

Belgorod State Technological University named after V.G. Shukhov

IT Department

Stremnev A.Y.

BASICS OF VISUAL BASIC FOR APPLICATIONS

The methodical recommendations
for the practical course "Information technologies"
for

УИИИ-11, ПСИИ-11

2018

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LABORATORY WORK № 1. ESSENTIALS OF VISUAL BASIC

Summary

Visual Basic (VB) (Visual Basic for Applications (VBA)) environment. Writing and launching programs. Debugging.

Task

1. Run MS Excel.
2. *Ribbon* > **RIGHT CLICK** > *Настройка ленты (Adjusting)*.
3. Select *Основные вкладки (Main Tabs)* > *Разработчик (Developer)*. Press **OK**.
4. *Ribbon* > *Разработчик (Developer)* > *Visual Basic*.
5. *Insert* > *Module* (find **Module1** in *Project Explorer*, find **Module1** in *Work space* and in *Title* of VBA window).
6. *Insert* > *Module* (find **Module2** in *Project Explorer*, find **Module2** in *Work space*).
7. **DOUBLE CLICK** on **Module1** in *Project Explorer* (find changes in the *Title* of VBA window).
8. **RIGHT CLICK** on **Module2** in *Project Explorer* > **Remove Module2** > *...Export...?* > *Нет (No)*.
9. *Title* of *Project Explorer* > *Закрыть (Close)*.
10. *View* > *Project Explorer*.
11. Find that *Title* of VBA window has name **Module1** and then write following program code in *Work space*.

Sub program_1()

Dim n As Double

Dim s As Variant

n=1

n=n+3

s=Inputbox("Input any number")

n=(n+s)/2

Msgbox ("Average value = " & n)

End Sub

12. *File* > *Save Книга1 (WorkBook1)* > *Select location (D:/Student/...)* > Type any *Имя файла (File Name)* > Set *Тип файла (File type)* as "*Книга Excel с поддержкой макросов xlsm*" (*Excel WorkBook with including of macros*). Press *OK*.

13. Close VBA window.

14. *Ribbon* > *Разработчик (Developer)* > *Код (Code)* > *Безопасность макросов (Macros safety)*. Select variant *Отключить все макросы с уведомлением (Blocking macros with notification)*. Press *OK*.

15. Close MS Excel.

16. Find and open your last created Excel file.

17. Press *Включить содержимое (Macros enabled)* in alert notification.

18. *Ribbon* > *Разработчик (Developer)* > *Visual Basic*.

19. **DOUBLE CLICK** on **Module1** in *Project Explorer* to open it in work space (if it has not happened automatically).

20. Put cursor in any place of program and choose **Run** button on toolbar (or **Run** > **Run Sub (F5)**).

21. Write **5** in open dialog – this is your program. Press *OK*.

22. See the next window – with result message ("**Average value = 4,5**"). Press *OK*.

23. Put cursor in any place of program and run step by step launch – *Debug* > *Step Into (F8)*.

24. Follow the active row of program code and do next steps (**F8**). During this process put mouse pointer above the variables (n, s) in code to see the tooltips with current values.
25. Do **F8** to the end of program. Last line (**End Sub**) will become white-color after yellow.
26. Put cursor behind the n-variable in code and use **RIGHT CLICK > Add Watch**.
27. Control the text **n** in **Add Watch** dialog. Press **OK**.
28. See the name of **n**-variable in **Watch (Watches) Window** (to show/hide **Watch (Watches) Window** use **View > Watch Window**).
29. Repeat pos. 26-28 for s-variable.
30. Put cursor in program, do **F8** and follow the changes of variables in **Watch Window**. Do **F8** till the end of program.
31. Change the active row **n=(n+s)/2** to **n=(n+s)/0**.
32. Run program (see pos. 20).
33. Write **5** in open dialog. Press **OK**.
34. Read the message in **Error Dialog** and select **Debug**.
35. Change the row **n=(n+s)/0** to **n=(n+s)/2** and do **Run > Continue**.
36. Run program.
37. Write **five** in open dialog. Press **OK**.
38. Read the message in **Error Dialog** and select **Debug**.
39. See the error place and the value of **s**-variable in **Watch Window**.
40. **Run > Reset** (we can't fix this error during runtime)
41. Close VBA window and save file.
42. **Ribbon > Разработчик (Developer) > Код (Code) > Макросы (Macros)**.
43. Select **program_1** in list and press **Выполнить (Run)**.

Report

1. Write work title with number, your name (first & last) and name of your group.
2. Answer the following questions (in writing, without text of questions):
 - a) How to open Visual Basic (VB/VBA) environment in MS Excel?
 - b) How to add module in VBA project?
 - c) How to show/hide Project Explorer?
 - d) How to save Excel file with macros?
 - e) How to run VB-program?
 - f) How to run program in step by step mode?
 - g) How we can follow the value of variable (expression) during runtime?
 - h) Describe the typical sequence to fix errors in program code.

LABORATORY WORK № 2.

VARIABLES. OPERATORS. BUILT-IN FUNCTIONS

Summary

Basic structure of Visual Basic (VB) (Visual Basic for Application (VBA)) programs. Using of variables, math and text operators and functions.

Table of build-in VB (VBA) operators and functions

Operator/Function	Purpose	Syntax
Math		
+	Addition	<number1>+<number2>
-	Subtraction	<number1>-<number2>
*	Multiplication	<number1>*<number2>
/	Division	<number1>/<number2>
\	Exact Division	<number1>\<number2> result – the whole part from division
mod	Remainder of the division	<number1> mod <number2>
^	Power	<number1> ^ <number2> number1 to number2 power (for number1<0, number2 must be integer)
Abs	Absolute value of a number	Abs(<number>) Returns Null for not numbers
Atn	Arctangent of a number	Atn (<number>) Returns angle in radians $[-\pi/2 \text{ до } +\pi/2]$ $\text{Arccos}(\langle \text{number} \rangle) = \text{Atn}(-\langle \text{number} \rangle * \text{Sqr}(-\langle \text{number} \rangle * \langle \text{number} \rangle + 1)) + 2 * \text{Atn}(1)$, range for number: (-1..1)
Cos	Cosine	Cos(<number>) Returns value in range $[-1 \dots +1]$; number – radian value

Exp	Exhibitor of number	Exp(<number>) Returns e^{number}
Fix, Int	Getting of entire part of a number	Fix(<number>); Int(<number>) Fix(1.7) returns 1; Int(1.7) returns 1; Fix(-1.7) returns -1; Int(-1.7) returns -2; Fix(-1.2) returns -1; Int(-1.2) returns -2;
Log	Natural logarithm of a number	Log(<number>) number > 0; $\text{Log}_x y = \text{Log}(y) / \text{Log}(x)$
Rnd	Random value	random value from the range [0;1)
Sgn	Number sign	Sgn(<number>) returns 1 for number>0; return 0 for number=0; returns -1 for number<0
Sin	Sine	Sin (<number>) Returns value in range [-1... +1]; number – radian value
Sqr	Root from a number	Sqr(<number>) number >=0
Tan	Tangent	Tan(<number>) number – radian value
Logical		
And	Logical 'And'	<logical value1> And <logical value2> True And True – returns True; True And False – returns False; False And False – returns False
Or	Logical 'Or'	<logical value1> And <logical value2> True Or True – returns True; True Or False – returns True; False Or False – returns False

Not	Logical 'Not'	Not <logical value> Not True – returns False; Not False – returns True
<, >, >=, <=, <>	Comparison operators	<number1> < <number2> if number1 < number2 – returns True; if number1 >= number2 – returns False
Date		
Now	Getting current date	Now()
Year	Getting year from the date	Year(<date>)
Month	Getting month (sequence number) from the date	Month(<date>)
Day	Getting day (sequence number) from the date	Day(<date>)
Hour	Getting hour from the date	Hour(<date>)
Minute	Getting minute from the date	Minute(<date>)
Second	Getting second from the date	Second(<date>)
Text		
& оператор	Connection of text strings	<string1> & <string2> ... & <stringN>
UCase	Converts string to upper case	UCase(<string>)
LCase	Converts string to lower case	LCase(<string>)
InStr	Execute search of one string in another one	InStr(<string1>,<string2>) returns first position of string1 in string2; without result – returns 0
Left	Returns of specified number of symbols from the start of string	Left(<string>,<number of symbols>)
Right	Returns of specified number of symbols from the end of string	Right(<string>,<number of symbols>)
Mid	Returns specified number of symbol form the specified position from string	Mid(<string>,<number1>,[<number2>]) string – source string; number1 – start position;

		number2 – number of symbols; if number2 omitted – till the end of string
LTrim	Delete all space-symbols from the start of string	LTrim(<string>)
RTrim	Delete all space-symbols from the end of string	RTrim(<string>)
Trim	Delete all space-symbols from the both sides of string	Trim(<string>)
Len	Returns quantity of symbols in text string	Len(<string>)
Chr	Returns of symbol by its ASCII-code	Chr(<ASCII-code> Chr(13) – returns Enter - text command
Asc	Returns of ASCII-code by its symbol	Asc(<symbol>)

Example

Part 1

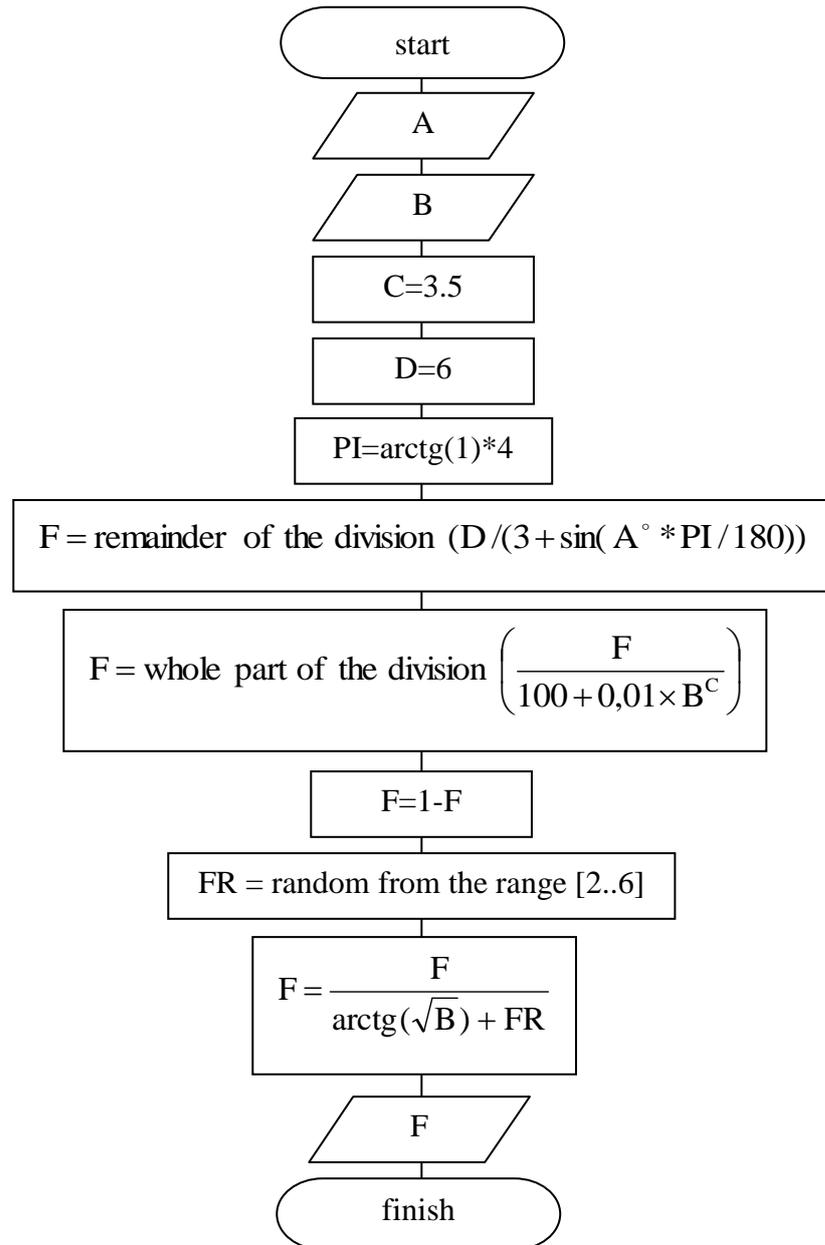
Make algorithm for expression calculation:

$$F = \frac{1 - \text{whole part of the division} \left(\frac{\text{remainder of the division } (D / (3 + \sin(A^\circ)))}{100 + 0,01 \times B^C} \right)}{\text{arctg}(\sqrt{B}) + \text{random from the range}[2..6]}$$

Write VB-program for this algorithm. The value of arguments A and B must be typed during runtime.

Solving for Part 1

Algorithm for expression calculation:



Program for this algorithm:

Sub program_1()

Dim A As Double

Dim B As Double

Dim C As Double

Dim D As Double

Dim PI As Double

Dim FR As Double

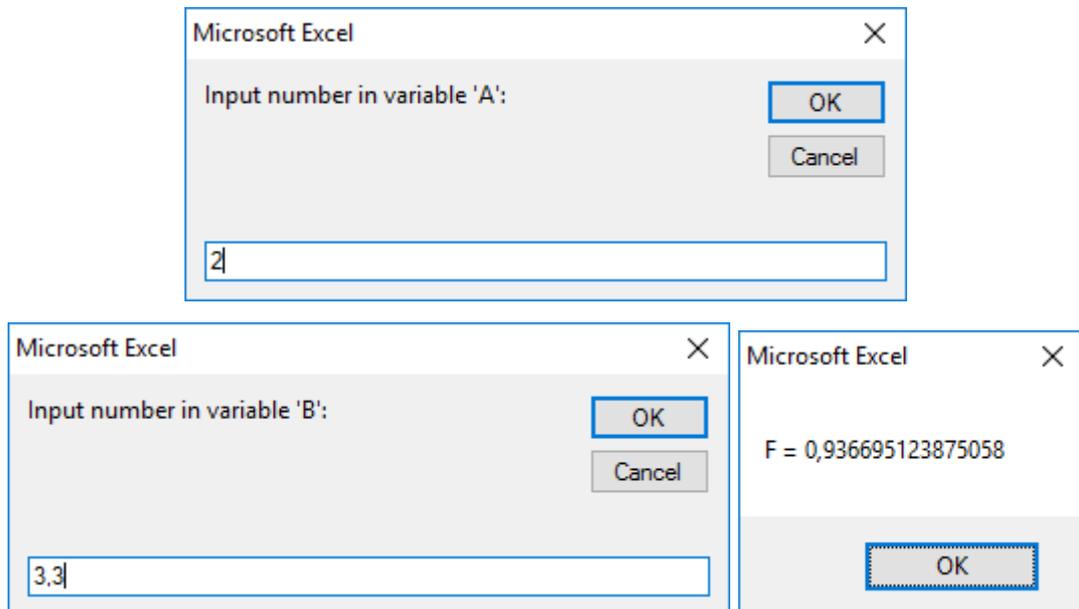
Dim F As Double

```

A = InputBox("Input number in variable 'A':")
B = InputBox("Input number in variable 'B':")
C = 3.5
D = 6
PI = Atn(1) * 4
F = D Mod (3 + Sin(A * PI / 180))
F = F \ (100 + 0.01 * (B ^ C))
F = 1 - F
FR=Rnd() * 4 + 2
F = F / (Atn(Sqr(B))+FR)
MsgBox "F = " & F
End Sub

```

Results:



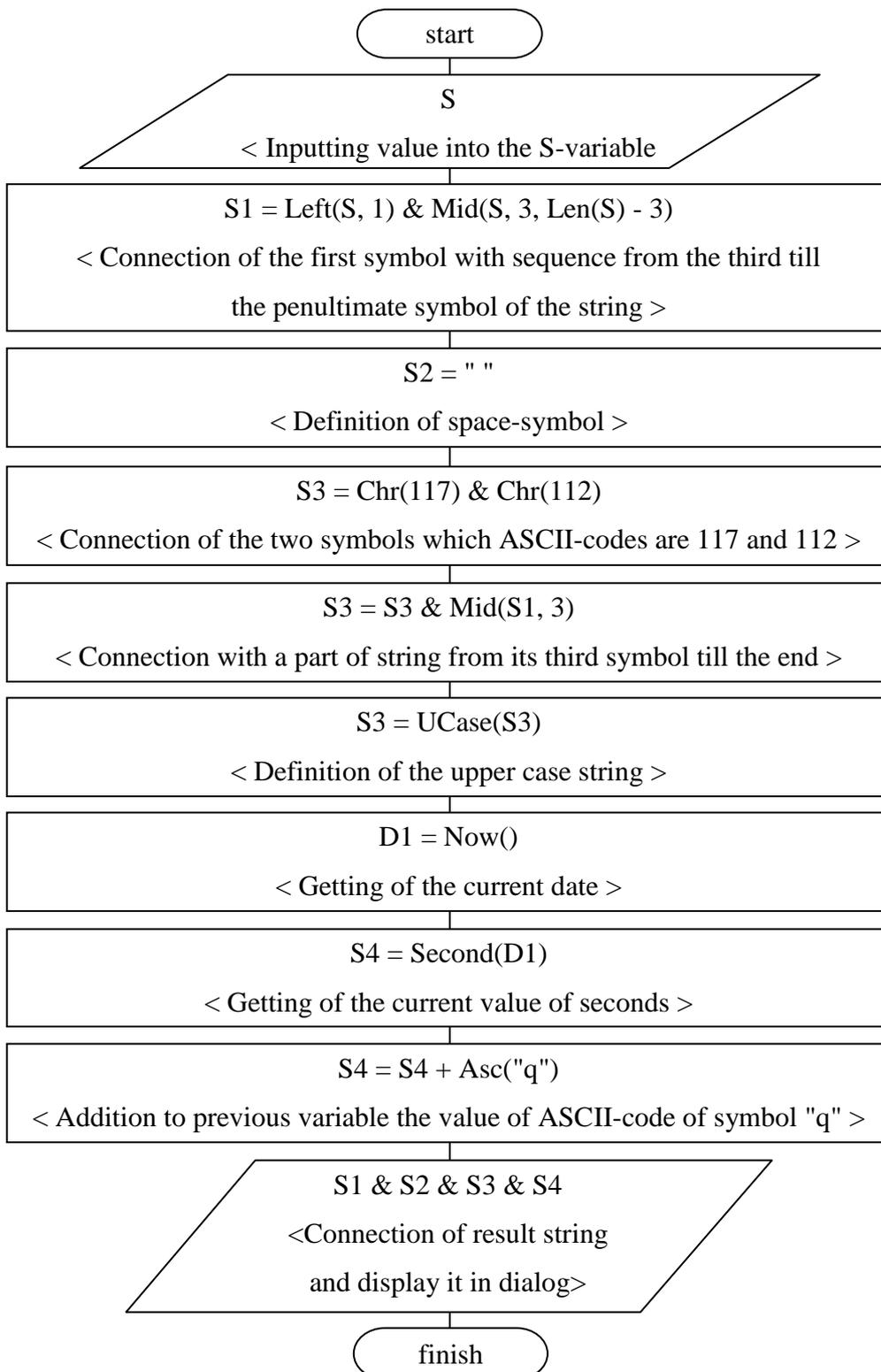
Part 2

We need to construct string which consists of following parts: 1) the string S without the second and the last symbol; 2) the space-symbol; 3) the upper case string1 in which first two symbols replaced by the two symbols which ASCII-

codes are 117 and 112; 4) the string – sum of current value of seconds and ASCII-code of symbol "q". String S must be typed during runtime.

Solving for Part 2

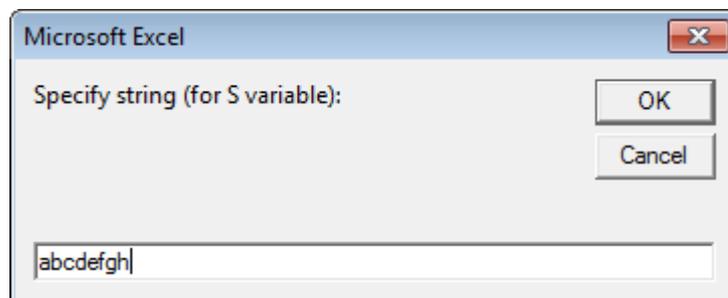
Algorithm for task solving:

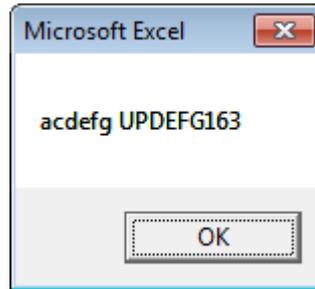


Program for this algorithm:

```
Sub program_2()  
Dim S As String  
Dim S1 As String  
Dim S2 As String  
Dim S3 As String  
Dim S4 As String  
Dim D1 As Date  
S = InputBox("Specify string (for S variable):")  
S1 = Left(S, 1) & Mid(S, 3, Len(S) - 3)  
S2 = " "  
S3 = Chr(117) & Chr(112)  
S3 = S3 & Mid(S1, 3)  
S3 = UCase(S3)  
D1 = Now()  
S4 = Second(D1)  
S4 = S4 + Asc("q")  
MsgBox S1 & S2 & S3 & S4  
End Sub
```

Results:





Task

Part 1

Make algorithm for expression calculation (see table of *Variants*).

Write VB-program for this algorithm. The value of arguments A and B must be typed during runtime.

Part 2

We need to construct string which consists of following parts (see table of *Variants*). String S must be typed during runtime.

Variants

Variant №	Description	
1	Part 1	$F = \frac{ A - B \times \sin(3 \times A^\circ) - \text{tg}(D^\circ)}{1 + \ln B}$
	Part 2	1) Upper case string from the first symbol till the third symbol (inclusively) of string S; 2) space-symbol; 3) the string from the fourth till the last symbol of string S.
2	Part 1	F = remainder of the division $\left(\frac{A}{B}\right) + \sqrt{1 + e^C \times D} - C^D$
	Part 2	1) The string from the second till the fourth symbol (inclusively) of string S; 2) upper case string from the "before the penultimate" till the penultimate symbol of string S.

3	Part 1	$F = \text{whole part of the division } \left(\frac{A}{B} \right) - \text{arctg} \left(\frac{ C-D }{C^D} \right)$
	Part 2	1) The string which consists of ASCII-codes of first three symbols of string S (codes must be separated by the space-symbol); 2) upper case string which consists of two last symbols of string S.
4	Part 1	$F = \text{whole part of the division } \left(\frac{A+B}{B} \right) + \frac{\text{arctg}(C+D)}{\text{random from the range } [1...3]}$
	Part 2	1) Upper case string from the first till the second symbol (inclusively) of string S; 2) upper case third symbol of string S; 3) ASCII-code of the last symbol of string S.
5	Part 1	$F = \sqrt{1-A} - B^{\left \frac{C+D}{\cos(C^\circ)} \right }$
	Part 2	1) The string from the second till the last symbol (inclusively) of string S; 2) ASCII-code of the fourth symbol of string S; 3) The string from the "before the penultimate" till the penultimate symbol of string S.
6	Part 1	$F = \left(A + \frac{1}{e^{B+C}} \right) \times (\ln D)^D$
	Part 2	1) ASCII-code of the last symbol of string S; 2) the string S without the second and the third symbols; 3) the string from the second till the penultimate symbol (inclusively) of string S.
7	Part 1	$F = (\log_7 A) + \frac{\sqrt{B}}{C^D + \cos(B^\circ)}$
	Part 2	1) The string S without the second and the penultimate symbol; 2) fourth symbol of string S; 3) sequence of three symbols, which ASCII-codes are 109, 97, 217.
8	Part 1	$F = \left(\frac{1}{A+B} + D ^e \right) \times \left(\cos(C^\circ) - \text{whole part of the division } \left(\frac{B}{D} \right) \right)$
	Part 2	1) The string from the third till the fourth symbol (inclusively) of string S; 2) sequence of four symbols, which ASCII-codes are 115, 104, 105, 112; 3) the string – current value of minutes.

9	Part 1	$F = \sqrt{\frac{e^{ 2-B }}{C + (1 - D \times \text{random from the range}[2...4])}}$
	Part 2	1) The string from the fourth till the last symbol (inclusively) of string S; 2) the last symbol of string S; 3) the string – the amount of symbols in string1 and string2.
10	Part 1	$F = \left(1 - \frac{A}{ C-1 }\right) + \log_{D+3}(B^2)$
	Part 2	1) Sequence of four symbols, which ASCII-codes are 119, 105, 110, 103; 2) the string from the "before the penultimate" symbol (inclusively) till the end of the string S; 3) space-symbol; 4) the string S without the second and the third symbols.
11	Part 1	$F = 2^e + \left(\text{remainder of the division} \left(\frac{A}{C + \cos((10 + D)^\circ)}\right)\right) \times (B - 1)$
	Part 2	1) Upper case string which consists of four symbols, which ASCII-codes are 115, 110, 111, 119; 2) space-symbol; 3) the string S without the second symbol.
12	Part 1	$F = 2^{\frac{A-B}{C} \times \cos((2 \times D)^\circ)} + \sqrt{\text{random from the range}[5...8]}$
	Part 2	1) The string S without the second and the last symbol; 2) the string S which third and fourth symbol replaced by the two symbols which ASCII-codes are 105 and 110.
13	Part 1	$F = \sqrt{\cos(A^\circ) + B^D} + \log_{2 \times C } D$
	Part 2	1) The string – current day of month; 2) the string S in which first three symbols replaced by the three symbols which ASCII-codes are 99, 97 and 116.
14	Part 1	$F = \left(1 + \ln A \frac{A}{B}\right)^{\cos((1/C)^\circ)} + \sqrt{D}$
	Part 2	1) The string – current value of seconds; 2) the string S without the second and the penultimate symbol.

15	Part 1	$F = e^{\frac{1}{\sqrt{A+2 \times B}}} + \ln(16 \times C) - \arctg(D)$
	Part 2	1) The upper case string S without three last symbols; 2) the string S in which last three symbols replaced by the three symbols which ASCII-codes are 100, 111 and 103.
16	Part 1	$F = \left(1 - \frac{\sqrt{1 - A^B}}{\cos(C^\circ)}\right) + \text{random from the range}[6..8] ^2$
	Part 2	1) The string S without the fourth and the last symbol; 2) the string – sum of current value of minutes and seconds; 3) the string – the length of string2.
17	Part 1	$F = \left(1 - \frac{1}{B}\right)^{\sin(A^\circ)} + \sqrt{C^e + D}$
	Part 2	1) Sequence of four symbols, which ASCII-codes are 114, 97, 105, 110; the first and the third symbols must be in upper case; 2) the string S without the second, the third and the fourth symbols.
18	Part 1	$F = \frac{A}{D^{(1-A-B)} + \sqrt{C}} \times \arctg(D) $
	Part 2	1) The string S in which last two symbols replaced by the symbols which ASCII-codes are 116 and 111; 2) the string – current value of hours; 3) the string – amount of symbols in string1.
19	Part 1	$F = \frac{\log_A^{(B+\frac{1}{C})}}{\sqrt{D} + \text{random from the range}[1..3]}$
	Part 2	1) The string S without the third and the fourth symbol; 2) the string – current day of month; 3) space-symbol; 4) ASCII-code of symbol "v".
20	Part 1	$F = \cos(A^\circ) + \frac{\sqrt{B+1}}{\ln(C) + \text{random from the range}[3..5]}$
	Part 2	1) The string S in which the second symbol replaced by the symbol with ASCII-code value 100; 2) the string from the "before the penultimate" till the penultimate symbol (inclusively) of string S.

Report

1. Write work title with number, your name (first & last) and name of your group.
2. Your task.
3. Algorithm (block-scheme).
4. Program code (listing).
5. Program results (scheme of dialogs with input data and calculated values).

LABORATORY WORK № 3. CONDITIONAL STATEMENTS

Summary

Visual Basic (VB) realization of algorithm for executing of the alternative sequences of actions.

Example

Part 1

Make algorithm for expression calculation:

$$y = \sqrt{\frac{2-x}{\ln x}}$$

Expression has argument limits.

Write VB-program for this algorithm. The value of argument (x) must be typed during runtime.

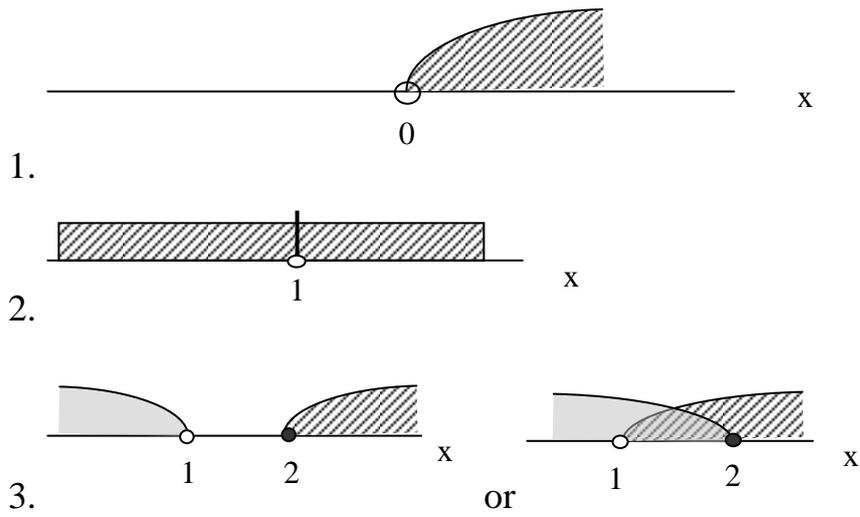
Solving for Part 1

For y-function we have following argument limits.

$$\left\{ \begin{array}{l} 1. x > 0 \\ 2. x \neq 1 \\ 3. (2-x \geq 0 \text{ and } \ln x > 0) \text{ or } (2-x \leq 0 \text{ and } \ln x < 0) \end{array} \right.$$

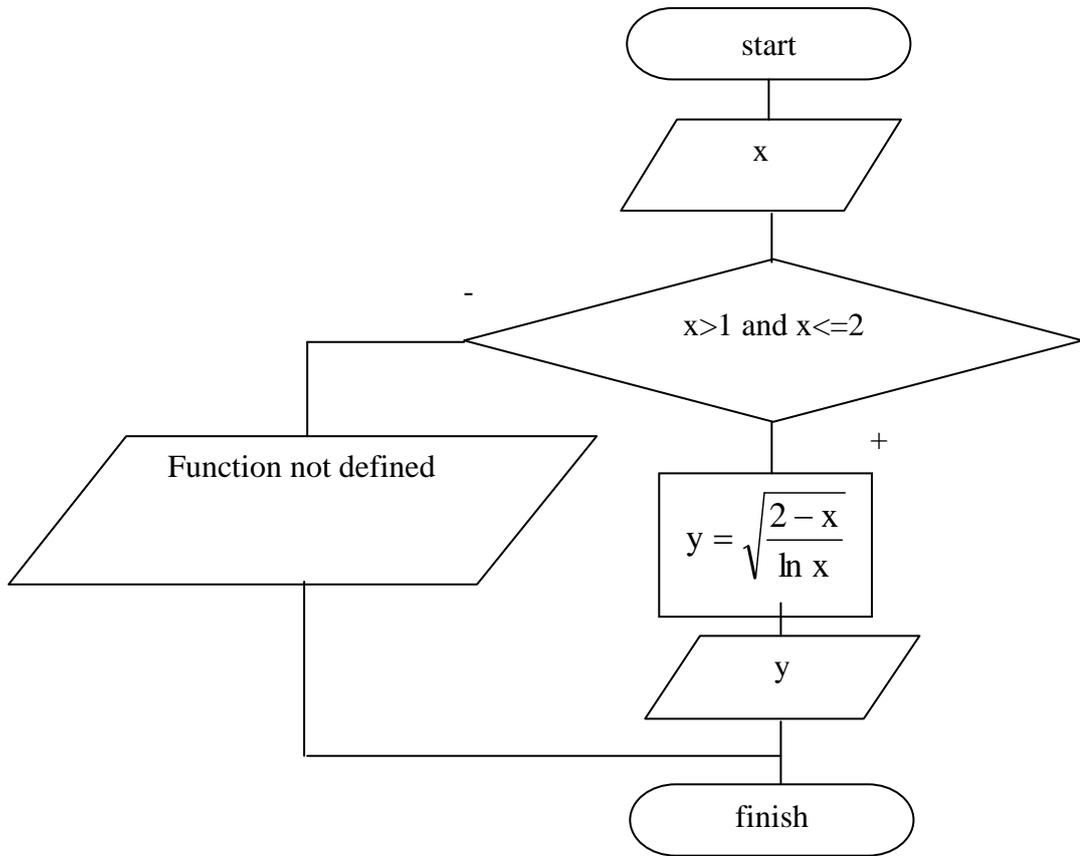
First limit is determined by the logarithm argument. The second limit depends on the division operation. Third limit is determined by the root operation

We can mark limits on x-axis.



So, summary limits for $y = f(x)$: $x = (1,2]$.

Algorithm for expression calculation $y = \sqrt{\frac{2-x}{\ln x}}$:



Program for this algorithm:

Sub program_1()

```
Dim x As Double
```

```
Dim y As Double
```

```
x = InputBox("Input x value: ")
```

```
If (x > 1 And x <= 2) Then
```

```
y = Sqr((2 - x) / Log(x))
```

```
MsgBox "For x = " & x & " y = " & y
```

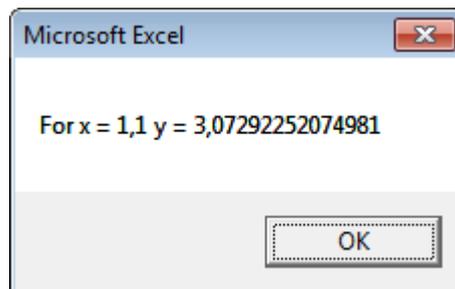
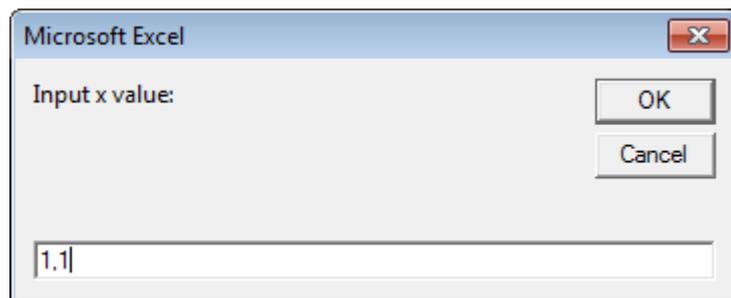
```
Else
```

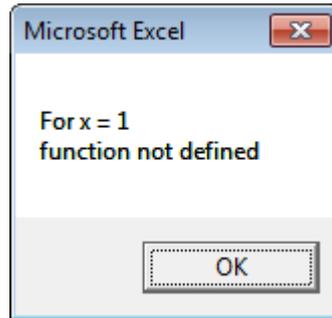
```
MsgBox "For x = " & x & Chr(13) & "function not defined"
```

```
End If
```

```
End Sub
```

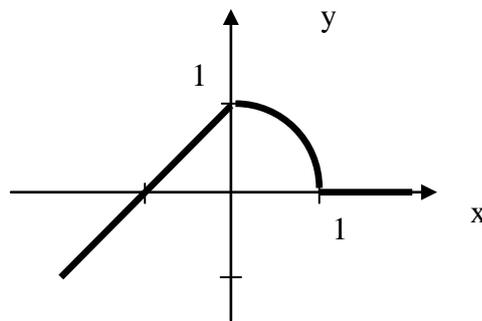
Results:





Part 2

We have graphic for $y = f(x)$.



Make algorithm and write VB-program for calculating $y = f(x)$. The value of argument (x) must be typed during runtime.

Solving for Part 2

Function $y = f(x)$ is unlimited and may be calculated in three ranges of x argument:

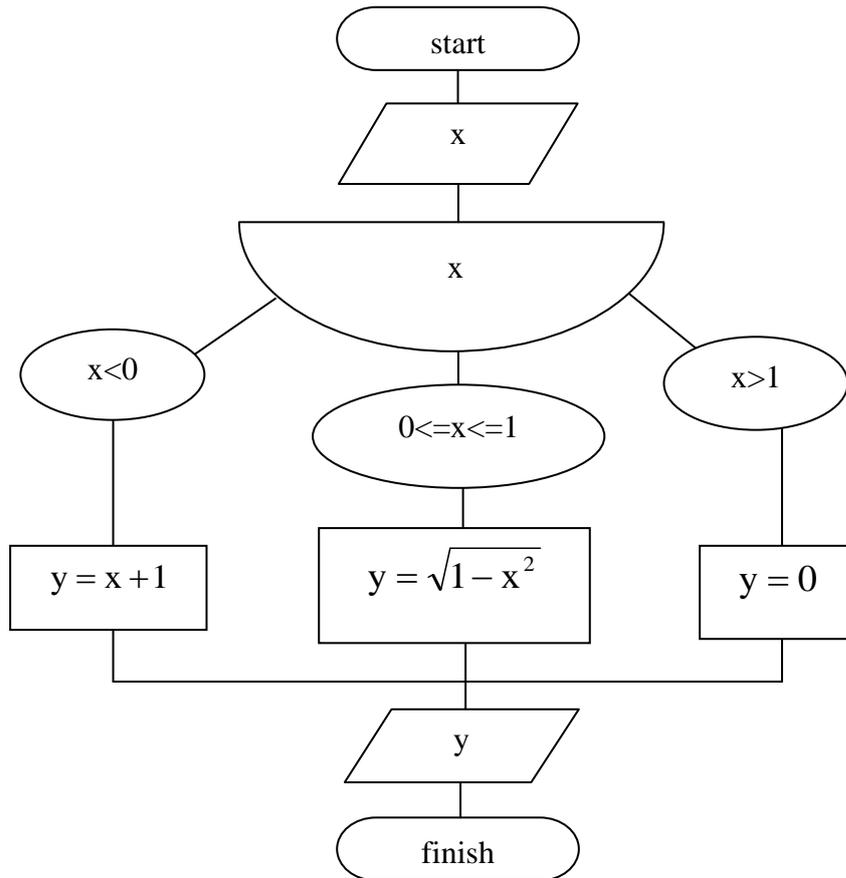
1. $x = (-\infty, 0)$, 2. $x = [0, 1]$, 3. $x = (1, +\infty)$:

range 1 is described by the equation: $y = x + 1$,

range 2 is described by the equation $x^2 + y^2 = 1$ or $y = \sqrt{1 - x^2}$,

range 3 is described by the equation $y = 0$.

Algorithm for expression $y=f(x)$ calculation:



Program for this algorithm:

Sub program_r2()

Dim x As Double

Dim y As Double

x = InputBox("Input x value: ")

Select Case x

Case Is < 0

y = x + 1

Case Is <= 1

y = Sqr(1 - x * x)

Case Else

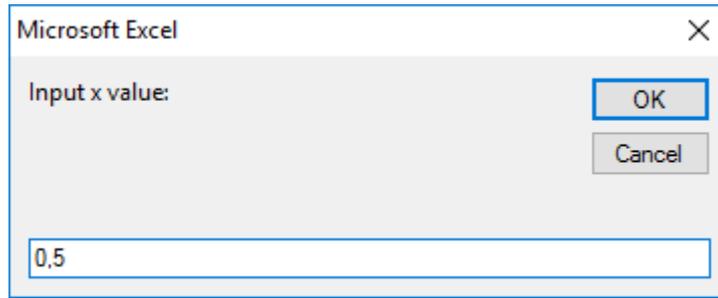
y = 0

End Select

MsgBox "For x = " & x & " y = " & y

End Sub

Results:



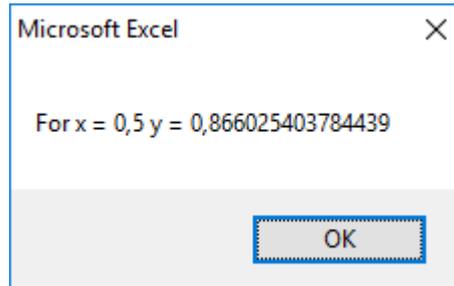
Microsoft Excel

Input x value:

0.5

OK

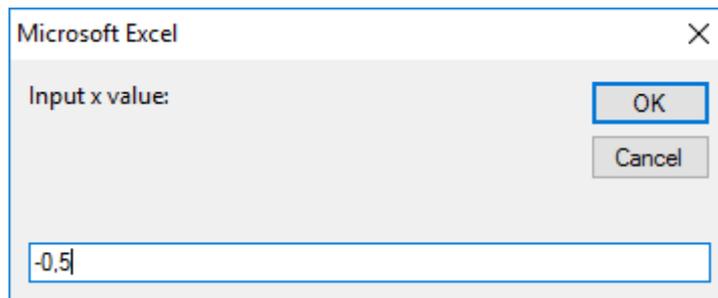
Cancel



Microsoft Excel

For x = 0,5 y = 0,866025403784439

OK



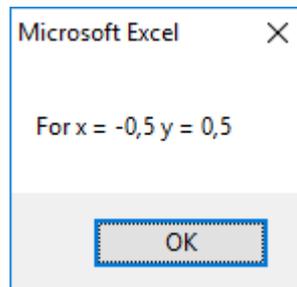
Microsoft Excel

Input x value:

-0.5

OK

Cancel



Microsoft Excel

For x = -0,5 y = 0,5

OK

Task

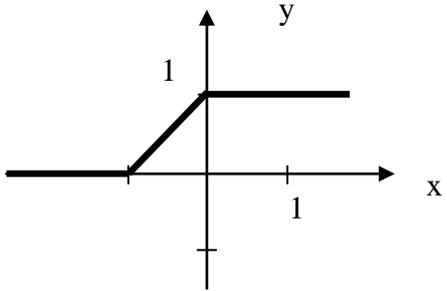
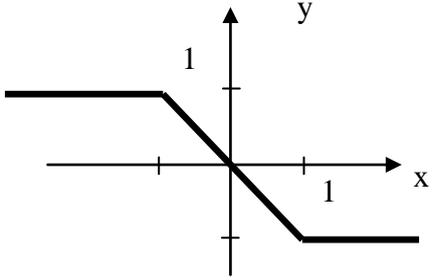
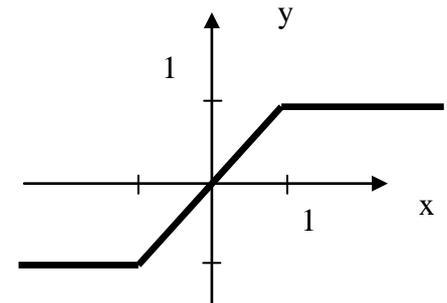
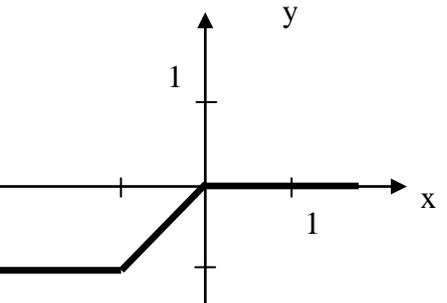
Part 1

Make algorithm for expression calculation (see table of *Variants*). Expression has argument limits. Write VB-program for this algorithm. The value of argument (x) must be typed during runtime.

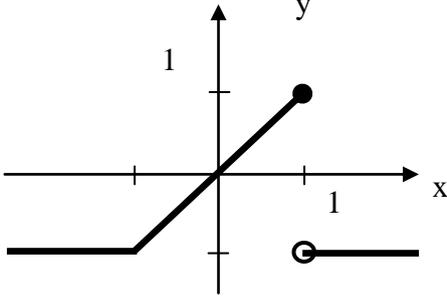
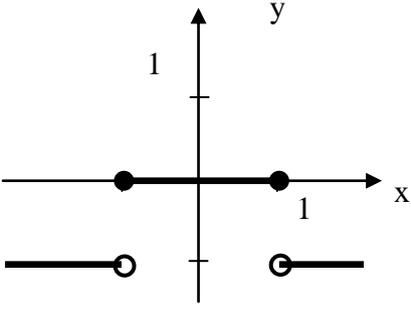
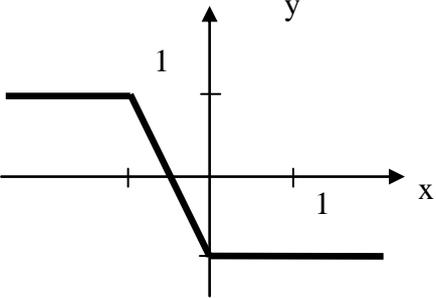
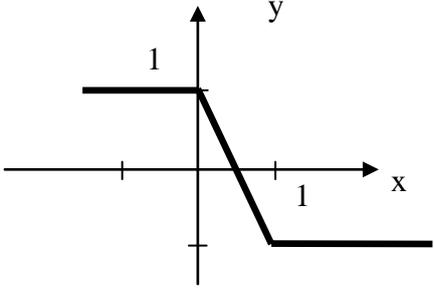
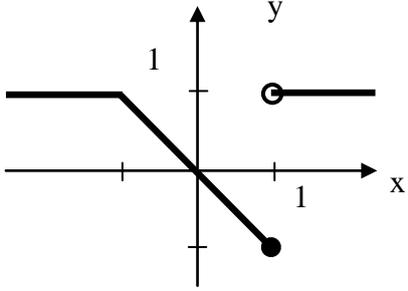
Part 2

We have graphic for $y = f(x)$ (see table of *Variants*). Make algorithm and write VB-program for calculating $y = f(x)$. The value of argument (x) must be typed during runtime.

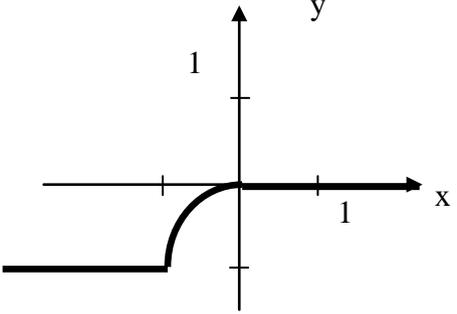
Variants

Variant №	Part 1	Part 2
1	$y = \frac{1}{x}$	
2	$y = \frac{1}{x^2 - x - 12}$	
3	$\sqrt{1-x}$	
4	$\sqrt{\frac{\ln x}{x}}$	

5	$y = \frac{1}{\sqrt{(2-x)}}$	<p>The graph shows a coordinate system with x and y axes. The y-axis has a tick mark at 1. The x-axis has a tick mark at 1. The function is plotted as a curve that is symmetric about the y-axis, with a sharp peak at the origin (0, 1). The curve approaches horizontal asymptotes as x goes to positive or negative infinity.</p>
6	$y = \frac{\ln x}{x-1}$	<p>The graph shows a coordinate system with x and y axes. The y-axis has a tick mark at 1. The x-axis has a tick mark at 1. The function is plotted as a curve that is symmetric about the y-axis, with a sharp peak at the origin (0, 1). The curve approaches horizontal asymptotes as x goes to positive or negative infinity.</p>
7	$y = \sqrt{1 - \ln x}$	<p>The graph shows a coordinate system with x and y axes. The y-axis has a tick mark at 1. The x-axis has a tick mark at 1. The function is plotted as a curve that is symmetric about the y-axis, with a sharp peak at the origin (0, 1). The curve approaches horizontal asymptotes as x goes to positive or negative infinity.</p>
8	$y = \sqrt{\frac{x+2}{x-2}}$	<p>The graph shows a coordinate system with x and y axes. The y-axis has a tick mark at 1. The x-axis has a tick mark at 1. The function is plotted as a curve that is symmetric about the y-axis, with a sharp peak at the origin (0, 1). The curve approaches horizontal asymptotes as x goes to positive or negative infinity.</p>
9	$y = \frac{1}{\sqrt{\ln x}}$	<p>The graph shows a coordinate system with x and y axes. The y-axis has a tick mark at 1. The x-axis has a tick mark at 1. The function is plotted as a curve that is symmetric about the y-axis, with a sharp peak at the origin (0, 1). The curve approaches horizontal asymptotes as x goes to positive or negative infinity.</p>

10	$y = \sqrt{\ln(x-1) \times \ln x}$	
11	$y = \frac{1}{x-1}$	
12	\sqrt{x}	
13	$\ln x$	
14	$y = \frac{1}{x \times (x-1)}$	

15	$y = \frac{\ln(4-x)}{\sqrt{x-3}}$	
16	$y = \frac{\ln(3-x)}{x^2 - x - 12}$	
17	$y = \sqrt{\frac{x^3}{x-2}}$	
18	$y = \sqrt{\frac{x-2}{(x+2)(3-x)}}$	
19	$y = (\ln x) \times \ln(2-x)$	

20	$y = \frac{1}{x^2 - x - 2}$	
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Report

1. Write work title with number, your name (first & last) and name of your group.
2. Your task.
3. Algorithm (block-scheme).
4. Program code (listing).
5. Program results (scheme of dialogs with input data and calculated values).