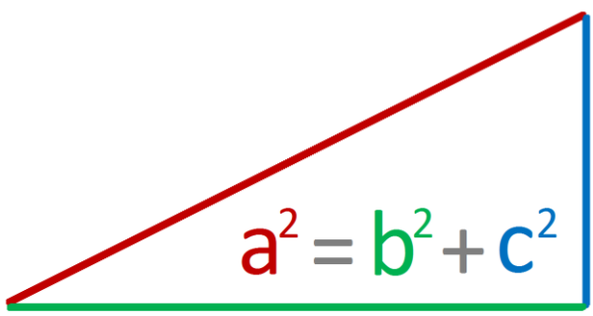
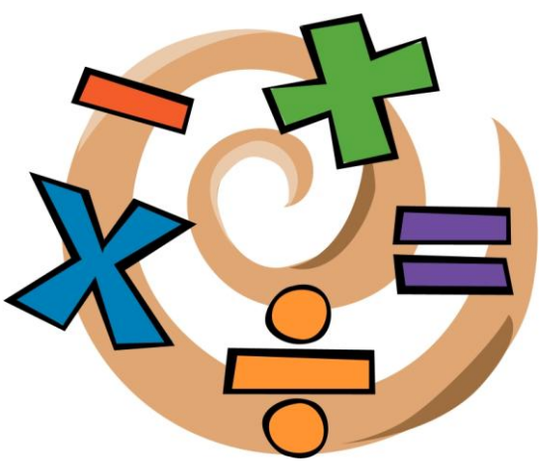
Mathematics

1 ESO





This book is dedicated to the students.

Also to my granddad and to all other mathematics teachers.

ESObook

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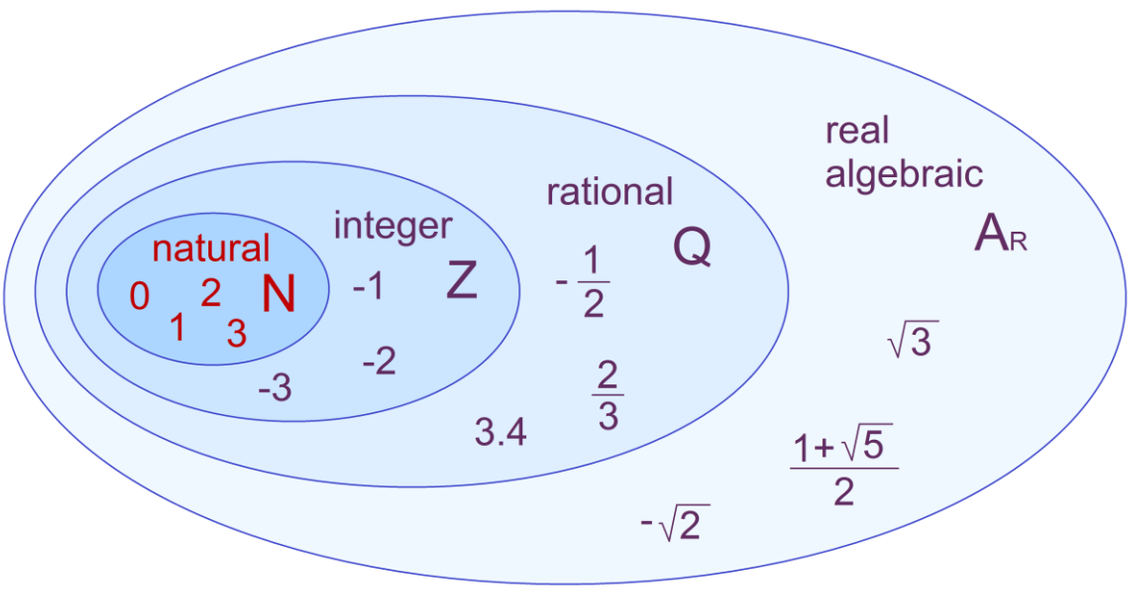
Unit 1

NATURAL NUMBERS



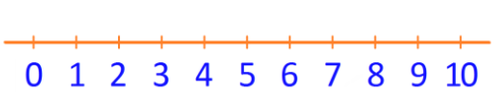
We classify numbers in various groups. The more complex groups contain the simpler groups.

The group of natural numbers only contains natural numbers.

The group of integers contains the natural numbers and the negative numbers.

The group of rational numbers contains integers, fractions and decimals.

We can represent numbers on a "number line":



1 Is number 2 an integer? Why?

2 What type of numbers do we use for:

a) The age of people?
b) The temperature?
c) The portions of pizza?
d) The floors of a building?

3 Draw a "number line" with numbers from 0 to 5 and put a circle around number 4.

1.1 What are natural numbers?

A natural number is a number that counts whole entities.

For example 3 tomatoes, 6 chairs, etc.

Two thirds is not a natural number.

1.2 Equalities and inequalities

A natural number can be less than, equal to, or greater than another.

"Equal to" (=) is the equality.

"Less than" (<) and "greater than" (>) are the inequalities.

"Less than or equal to" (≤) and "greater than or equal to" (≥) are the equalities or inequalities.

=	equal to	8 = 8
<	less than	1 < 2
>	greater than	4 > 3
≤	less than or equal to	4 ≤ 20
≥	greater than or equal to	7 ≥ 7

A school bus can carry 55 students.

If we don't know how many students are on the bus, we can say that:

The number of students on the bus is ≤ 55

Write:

A number that is equal to 8	$8 = 8$
A number that is less than 8	$5 < 8$
A number greater than 8	$14 > 8$
A number less than or equal to 8	$1 \leq 8$
A number greater than or equal to 8	$8 \geq 8$

4 Which of these numbers are natural numbers?

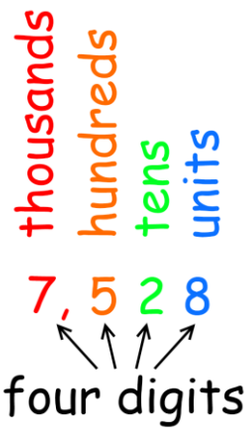
a) 3	d) 8	g) 0	j) 7
b) -8	e) 2	h) 2/3	k) 17
c) 2.6	f) √6	i) 25	l) -7

5 Which inequalities are correct?

a) 0 > 1	d) 5 ≥ 2	g) 6 < 8	j) 8 ≤ 7
b) 9 ≥ 9	e) 41 > 39	h) 5 ≤ 6	k) 2 ≥ 1
c) 7 < 12	f) 24 ≤ 25	i) 1 > 7	l) 4 < 5

6 Amelia has ten apples and one orange. Julia has six apples and four oranges. Who has more pieces of fruit? Why?

1.3 Units, tens, hundreds, thousands…



Natural numbers are made of digits.

The first digit on the right represents the units.

The second digit from the right represents the tens.

The third digit represents the hundreds.

The fourth digit represents the thousands.

Etc.

23 is a number with two digits.

4 is a number with one digit.

876 is a number with three digits.

34,826 is a number with five digits.

We count in units of ten. So the number 58 has five "tens" and eight "units".

The number 876 has eight "hundreds", seven "tens" and six "units".

The number 4,789 has four "thousands", seven "hundreds", eight "tens" and nine "units".

➢ Count the number of digits of the following numbers:

a) 53 *two digits (5 is one digit, 3 is another digit).*

b) 4 *one digit*

➢ Count the units, tens, and hundreds in these numbers:

a) 6 *six units*

b) 354 *three hundreds, five tens and four units*

c) 2,861 *two thousands, eight hundreds, six tens and one unit.*

➢ Write a number with…

a) One digit *7*

b) Four digits *2904*

7 Count the number of digits of the following numbers:

a) 38
b) 78
c) 254
d) 878
e) 9,543
f) 5,246
g) 45,793
h) 2,628,571

8 Count the units, tens, hundreds and thousands in these numbers:

a) 3
b) 78
c) 254
d) 878
e) 543
f) 246
g) 5,793
h) 2,571

9 Write a number with…

a) One digit
b) Two digits
c) Three digits
d) Four digits
e) Five digits
f) Seven digits

1.4 Properties of addition and multiplication

Commutative property

In addition and multiplication it does not matter which number is first and which number is second.

$$a + b = b + a$$

$$a \cdot b = b \cdot a$$

$7 + 5$ has the same result as $5 + 7$; the result is 12.

$7 \cdot 5$ has the same result as $5 \cdot 7$; the result is 35.

Associative property

When we add or multiply more than two numbers, we can group some of them in brackets if we want.

$$a + b + c = a + (b + c)$$

$$a + b + c = (a + b) + c$$

$$a \cdot b \cdot c = a \cdot (b \cdot c)$$

$$a \cdot b \cdot c = (a \cdot b) \cdot c$$

$7 + 5 + 3 = 7 + (5 + 3) = (7 + 5) + 3 = 15$

$7 \cdot 5 \cdot 3 = 7 \cdot (5 \cdot 3) = (7 \cdot 5) \cdot 3 = 105$

Solve:

a) $8 + 12 + 5$

$= 8 + (12 + 5)$

$= 8 + 17 = 25$

b) $4 \cdot 6 \cdot 3$

$= 4 \cdot (6 \cdot 3)$

$= 4 \cdot 18 = 72$

c) $7 \cdot 3 \cdot 15$

$= 7 \cdot (3 \cdot 15)$

$= 7 \cdot 45 = 315$

10 Solve:

a) $6 + 15 + 8$ c) $6 + 4 + 31$

b) $7 + 55 + 8$ d) $14 + 12 + 11$

11 Solve:

a) $7 + 1 + 5 + 3 + 7 + 6 + 2 + 14$

b) $12 + 17 + 47 + 25 + 14 + 120 + 20$

12 Solve:

a) $3 \cdot 16 \cdot 20$ d) $42 \cdot 1 \cdot 9$

b) $22 \cdot 12 \cdot 5$ e) $13 \cdot 66 \cdot 5$

c) $1 \cdot 22 \cdot 4$ f) $22 \cdot 21 \cdot 15$

13 Solve:

a) $4 \cdot 36 \cdot 7 \cdot 2 \cdot 3$

b) $8 \cdot 5 \cdot 4 \cdot 2 \cdot 10 \cdot 2 \cdot 5$

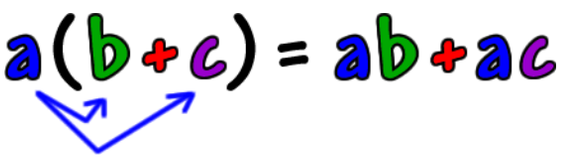
c) $3 \cdot 25 \cdot 51 \cdot 64 \cdot 5 \cdot 12 \cdot 40$

14 A cook buys 12 melons. Each melon weighs 4 Kg. How many Kg of melons does the cook buy?

Distributive property

$$a \cdot (b + c) = a \cdot b + a \cdot c$$

To multiply a number by the addition of others is the same thing as multiplying the number by each of the numbers in the addition.



Use the distributive property to rewrite:

a) $4 \cdot (5 + 2)$
$= 4 \cdot 5 + 4 \cdot 2$

b) $4 \cdot (5 - 2)$
$= 4 \cdot 5 - 4 \cdot 2$

c) $(5 + 2) \cdot 4$
$= 5 \cdot 4 + 2 \cdot 4$

d) $(5 - 2) \cdot 4$
$= 5 \cdot 4 - 2 \cdot 4$

Use the distributive property to rewrite:

a) $4 \cdot 5 + 4 \cdot 2$
$= 4 \cdot (5 + 2)$

b) $4 \cdot 5 - 4 \cdot 2$
$= 4 \cdot (5 - 2)$

c) $5 \cdot 4 + 2 \cdot 4$
$= (5 + 2) \cdot 4$

d) $5 \cdot 4 - 2 \cdot 4$
$= (5 - 2) \cdot 4$

15 Use the distributive property to rewrite:

a) $3 \cdot (5 + 6)$
b) $4 \cdot (9 - 2)$
c) $(7 + 2) \cdot 4$
d) $(3 - 2) \cdot 3$

16 Use the distributive property to rewrite:

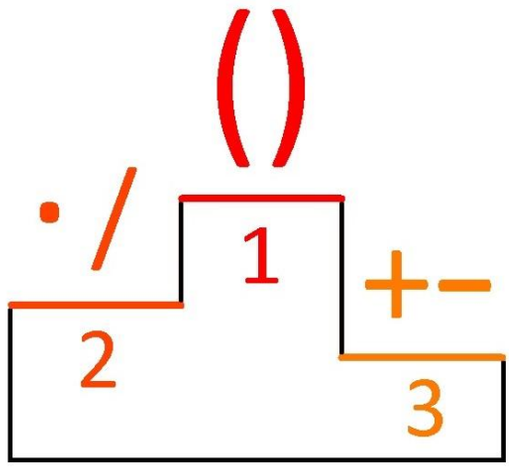
a) $2 \cdot 5 + 2 \cdot 6$
b) $20 \cdot 3 - 20 \cdot 8$
c) $6 \cdot 8 + 6 \cdot 5$
d) $15 \cdot 12 - 15 \cdot 3$

17 Which property of calculus are we using?

a) $3 + 6 = 6 + 3$
b) $(-8) + (-5) = (-5) + (-8)$
c) $8 + 5 + 2 = 8 + (5 + 2)$
d) $3 \cdot (4 \cdot 7) = 3 \cdot 4 \cdot 7$
e) $8 \cdot 5 \cdot 2 = 8 \cdot (5 \cdot 2)$
f) $8 \cdot 5 + 8 \cdot 2 = 8 \cdot (5 + 2)$

18 In a class there are 24 students. Each student has 3 pens and 2 pencils. How many pens and pencils are there in the class?

1.5 Order of operations



Sometimes there is a combination of operations. In that case, follow the order (we must solve the different operations in that order):

1st Operations inside brackets

2nd Products and divisions

3rd Sums and subtractions

For example, we multiply 4 by the sum of 3 and 5 and then we add six: $4 \cdot (3+5) + 6 = 4 \cdot 8 + 6 = 32 + 6 = \mathbf{38}$

(3+5) 4•8 32+6

Solve:

a) $3 + 4 \cdot (5 + 2)$

$= 3 + 4 \cdot 7$

$= 3 + 28$

$= 31$

b) $8 \cdot 5 - 3 \cdot (9 + 2)$

$= 40 - 3 \cdot 11$

$= 40 - 33$

$= 7$

c) $6 + [(5 + 2) \cdot 4] \cdot (8 + 2)$

$= 6 + (7 \cdot 4) \cdot (8 + 2)$

$= 6 + 28 \cdot 10$

$= 6 + 280$

$= 286$

19 Which operation is first in the order?

20 Which operation is second in the order?

21 Which operation is third in the order?

22 Solve:

a) $4 + 2 \cdot 5$

b) $3 \cdot 4 - 10$

c) $3 \cdot (4 + 4)$

d) $6 + 8 / 4$

e) $(8 - 2) / 3$

f) $15 / 5 - 1$

23 Solve:

a) $5 + 6 \cdot (4 + 7)$

b) $3 \cdot 8 - 2 \cdot (3 + 1)$

c) $2 + [(7 + 3) \cdot 4] \cdot (2 + 3)$

d) $1 + 2 \cdot (5 - 1) \cdot (5 \cdot 5)$

e) $8 \cdot 5 \cdot 2 - (6 \cdot 4)$

f) $4 + (5 + 8) \cdot 5 - 3 \cdot [2 \cdot (1 + 2)]$

24 Solve:

a) $0 + 2 \cdot (3 \cdot 7)$

b) $6 \cdot 3 - 3 \cdot (2 + 1)$

c) $5 + 4 \cdot (2 + 2) \cdot (1 \cdot 1)$

d) $\frac{2 \cdot (6+14)}{10}$

25 A cook buys 26 bags of onions. Each bag has 8 Kg of onions.
After using 50 Kg of onions, how many Kg of onions does the cook still have?

1.6 Ancient number systems

Through history, different cultures used different numbers and numbering systems.

Modern numerals

In our **modern** decimal number system the value of the digits depends on their position on the number. It is a "positional number system". There is a position for the units, a position for the tens, a position for the hundreds…

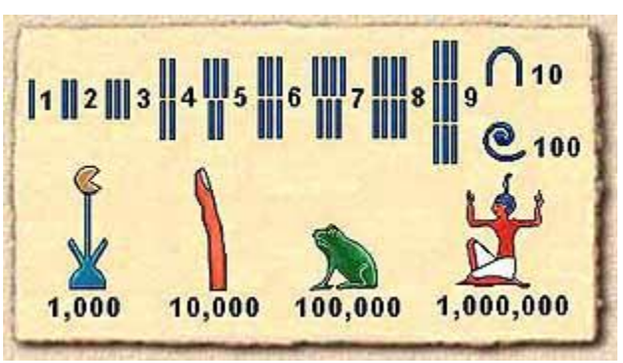
Our decimal number system is an international language.

6581

Egyptian numerals

The Egyptians used a decimal base.

They had 7 signs.



Their system was additive: they repeated the sign for each decimal as many times as necessary.

The higher number is first, then the lower number:

= 214

= 2131

26 Translate into modern decimal numerals:

a) b) c) d)

27 Translate into Egyptian numerals:

a) 4 c) 201 e) 521

b) 25 d) 143 f) 1,204,627

28 Draw a "number line" with Egyptian numerals from 0 to 16 and put a circle around number

29 Write a modern numeral with 9 units, 3 tens and 2 hundreds.

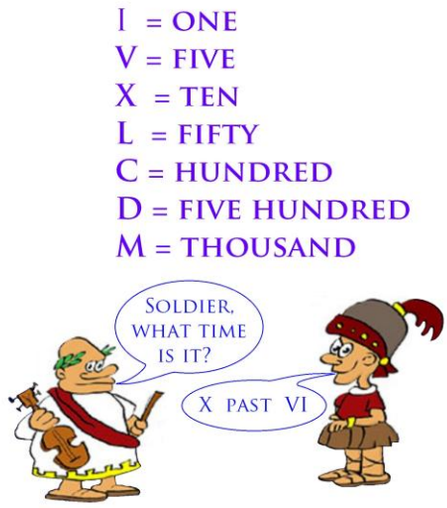
30 Write an Egyptian numeral with 7 units, 5 tens and 2 hundreds.

Roman numerals

Like the Egyptian numerals, Roman numerals are additive.

We can write the same numeral twice or three times, but not four times.

I = 1	X = 10	C = 100
II = 2	XX = 20	CC = 200
III = 3	XXX = 30	CCC = 300



To write 4: we put "I" before the "V": IV = 4

To write 6, 7 or 8: we put several "I" after the "V": VI = 6 VII = 7 VIII = 8

To write 9: we put "I" before the "X": IX = 9

To write 11, 12 or 13: we put several "I" after the "X": XI = 11 XII = 12 XIII = 13

To write 14: we write 10 and 4: XIV = 14

To write 90: we put "X" before the "C": XC = 90

Translate these Roman numerals into modern decimal numerals:

a) VII

5 + 1 + 1 = 7

b) CCXIII

100 + 100 + 10 + 1 +1 + 1

= 213

c) CIX

100 + (10 - 1) = 100 + 9

= 109

d) CXCIX

100 + (100-10) + (10-1)

= 199

31 Translate into modern decimal numerals:

a) CXII
b) CCCIX
c) CDXIII
d) MMXIII
e) MMXIV
f) MDXC
g) MXX
h) MCML

32 Translate into Roman numerals:

a) 10
b) 36
c) 2015
d) 129
e) 196
f) 2000

33 Draw a "number line" with Roman numerals from 0 to 14 and put a circle around number VI.

34 Write a Roman number with 6 units, 4 tens and 5 hundreds.

Activities

35 Draw a "number line" with numbers from 0 to 10 and put a circle around numbers **3** and **8**.

36 Which of these numbers are natural numbers?

a) 6
b) 0.5
c) –8
d) $\frac{1}{10}$
e) 2.1
f) 33
g) –8
h) 100
i) √10
j) 17
k) –6
l) 4

37 Write a number that is less than:

a) 10
b) 6
c) 11
d) 1
e) 84
f) 36

38 Write a number that is greater than:

a) 8
b) 5
c) 12
d) 44
e) 0
f) 94

39 Which inequalities are correct?

a) $4 > 1$
b) $8 \geq 0$
c) $7 < 5$
d) $5 \leq 6$
e) $5 \geq 2$
f) $41 > 40$
g) $3 \leq 4$
h) $6 < 7$

40 Count the number of digits of the following numbers:

a) 18
b) 11
c) 2544
d) 354
e) 1,722
f) 43,724
g) 725,793
h) 5,068,239

41 Count the units in these numbers:

a) 8
b) 578
c) 68
d) 94
e) 223
f) 1,83
g) 4,91
h) 7,56
i) 546,34
j) 0.5

42 Count the tens in these numbers:

a) 9
b) 38
c) 27
d) 178
e) 113
f) 356
g) 6,793
h) 1,571
i) 2,124

43 Count the hundreds in these numbers:

a) 2
b) 72
c) 94
d) 628
e) 263
f) 876
g) 5,793
h) 2,571
i) 2,934

44 Count the number of units, tens, hundreds and thousands in these numbers:

a) 9
b) 72
c) 39
d) 151
e) 283
f) 755
g) 5,115
h) 9,594
i) 4,134

45 Write a number with…

a) one digit
b) Two digits
d) Five digits
d) Nine digits

46 Write the number that has 3 units, 6 tens, 5 hundreds and 2 thousands.

47 Write the number that has 8 units, no tens, 1 hundreds and 5 thousands.

48 Number 4,254 How many units, tens, hundreds and thousands does it have?

49 Which property of arithmetic (properties of addition and multiplication) are we using?

a) $4 + 5 = 5 + 4$
b) $8 \cdot (5 + 2) = 8 \cdot 5 + 8 \cdot 2$
c) $(-8) \cdot 5 = 5 \cdot (-8)$
d) $8 + 5 + 2 = 8 + (5 + 2)$
e) $(-12) + (-3) = (-3) + (-12)$
f) $3 \cdot 24 \cdot 6 = 3 \cdot (24 \cdot 6)$
g) $6 + 1 + (-7) = 6 + [1 + (-7)]$
h) $4 \cdot 3 + 4 \cdot 15 = 4 \cdot (3 + 15)$
i) $15 + 82 = 82 + 15$
j) $20 \cdot (30 \cdot 11) = 20 \cdot 30 \cdot 11$

50 Use the commutative property to rewrite these expressions:

a) $4 + 5$
b) $8 \cdot 5$
c) $2 + 4$
d) $5 + 8$
e) $5 \cdot 12$
f) $14 \cdot 7$
g) $1 \cdot 7$
h) $6 + 5$

51 Use the associative property to rewrite these expressions (in both possible ways):

a) $1 + 2 + 7$
b) $2 \cdot 4 \cdot 5$
c) $8 + 5 + 2$
d) $8 + 5 + 8$
e) $8 \cdot 5 \cdot 2$
f) $8 + 5 + 2$
g) $3 \cdot (4 \cdot 7)$
h) $1 + (5 + 32)$

52 Use the distributive property to rewrite these expressions:

a) $4 \cdot (5 + 2)$
b) $-4 \cdot (2 + 6)$
c) $3 \cdot (5 + 2)$
d) $8 \cdot (5 + 2)$
e) $6 \cdot (4 \cdot 7)$
f) $8 \cdot 5 + 8 \cdot 2$
g) $14 \cdot 3 + 14 \cdot 4$
h) $6 \cdot 7 + 6 \cdot 1$

53 Solve:

a) $8 \cdot 4 \cdot 12$
b) $5 \cdot 1 \cdot 26$
c) $8 \cdot 15 \cdot 25$
d) $2 \cdot 10 \cdot 19$
e) $3 \cdot 18 \cdot 27$
f) $4 \cdot 26 \cdot 7$

54 If there are different operations at the same time, which operations we do:

a) First
b) Second
c) Third

55 Solve:

a) $3 + 5 \cdot 4$
b) $6 \cdot 10 - 5$
c) $18 - 6 \cdot 2$
d) $3 \cdot 7 + 9$

56 Solve:

a) $2 \cdot (4 + 5)$
b) $6 \cdot (15 + 2)$
c) $3 / (7 - 3)$
d) $7 / (15 - 9)$
e) $(5 + 6) \cdot 3$
f) $(25 + 12) \cdot 4$
g) $(25 - 22) / 14$
h) $(31 - 11) / 9$

57 Solve:

a) $7 - 2 + 8 + 15 + 6$
b) $5 + 6 \cdot 3 - (7 - 3)$
c) $2 - 5 \cdot 4 + 8 \cdot 4 + 6 / 3 - (7 - 8 / 2)$

58 Solve:

a) $4 + 3 \cdot 2 - \frac{(8 - 4)}{2}$

b) $3 \cdot (4 - 2) - \frac{14}{(1 + 6)}$

c) $5 \cdot 2 - \frac{(16 - 4)}{(2 + 4)}$

d) $1 + 4\,[6 \cdot 2 - \frac{(50 - 30)}{(4 + 1)}]$

59 Solve:

a) $(-9 + 21) \cdot 3 - 10$

b) $2 \cdot 3 + (6 - 7 - 3)$

c) $1 + 3\,[15 - \frac{(7-3)}{2}]$

d) $8 + 2 \cdot (15 - 5) - \frac{25}{(1+4)}$

e) $7 \cdot 2 - \frac{(7-1)}{(2+4)}$

f) $4\,[3 \cdot 2 - \frac{(25-15)}{(3+2)}] + 26$

60 Solve:

a) $55 - 2 - 6 \cdot 7 + 10$

b) $2 + [(6 \cdot 3) \cdot (7-3)]$

c) $(4 + 5) \cdot 7 - \frac{(89-9)}{10}$

d) $10 \cdot (6+3) - \frac{5}{(8-3)}$

e) $3 - 4 \cdot 2 - \frac{(2+8)}{(8+2)}$

f) $4\,[6 \cdot 2 - \frac{(10-8)}{(1+1)}] \cdot 2$

61 Translate into modern decimal numerals:

a)

b)

c)

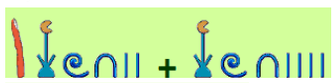
d)

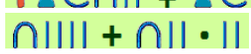
62 Use the Egyptian symbols to write:

a) 16
b) 78
c) 251
d) 1818

63 Was the Egyptian system good for writing large numbers? Why?

64 Solve (write the result in ancient Egyptian):

a) 

b) 

c)

65 Use the Roman numbers: I = 1 ; V = 5 … to write:

a) 16
b) 78
c) 251
d) 1818

66 Was the Roman system good for writing large numbers? Why?

67 What number can you read here?
MDCCLXXXIX

68 Translate to decimal numerals:

a) LXXI
b) CCCX
c) MMXIV
d) MMI
e) LXXXIV
f) MMMCDLXXXIX

69 Translate into ancient Egyptian:

a) XXI
b) XIV
c) CLXXIV
d) MMXX

70 If we put a bar above a Roman number, we multiply it by 1000.
If we put a double bar, we multiply it by 1,000,000.
For example: $\overline{\text{XI}}$ = 11,000
For example: $\overline{\overline{\text{IV}}}$= 4,000,000

Translate into modern decimal numerals:

a) $\overline{\text{III}}$
b) $\overline{\text{XIII}}$
c) $\overline{\text{XXIV}}$
d) $\overline{\text{XVIII}}$
e) $\overline{\text{MM}}$
f) $\overline{\overline{II}}$
g) $\overline{\overline{XII}}$
h) $\overline{\overline{CXVI}}$
i) $\overline{\overline{DLXXX}}$
j) $\overline{\overline{MM}}$

Word Problems

71 Sarah buys a table for 45 € and sells it for 72 €. What profit does she make?

72 Sarah buys a table for 52 € and makes a profit of 30 €. What is the selling price?

73 Sally earns 1,432 €. She spends 472 € on food, 552 € on the house and she gives Alan 25 €. Can she buy a computer that costs 436 €?

74 The original price of a bicycle is 160 €. But Peter has a 30 € discount. What price does Peter pay?

75 Andy buys the ice cream with a 5 € note. What change does he get?

76 Sally buys the ice cream and the sandwich.
What change does she get if she pays with:
a) 5 € note?
b) 10 € note?

77 Sally was born 16/10/2001. What will be her age on 25/4/2015?

78 Mount Everest is 8,848 m above sea level. The "Mariana Trench" is 10,971 m below sea level. What is the altitude of Mount Everest measured from the Mariana Trench?

79 How many years are 4380 days?

80 How many weeks are 147 days?

81 How many days are 120 hours?

82 How many hours are 360 minutes?

83 How many minutes are 1440 seconds?

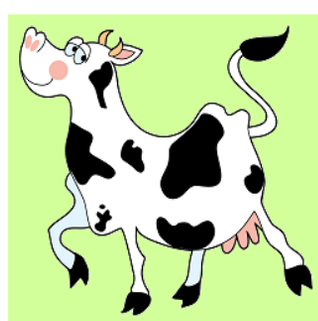
84 Julia cycles 400 m in one minute. How many metres does she cycle in half an hour?

85 Amelia walks 50 m in one minute. How far does she walk in:
a) 20 minutes?
b) 5 minutes?
c) 1 hour?
d) An hour and a half?

86 A teacher corrects 26 exams.
In each exam there are 4 questions on "properties of calculus" and 2 questions on "Roman numerals".
How many questions must the teacher correct?

87 John makes 14 telephone calls, each telephone call costs 3 €.
With the same money, how many telephone calls can he make if each telephone call costs 2 €?

88 Decimus has XVIII cows, Cato has XIX cows, and Maximus has XC cows.
a) How many cows has each of them?
b) Express in Roman numerals the total amount of cows.



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