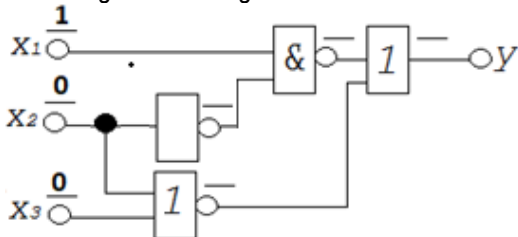


Information units 1 bit – elementary unit 1B (Byte) = 8 bits 1KB (KiloByte) = 2^{10} B (1024 B) 1MB (MegaByte) = 2^{10} KB (1024 KB) 1GB (GigaByte) = 2^{10} MB (1024 MB) 1TB (TeraByte) = 2^{10} GB (1024 GB)	Information units 1 Kbit (Kilobit) = 2^{10} bits = 1024 bits 1 Mbit (Megabit) = 2^{10} Kbits (1024 Kbits) 1 Gbit (Gigabit) = 2^{10} Mbits (1024 Mbits) 1 Tbit (Terabit) = 2^{10} Gbits (1024 Gbits)	Conversion table <table> <tr> <th>octal</th> <th>binary</th> </tr> <tr><td>0</td><td>000</td></tr> <tr><td>1</td><td>001</td></tr> <tr><td>2</td><td>010</td></tr> <tr><td>3</td><td>011</td></tr> <tr><td>4</td><td>100</td></tr> <tr><td>5</td><td>101</td></tr> <tr><td>6</td><td>110</td></tr> <tr><td>7</td><td>111</td></tr> </table>		octal	binary	0	000	1	001	2	010	3	011	4	100	5	101	6	110	7	111																																													
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6	110																																																																	
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Table of powers of number 2 <table> <tr><td>$2^0 = 1$</td><td></td><td></td></tr> <tr><td>$2^1 = 2$</td><td>$2^9 = 512$</td><td>$2^{-1} = 0,5$</td></tr> <tr><td>$2^2 = 4$</td><td>$2^{10} = 1024$</td><td>$2^{-2} = 0,25$</td></tr> <tr><td>$2^3 = 8$</td><td>$2^{11} = 2048$</td><td>$2^{-3} = 0,125$</td></tr> <tr><td>$2^4 = 16$</td><td>$2^{12} = 4096$</td><td>$2^{-4} = 0,0625$</td></tr> <tr><td>$2^5 = 32$</td><td>$2^{13} = 8192$</td><td>$2^{-5} = 0,03125$</td></tr> <tr><td>$2^6 = 64$</td><td>$2^{14} = 16384$</td><td>$2^{-6} = 0,015625$</td></tr> <tr><td>$2^7 = 128$</td><td>$2^{15} = 32768$</td><td>$2^{-7} = 0,0078125$</td></tr> <tr><td>$2^8 = 256$</td><td>$2^{16} = 65536$</td><td>$2^{-8} = 0,00390625$</td></tr> </table>		$2^0 = 1$			$2^1 = 2$	$2^9 = 512$	$2^{-1} = 0,5$	$2^2 = 4$	$2^{10} = 1024$	$2^{-2} = 0,25$	$2^3 = 8$	$2^{11} = 2048$	$2^{-3} = 0,125$	$2^4 = 16$	$2^{12} = 4096$	$2^{-4} = 0,0625$	$2^5 = 32$	$2^{13} = 8192$	$2^{-5} = 0,03125$	$2^6 = 64$	$2^{14} = 16384$	$2^{-6} = 0,015625$	$2^7 = 128$	$2^{15} = 32768$	$2^{-7} = 0,0078125$	$2^8 = 256$	$2^{16} = 65536$	$2^{-8} = 0,00390625$	Conversion table <table> <tr> <th>hexadecimal</th> <th>binary</th> <th>hexadecimal</th> <th>binary</th> </tr> <tr><td>0</td><td>0000</td><td>8</td><td>1000</td></tr> <tr><td>1</td><td>0001</td><td>9</td><td>1001</td></tr> <tr><td>2</td><td>0010</td><td>A</td><td>1010</td></tr> <tr><td>3</td><td>0011</td><td>B</td><td>1011</td></tr> <tr><td>4</td><td>0100</td><td>C</td><td>1100</td></tr> <tr><td>5</td><td>0101</td><td>D</td><td>1101</td></tr> <tr><td>6</td><td>0110</td><td>E</td><td>1110</td></tr> <tr><td>7</td><td>0111</td><td>F</td><td>1111</td></tr> </table>		hexadecimal	binary	hexadecimal	binary	0	0000	8	1000	1	0001	9	1001	2	0010	A	1010	3	0011	B	1011	4	0100	C	1100	5	0101	D	1101	6	0110	E	1110	7	0111	F	1111
$2^0 = 1$																																																																		
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3	0011	B	1011																																																															
4	0100	C	1100																																																															
5	0101	D	1101																																																															
6	0110	E	1110																																																															
7	0111	F	1111																																																															
Tick the programming language which you will use to perform the problems proposed in the topics II and III: ☐ Pascal ☐ C/C++																																																																		

Nr	Item	Score	
Topic I. (25 points)			
1	a) When registering in a computer system, users receive a password containing 16 distinct symbols from a set of 32 symbols. These 32 symbols are considered messages from an information source that have been encoded using binary words of equal minimum length (in bits). 12 KB have been reserved for storing all the passwords of registered users in a certain period. Determine the number of passwords that can be stored in the 12 KB. Write the used formula to calculate the amount of information in a message from an information source with n possible messages: _____ Write the calculations: Answer: _____ passwords b) A video tutorial has a duration of 32 minutes, a frequency of 25 frames per second and the amount of information in one frame is approximately equal to 8 Mbits. Determine and write in the space reserved for the answer the amount of information in Gigabites (Gbits) contained in the given tutorial. Write the used formula: _____ Write the calculations: Answer: _____ Gbits	L 0 1 2 3 4 5 6 7 8 9	L 0 1 2 3 4 5 6 7 8 9
2	a) Tick the correct answer for the following statement: - Extended ASCII codes are 10- position. ☐ True ☐ False b) Write the following numbers in descending order in the space provided: (43,5)₁₆, (1100100,011)₂, (38,125)₁₀, (47,25)₈ Answer:(_____) __ > (_____) __ > (_____) __ > (_____) __ Perform and write the conversion of three of the given numbers in the binary number system:	L 0 1 2 3 4 5 6 7 8	L 0 1 2 3 4 5 6 7 8

3	Let the logic circuit be given:  The input variable values are: $x_1 = 1, x_2 = 0, x_3 = 0.$ a) Write in the spaces provided (above the “_” sequences) after each logic gate the values obtained after executing the respective logic operations.	b) Write in the space provided below the logical function, which is materialized by the logic circuit in the left column $f(x_1, x_2, x_3) =$ _____ c) Tick two combinational circuits in the following list: Multiplexer ☐ Shift register ☐ Adder ☐ RS flip-flop ☐ Direct counter ☐ Note: If more than two circuits are ticked, no points will be awarded.	L 0 1 2 3 4 5 6 7 8	L 0 1 2 3 4 5 6 7 8
Topic II. (32 points)				
	There are given tree mathematical expressions. Write the given expressions in the programming language you are studying - Pascal or C++ in the space reserved below. - Mathematical expression: $3x_1 \neq 2x_2 x_3$ Expression in the programming language: _____ - Mathematical expression: $7x + \sqrt{4 - \cos^4 x}$ Expression in the programming language: _____ - Mathematical expression: $\frac{ 5x+4 }{3 - e^{2x}} + 4,5$ Expression in the programming language: _____ Functions in the Pascal language: <code>sin (x)</code>, <code>cos (x)</code>, <code>sqr (x)</code>, <code>sqrt (x)</code>, <code>abs (x)</code>, <code>exp (x)</code> Functions in the C++ language: <code>sin (x)</code>, <code>cos (x)</code>, <code>pow (x)</code>, <code>sqrt (x)</code>, <code>abs (x)</code>, <code>fabs (x)</code>, <code>exp (x)</code>	L 0 1 2 3 4 5 6 7 8	L 0 1 2 3 4 5 6 7 8	

2

Let the program in Pascal language be given:

```

Program pr2;
  var a, b, y : real;
      x : integer;
      op : char;
begin
  y := 0.15;
  read( op, a , b);
  case (op) of
    '+': x := trunc(a + b);
    '-': begin x := trunc(a - trunc(b)); y := x div 2; end;
    '*': begin y := a * b; x := trunc(y); end;
    '%': x := trunc(a) mod trunc(b);
    else x := trunc(y);
  end;
  write('x=', x, ' ', 'y=', y:0:2);
end.

```

Write in the right column of the following table what the program **pr2** will display for each set of values of the variables **op**, **a** and **b** indicated in the left column.

Values of the variables	Output
op = '+' ; a = 10.5; b = -5.7	x=_____ y= _____
op = '-' ; a = 10.5; b = -5.7	x=_____ y= _____
op = '*' ; a = 2.5; b = -3.3	x=_____ y= _____
op = '%' ; a = 27.5; b = 5.2	x=_____ y= _____
op = '/' ; a = 1.2; b = -3.4;	x=_____ y= _____

Let the program in C++ language be given:

```

//Program Pr2
#include <iostream>
#include <iomanip>
using namespace std;
int main() {
  float a, b, y = 0.15;
  int x;
  char op;
  cin >> op >> a >> b;
  switch (op) {
    case '+': x = int(a + b); break;
    case '-': x = a - int(b); y = x / 2; break;
    case '*': y = a * b; x = y; break;
    case '%': x = int(a) % int(b); break;
    default: x = y;
  }
  cout << "x=" << x << " " << "y=" << fixed << setprecision(2) << y;
  return 0;
}

```

Write in the right column of the following table what the program **pr2** will display for each set of values of the variables **op**, **a** and **b** indicated in the left column.

Values of the variables	Output
op = '+' ; a = 10.5; b = -5.7	x=_____ y= _____
op = '-' ; a = 10.5; b = -5.7	x=_____ y= _____
op = '*' ; a = 2.5; b = -3.3	x=_____ y= _____
op = '%' ; a = 27.5; b = 5.2	x=_____ y= _____
op = '/' ; a = 1.2; b = -3.4;	x=_____ y= _____

L
0
1
2
3
4
5
6
7
8
9L
0
1
2
3
4
5
6
7
8
9

3	a) The left column of the following table contains a program in the Pascal language. The program contains a repetitive for statement. Write in the right column of the given table a program, which will produce the same result as the program in the left column, but the for statement will be replaced by the repeat statement. <table><tr><td><pre>Program pp; var i, k: integer; begin k := 3; for i := 10 downto k do begin if i > k then if i mod 4 > 1 then write(i, ' '); k := k+1; end; end. </pre></td><td></td></tr></table> b) Write what will be displayed as a result of executing the given program: _____	<pre>Program pp; var i, k: integer; begin k := 3; for i := 10 downto k do begin if i > k then if i mod 4 > 1 then write(i, ' '); k := k+1; end; end. </pre>		L 0 1 2 3 4 5 6 7 8	L 0 1 2 3 4 5 6 7 8
<pre>Program pp; var i, k: integer; begin k := 3; for i := 10 downto k do begin if i > k then if i mod 4 > 1 then write(i, ' '); k := k+1; end; end. </pre>					
	a) The left column of the following table contains a program in the C++ language. The program contains a repetitive for statement. Write in the right column of the given table a program, which will produce the same result as the program in the left column, but the for statement will be replaced by the do while statement. <table><tr><td><pre>// program pp #include <iostream> using namespace std; int main() { int i, k=3; for(i=10; i > k; i--) { if(i % 4 > 1) cout << i << ' '; k++; } return 0; } </pre></td><td></td></tr></table> c) Write what will be displayed as a result of executing the given program: _____	<pre>// program pp #include <iostream> using namespace std; int main() { int i, k=3; for(i=10; i > k; i--) { if(i % 4 > 1) cout << i << ' '; k++; } return 0; } </pre>			
<pre>// program pp #include <iostream> using namespace std; int main() { int i, k=3; for(i=10; i > k; i--) { if(i % 4 > 1) cout << i << ' '; k++; } return 0; } </pre>					

4

To determine a student's semester grade, first the average of n current grades is calculated - grades obtained during the semester, then the average between the thesis grade and the average of the current grades is calculated.

Task. Write a program that will determine the student's semester grade.

Input. From the keyboard is read an integer t - the grade obtained by the student on the thesis. Then is read the integer n ($2 \leq n \leq 10$) - the number of the student's current grades. Finally, the n current grades are read - integers.

Output. A real number is displayed on the screen - the student's semester grade.

Note. The average of n grades obtained during the semester and the semester grades are real numbers.

Example:

Input	Output
9	9.125
4	Explanation:
8 9 10 10	$(8+9+10+10) / 4=9,25$ $(9,25+9) / 2=9,125$

L
0
1
2
3
4
5
6
7

L
0
1
2
3
4
5
6
7

Topic III. (30 points)

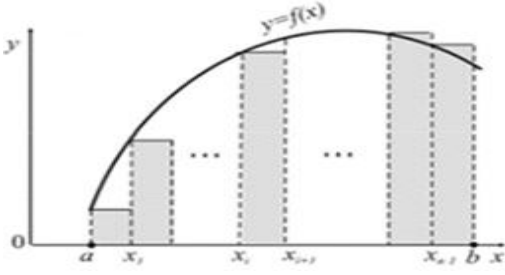
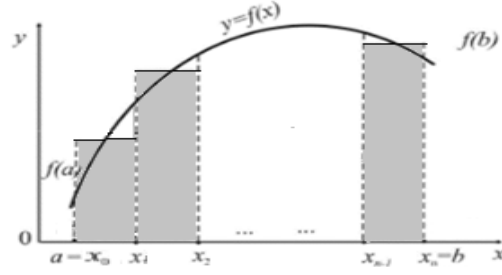
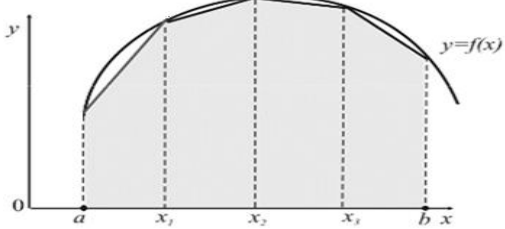
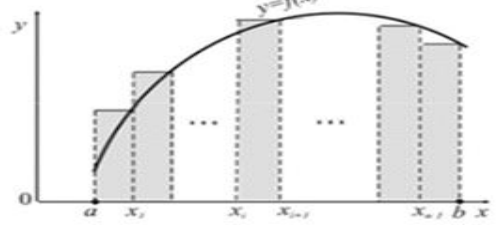
1	The following Pascal program is given: <pre> Program pr1; var t : array[1..40] of integer; i : integer; function fs(q : integer) : integer; var nr, j, c : integer; begin nr := 0; j := 1; c := q div 2; while j <= c do begin if q mod j = 0 then nr := nr + j; j := j + 1; end; fs := nr; end; procedure xx (a, b : integer); var k : integer; begin for k := a to b do if k mod 2 <> 0 then t[k] := fs(k) else t[k] := t[k] mod 10 * 10 + t[k] div 10; end; begin for i := 1 to 40 do t[i] := i; xx(34, 35); for i:= 34 to 35 do write(t[i], ' '); end. </pre>	Perform the following tasks for the program pr1: a) Write the number of formal parameters used in the program pr1: _____ b) Underline the header of the function fs in the text of the program pr1. c) Write the name of the repetitive statement with initial test used in the program pr1: _____ d) Tick the truth value of the statement "Program pr1 contains communication through global variables": ☐ True ☐ False e) Write the value of the component t[9]: _____ f) Write what will be displayed as a result of executing the pr1 program: _____	L 0 1 2 3 4 5 6 7	L 0 1 2 3 4 5 6 7
---	---	---	---	---

	The following C++ program is given <pre>//program pr1 #include <iostream> using namespace std; int t[41]; int fs(int q) { int nr = 0, j = 1, c = q / 2; while (j <= c) { if (q % j == 0) nr = nr + j; j++; } return nr; } void xx (int a, int b){ int k; for (k = a; k <= b; k++) if(k % 2 != 0) t[k] = fs(k); else t[k]=t[k]%10 * 10 + t[k]/10; } int main() { int i; for (i = 1; i <= 40; i++) t[i] = i; xx(34, 35); for (i = 34; i <= 35; i++) cout << t[i] <<" "; return 0; }</pre>	Perform the following tasks for the program pr1: a) Write the number of formal parameters used in the program pr1: _____ b) Underline the header of the function fs in the text of the program pr1. c) Write the name of the repetitive statement with initial test used in the program pr1: _____ d) Tick the truth value of the statement "Program pr1 contains communication through global variables": ☐ True ☐ False e) Write the value of the component t[9]: _____ f) Write what will be displayed as a result of executing the pr1 program: _____						
2	A person can go on vacation for m consecutive days in a period of n days, which are numbered from 1 to n ($10 \leq n \leq 60$). The given person wants the daily temperature to be greater than or equal to 24 degrees on each day of the m days of vacation. Task: Write a program that determines <i>the number of periods of m days with a daily temperature greater than or equal to 24 degrees and the first day of the last such period</i>. The program must contain a function named TP, which receives as a parameter an integer – <i>the first day</i> from a studied period of m days. The function will return an integer – 1 if all m days of the studied period have a daily temperature greater than or equal to 24 degrees or 0 – otherwise. Input: The text file temp.in contains on the first line two integers separated by a space: n - the period in which the vacation is allowed and m - the duration of the vacation. The second line contains n integers separated by a space - the daily temperatures of the n days. Output: The text file temp.out contains on one line two integers separated by a space: <i>the number of periods of m days with a daily temperature greater than or equal to 24 degrees and the first day of the last such a period</i>. Note. It is known that there are periods of m days with daily temperature greater than or equal to 24 degrees. Example: <table><tr><th>temp.in</th><th>temp.out</th><th rowspan="2">The solution will be appreciated for: types and variable declarations; operations with the text files; reading and writing data; algorithm organization.</th></tr><tr><td>10 3 20 24 28 25 27 21 20 25 25 29</td><td>3 8 Explanation: - first period - start: day 2 (24, 28, 25) - second period - start: day 3 (28, 25, 27) - third period - start: day 8 (25, 25, 29)</td></tr></table>	temp.in	temp.out	The solution will be appreciated for: types and variable declarations; operations with the text files; reading and writing data; algorithm organization.	10 3 20 24 28 25 27 21 20 25 25 29	3 8 Explanation: - first period - start: day 2 (24, 28, 25) - second period - start: day 3 (28, 25, 27) - third period - start: day 8 (25, 25, 29)	L 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16	L 0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16
temp.in	temp.out	The solution will be appreciated for: types and variable declarations; operations with the text files; reading and writing data; algorithm organization.						
10 3 20 24 28 25 27 21 20 25 25 29	3 8 Explanation: - first period - start: day 2 (24, 28, 25) - second period - start: day 3 (28, 25, 27) - third period - start: day 8 (25, 25, 29)							

[illegible]

3

- a) The table below presents the geometric illustration of four methods for numerically calculating the definite integral. Write in the space provided in the cells of the table the name of one of the three methods - **the method of middle rectangles**, **the method of right rectangles** or **the method of left rectangles**, which correspond to the geometric illustration in the corresponding cell.

The method of _____ 	The method of _____ 
The method of _____ 	The method of _____ 

- b) The following table presents programs in **Pascal** and **C++ languages**, which calculate the solution of the equation $f(x) = 0$ on the segment $[0; 0.3]$ for 30 iterations using the **chords method**. Some statements in these programs are incomplete. Write in the spaces provided the missing parts of the instructions in the program in the studied language, so that the program calculates the solution of the given equation using the **chords method**.

Pascal language	C++ language
<pre> program p3; var a, b, e, c, x: _____ ; n, i: integer; function f(x:real): real; begin f := exp(3*x) - 7*x - 0.5; end; begin a := 0; b := 0.3; n := 30; c := a - (f(a)) / (f(b) - f(a)) * (b-a) if f(c)*f(a) _____ then begin e:=b; x:=a; end else begin e:=a; x:=b; end; for i := 1 _____ do x:= x- (f(x)) / (f(e) - f(x)) * (e- x); write(x:10:8); end.</pre>	<pre> // program p3; #include <iostream> #include <math.h> using namespace std; _____ a, b, c, e, x; int i, n; double f(double x) {return exp(3*x) - 7*x - 0.5;} int main(){ a = 0; b = 0.3; n = 30; c = a - f(a) / (f(b) - f(a)) * (b-a); if (f(c)*f(a) _____ 0) {e=b; x=a;} else {e=a; x=b;} for (i = 1; i _____ ; i++) x= x- (f(x)) / (f(e) - f(x)) * (e-x); cout << x; return 0; }</pre>

- c) Write in the space provided the mathematical form of the function, the solution of which is calculated by the program p3: $f(x) =$ _____

L
0
1
2
3
4
5
6
7L
0
1
2
3
4
5
6
7

Topic IV. (13 points)

- 1 A database was created in MS Access. Fragments of the content of the database tables are presented in *Image 1*:

Clasificare				Locuri			
Cod_clasific	Disciplina	Clasa		Cod_loc	Medalia	Min	Max
A	TIC	5-9		loc_1	Aur	26	30
B	TIC	10-12		loc_2	Argint	20	25
C	C++	5-9		loc_3	Bronz	14	19
D	C	10		Mentiune		8	13
E	C++	11		Participare		1	7
F	C#	12					

Participanti			
Cod_elev	Cod_clasific	Cod_loc	Punctaj
1	B	loc_2	24
2	C	loc_3	16
3	E	Mentiune	9
4	D	loc_1	30
5	F	loc_2	25
6	C	Mentiune	12
7	E	Participare	6

Image 1

Based on the content of the table fragments:

- a) Complete in the *Image 2* all the necessary elements, including the relations between the tables, to define in **Design View** a grouping and totaling query that:

- Will display data from four fields – *Clasa*, *Disciplina*, *Medalia* and *Cod_loc*.
- The records will be grouped by three fields *Clasa*, *Disciplina* and *Medalia*. **The number of places** (count function, *Cod_loc* field) **with medals** (*Medalia* field) will be calculated for the **C**, **C++** and **C#** programming languages (*Disciplina* field);
- The records will be sorted in descending order of classes (*Clasa* field).

Query1

Table	Field	Table	Field	Table	Field
Clasificare	Cod_clasific	Participanti	Cod_elev	Locuri	Cod_loc
	Disciplina		Cod_clasific		Medalia
	Clasa		Cod_loc		Min
			Punctaj		Max

Field:	Table:	Total:	Sort:	Show:	Criteria:	or:
		Group By				
				☐		
				☐		
				☐		
				☐		

Image 2

- a) Write the type of the *Clasa* field in the *Clasificare* table: _____