PROBLEM SET 5

Modular Programming

1. Consider the following :

```java
static int meth(int n) {
        int d, s;
        s = 0;

        while (n > 0) {
            d = n % 10;
            s += d;
            n /= 10;
        }
        return s;
    }
```

Find the result of each of the following method calls, determine what the method does.

i) `meth(876)`   **ii)** `meth(9056)`   **iii)** `meth(9)`   **iv)** `meth(22222)`

2. Trace and find the output of the following program.

```java
public class Main {
    public static void main(String[] args) {
        int k, n, res;
        n = 3;
        for (k = n; k < n * 4; k += n + 1) {
            System.out.println(k);
            for (res = 3 * n; res >= k; res -= n) {
                System.out.println(func2(res, k));
            }
            System.out.println(res);
        }
        System.out.println(k);
    }

    static int meth(int n1, int n2) {
        int m;
        m = n1;

        while (n1 > n2) {
            m += n2;
            n2 *= 2;
        }
        return m;
    }
}
```

3. Consider the following method:

```
static int meth(int a) {
        int b, c, k, d;
        b = a + (int) Math.sqrt(a + a / 2 * 2);
        d = b - a;
        c = (int) Math.pow(d, 2);
        for (k = 0; k < b - a; k++) {
            if (c == d * (b - a)) {
                d /= 2;
            } else {
                // Your code here if the condition is not met
            }
        }
        c /= 2;
        return (c + d);
    }
```

Find the result of each of the following method calls.

i) `meth(2)`   **ii)** `meth(5)`   **iii)** `meth(0)`   **iv)** `meth(8)`

4. Define a for each of the following problems:

a) Given a real number, return its fractional part. For example, if **35.08** is given, the method should return **0.08**.

b) Given a length in feet, convert it into milimeters. (1 foot = 12 inches, 1 inch = 2.54 cm)

c) Given a temperature in degrees Fahrenheit (F), convert it into degrees Centigrade (C) using the formula:

$$C = \frac{F - 32}{1.8}$$

d) Given a temperature in degrees Centigrade (C), convert it into degrees Fahrenheit (F).

e) Calculate the area of a circle. (π = 3.1416)

Area of a circle = πr^2

f) Calculate the perimeter of a circle. (π = 3.1416)

Perimeter of a circle = $2 \pi r$

g) Calculate the volume of a cylinder, using the method you defined in question **4.e**.

Volume = $\pi r^2 h$

h) Calculate the surface area of a cylinder, using the methods you defined in question **4.e** and **4.f**.

Surface Area = $2 \pi r^2 + 2 \pi r h$

i) Given the radius of a circle, return its area and perimeter.

j) Given the base radius and height of a cylinder, return its volume and surface area, using the method you defined in question **4.i**.

k) Given the cost of an item in YTL and the percentage of the VAT (KDV) for that item, calculate the amount of VAT you have to pay for it.

l) Given the marks a student got from Midterm 1, Midterm 2 and Final Exam of a course, calculate the average grade of that student.

m) Given a three digit positive integer, find the sum of its digits. For example, if the given integer is 357, the method should return 15 (which is calculated as 3 + 5 + 7 = 15).

n) Given a three digit positive integer, find the product of its digits. For example, if the given integer is 357, the method should return 105 (which is calculated as 3 x 5 x 7 = 105).

o) Given any positive integer with any number of digits, find the sum of its digits. For example, if the given integer is 35 the method should return 8, if it is 3572 the method should return 17.

p) Given any positive integer with any number of digits, find the product of its digits. For example, if the given integer is 35 the method should return 15, if it is 3572 the method should return 210.

q) Given any positive integer with any number of digits, find how many digits it contains. For example, if the given integer is 35 the method should return 2, if it is 3572 the method should return 4.

r) Calculate the absolute difference of two given numbers (x and y), where the absolute difference is x – y or y – x, whichever is positive. Do not call the `abs` or `fabs` method in your method.

s) In a company, a worker normally gets a constant pay per week for upto 40 hours work. For each extra working hour, he gets some extra pay. Given the hours a worker worked in a week, and the amounts of the constant pay and the extra pay, calculate his pay for the week.

t) A company gives 10% salary increase to its workers whose salaries are less than 15000 TL, and 8% salary increase to the other workers. However, 5% of the increase the workers take is cut for foundation. Given the amount of the previous salary of a worker in that company, calculate his new salary.

u) Given the lengths of three sides of a triangle, determine whether that triangle is equileteral or not.

v) Given the lengths of three sides of a triangle, determine whether that triangle is a right-triangle or not, using the Pythagorean theorem (hypotenuse of a right-triangle is equal to the square root of the sum of the squares of its perpendicular sides). Do not assume that, the sides are given in any order.

w) Given a positive integer, calculate its factorial.

x) In Fibonacci's sequence,

       1, 1, 2, 3, 5, 8, 13, …

the first two terms are 1 and each successive term is found by adding the previous two terms. Given N, return the Nth term of the Fibonacci's sequence.

y) In a biology experiment, a student finds that a sample of an organism doubles in population every hour. Given the number of organisms she starts with, and the minimum number of the organisms she wants to obtain, calculate how many days and hours she needs to reach her aim.

z) Given two integers, determine whether the first one is divisible by the second one.

aa) A prime number is a number which is divisible by only 1 and itself. 0 and 1 are not prime numbers. The smallest prime number is 2. Given a positive integer, determine whether it is a prime number, using the method you defined in question **4.z**.

bb) Given a time duration in minutes, return this time duration in days, hours, and minutes. For example, if the duration is 3550 min., return the values: 2 (days), 11 (hours), and 10 (min).

cc) Check if a character is a lowercase letter.

dd) Check if a character is an uppercase letter.

ee) Given a lowercase letter, return the uppercase of that letter.

ff) Given an uppercase letter, return the lowercase of that letter.

5. **Analyze the following problems and develop a program for each of them, using <u>one or more</u> of the methods you defined in question 4.**

a) Given the diameter of a circle and a letter (A or P) as input, compute the area of the circle if the letter is A, the perimeter of the circle if the letter is P.

b) Given the height of a cylinder in feet and the radius of its base in millimeters, and a letter (V or S) as input, compute the volume of the cylinder in mm^3 if the letter is V, the surface area of the cylinder in mm^3 if the letter is S.

c) Given the base radius and height values for some cylinders, display the base radius, base area, base perimeter, height, volume, and surface area of each cylinder.

d) Given some time durations in minutes, ending with –1, display each time duration in days, hours and minutes.

e) Given x and y pairs, make a table that shows those numbers and their absolute difference. Your program should stop when the user enters two numbers that are equal to each other.

f) Given a set of real numbers where the lowest one is -250, output a list of those numbers, and the number of negative values and the number of positive values whose fractional part is greater than 0.25 at the bottom of the list, with proper messages.

g) Given a three-digit integer, calculate the sum of its digits, if the integer is greater than 500, the product of its digits, if the integer is less than or equal to 500. Do not allow the user to enter a negative integer, or an integer which is not three-digit. For example, if the given integer is 760, the output should be 13, but if it is 352, the output should be 30.

h) Given an integer, calculate the product of its digits, if it contains 4 or more digits, the sum of its digits, if it contains less than 4 digits. Do not allow the user to enter a negative integer as input. For example, if the given integer is 3521, the output should be 30, but if it is 61, the output should be 7.

i) In a company, a worker normally gets 750 TL per week for up to 40 hours work. For each extra working hour, he gets 75 TL extra pay. Given the number of workers in that company, and each worker's ID number and hours he worked this week, display each worker's ID number and his pay for the week.

j) Given some positive integers, determine whether each of them is prime or not.

k) Make a table that shows the temperatures between 0 and 100 degrees Fahrenheit, in increments of 5 degrees, and the corresponding temperatures in degrees Centigrade.

l) A company gives 10% salary increase to its workers whose salaries are less than 10500 TL, and 8% salary increase to the other workers. However, 5% of the increase the workers take is cut for foundation. Given the number of workers in that company, and the amount of the previous salary of each worker, together with his name, calculate the new salary of each worker.

m) Given a value for X, calculate the result of the sum of the following series, until a term that is less than 0.00005 is reached.

$$X - \frac{X^3}{3!} + \frac{X^5}{5!} - \frac{X^7}{7!} + \ldots$$

n) In a biology experiment, a student finds that a sample of an organism doubles in population every hour. If she starts with 100 organisms, after how many hours will she have more than 10 million organisms?

o) Given the number of students in a class, and the IDs and the grades of the students they got from Midterm 1, Midterm 2 and Final Exam of a course, make a table which shows the student IDs, their grades from the exams, and their average grades.

p) In a supermarket, all items have a VAT (KDV) of 12%. Given the item ID and the cost of each item sold in that supermarket, make a table which shows the ID, cost, amount of VAT, and cost with VAT of each item. Use 0 as the sentinel value for the item IDs.

q) Given the lengths of three sides of a triangle in feet, display the area of the triangle in ft^2 if it is a right triangle, its perimeter in millimeters if it is equilateral, the message NONE otherwise.

r) Given an integer k, output the kth term of the Fibonacci's sequence if k is two-digit, $(k/10)^{th}$ term if k is three-digit, 15th term otherwise.

s) Given a letter (uppercase or lowercase) and a sentence ending with '.', count how many of the words in the sentence are beginning with the letter entered by the user. (Do not forget to validate that the user enters a letter.)