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It has been published by us (soemtron.org) to disseminate information about the Soemtron 22x range of electronic desk calculators manufactured by V.E.B. Büromaschinenwerk Sömmerda, as a project by us to gather and centralise whatever information can be found about these increasingly rare early electronic calculators.

If you have any information, books, drawings, circuits, hardware, test equipment or other memorabilia relating to the Soemtron 220, 222, 224 calculators, trade names (Daro, Soemtron, V.E.B. Büromaschinenwerk Sömmerda) please contact us at mike@soemtron.org

This document has been scanned from an original book, run through OCR software to regenerate the German text and then automatically translated to English and imported into Microsoft Word. Layout has been duplicated in line with the original document as much as possible to retain the flow of the original.

With this in mind some of the syntax presented here is a little strange to say the least !. Some portions have been reworked to be more readable English text but there is obviously more to be done.

If you can help with this, or indeed have any helpful information or comments, please email us at mike@soemtron.org

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Please use, and hopefully enjoy, this in information in the spirit in which we undertook to generate it -

As an information source for an interesting piece of early calculator history before the advent of modern electronics, in the days when “hands on” engineers thought through the problems and challenges of designing equipment, with little resources, to produce the best end product they could.

***1 V.E.B - Volkes Eigener Betrieb**
Peoples Owned Company

Programmiertes Lehrmaterial

Facharbeiter für Datenverarbeitung

Elektronischer Tischrechner Soemtron 220

Bedienung und Übung

M
035

ag Die Wirtschaft Berlin

Programmiertes Lehrmaterial
Facharbeiter für Datenverarbeitung

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Programmed teaching material
Data processing for skilled workers

Electronic Desk calculators Soemtron 220

Operation and exercises

THE ECONOMIC PUBLISHING HOUSE BERLIN

Author.
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ES 21 A

Table of contents

Preface

This book is offers a complex training curriculum for "electronic desk calculators" giving the skilled worker a concise guidance for the operation of the Soemtron 220 electronic desk calculator. The programmed form of the teaching material makes individual learning and an independent compilation possible of the material. Numerous exercises show practical work with the computer and the acquisition of a certain computing talent.

The Authors and publishing house wish to hear of teaching success when using this teaching material. References to the improvement of the teaching material with a NAK accumulating up situation are gladly received.

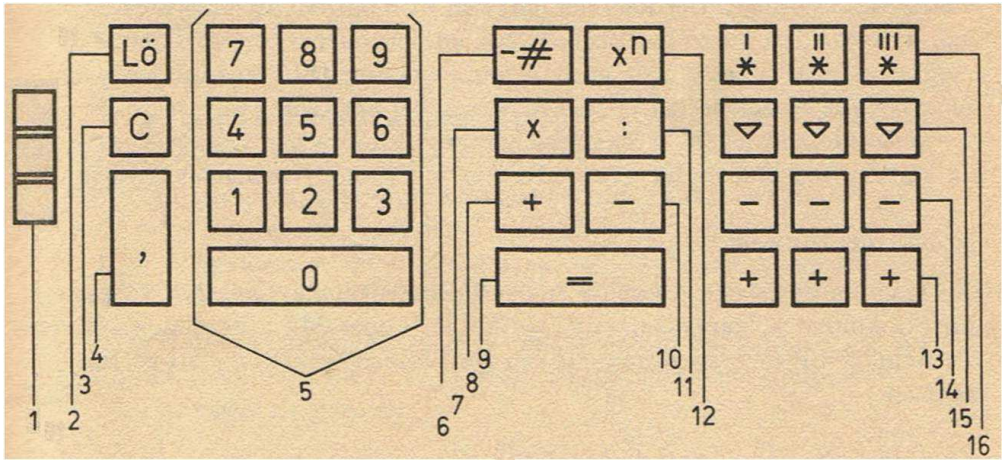
Author and publishing house

1

1. Structure of the operating controls

The electronic desk calculator type 220 has been developed using transistor diode technology in connection with ferrite core matrix storage. With it you can with related polarity symbol, add subtract, multiply, divide and raise to powers.

Control keyboard and display



1	Decimal point pre-selection	9	Equals (result)
2	Clear	10	Subtract
3	Correction	11	Divide
4	Decimal point (comma)	12	Raise to power
5	Numerical keyboard	13	Add to memory
6	Input negative values	14	Subtract to memory
7	Multiply	15	Memory recall without deletion of the memory
8	Add	16	Memory recall with deletion of the memory

Display

The input and output results are shown in the illuminated display. Each Illuminated figure tubes contains the numbers from 0 to 9.

Decimal point (comma) mechanism

Adjusting the decimal point of a number is by turning the knurled knob. The number of decimal points is indicated by numbers on the edge of the knurled knob. Used when adjusting the decimal point before an arithmetic operation, for the highest possible decimal point result. The decimal point (comma) is shown by an illuminated lamp in the appropriate display position.

The possible decimal point settings are -

0; 1; 2; 3; 4; 6; 9; 10; 11; 12; 14.

The Setting “Z” is for the Type 220 without meaning.

Arithmetic and logic unit

The electronic desk calculator is equipped with a ferrite core memory and possesses three free storage registers. Intermediate results can be stored, constants and final additive and subtractive results, and can also have addition and subtraction directly to the memory registers, but only if the appropriate memory keys are used. The computer gets the value automatically from the memory, transports it into the arithmetic unit, adds or subtracts the keyed in value and transfers the sum or the difference back into the memory. The stored values can be recalled with or without deletion to the display and can also be used for further arithmetic operations.

Technical reference

The calculator is intended for the connection to 220V AC mains. It can also be operated from 110V, 127V or 242V. Necessary conversions are to be made only by the service centre.

Input and output size of the computer

The electronic table computer Soemtron 220 has a capacity of 15 digits of input and output. The sign stands behind the number. The display stops with an overflow; the keyboard is then disabled. The arithmetic registers must cleared before a new processing step by operation of the erase key (Lö) and the correction key (C).

Go to section 2

From section 1

2 2. The keyboard of the Soemtron 220 electronic desk calculator

Starting

The on-off mains switch is located on the right side under the lower dust cover. On the top right in the indicator display an indicator light show whether the computer is operational.

Before use the erase key and the correction key are must be pressed, in order to make sure all values are deleted. The memory registers are not cleared by the erase key, but by the register “memory call with deletion of the memory” keys for registers 1, 2, and 3.

Numerical keyboard

The numeric keyboard contains the number 0 to 9 grouped together in a certain order.

Memory keyboard

The desk calculator has three temporary storage locations. For each memory there is a key for addition, one for subtraction, one for memory call without deletion and one for memory call with deletion.

If a "memory call without deletion" key is pressed, the value of that register is shown in the display. This value also remains in the memory for that register, if the Erase key “Lö” is pressed after a recall of the register contents.

If a value is called up with a "memory recall with deletion" key from the memory, it appears in the display and the respective memory register is cleared.

Correction key (C)

With the help of the correction key, wrongly entered values can be corrected, provided that after entering the wrong value no other function key was pressed. Otherwise the correction key deletes only the indicated value.

Erase key (Lö)

Pressing the erase key clears the arithmetic unit and the display. Contents of the three memory registers remain.

Decimal point (Comma) key

The decimal point (comma) key is used in connection with the rotating decimal point position selector switch. It is pressed at the place, at which the decimal point occurs in the number.

The decimal point (comma) is represented in the display by a zero overwritten with one (Ø in this manual). Operation of a function key causes the number with the decimal point to align to the correct place in the arithmetic unit, which is has been set by the rotary decimal point position selector switch and indicated by a lamp in the display.

Go to section 3

From section 2

3

2.1. Practice use of the numerical keyboard

Do not switch on for the computer!

Above it serving the numerical keyboard, without seeing on the keys!

Use the fingers of the right hand.

If you use the ETR 220 only as auxiliary device for your work, you can also use the left hand. This leaves the right hand for notes.

Switch the equipment on now!

Press the groups of numbers

159; 348; 617; 248; 629; 734916

successively. Do not watch the keys. Control by looking at the display to see whether the correct values are entered.

Repeat this task several times!

Learn now, how the different arithmetic operations on the desk calculator are implemented. Accomplish the exercises carefully!

Go to section 4

From section 3

4

3. Addition

Addition is possible in the arithmetic unit and in the register memory storage unit.

Addition in the arithmetic unit

After each number to be added, the addition key (+) should be pressed with the result appearing in the display after operation of the equals key.

Example

2 + 3 = 5

Solution steps	Display
Clear the arithmetic unit (Lö key)	0
Rotate decimal point to 0	0
Enter 2	2
Add	2
Enter 3	3
Add	3
Equals key	5

Now complete some exercises!

Go to section 9

From section 14

5

3.2. Addition of decimal numbers

EXAMPLE

17,8 + 16.4 + 27.332 = 61,532

Solution steps	Display
Clear the arithmetic unit “Lö key”	0
Rotate decimal point to “3”	0
Enter 1 7 , 8	1,7 Ø 8
Add	17,800
Enter 1 6 , 4	1,6 Ø 4
Add	16,400
Enter 2 7 , 3 3 2	27,332
Add	27,332
Equals key	61,352

Question

Have you the got the indicated result?

Yes! Go to section 15
No! Go to section 7

From section 15

6 Your answer is correct!

The decimal point must be pressed after keying the whole number in.

Go to section 16

From section 5

7 Examine the keyed in number sequence!

Read sections 1 & 2 again and repeat the tasks

From section 18

8 Practice task

Pay attention to the decimal point !

36,0 + 16,0 + (-13) + 5,0 = 44
100 + (-3849,1213) + (-0,00004) + 14,02 = —3735,10134
425 + 325,5 + (-25,76) + (-27) = 697,74

Question

Have you the got the indicated result?

Yes! Go to section 12
No! Go to section 21

From section 4

9 Exercises

413 + 211 = 624
987 + 345 = 1332
87 + 1952 = 2039

Continue from Section 10

From section 9

10

3.1 Addition in the arithmetic unit with several addends

EXAMPLE

12 + 13 + 25 = 50

Solution steps	Display
Clear the arithmetic unit (Lö)	0
Decimal point position	0
Enter 1 2	12
Add	12
Enter 1 3	13
Add	13
Equals	25
Add	25
Enter 2 5	25
Add	25
Equals	50

Question

Can you also omit operation of the equal key and the addition key after entering the number 13 and pressing the addition key?

Yes! To section 23
No! To section 20

From section 15

11

The answer is wrong!

If only whole numbers are added and if the decimal point key is not pressed, the decimal point marked in the display must not be considered when reading off the result.

To section 16

From section 8

12

You solved the tasks correctly.

Thus you control the decimal point mechanism of the ETR 220.
Read again about the meaning of the correction key under section number 2.

Afterwards continue from section 13

From section 12

13

3.4. Learn about correction of wrongly entered values

EXAMPLE

17 + (36) 37 = 54

(The number 36 should instead become the number 37)

Solution steps	**Display**
Clear the arithmetic unit “Lö" Key	0
Decimal point position 0	0
Enter 1 7	17
Add	17
Enter 3 6	36
Clear key "C"	0
Enter 3 7	37
Add	37
Equals	54

Question

Is it possible to correct after keying the number 36 and operation of a function key in the wrong number?

Yes! To section 26
No! To section 28

From section 23

14

Exercises

2S + 75 + 17 = 117
56 + 13 + 111 + 19 = 199
158 + 97 + 325 + 7 + 39 = 626

If you received the correct results, continue from section 5

From section 5

15

Exercises

13,9 + 17,8 + 16,4 = 48,1
1,3 + 0,5 + 7,8 + 14,9 = 24,5
684,2 + 966 + 737,8 + 684,1 + 20,3 + 0,5 = 3092,9
76,12 + 3 + 0,627 + 223,0 + 4,05 + 0,7 = 309,497

Work with the decimal point key! It works only in connection with the rotary decimal point switch position.

Question

Does the decimal point key also have to be pressed when counting whole numbers, if the rotary decimal point switch is not in zero position?

Yes! To section 6
No! To section 1

From section 6 and 11

16

3.3. Addition of negative addends

EXAMPLE

8 + 2 + (- 3) = 7

Solution steps	**Display**
Clear the arithmetic unit ("Lö" Key)	0
Decimal point position	0
Enter 8	8
Add	8
Enter 2	2
Add	2
Enter 3	3
Negate value (-#)	3 -
Add	3 -
Equals	7

Question

Can this task be solved differently?
Think of the arithmetic rules!

Compare your result with the indicated solution! To section 18

From section 28

17

Learn the transfer of values into the memory registers

Values can be transferred to a memory register only from the display

Task

Input the number 56 into the memory registers I, II and III

Solution steps	**Display**
Clear the arithmetic unit and the memory registers (Lö for I*, II*, III*)	0
Decimal point position "0"	0
Enter 5 6	56
Add to memory registers I, III and III	56
Deletion of the arithmetic unit: Lö as a check	0
Recall memory without deletion (Iv)	56
Lö	0
Recall memory without deletion (IIv)	56
Lö	0
Recall memory without deletion (IIIv)	56
Lö	0

Question

What happens, if you operate the memory recall key with deletion (*) of the appropriate memory in place of the Lö after the memory recall without deletion?

Examine your answer! To section 24

From section 16

18

Before the number 3 stands for two signs. + (- 3) is identical to +1 times - 3 = -3.

Therefore would be counted as: 8 + 2 - 3 = 7 To section 8

From section 24

19

Addition of positive numbers in the memory

10 + 22 = 32

Solution steps	Display
Clear the arithmetic unit (Lö) as well as the memory I (I*)	0
Decimal point position 0	0
Enter 1 0	10
Add to memory register 1	10
Enter 2 2	22
Add to memory register 1	22
Recall memory register 1 without deletion	32

Likewise the addition takes place in memory registers II and III.
Solve further tasks!

To section 27

From section 10

20

The answer is wrong.

Reread section 3 and then answer the question again.

From section 8

21

Read again about the decimal point mechanism under section 1 and 2, and then repeat the exercises!

From section 25

22

Exercises.

55 + (-13} + 15 + (-2) = 55
77,3 + 18,99 + 0,083 = 96,373
78,99 + (-19,887) + 17,3 + (-88,04) = —11,637
146 + (-126) + 100 + (-100,9) + (-200,79) = —181,69

Alternately use the memory 1, II and III.

To section 29

From section 10

The answer is correct!

23

The addition key is pressed after each addend and the equal's key at the end.

To section 14

From section 17

The answer must read in a general manner:

24

The value appears in the display. It is deleted at the same time in the memory register. For further calculations this value from the memory register cannot be recalled. It must be entered again into the memory register.

To section 19

From section 27

Addition of negative numbers in the memory registers

25

Negative numbers can be transferred via the display to the memory registers. They become with call of the memory related to polarity symbol into the display back-transfer. The positioning of decimal point is to be always considered.

EXAMPLE

42 + (-15) + 12 + (-9) + (-40) = -10

Solution steps	Display
Clear the arithmetic unit and the memory registers I*, II*, and III*	0
Decimal point position "0"	0
Enter 4 2	42
Add tomemory register 1	42
Enter 1 5	15
Negate Key (-#)	15 -

Solution steps	Display
Add to memory register 1	15 -
Enter 1 2	12
Add to memory register 1	12
Enter 9	9
Negate key (-#)	9 -
Add to memory register 1	9 -
Enter 4 0	40
Negate key (-#)	40 -
Add to memory register 1	40 -
Recall from memory register 1 without deletion	10 -

Repeat the task using memory register II.

Continue working from section 22

From section 13

26

The answer is wrong.

Read section 2 again about the function of the erase key. Then answer the question again!

From section 19

27

Exercises

13,5 + 17,33375 + 7 = 37 833750
52,0021 + 3,13 + 7,75 = 62,8821
25 + 18,7 + 51,6 = 95,3
176,240 + 586,679 + 374,178 = 1137,097

Alternately use memory registers I, II and III. To section 25

From section 13

28

The answer is correct !

Describe the use of the correction key. Read, again if necessary section 2.

Continue working from section 17

From section 22

29

4. Learn about subtraction

Subtraction is like addition in calculations in the use of the memory registers.

Subtraction in the arithmetic unit

EXAMPLE

97 - 86 = 11

Solution steps	Display
Clear the arithmetic unit "Lö" and the memory registers I* II* III*	0
Decimal point position "0"	0
Enter 9 7	97
Add	97
Enter 8 6	86
Subtract	86
Equals	11

Clear further tasks! To section 37

From section 34

30

Exercises

66 - (-27) = 93
198,76 - (-32,753) = 231,513
198,5 - (-1989,6) = 2188,1
(-1000,00001) - (-987,0003) - 760 + (-340) = -1112,999710

Successively use all three memory registers.
If your solutions differ from the results given,
and read the solution steps again. To section 34

(-105) - (-99) = -6

Remember that after entering the number 105, the negate key must be pressed, then the key for addition to a memory register.

Question

What happens, if you press the addition key after entering the number 105 into a memory register and then press negate key?

Compare your answer with section 33

From section 37

31

4.1. Subtraction of negative whole numbers

EXAMPLE

(- 8) - (- 2) = - 6

Solution steps	**Display**
Clear the arithmetic unit with the "Lö" key	0
Decimal point position "0"	0
Enter 8	8
Negate key (-#)	8 -
Add	8 -
Enter 2	2
Negate key	2 -
Subtract key	2 -
Equals	6

Solve some more tasks! To section 35

From section 36

32

Exercises

619 - 328 = 291
1987,3542 - 987.213 = 1000,1412
9999,98 - 52.7635 - 0.0007 - 0.001 = 9947.2148

Use all 3 memory registers successively!

Question

Did you receive the correct solutions?

Yes! To section 34
No! Repeat the solution steps! To section 36

Release it thereafter the tasks again!

From section 30

33

The answer would have to read in a general manner:

After entering the number 105, if the key for memory register addition is pressed and afterwards the negate key, the instruction works

To store the number 105 in a memory register without a minus sign. In the display would be -105, in the memory +105. One would continue working with positive sign. The addressed memory is to be cleared to begin the calculation again.

To section 38

From section 32

34

4.3. Subtraction of negative whole numbers in the memory register.

EXAMPLE

(+33) - (-19) = 52

Solution steps	**Display**
Clear the arithmetic unit using "Lö" key and the memory registers (I* II* III*)	0
Decimal point position "0"	0
Enter 3 3	33
Addition to memory register 3	33
Enter 1 9	19
Negative entry key (—#)	19 -
Subtract to memory register 3	19
Recall register 3 without deletion	2

Completion of the exercise! To section 30

From section 31

35

Exercises

980 - (-343) = 1323
18743,542 - (-1009,5134) = 19753,0554
(-647) - (-783) = 136
(-1035,67) - (-987,65321) = -48,016790
(-100,0001) - (-999,99991) = 899,999810

Question

Do your results agree with the examples?

Yes! To section 36
No! Repeat the solution steps. To section 31

Release it thereafter the tasks again!

From section 35.

36

4:2 Subtraction of positive whole numbers in the memory

EXAMPLE

81 - 22 = 59

Solution steps	**Display**
Clear the arithmetic unit (Lö) and the memory registers (I* II* III*)	0
Decimal point position	0
Enter 8 1	81
Add to memory register 1	81
Enter 2 2	22
Subtract to memory register 1	22
Memory register 1 recall without deletion	59

Delete some exercises now! To section 32

From section 29

37

Exercises

123 - 96 = 27
1232 597 - 084,6543 - 247,9427
10000000,00015 - 5000000,00030 = 4999999,999850

Question

Do your results agree with the examples?

Yes! To section 31
No! Repeat the solution steps again. To section 29

Release it thereafter the exercises again.

From section 33

38

5. Multiplication

Multiplication is possible only in the arithmetic unit.

Multiplication of 2 factors

11 x 11 = 121

Solution steps	Display
Clear the arithmetic unit	0
Enter 1 1	11
Multiply	11
Enter 1 1	11
Equals	121

To section 44

From section 45

39

5.3. Multiplication with bracketed terms

EXAMPLE

653 x (4.15 + 2.8 - 0.020) = 4525.290

Solution steps	Display
Clear the arithmetic unit	0000
Decimal point setting "3"	0,000
Enter 6 5 3 ,	6,53 Ø
Multiply	653,000
Enter 4 , 1 5	4, Ø 15
Add	4,150
Enter 2 , 8	0,2 Ø 8
Add	2,800
Enter 0 , 0 2 0	0, Ø 02
Subtract	0,020
Equals	4525,290

Solve the following tasks:

952,3 x (8.4 + 003 - 0.01) = 8018,366
10,06 x (- 5.2 - 2.1 - 3.3) = -106.636

Question

When is the negate key (-#) to be pressed in the second task?
Before 5,2 To section 40
After 5,2 To section 49
After 3,3 To section 46

After the addition in that clammy ones without attention of the signs To section 42

From section 39

Your answer is wrong, concomitantly the result.

40

To section 50

From section 52

41

5.1. Multiplication with 3 and more factors

EXAMPLE

12 x 13 x 20 = 3120

Solution steps	Display
Clear the arithmetic unit	0
Enter 1 2	12
Multiply	12
Enter 1 3	13
Equals	156
Multiply	156
Enter 2 0	20
Equals	3120

Question

Is it possible to dispense with the indication of the intermediate result?

Yes! To section 47
No! To section 51

From section 39

42

Your answer and the result are correct.

To section 53

From section 44

43

The result is wrong, repeat the task again!

Consider the sum of the number of places of the factors.

From section 38

44

Exercises

(-18) x (- 5) = 90
3758 x (- 27870) = -104735460
99999999 x 99999999 = ...

On completion of this task -

The display stops To section 48
The display does not stop To section 43

From section 51

45

5,2 Multiplication with decimal point.

Multiplication with decimal point the sum of the decimal places of the factors with the rotary control must be stopped.

The last decimal place is rounded
Solve the following tasks:

5678,123 x 0,002 = 11,356246
613,54 x (- 97.350) = 59728,119000
(-183,542) x (- 1906.0017) = 349831,3640214

Question

Do your results agree with the examples?
Yes ! To section 39
No! Complete the solution steps again. To section 41
Release it thereafter the tasks again.

From section 39

46

Your answer is incorrect and consequently also the result To section 50

From section 41

47

The answer is wrong!

After each entry the intermediate result must be determined with the equals key, otherwise only one product of first and the last factor.

Solve the task again!

From section 44

48

The entered numbers are correct.

Question

Why does the display stop? To section 52

From section 39

49

The answer is correct and consequently the result.

The negative values were added. To section 53

From sections 40 and 46

50

Count the tasks again as follows:

Solution steps	**Display**
Clear the arithmetic unit and the memory registers	00000
Decimal point setting 3	00,000
Enter 1 0 , 0 6	10, Ø 06
Add for memory register 1	10,060
Enter 5 , 2	0,5 Ø 2
Add	5,200
Enter 2 , 1	0,2 Ø 1
Add	2,100
Enter 3 , 3	0,3 Ø 3
Add	3,300
Equals	10,600
Negate value “-#”	10,600 -
Multiply key	10,600 -
Recall memory register 1 with deletion (I*)	10,060
Equals	106,636 -

To section 39

From section 41

51

The answer is correct.

If the intermediate result is not determined with the equals key, it does not come off. The result would be a product of first and the last factor.

Solve the following tasks:

57 x 15 x 3125 = 2671875
71 x 717 x 171 = 8705097
3785 x 4296 x 901 = 14650584360

Question

Do your results agree with the examples?

Yes! To section 45
No! Read the solution steps.

From section 48

52

Your answer is correct, if it reads:

If sum of the number of places of the factors is larger than 15, then capacity of the computer is exceeded.

Solve now the task

99999999 x 9999999 = 999999890000001 To section 41

From section 49

53

6. Learn division

Simple division

EXAMPLE

153 : 3 = 51

Solution steps	**Display**
Clear the arithmetic unit	0
Decimal point position 0	0
Enter 1 in 5 3	153
Divide	153
Enter 3 in	3
Equals	51

Release it now some tasks! To section 56

From section 61

54

6.3. Division with a bracketed term

EXAMPLE

20 : (2 + 4 - 1) = 4

Solution steps	**Display**
Clear the arithmetic unit	0
Decimal point position 0	0
Enter 2 0	20
Divide	20
Enter 2	2
Add	2
Enter 4	4
Add	4
Enter	1
Subtract	1
Equals	4

Do the following task:

232 : (16 • 4 + 18) = 2.83

Position the rotating decimal point control on 2!

Note that this task can be counted not continuous.
If you compute first the divisor, bring it into a memory, implement you thereafter the division!

Count it now some tasks for exercise! To section 62

From section 63

6.1 Division with constant dividends

55

EXAMPLES

16 : 2 = 8
16 : 8 = 2

Solution steps	**Display**
Clear the arithmetic unit and the memory registers (I*, II*, III*)	0
Decimal point position 0	0
Enter 1 6	16
Add to memory register 1	16

Solution steps	Display
Divide	16
Enter 2	2
Equals	8
Recall memory register 1 without deletion	16
Divide	16
Enter 8	8
Equals	2

Solve now some tasks! To section 60

From section 53

56 Exercises

1869 : 3 = 623

101 : 4 = 25

Question

How does the indicated result of the second task develop?

Compare your answer with To section 63

From section 59

57 6.2. Division with constant Divisor

EXAMPLES

9 : 3 = 3

15 : 3 = 5

Solution steps	Display
Clear the arithmetic unit (Lö) and the memory registers (I*, II*, III*)	0
Decimal point position 0	0
Enter 9	9
Divide	9
Enter 3	3
Add to memory register 1	3
Equals	3
Enter 1 5	15
Divide	15
Recall memory register 1 without deletion	3
Equals	5

To section 61

From section 62

58

6.4. Subtraction of two Quotients

EXAMPLE

$$\frac{5{,}1387}{2{,}413} - \frac{0{,}2312}{1{,}135} = 1{,}9259$$

Solution steps	Display
Clear the arithmetic unit and the memory	00000
Decimal point position 4	0,0000
Enter 5 , 1 3 8 7	5,1387
Divide	5,1387
Enter 2 , 4 1 3	2, Ø 413
Equals	2,1296
Add to memory register 3	2,1296
Enter 0 , 2 3 1 2	0,2312
Divide	0,2312
Enter 1 , 1 3 5	1, Ø l35
Equals	0,2037
Subtract to memory register 3	0,2037
Recall memory register 3 with deletion	1,9259

To section 64

From section 60

59

6.2. Division with constant divisor

Try those tasks with the help of your realizations over those to solve the division independently!

EXAMPLES

9 : 3 - 3
15 : 3 = 5

Question - Did you receive the indicated results?

Yes! To section 6l
No! To section 57

From section 55

60

Exercises

4638,5 : 18 = 257,69
4638,5 : 24 = 193,27

Question - Did you receive the indicated results?

Yes! To section 59
No! Read again about the solution steps with the division with constant dividends!

Repeat the tasks again!

From sections 57 and 59

61

Exercises

7654,32 : 234 = 32,711
2442,37 : 234 = 10,437
73,3 : 5 = 14,7
91,7 : 5 = 18,3
199,9 : 5 = 39,98

If you get other than the indicated results, examine whether you pressed the decimal point key at the correct place and adjusted the decimal point rotary control correctly.

Repeat the calculations!

If you received the correct results, continue at section 54

From section 54

62

Exercises

15 x [3 + 3 - (-9)] = 1
15 x [-3 + 3 + (-6)] = -2,5
199,65 : [-77,1 + 43,4 + (-22,l) - 13,5] = 2,88
625 : (68,331 + 215,779 - 259,11) = 25
(25,16 x 4,15) : (16,3 x 2,1) - (3,2 x 1,9) = 3,0296

Consider with the second task that you have to press the divide key and enter 3. Afterwards are more negative the key for the input. To press values and the addition key.
Think with the fifth task of the decimal point setting. If you compute first the divisor, store it, then determine the dividends and afterwards the quotients.

To section of 58

From section 56

63

The computer can use only integral quotients, if no decimal places are indicated. If a genuine divisibility is missing, the dividend must be extended by powers of ten. These powers of ten are to be considered when reading off. The task of 101 : 4 is on 101,00: to extend 4 = 25.25. The same procedure is accomplished by the computer, if for the operation the decimal place is indicated by the rotary control and decimal point key. The task then reads:

101,00 : 4 = 25.25

Therefore the result with decimal point can be read off directly.

Count they the now following gave up:

```
   12,3  :   3     =    4,1
 1754,7  :   5,1   = 344,1
19637,0  :  60,02 = 327,17
```

Question

Did you receive the indicated results?

Yes! To section 55
No! Read again the solution steps. To section 53
release it then the tasks again!

From section 58

61

7. Powers

When raising to a power first adjust the rotary decimal point control, then the base number is keyed in and afterwards the Multiply key pressed. Then press once the raise to power (x^n) key k -, if k is the exponent. The equals key is not to be pressed.

EXAMPLE

16^6 = 16.777.216
Basis = 16, Exponent k = 6

Solution steps	**Display**
Clear the arithmetic unit	0
Decimal point setting 0	0
Enter 1 6	16
Multiply	16
Raise to power	256
Raise to power	4096
Raise to power	65536
Raise to power	1048576
Raise to power	16777216

Now solve the following tasks

275^3 = 20 796 875
7^{12} = 13 841 287 201
22^5 = 5 153 632
$2{,}5^5$ = 97,656250

Practice, until you have solved all the tasks correctly!

To section 65

From section 64

65

8. Exercises to the imported arithmetic operations

1. Computation of the arithmetic means [AG] it is used, if.

After averages more economically or other features becomes.

Task

A VEB refers a materials type in the year at the following prices:

60 t zu 20,- M je t

80 t zu 22,- M je t

160 t zu 15,- M je t

40 t zu 23,- M je t

What is the in-plant material sliding average price (MVP) ?

Since the material sliding average price is affected by the quantities, the weighed arithmetic means (AG) is to be computed.

$$A_g = \frac{\sum_{k=1}^{n} m_k \; g_k}{\sum_{k=1}^{n} g_k}$$

mk \ = values which can be averaged (here the prices)
office = quantities

$$mvp = \frac{20 \times 60 + 22{,}80 + 15 \times 160 + 23 \times 40}{60 + 80 + 160 + 40} = 18{,}47$$

18.48 M for each t is the material sliding average price.

The last number had to be rounded up, because otherwise with larger quantities arise differences.

Solution steps	**Display**
Clear the arithmetic unit and the memory	000
Decimal point setting 2	0,00
Enter 6 0 ,	6,0 Ø
Add to memory register1	60,90
Multiply	60, 00
Enter 2 0 ,	2,0 Ø
Equals	1200,00
Add to memory register 2	1200,00
Enter 8 0 ,	8,0 Ø
Add to memory register 1	80,00
Multiply	80,00
Enter 2 2 ,	2,2 Ø
Equals	1760,00
Add to memory register 2	1760,00
Enter 1 6 0 ,	16,0 Ø
Add to memory register 1	160,00
Multiply	160,00
Enter 1 5 ,	1,5 Ø
Equals	2400,00
Add to memory register 2	2400,00
Enter 4 0 ,	4,0 Ø
Add to memory register 1	40,00
Multiply	40,00
Enter 3 ,	2,3 Ø
Equals	920,00
Add to memory register 2	920,00
Recall memory register 2 without clear	6280,00
Divide	6280,00
Recall memory register 1 without clear	340,00
Equals	18,47

2. Computation of the chronological means (C)

Task

VEB was busy in the first half-year of 19.. the following workers:

am.	1.1.	104 workers
am	1.2.	110 workers
am	1.3.	108 workers
am	1.4.	118 workers
am	1.5.	128 workers
am	1.6.	64 workers
am	30.6.	112 workers

On average how many workers were employed in the first half-year ?

Since time sizes and period sizes may not be compared directly with one another, the chronological means is to be calculated.

$$C = \frac{\frac{X_1}{2} + \frac{X_n}{2} + \sum_{i=2}^{n-1} x_i}{n-1}$$

x_i = Number of workers
n = 7

$$c = \frac{\frac{104}{2} + \frac{112}{3} + 110 + 108 + 118 + 128 + 64}{6} = 106$$

106 workers were employed on average in the first half-year in this VEB:

Solution steps	Display
Clear the arithmetic unit and the memory	00
Decimal point setting with the rotary control on 0	00
Enter 1 0 4	104
Divide	104
Enter 2	2
Add to memory register 2	2
Equals	52
Add to memory register 1	52
Enter 1 1 2	112
Divide	112
Recall memory register 2 without deletion	2
Equals	56
Add to memory register 1	56
Enter 1 1 0	110
Add to memory register 1	110
Enter 1 0 8	108
Add to memory register 1	108
Enter 1 1 8	118
Add to memory register 1	118
Enter 1 2 8	128
Add to memory register 1	128
Enter 6 4	64
Add to memory register 1	64
Recall memory register 1 without deletion	636
Divide	636
Enter	6
Equals	106

3. Computation of the harmonious means [Hg] it is used, if proportionality factors are to be determined, of which the counters as well-known sizes is indicated.

Task

Four workers (A, B, C and D) manufacture assemblies in a VEB:

A needs 2 minutes for 1 assembly and works for 7.0 hours each day
B needs 4 minutes for 1 assembly and works for 6.5 hours each day
C needs 3 minutes for 1 assembly and works for 6.0 hours each day
D needs 5 minutes for 1 assembly and works for 7.5 hours each day

How much do minutes need the workers to average-to manufacturing an assembly?

$$H_g = \frac{\sum_{k=1}^{n} g_k}{\sum_{k=1}^{n} \frac{1}{m_k} \times g_k}$$

m_k = values which can be averaged (minutes for every assembly)
g_k = work time

$$H_g = \frac{7 + 6{,}5 + 6 + 7{,}5}{\frac{7}{2} + \frac{6{,}5}{4} + \frac{6}{3} + \frac{7{,}5}{5}} = 3{,}13$$

3.13 minutes are needed on average for each assembly.

Solution steps	Display
Clear the arithmetic unit and the memory	0000
Decimal point setting with the rotary control set to 2	00,00
Enter 7 ,	0,7 Ø
Add to memory register 1	7,00
Divide	7,00
Enter 2 ,	0,2 Ø
Equals	350
Add to memory register 2	3,50
Enter 6 , 5	6, Ø 5
Add to memory register 1	6,50
Divide	6,50
Enter 4 ,	0,4 Ø
Equals	1,63
Add to memory register 2	1,63
Enter 6 ,	0,6 Ø
Add to memory register 1	6,00
Divide	6,00
Enter 3 ,	0,3 Ø
Equals	2,00
Add to memory register 2	2,00
Enter 7 , 5	7, Ø 5

Solution steps	Display
Add to memory register 1	7,50
Division	7,50
Enter 5 ,	0,5 Ø
Result	1,50
Add to memory register 2	1,50
Recall memory register 1 without clear	27,00
Division	27,00
Recall memory register 2 without clear	8,63
Result	3,13

4. Computation of the anti-harmonious means (H')

Task

Four groups $i(i = 1(1)4)$ manufacture assemblies in the following quantities in one hour:

Group i = 1 12 pieces
Group i = 2 16 pieces
Group i = 3 22 pieces
Group i = 4 18 pieces

How much time on average is needed, in order to manufacture an assembly?

It is asked consciously for the mean, not for the average. Therefore a progressive means is to calculate the anti-harmonious means H'.

$$H' = \frac{\sum_{i=1}^{n} X_i^{\,2}}{\sum_{i=1}^{n} X_i}$$

$$H' = \frac{122 + 162 + 222 + 182}{12 + 16 + 22 + 18} = 17.76$$

17.76 minutes are on average needed, in order to make an assembly.

Solution steps	Display
Clear the arithmetic unit and the memory registers	000
Decimal point setting with the rotary control on 2	0,00
Enter 1 2 ,	1,2 Ø
Add to memory register 2	12,00
Multiply	12,00
Raise to power (-#)	144,00
Add to memory register 1	144,00
Enter 1 6 ,	1,6 Ø
Add to memory register 2	16,00
Multiply	16,00
Raise to power (-#)	256,00
Add to memory register 1	256,00
Enter 2 2 ,	2,2 Ø
Add to memory register 2	22,00
Multiply	22,00
Raise to power (-#)	484,00
Add to memory register 1	484,00
Enter 1 8 ,	1,8 Ø
Add to memory register 2	18,00
Multiply	18,00
Raise to power (-#)	324,00
Add to memory register 1	324,00
Recall memory register 1 without deletion	1208,00
Divide	1208,00
Recall memory register 1 without deletion	68,00
Equals	17,76

4. Compute a trend

The trends are time series. Time-dependent economic processes in their trend are represented by it. The development of many economic features, like conversion of a sales office, existence of media or work articles, production of an enterprise in quantities or values, can be shown in a two-dimensional Cartesian coordinate system. On the ordinate, the amounts of the economic features stand for the y axis. On the other axis, which is the x axis, is the time, on which the economic features occurred. The trend results thus as a function of the time. It can be a straight line, in addition, assume arbitrary other forms. It computed according to the method of the smallest squares.

EXAMPLE

Production development VEB

Year	X	Y	X x Y	x2
1960	-5	1,232	-6,160	25
1961	-4	1,614	-6,456	16
1962	-3	2,011	-6,033	9
1963	-2	2,453	-4,906	4
1964	-1	2,857	-2,857	1
1965	0	3,185	0,0	0
1966	1	3,409	3,409	1
1967	2	3,825	7,650	4
1968	3	4,186	12,558	9
1969	4	4,701	18,804	16
1970	5	5,109	25,545	25
E	0	34,582	41,554	110

y = production value in million Marks.
x = spare numbering of the periods.

$x \cdot y$ and x^2 = further sizes necessary for the computation of the trend.

The function of the trend is accepted for the simplification of the calculation as linear. The general equation for a linear function reads:

y = ax + b

The quantities a, b are to be calculated.

If the empirical values with y_i are designated, the values of the theoretical function with Y_i, applies according to the method of the smallest squares:

$\sum (y_i - Y_i)^2 = \rightarrow$ Minimum if given sizes are used for Y, then this is written:

$\sum (y_i + (ax + b))^2 = \rightarrow$ Min.

This expression is set zero:

$$\sum (y_i + (ax + b))^2 = 0$$

This equation is differentiated partially after x and after y:

I -- $\sum y_i + a \sum x_i + nb = 0$

II -- $\sum x_i y_i + a \sum x_i^2 + b \sum x_i = 0$

From this follows -

I -- $\sum y_i = a \sum x_i + nb$

II -- $\sum x_i y_i + a \sum x_i^2 + b \sum x_i$

And

$$a = \frac{n \sum x_i y_i - \sum x_i y_i}{n \sum x^2 - \left(\sum x\right)^2}; \quad a = \frac{\sum x_i^2 \cdot \sum y_i - \sum x_i \cdot \sum z_i y_i}{n \sum x^2 - \left(\sum x\right)^2};$$

In the results for A and b stand members, which contain the quantity $\sum x_i$. There is a possibility, $\sum x_i$; to set to zero.
The time periods are numbered in such a way that its sum zero results in. In addition the middle period, in the example the year 1965, receives the number zero. Those before it and behind it standing periods accordingly negatively or positively numbered.

if $\sum x_i = 0$ are, a and b are simplified:

$$a = \frac{\sum x_i y_i}{\sum x_i^2} \qquad b = \frac{\sum y_i}{n}$$

From this follows :

$$a = \frac{41{,}554}{110}; \qquad b = \frac{34{,}582}{11}$$

a = 0,3778; b = 3,1438 D

The function of the trend reads:

Y = 0,3778 x + 3,1438

Solution steps	Display
Clear the arithmetic unit and the memory	00000
Set the decimal point to 4 with the rotary control	0,0000
Enter - ,	5, Ø 000
Multiply	5,0000
Enter 1 , 2 3 2	1, Ø 232
Add to memory register 1	1,2320
Equals	6,1600
Add to memory register 2	6,1600

Solution steps	Display
Enter - 4 ,	4, Ø 000-
Multiply	4,0000
Enter 1 , 6 1 4	1, Ø 614
Add to memory register 1	1,6140
Equals	6,4560
Add to memory register 2,	6,4560
Enter - 3 ,	3, Ø 000
Multiply	3,0000
Enter 2 , 0 1 1	2, Ø 011
Add to memory register 1	2,0110
Equals	6,0330
Add to memory register 2	6,0330
Enter - 2 ,	2, ®000
Multiply	2,0000
Enter 2 , 4 5 3	2, Ø 453
Add to memory register 1	2,4530
Equals	4,9060
Add to memory register 2	4,9060
Enter - 1 ,	1, Ø 000
Multiply	1,0000
Enter 2 , 8 5 7	2, Ø 857
Add to memory register 1	2,8570
Equals	2,8570
Add to memory register 2	2,8570
Enter 3 , 1 8 5	3,0185
Add to memory register 1	3, Ø 185
Enter 1 ,	0.0010
Multiply	1,0000
Enter 3 , 4 0 9	3,0409
Add to memory register 1	3,4090
Equals	3,4090
Add to memory register 2	3,4090
Enter 2 ,	0,002 Ø
Multiply	2,0000
Enter 3 , 8 2 5	3, Ø 825
Add to memory register 1	3,8250
Equals	7,6500
Add to memory register 2	7,6500
Enter 3 ,	0,003 Ø
Multiply	3,0000
Enter 4 , 1 8 6	4, Ø 186

Solution steps	Display
Add to memory register 1	4,1860
Equals	12,5580
Add to memory register 2	12,5580
Enter 4 ,	0,004 Ø
Multiply	4,0000
Enter 4 , 7 0 1	4, Ø 701
Add to memory register 1	4,7010
Equals	18,8040
Add to memory register 2	18,8040
Enter 5 ,	0,005 Ø
Multiply	5,0000
Enter 5 , 1 0 9	5, Ø 109
Add to memory register 1	5,1090
Equals	25,5450
Add to memory register 2	25,5450
Enter - 5 ,	5, Ø 000-
Multiply	5,0000-
Raise to power (-#)	25,0000
Add to memory register 3	25,0000
Enter - 4 ,	4, Ø 000-
Multiply	4,0000-
Raise to power	16,0000
Add to memory register 3	16,0000
Enter - 3 ,	3, Ø 000-
Multiply	3,0000-
Raise to power	9,0000
Add to memory register 3	9,0000
Enter - 2 ,	2, Ø 000-
Multiply	2,0000-
Raise to power	4,0000
Add to memory register 3	4,0000
Enter 2 ,	0,002 Ø
Multiply	2,0000
Raise to power	4,0000
Add to memory register 3	4,0000
Enter 3 ,	0,003 Ø
Multiply	3,0000
Raise to power	9,0000
Add to memory register 3	9,0000
Enter 4 ,	0,004 Ø
Multiply	4,0000

Solution steps	Display
Raise to power (-#)	16,0000
Add to memory register 3	16,0000
Enter 5 ,	0,005 Ø
Multiply	5,0000
Raise to power (-#)	25,0000
Add to memory register 3	25,0000
Enter 2 ,	0,002 Ø
Add to memory register 3	2,0000
Recall from memory register 2 with deletion	41,5540
Divide	41,5540
Recall from memory register 3 with deletion	110,0000
Equals	0,3778
Recall from memory register 1 with deletion	34,5820
Divide	34,5820
Enter 1 1 ,	0,011 Ø
Equals	3,1438

5. Root computation

Roots cannot be computed with the electronic desk calculator directly. If the numeric value of a root is to be calculated, the iteration formula must be used. Iteration means approximation. An approximate solution is accepted y_n estimated or y_n is an inaccurate solution. With the relationship $y_n + 1 = f(y_n)$ the solution is improved. In order to obtain a still larger accuracy, y_{n+1} becomes to y_n. The more such steps to be calculated, the solution becomes the more exact. For the root computation the iteration formula reads:

$$y_n + 1 = f(y_n) = \frac{1}{k}\left(\frac{x}{y_n^{\,k-1}} + (k-1)y_n\right);$$

k = index of a radical
x = Radikant ?

There are three possibilities of using this formula.

1. The solution is arbitrarily small selected not estimated, but generally one will set it with 1.
2. The solution is measured by a certain procedure.
3. The solution becomes simply estimated. It unimportant here whether the estimated value is larger or smaller than the exact solution.

The first way is somewhat time-consuming, but however the simplest.
The second way is mathematically accurate.
The third way is relatively favourable. It is easily stampable.

Square roots

Iteration formula: $x_n + 1 = \frac{1}{2}\left(\frac{x}{y_n} + y_n\right)$.

Variant 1

EXAMPLE - $\sqrt{7}$ = 2.6458

As the first solution 1 is selected. The calculation is broken off, if the difference of two successive approximation solutions is <0.01. For this the four approximations are:

$$\frac{1}{2}\left(\frac{7}{1} + 1\right) = 4{,}0000$$
$$\frac{1}{2}\left(\frac{7}{4} + 4\right) = 2{,}8750$$
$$\frac{1}{2}\left(\frac{7}{2{,}875} + 2{,}875\right) = 2{,}6549$$
$$\frac{1}{2}\left(\frac{7}{2{,}6549} + 2{,}6549\right) = 2{,}6548$$

Solution steps	Display
Clear the arithmetic unit and the memory	00000
Decimal point setting to 4	0,0000
Enter 7 ,	0,007 Ø
Add to memory register 1	7,.0000
Divide	7,0000
Enter 1 ,	0,001 Ø
Add to memory register 2	1,0000
Equals	7,0000
Add to memory register 2	7,0000
Recall from memory register 2 with deletion	8,0000
Divide	8,0000
Enter 2 ,	0,002 Ø
Add to memory register 3	2,0000
Equals	4,0000
Add to memory register 2	4,0000
Recall from memory register 1 without deletion	7,0000

Solution steps	Display
Divide	7,0000
Recall from memory register 2 without deletion	4,0000
Equals	1,7500
Add to memory register 2	1,7500
Recall from memory register 2 with deletion	5,7500
Divide	5,7500
Recall from memory register 3 without deletion	2,0000
Equals	2,8750
Add to memory register 2	2,8750
Recall from memory register 1 without deletion	7,0000
Divide	7,0000
Recall from memory register 2 without deletion	2,8750
Equals	2,4348
Add to memory register 2	2,4348
Recall from memory register 2 with deletion	5,3098
Divide	5,3098
Recall from memory register 3 without deletion	2,0000
Equals	2,6549
Add to memory register 2	2,6549
Recall from memory register 1 without deletion	7,0000
Divide	7,0000
Recall from memory register 2 without deletion	2,6549
Equals	2,6366
Add to memory register 2	2,6366
Recall from memory register 2 with (or without) deletion	5,2915
Divide	5,2915
Recall from memory register 3 with (or without) deletion	2,0000
Equals	2,6458
(Copy in the indicator solution present)	
Multiply (to the sample!)	2,6458
Raise to power (-#) (to the sample!)	7,0003

Variant 2

EXAMPLE

$$\sqrt{156.25} = 12{,}5$$

The radicand is divided to the left and to the right from the decimal point in groups of two numbers. In the example there are three groups:

$$\sqrt{156.25} = 12{,}5$$

The approached first solution is measured from the extreme left code number, even if this code number consists only of a number.

The root from 1 = 1.

Left before the decimal point are two code numbers. The solution of this root must be two digits therefore. Therefore is to be set for the first approximation at least $y_n = 10$.

The decimal point is set to the calculation by the rotary control at 6.
The following steps result:

$$\frac{1}{2}\left(\frac{156{,}25}{10} + 10\right) = 12{,}812500$$

$$\frac{1}{2}\left(\frac{156{,}25}{12{,}8125} + 12{,}8125\right) = 12{,}505\,161$$

$$\frac{1}{2}\left(\frac{156{,}25}{12{,}505\,161} + 12{,}505\,161\right) = 12{,}500\,001$$

In this example the first approximation can be measured more exactly on $y_n = 12$ since $12^2 = 144$. Also for this we indicate the necessary steps to them.

$$\frac{1}{2}\left(\frac{156{,}25}{12} + 12\right) = c$$

$$\frac{1}{2}\left(\frac{156{,}25}{12510416} + 12{,}510416\right) = 12{,}500004$$

During the first approximation of $y_n = 12$ a step can be saved in relation to the first approximation of $y_n = 10$ Hence follows that for reaching a certain accuracy the less step are necessary, the more exact the initial solution is.

Count the variant 2 on both initial approximations on the ETR!
Use under variant 1 indicated solution step.

Variant 3 - EXAMPLE

$\sqrt{71} = 8{,}4261$

The initial solution is to be set with $y_n = 8$. $8^2 = 64$, the root from 71 must be thus larger than 8.

Set the decimal point to 4 with the rotary control. As approximation solutions arise:

$$\frac{1}{2}\left(\frac{71}{8} + 8\right) = 8{,}4375$$

$$\frac{1}{2}\left(\frac{71}{8{,}4375} + 8{,}4375\right) = 8{,}4261$$

$$\frac{1}{2}\left(\frac{71}{8{,}4261} + 8{,}4261\right) = 8{,}4261$$

The second and the third approximations have the same result. With four places behind the decimal point no larger accuracy can be attained. The calculation is finished.

Calculate thief after task the solution steps indicated by variant 1!
Practice the root counting with the help of the iteration formula and the solution steps of the variant 1:

$\sqrt{9{,}90353} = 3{,}0155$

$\sqrt{26{,}173456} = 5{,}1160$

$\sqrt{309374\ {,}013796} = 556\,{,}214$

$\sqrt{\frac{100}{0\ {,}16}} = 25$

$\sqrt{7{,}23} = 19{,}3197$

Cube roots or roots of third degree
In order to solve it, the iteration formula becomes

$$y_n + 1 = f(y_n) = \frac{1}{3}\left(\frac{x}{{y_n}^2} + 2y_n\right)$$

All three variants are possible. We select variant 2

EXAMPLE

$\sqrt[3]{1953{,}125} = 12{,}5$

The radicand is to be divided from the decimal point to the left and right in groups of three numbers. That is -

$3\sqrt{1/195,/125.}$

The first approximation solution is measured the extreme left code number. This is directly 1.
The radicand consists of two code numbers before the decimal point and one behind the decimal point, therefore the solution must be two digits. For the first approximation solution is therefore to be set $y_n = 10$.

For the calculation the decimal point is set with the rotary control at 6. The following solution steps result:

$$\frac{1}{3}\left(\frac{1953{,}125}{10^2} + 2 \cdot 10\right) = 13{,}177083$$

$$\frac{1}{3}\left(\frac{1953{,}125}{13{,}177083^2} + 2 \cdot 13{,}177083\right) = 12{,}534201$$

$$\frac{1}{3}\left(\frac{1953{,}125}{12{,}534201^2} + 2 \cdot 12{,}534201\right) = 12{,}499065$$

$$\frac{1}{3}\left(\frac{1953{,}125}{12{,}499065^2} + 2 \cdot 12{,}499065\right) = 12{,}500018$$

$$\frac{1}{3}\left(\frac{1953{,}125}{12{,}500018^2} + 2 \cdot 12{,}500018\right) = 12{,}500000$$

Solution steps	**Display**
Clear the arithmetic unit and the memory	0000000
Set the decimal point with the straight knurl	0,000000
Enter 1 9 5 3 , 1 2 5	19,53 Ø 125
Add to memory register 1	1953,125000
Enter 1 0 ,	0,.00010 Ø
Multiply	10,000000
Raise to power	100,000000
Add to memory register 2	100,000000
Recall from memory register 1 without deletion	1953,125000
Divide	1953,125000

Solution steps	Display
Recall from memory register 2 with deletion	100,000000
Equals	19,531250
Add to memory register 2	19,531250
Enter 2 ,	0,00002 Ø
Multiply	2,000000
Enter 1 0 ,	0,00010 Ø
Equals	20,000000
Add to memory register 2	20,000000
Recall from memory register 2 with deletion	39,531250
Divide	39,531250
Enter 3 ,	0,00003 Ø
Equals	13,177083
Add to memory register 3	13,177083
Multiply	13,177083
Raise to power (-#)	173,635516
Add to memory register 2	173,635516
Recall from memory register 1 without deletion	1935,125000
Divide	1953,125000
Recall from memory register 2 with deletion	173,635516
Equals	11,248436
Add to memory register 2	11,248436
Recall from memory register 3 with deletion	13,177083
Multiply	13,177083
Enter 2 ,	0,00002 Ø
Equals	26,354166
Add to memory register 2	26,354166
Recall from memory register 2 with deletion	37,602602
Divide	37,602602
Enter 3 ,	0,00003 Ø
Equals	12,534201
Add to memory register 3	12,534201
Multiply	12,534201
Raise to power	157,145195
Add to memory register 2	157,145195
Recall from memory register 1 without deletion	1953,125000
Divide	1953,125000
Recall from memory register 2 with deletion	157,145195
Equals	12,428792
Add to memory register 2	12,428792
Recall from memory register 3 with deletion	12,534201
Multiply	12,534201
Enter 2 ,	0,00002 Ø

Solution steps	Display
Equals	25,068402
Add to memory register 2	25,068402
Recall from memory register 2 with deletion	37,497194
Divide	37,497194
Enter 3 ,	0,00003 Ø
Equals	12,499065
Add to memory register 3	12,499065
Multiply	12,499065
Raise to power	156,225956
Add to memory register memory 2	156,225956
Recall from memory register 1 without deletion	1953,125000
Divide	1953,125000
Recall from memory register 2 with deletion	156,225956
Equals	12,501924
Add to memory register 2	12,501924
Recall from memory register 3 with deletion	12,499065
Multiply	12,499065
Enter 2 ,	0,00002 Ø
Equals	24,998130
Add to memory register 2	24,998130
Recall from memory register 2 with deletion	37,500054
Divide	37,500054
Enter 3 ,	0,00003 Ø
Equals	12,500018
Add to memory register 3	12,500018
Multiply	12,500018
Raise to power	156,250450
Add to memory register 2	156,250450
Recall from memory register 1 without deletion	1953,125000
Divide	1953,125000
Recall from memory register 2 with deletion	156,250450
Equals	12,499964
Add to memory register 2	12,499964
Recall from memory register 3 with deletion	12,500018
Multiply	12,500018
Enter 2 ,	0,00002 Ø
Equals	25,000036
Add to memory register 2	25,000036
Recall from memory register 2 with deletion	37,500000
Divide	37,500000
Enter 3 ,	0,00003 Ø
Equals	12,500000

6. Computation of the geometrical by means of

EXAMPLE

2 cement plants produce in a certain period 20 kt of cement
3 cement plants produce in a certain period 25 kt of cement
1 cement plant produced in a certain period 30 kt of cement
2 cement plants produce in a certain period 16 kt of cement

What is the average this period for cement produced in these 8 plants ?
Here the weighed geometrical means (Gg) is to be used. With it a middle progressive production development can be represented.

$$G_{g=}\sqrt[\sum_{i=1}^{n} z_i]{\prod_{i=1}^{n} x_i^{\,zi}}$$

xi = production which can be averaged
zi = Weights

It is to be counted

$$\sqrt[2+3+1+2]{20^{\,2} \bullet 25^{\,3} \bullet 30^{\,1} \bullet 16^{\,2}} =$$

$$\sqrt[8]{400 \bullet 15625 \bullet 30 \bullet 256} = \sqrt[8]{48\,000\,000\,000} \cdot$$

For the solution of this root the iteration formula for roots of respected degree is to be used.

$$\frac{1}{8}\left(\frac{48\,000\,000\,000}{20^7} + 7 \bullet 20\right) = 22{,}1875$$

$$\frac{1}{8}\left(\frac{48\,000\,000\,000}{22{,}1875^7} + 7 \bullet 22{,}1875\right) = 21{,}6808$$

$$\frac{1}{8}\left(\frac{48\,000\,000\,000}{21{,}6808^7} + 7 \bullet 21{,}6808\right) = 21{,}6353$$

$$\frac{1}{8}\left(\frac{48\,000\,000\,000}{21{,}6353^7} + 7 \bullet 21{,}6353\right) = 21{,}6349$$

$$\frac{1}{8}\left(\frac{48\,000\,000\,000}{21{,}6349^7} + 7 \bullet 21{,}6349\right) = 21{,}6349$$

Practice:

$21{,}6349^8$ = 47 999 767 893,0702
$21{,}6350^8$ = 48 001 540 330,3906

The 8 cement plants produce on the average 21,6349 kt cement.

Solution steps	**Display**
Clear the arithmetic unit and the memory	00000
Set the decimal point with the rotary control to 4	0,0000
Enter 2 0 ,	0,020 Ø
Multiply	20,0000
Raise to power	400,0000
Add to memory register 1	400,0000
Enter 2 5 ,	0,025 Ø
Multiply	25,0000
Raise to power	625,0000
Raise to power	15 625,0000
Multiply	15 625,0000
Recall from memory register 1 with deletion	400,0000
Equals	6 250 000,0000
Add to memory register 1	6 250 000,0000
Enter 3 0 ,	0,030 Ø
Multiply	30,0000
Recall from memory register 1 with deletion	6 250 000,.0000
Equals	187 500 000,0000
Add to memory register 1	187 500 000,0000
Enter 1 6 ,	0,016 Ø
Multiply	16,0000
Raise to power	256,0000
Multiply	256,0000
Recall from memory register 1 with deletion	187 500 000,0000
Equals	48 000 000 000,0000
addition key memory 1	48 000 000 000,0000
Enter 2 0 ,	0,020 Ø
Multiply	20,0000
Raise to power 6 times	1 280 000 000,0000
Add to memory register 2	1 280 000 000,0000
Recall from memory register 1 without deletion	48 000 000 000,0000
Divide	48 000 000 000,0000
Recall from memory register 2 with deletion	1 280 000 000,0000
Equals	37,5000
Add to memory register 2	37,5000

Solution steps	Display
Enter 7 ,	0,007 Ø
Multiply	7,0000
Enter 2 0 ,	0,020 Ø
Equals	140,0000
Add to memory register 2	140,0000
Recall from memory register 2 with deletion	177,5000
Divide	177,5000
Enter 8 ,	0,008 Ø
Equals	22,1875
Add to memory register 3	2,1875
Multiply	22,1875
raise to power 6 times	2 647 028 592,5031
addition key of the memory 2	2 647 028 592,5031
Recall from memory register 1 without deletion	48 000 000 000,0000
Divide	48 000 000 000,0000
Recall from memory register 2 with deletion	2 647 028 592,5031
Equals	18,1335
Add to memory register 2	18,1335
Recall from memory register 3 with deletion	22,1875
Multiply	22,1875
Enter 7 ,	0,007 Ø
Equals	155,3125
Add to memory register 2	155,3125
Recall from memory register 2 with deletion	173,4460
Divide	173,4460
Enter 8 ,	0,008 Ø
Equals	21,6808
Add to memory register 3	21,6808
Multiply	21,6808
raise to power 6 times	2 251 786 100,2796
addition key of the memory 2	2 251 786 100,2796
Recall from memory register 1 without deletion	48 000 000 000,0000
Divide	48 000 000 000,0000
Recall from memory register 2 with deletion	2 251 786 100,2796
Equals	21,3164
Add to memory register 2	21,3164
Recall from memory register 3 with deletion	21,6808
Multiply	21,6808
Enter 7 ,	0,007 Ø
Equals	151,7656
Add to memory register 2	151,7656
Recall from memory register 2 with deletion	173,0820
Divide	173,0820

Solution steps	Display
Enter 8 ,	0,008 Ø
Equals	21,6353
Add to memory register 3	21,6353
Multiply	21,6353
Raise to power 6 times	2 218 913 881,9223
Add to memory register 2	2 218 913 881,9223
Recall from memory register 1 without deletion	48 000 000 000,0000
Divide	48 000 000 000,0000
Recall from memory register 2 with deletion	2 218 913 881,9223
Equals	21,6322
Add to memory register 2	21,6322
Recall from memory register 3 with deletion	21,.6353
Multiply	21,6353
Enter 7 ,	0,007 Ø
Equals	151,4471
Add to memory register 2	151,4471
Recall from memory register 2 with deletion	173,0793
Divide	173,0793
Enter 8 ,	0,008 Ø
Equals	21,6349
Copying the result from the display	
Sample	
Multiply	21,6349
Raise to power 7 times	47 999 767 893,0702
Clear the arithmetic unit and the memory	0,0000
Enter 2 1 , 6 3 5 0	21,6350
Multiply	21,6350
Raise to power 7 times	48 001 540 330,3906

to section 66

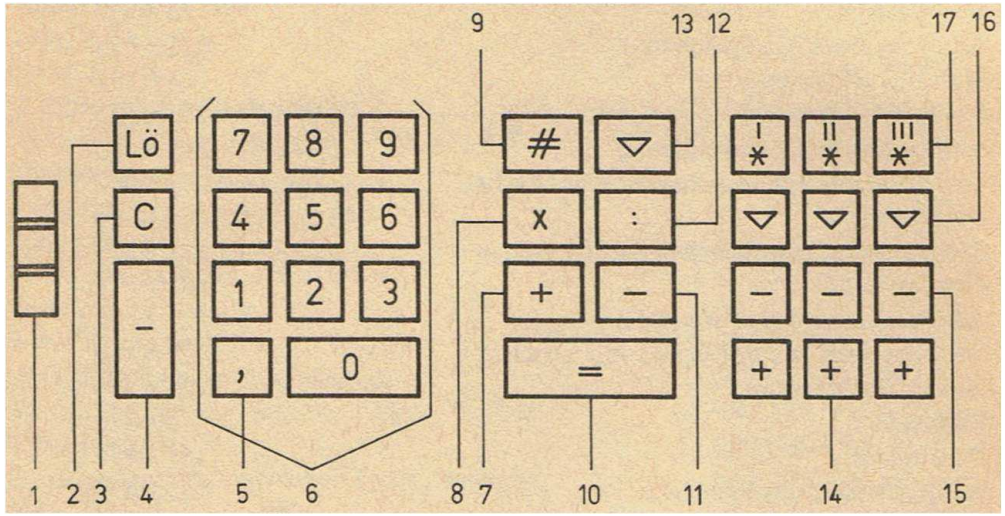
From section 65

66

9. Learn about the electronic desk calculator Soemtron 222

The VEB Office Machine Works Sömmerda further developed the ETR 220. Its successor is the ETR 222.

Keyboard of the Soemtron 222 Electronic Calculator.



1 Decimal point setting
2 Erase
3 Correction key
4 Sign
5 Decimal point
6 Numeric keyboard
7 Add
8 Multiply
9 Exchange the operand registers
10 Equals (result)
11 Subtract
12 Divide
13 Return the constant operands for decimal point calculation
14 Memory register - Add
15 Memory register - Subtract
16 Memory recall without deletion
17 Memory recall with deletion

With the advent of the ETR 222, four of the ETR 220's keys were changed.

- The **sign key** is to the left of the numeric keyboard. The function is not changed.
- The **numeric key** "0" was made smaller.
- The **Decimal Point key** is under the figure key "1". The decimal point is not visible in the display during input.
- The **Raise to Power** key was removed. For powers the base number is keyed in, for the exponent n the multiplication key (n-1) is to be pressed times, afterwards the equals key once.
- The keyboard contains the key "exchanging the operand registers" (9) and "returning the constant operands for decimal point calculation" (13)_.

  When pressing the key "exchanging the operand registers", both operand register values are exchanged.

EXAMPLE

5 x 8 = 40
8 : 2 = 4

Solution steps	**Display**
Clear the arithmetic unit	0
Set the decimal point to zero	0
Enter 5	5
multiplication key	5
Enter 8	8
Equals	40
Key "exchanging the operand registers"	8
Divide	8
Enter 2	2
Equals	4

By pressing the key "Return the constant operand for point calculation" the multiplier or the divisor remains as constant factor.

EXAMPLE

30 : 5 = 6
75 : 5 = 15

Solution steps	**Display**
Clear the arithmetic unit	0
Set the decimal point to zero	0
Enter 3 0	30
Divide	30
Enter 5	5
Equals	6
Key "returning the constant operand for point calculation "	5
Enter 7 5	75
Divide	75
Equals	15

The ETR 222 does not contain any further changes.

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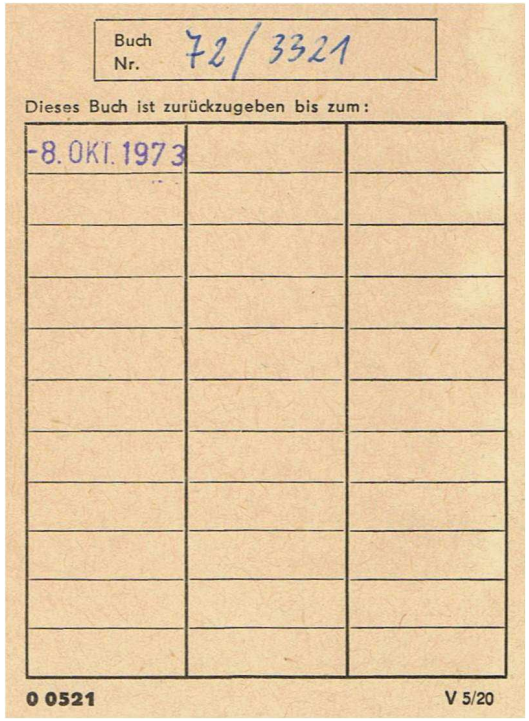

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