util.Scanner(System.in);

        int number = (int)(Math.random() * 100) + 1;
        int guess = 0;

        while (guess != number && guess >= 0) {
            System.out.print("Enter your guess: ");
            guess = in.nextInt();
            if (guess == number)
                System.out.println("YES!");
            else if (Math.abs(guess - number) < 10)
                System.out.println("Close!");
            else
                System.out.println("No");
        }
    }
}
```