

At this exam, you have little time. Recommendation: Solve two out of the three given problems.

- You have **55 minutes** from the moment that the beginning of the exam is announced.
- This exam consists of three problems. Each is worth up to five credits, out of 100 credits for the whole course. At most ten credits can be gained from the present term exam.

You need to **work on two problems** to achieve an optimal outcome.

- If you **choose to work on two problems**, these will both count normally (i.e., up to five credits each), yielding an **optimum total of ten credits**.
- If you choose to work on all three problems, the outcomes will be ordered by the number of credits achieved. **The best two problems count normally**, i.e., with up to five credits each, and **the remaining problem does not count**, again yielding up to ten credits for the exam as a whole. The outcome of the remaining problem does not influence your grade.
- Any concerns on scheduling, grading, or any other matter should be addressed to the VHOD.

Make sure that **every paper** that you submit contains your **name** and **student ID**. Any access to means of communication is a case of cheating irrespective of what is communicated. It is enough to **turn off your cell phones**. *You absolutely do not need to place your cell phones on the front desk.*

Recall that it is sufficient to **solve two out of the three present exam problems**. Feel free to hand in your submission at any time and leave the room without disturbing the other participants.

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TERM EXAM I – PROBLEM 1

Consider the following program:

```
import java.util.Scanner;

public class ProblemOne
{
    public static int eliminate(int p, int q)
    {
        while(( p % q ) == 0) p = p/q;

        return p;
    }

    public static void main(String[ ] args)
    {
        Scanner stdin = new Scanner(System.in);

        System.out.print("Specify p: ");
        int p = stdin.nextInt( );
        System.out.print("Specify q: ");
        int q = stdin.nextInt( );
        stdin.close( );

        System.out.println( "Result: " + eliminate( p, q ) );
    }
}
```

- a) Describe¹ how the return value of `eliminate(p, q)` depends on the values of `p` and `q`.
- b) What return value will be obtained by a call to `eliminate(99, 3)`?
- c) Is the argument `q` passed by reference or by value? Why?

¹ The description is simple. You do not need much text. If you find yourself writing over three sentences, think again.

TERM EXAM I - PROBLEM 2

a) Write a method² that takes a single argument,

- a natural number n ,

and returns the **closest cubic number** which is **smaller than n or equal to n** , i.e., the greatest natural number k with $k \leq n$ which can be written as the cube $k = m^3$ of a natural number m .

Accordingly, e.g., if the argument value is 100, the return value should be 64; if the argument is given as 8, the return value must also be 8; and for the argument 6, the method should return 1.

Use elementary arithmetics only, i.e., do not call any methods from the built-in "Math" class.

b) How do the time requirements of your method scale asymptotically as a function of n ?

² Note that you only need to write a single method here, accomplishing the described task, not a full Java program. Therefore, **not much code is needed**. If you find yourself writing over 15 lines of code, think about the problem again.

TERM EXAM I – PROBLEM 3

Consider the vector arithmetics code given below. Therein, vectors are stored as arrays:

```
public class ProblemThree
{
    public static void vadd(double[] v, double[] w) // vector addition
    {
        if(v.length != w.length) return; // dimension of the vectors does not match
        for(int i = 0; i < v.length; i++) v[i] = v[i] + w[i];
    }

    public static double sprod(double[] v, double[] w) // scalar product
    {
        if(v.length != w.length) return 0.0; // dimension of the vectors does not match
        double s = 0.0;
        for(int i = 0; i < v.length; i++) s = s + v[i]*w[i];
        return s;
    }

    public static void smult(double[] v, double s) // scalar multiplication
    {
        for(int i = 0; i < v.length; i++) v[i] = s * v[i];
    }

    public static void main(String[] args)
    {
        double[] x = {2.0, 1.0, 0.0};
        double[] y = {1.0, 1.0, 1.0};

        smult(x, -1);

        // state A: what is the value of the arrays x and y here?
        vadd(x, y);

        // state B: what is the value of the arrays x and y here?
        System.out.println("Result: " + sprod(x, y)); // the program output is written here
    }
}
```

- Do you agree with the following statement? “In this code, the arguments v and w are passed by reference, whereas the argument s is passed by value.” Explain³ why you agree or disagree.
- The method “smult” is supposed to multiply the vector v with the scalar s . Why does it not need a return value, i.e., why can **void** be used as the return type of the method “smult”? Explain.³
- What is the value of the arrays x and y in “state A” and “state B”? What is the program output?
- What is the type of the argument of the method “main”? What is the return type of “sprod”?

Remark: If an array a has n elements, the elements are $a[0]$ to $a[n-1]$, and $a.length$ has the value n .

³ The explanation is simple. You do not need much text. If you find yourself writing over three sentences, think again.

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