Section 3 Arithmetic

I. OVERALL OBJECTIVES

Through mathematical activities, to help pupils acquire basic and fundamental knowledge and skills regarding numbers, quantities and geometrical figures, to foster their ability to think and express with good perspectives and logically on matters of everyday life, to help pupils find pleasure in mathematical activities and appreciate the value of mathematical approaches, and to foster an attitude to willingly make use of mathematics in their daily lives as well as in their learning.

II. OBJECTIVES AND CONTENT FOR EACH GRADE

[Grade 1]

1. Objectives
   (1) Through activities using concrete objects and so on, to help pupils enrich their number sense. To help them understand the meaning and the representations of numbers, and to help them understand addition and subtraction, and explore ways of the calculations, and use the calculations.
   (2) Through activities using concrete objects and so on, to help pupils enrich their experiences that will form the foundation for understanding quantities and measurements, and enrich their sense of quantities.
   (3) Through activities using concrete objects and so on, to help pupils enrich their experiences that will form the foundation for understanding geometrical figures, and enrich their sense of geometrical figures.
   (4) Through activities using concrete objects and so on, to help pupils represent numbers and quantities as well as their relations by using words, numbers, algebraic expressions, figures and diagrams and interpret such representations.

2. Content
   A. Numbers and Calculations
   (1) Through activities such as counting the numbers of concrete objects, to help pupils understand the meaning of numbers and use numbers.
      a. To compare numbers of objects by making one-to-one

correspondence between objects.

- b. To correctly count or represent the number and order of objects.
- c. To make a sequence of numbers and to put numbers on a number line by judging the size and the order of the numbers.
- d. To consider a number in relation to other numbers by regarding it as a sum or difference of other numbers.
- e. To understand the representations of two-digit numbers.
- f. To get to know the representations of three-digit numbers in simple cases.
- g. To consider numbers using ten as a unit.

(2) To help pupils understand the meaning of addition and subtraction and use the calculations.

- a. To get to know situations where addition and subtraction are used.
- b. To explore ways of addition of two one-digit numbers, and subtraction as the inverse operation, and to do these calculations accurately.
- c. To explore ways of addition and subtraction of two-digit numbers and so on in simple cases.

B. Quantities and Measurements

(1) Through activities such as comparing sizes of concrete objects, to help pupils enrich their experiences that will form the foundation for understanding quantities and measurements.

- a. To directly compare length, area and volume.
- b. To compare quantities by using familiar objects as a unit in terms of multiples of it.

(2) To help pupils read clock times in their daily lives.

C. Geometrical Figures

(1) Through activities such as observing and composing the shapes of familiar objects, to help pupils enrich their experiences that will form the foundation for understanding geometrical figures.

- a. To recognize the shapes of objects, and to grasp their features.
- b. To express the position of an object by correctly using the words concerning direction and position such as "front and rear," "right and left," and "above and below."

D. Mathematical Relations

(1) To help pupils represent situations where addition and subtraction are

used, by using algebraic expressions, and interpret these expressions.

(2) To help pupils represent the number of objects using pictures or figures, and interpret them.

[Mathematical Activities]

(1) The content listed in "A. Numbers and Calculations," "B. Quantities and Measurements," "C. Geometrical Figures" and "D. Mathematical Relations" should be taught through, for example, the following mathematical activities:

    a. Activities to count concrete objects by making groups, to divide them equally, and to organize and represent them.

    b. Activities to express the meaning and ways of calculation by using concrete objects, words, numbers, algebraic expressions, figures and diagrams.

    c. Activities to compare directly the length, area and volume of familiar objects, and to compare them by using other objects.

    d. Activities to find various shapes of objects in familiar situations, and to compose or decompose the shapes by using concrete objects.

    e. Activities to represent by using algebraic expressions real situations associated with numbers and quantities, and connect the algebraic expressions to real situations.

[Terms and Symbols]

   ones place,   tens place,   +,   ,   =

[Grade 2]

1. Objectives

(1) Through activities using concrete objects and so on, to help pupils enrich their number sense. To help them deepen their understanding of the meaning and the representations of numbers, as well as their understanding of addition and subtraction, and use the calculations. Furthermore, to help them understand the meaning of multiplication, explore ways of the calculation, and use the calculation.

(2) Through activities using concrete objects and so on, to help pupils understand the units and measurements of length and volume and so on, and enrich their sense of quantities.

(3) Through activities using concrete objects and so on, to help pupils understand geometrical figures such as triangles and quadrilaterals,

and enrich their sense of geometrical figures.

(4) Through activities using concrete objects and so on, to help pupils represent numbers and quantities as well as their relations by using words, numbers, algebraic expressions, figures, diagrams, tables, and graphs, and interpret such representations.

2. Content

A. Numbers and Calculations

(1) To help pupils understand the meaning and the representations of numbers, and extend their ability to use numbers.

    a. To count objects by arranging them into groups of the same size, or by classifying them.

    b. Up to four-digit numbers, to understand the representations of numbers, understand size and order of numbers by the decimal positional numeration system.

    c. To understand relative size of numbers by regarding 10 or 100 as a unit.

    d. To consider a number in relation to other numbers by regarding it as a product of other numbers.

    e. To get to know simple fractions such as 1/2 and 1/4.

(2) To help pupils deepen their understanding of addition and subtraction, and extend their ability to use the calculations.

    a. To explore ways of addition of two-digit numbers, and subtraction as the inverse operation, to understand that these calculations are based on the basic calculations of one-digit numbers, and to do these calculations accurately. To understand the way of calculation using algorithms in column forms.

    b. To explore ways of addition and subtraction of three-digit numbers and so on in simple cases.

    c. To explore properties of addition and subtraction and to make use of the properties in order to explore ways to calculate or check the results.

(3) To help pupils understand the meaning of multiplication and use the calculation.

    a. To get to know situations where multiplication is used.

    b. To explore simple properties which hold for multiplication, and to make use of them for making the multiplication table up to 9 times

9 and for checking the results of calculations.

    c. To learn the multiplication table up to 9 times 9 and to multiply one-digit numbers accurately.

    d. To explore ways of multiplication of a two-digit number and a one-digit number in simple cases.

B. Quantities and Measurements

(1) To help pupils understand the meaning of units and measurements of length and measure the length.

    a. To get to know the units of length (millimeter [mm], centimeter [cm] and meter [m]).

(2) To help pupils understand the meaning of units and measurements of volume and measure the volume.

    a. To get to know the units of volume (milliliter [ml], deciliter [dl] and liter [l]).

(3) To help pupils understand time and use it.

    a. To get to know days, hours and minutes and to understand the relationships between them.

C. Geometrical Figures

(1) Through activities such as observing and composing the shapes of objects, to help pupils pay attention to the elements that compose geometrical figures, and understand geometrical figures.

    a. To get to know triangles and quadrilaterals.

    b. To get to know squares, rectangles, and right triangles.

    c. To get to know objects that have the shape of a box.

D. Mathematical Relations

(1) To help pupils understand the mutual relationships between addition and subtraction and explain them by using algebraic expressions.

(2) To help pupils represent situations where multiplication is used, by using algebraic expressions, and interpret these expressions.

(3) To help pupils organize and classify numbers and quantities in everyday life and represent them by using simple tables and graphs, and interpret these representations.

[Mathematical Activities]

(1) The content listed in "A. Numbers and Calculations," "B. Quantities and Measurements," "C. Geometrical Figures" and "D. Mathematical Relations" should be taught through, for example, the following

mathematical activities:

   a. Activities to find situations in everyday life where integers are used.

   b. Activities to find properties and rules of the multiplication by constructing and observing multiplication tables.

   c. Activities to estimate the length and volume of objects in everyday life and measure them by using units.

   d. Activities to draw and make squares, rectangles, and right triangles and tessellate them on a plane.

   e. Activities to express and explain the mutual relationships between addition and subtraction by using figures, diagrams and algebraic expressions.

[Terms and Symbols]

   unit, straight line, right angle, vertex, side, face, ×, ,

3. Handling the Content

(1) As for the content (1) in "A. Numbers and Calculations," the number 10,000 should be dealt with.

(2) As for the content (2) in "A. Numbers and Calculations," and (1) in "D. Mathematical Relations," symbols such as （ ）and can be used when necessary.

(3) As for the content (2)-c in "A. Numbers and Calculations," commutative law and associative law should be dealt with.

(4) As for the content (3)-b in "A. Numbers and Calculations," the way in which the product increases when the multiplier increases by 1 and commutative law should be dealt with.

[Grade 3]

1. Objectives

(1) To help pupils use addition and subtraction appropriately, to help them deepen their understanding of multiplication and use the calculation appropriately. To help them understand the meaning of division, explore ways of the calculation, and use the calculation. Furthermore, to help them understand the meaning and the representations of decimal numbers and fractions.

(2) To help pupils understand the units and measurements of length, weight and time.

(3) To help pupils understand geometrical figures such as isosceles triangles and equilateral triangles by paying attention to the elements that compose the geometrical figures.

(4) To help pupils represent numbers and quantities as well as their relations by using words, numbers, algebraic expressions, figures, diagrams, tables, and graphs, and interpret such representations.

2. Content

A. Numbers and Calculations

(1) To help pupils deepen their understanding of the representations of integers, and extend their ability to use the numbers.

   a. To get to know the unit of ten-thousands (man in Japanese).

   b. To get to know numbers that are 10 or 100 times as many or 1/10 of another number, and the representations of the numbers.

   c. To deepen their understanding of relative size of numbers.

(2) To help pupils add and subtract accurately, and extend their ability to use the calculations appropriately.

   a. To explore ways of addition and subtraction of 3- and 4-digit numbers and to understand that those calculations are based on basic calculations of 2-digit numbers and so on. To understand the way of calculations using algorithms in column forms.

   b. To add and subtract accurately, and to use the calculations appropriately.

   c. To explore properties of addition and subtraction and to make use of the properties in order to explore ways to calculate or check the results.

(3) To help pupils deepen their understanding of multiplication, multiply accurately, and extend their ability to use the calculation appropriately.

   a. To explore ways of multiplication of 2- or 3-digit numbers and 1- or 2-digit numbers and understand that those calculations are based on basic multiplication of 1-digit numbers. To understand the way of calculation using algorithms in column forms.

   b. To multiply accurately, and to use the calculation appropriately.

   c To explore properties of multiplication and to make use of the properties in order to explore ways to calculate or check the results.

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(4) To help pupils understand the meaning of division, and use the calculation.
  a. To get to know situations where division is used. Also, to get to know remainders.
  b. To understand the relationships between division and multiplication and between division and subtraction.
  c. To divide accurately when both the divisors and the quotients are 1-digit numbers.
  d. To explore ways of division in simple cases when the divisors are 1-digit numbers and the quotients are 2-digit numbers.
(5) To help pupils understand the meaning and the representations of decimal numbers.
  a. To use decimal numbers in expressing size of fractional part. To get to know the representations of decimal numbers to the tenths place.
  b. To understand the meaning of addition and subtraction of decimal numbers through the tenths place. To explore ways of the calculations and do the calculations through the tenths place.
(6) To help pupils understand the meaning and the representations of fractions.
  a. To use fractions in expressing size of fractional parts or quantities obtained as a result of equal partitioning. To get to know the representations of fractions.
  b. To get know that a fraction can be represented as a collection of unit fractions.
  c. To understand the meaning of addition and subtraction of fractions in simple cases, and to explore ways of the calculations.
(7) To help pupils get to know the representations of numbers on soroban (Japanese abacus) and do simple addition and subtraction by using soroban.
  a. To get to know the representations of numbers on soroban.
  b. To get to know ways of addition and subtraction.
B. Quantities and Measurements
  (1) To help pupils deepen their understanding of length, and to help them understand the meaning of units and measurements of weight, and measure the weight.

a. To get to know the unit of length (kilometer [km]).

b. To get to know the units of weight (gram [g] and kilogram [kg]).

(2) To help pupils estimate length and weight and measure them by selecting appropriate units and instruments according to their purposes.

(3) To help pupils understand time.

a. To get to know seconds.

b. To determine clock time and elapsed time which are necessary in their daily lives.

C. Geometrical Figures

(1) Through activities such as observing and composing geometrical figures, to help pupils pay attention to the elements that compose geometrical figures and understand geometrical figures.

a. To get to know isosceles triangles and equilateral triangles.

b. To get to know angles.

c. To get to know circles and spheres. Also, to get to know the center, radius and diameter of such figures.

D. Mathematical Relations

(1) To help pupils represent situations where divisions are used, by using algebraic expressions, and interpret these expressions.

(2) To help pupils understand algebraic expressions that represent the relationships between numbers/quantities and use these expressions.

a. To represent the relationships between numbers/quantities in algebraic expressions, and to make connections between algebraic expressions and diagrams.

b. To represent numbers and quantities by using　, to represent the relationships between numbers/quantities in algebraic expressions, and to explore the expressions by substituting numbers for the □.

(3) To help pupils organize and classify data, and represent them clearly by using tables and graphs, and interpret these representations.

a. To get to know how to interpret and draw bar graphs.

[Mathematical Activities]

(1) The content listed in "A. Numbers and Calculations," "B. Quantities and Measurements," "C. Geometrical Figures" and "D. Mathematical Relations" should be taught through, for example, the following mathematical activities:

a. Activities to explore and explain the meaning and ways of calculating integers, decimal numbers and fractions by using concrete objects, words, numbers, algebraic expressions, figures and diagrams.

b. Activities to express decimal numbers and fractions by using concrete objects, figures, diagrams and number lines and to compare sizes.

c. Activities to investigate the relationships among the units within each quantity such as length, volume, and weight.

d. Activities to construct isosceles triangles and equilateral triangles using a ruler and a pair of compasses.

e. Activities to organize data from perspectives, such as dates, locations, and to represent the data in tables.

[Terms and Symbols]

sign of equality, sign of inequality, decimal point, tenth place, number line, denominator, numerator, ÷

3. Handling the Content

(1) As for the content (1) in "A. Numbers and Calculations," the number 100 million should be dealt with.

(2) As for the content (2) and (3) in "A. Numbers and Calculations," consideration should be given to enable pupils to do simple mental calculations.

(3) As for the content (2)-c in "A. Numbers and Calculations," commutative law and associative law should be dealt with.

(4) As for the content (3) in "A. Numbers and Calculations," the calculations in cases where either the multiplier or the multiplicand is 0 should be dealt with.

(5) As for the content (3)-c in "A. Numbers and Calculations," commutative law, associative law and distributive law should be dealt with.

(6) As for the content (5) and (6) in "A. Numbers and Calculations," the decimal numbers 0.1 and the fraction 1/10 and so on should be dealt with by using number lines with each other.

(7) As for the content (1)-b in "B. Quantities and Measurements," the unit of "ton"[t] should be touched upon.

[Grade 4]

1. Objectives

(1) To help pupils deepen their understanding of division and use the calculation appropriately. To help them deepen their understanding of the meaning and the representations of decimal numbers and fractions, understand the meaning of addition and subtraction of decimal numbers and fractions, explore ways of addition and subtraction, and use them. Moreover, to help them understand round numbers and use them according to their purposes.

(2) To help pupils understand the units and measurements of area, determine the area of geometrical figures, and understand the unit and measurements of angle.

(3) To help pupils understand plane figures, such as parallelograms and rhombuses, and solid figures, such as rectangular parallelepiped, by paying attention to the elements that compose the geometric figures and the relationships of those elements.

(4) To help pupils represent numbers and quantities as well as their relations by using words, numbers, algebraic expressions, figures, diagrams, tables, and graphs, and investigate such representations.

2. Content

A. Numbers and Calculations

　(1) To help pupils deepen their understanding that integers are represented by the decimal positional numeration system.

　　a. To understand units such as hundred million (oku in Japanese) and trillion (cho in Japanese), and to summarize the decimal positional numeration system.

　(2) To help pupils understand round numbers and use them according to their purposes.

　　a. To get to know cases where the use of round numbers is appropriate.

　　b. To get to know the rounding to the nearest integer.

　　c. To estimate the results of four rules of calculation according to one's purpose.

　(3) To help pupils deepen their understanding of division of integers, divide accurately, and extend their ability to use the calculation appropriately.

　　a. To explore ways of division in the cases where the divisor is a 1-digit or 2-digit number and the dividend is a 2-digit or 3-digit

number, and to understand that these calculations are based on the basic calculations. Also, to understand the way of calculation using algorithms in column forms.

    b. To divide accurately, and to use the calculation appropriately.

    c. To investigate the relationships between dividend, divisor, quotient and remainder and to put them in the following formula:

$$(\text{dividend}) = (\text{divisor}) \times (\text{quotient}) + (\text{remainder})$$

    d. To explore properties of division and to make use of the properties in order to explore ways to calculate or check the results.

(4) To help pupils consolidate the ability to calculate integers and extend their ability to use the calculations.

(5) To help pupils deepen their understanding of decimal numbers as well as their understanding of addition and subtraction of decimal numbers, and to help them understand the meaning of multiplication and division in decimal numbers, and use the calculations.

    a. To get to know the fact that decimal numbers are represented in the same manner as integers, and to deepen their understanding of the relative size of numbers.

    b. To explore ways of addition and subtraction of decimal numbers and to do the calculations.

    c. To explore ways of multiplication and division of decimal numbers in cases where multipliers and divisors are integers, and to do the calculations.

(6) To help pupils deepen their understanding of fractions, and to help them understand the meaning of addition and subtraction of fractions with the same denominators, and use the calculations.

    a. To pay attention to the fact that there are fractions that are the same in size in simple cases.

    b. To explore ways of addition and subtraction of fractions with the same denominators, and to do the calculations.

(7) To help pupils add and subtract using soroban (Japanese abacus).

B. Quantities and Measurements

(1) To help pupils understand the meaning of units and measurements of area, and determine the area by calculation.

    a. To get to know the units of area (square centimeter [cm^2], square meter [m^2], square kilometer [km^2]).

b. To explore ways to determine the area of squares and rectangles.

(2) To help pupils understand the meaning of unit and measurements of angle, and measure angles.

    a. To regard the size of an angle as the amount of turn.

    b. To get to know the unit of angle measurement (degree [°]).

C. Geometrical Figures

(1) Through activities such as observing and composing geometrical figures, to help pupils pay attention to the elements that compose geometrical figures as well as their positional relationships, and deepen their understanding of geometrical figures.

    a. To understand the relationships such as parallelism and perpendicularity of straight lines.

    b. To get to know parallelograms, rhombuses and trapezoids.

(2) Through activities such as observing and composing geometrical figures, to help pupils understand solid geometrical figures.

    a. To get to know cubes and rectangular parallelepiped.

    b. To understand such relationships as parallelism and perpendicularity of straight lines and planes in connection with rectangular parallelepiped.

(3) To help pupils understand how to represent the position of an object.

D. Mathematical Relations

(1) To help pupils represent and explore the relationships between two numbers/quantities as they vary simultaneously.

    a. To represent how the numbers/quantities vary on a broken-line graph and to interpret the features of their variation.

(2) To help pupils understand the algebraic expressions that represent the relationships between numbers/quantities, and use these expressions.

    a. To understand algebraic expressions that contain some of the four basic operations and parentheses ( ), and to calculate them accurately.

    b. To understand the idea of formulas and to use them.

    c. To represent numbers and quantities by using   and , to represent the relationships between numbers/quantities in algebraic expressions, and to explore the expressions by substituting numbers for the   and .

(3) To help pupils deepen their understanding of the properties of the four basic operations.

    a. To summarize the properties of commutative, associative, and distributive laws.

(4) To help pupils gather and organize data according to their purposes, and represent them clearly by using tables and graphs, and explore features of data.

    a. To explore features of the data by organizing the data from two viewpoints.

    b. To get to know how to interpret and draw broken-line graphs.

[Mathematical Activities]

(1) The content listed in "A. Numbers and Calculations," "B. Quantities and Measurements," "C. Geometrical Figures" and "D. Mathematical Relations" should be taught through, for example, the following mathematical activities:

    a. Activities to estimate the result of calculations according to one's purpose, and to make proper decisions about the way of the calculations and the results.

    b. Activities to explore and explain ways to determine the area of geometrical figures composed of rectangles by using concrete objects, words, numbers, algebraic expressions, figures and diagrams.

    c. Activities to actually measure the area of objects found in everyday life.

    d. Activities to investigate features of geometric figures, such as parallelograms, rhombuses and trapezoids, by tesselating them on a plane.

    e. Activities to find two quantities in everyday life that vary in proportion to each other, and to represent and investigate the relationships of numbers/quantities in tables and graphs.

[Terms and Symbols]

sum, difference, product, quotient, more than or equal, less than or equal, less than, proper fraction, improper fraction, mixed fraction, parallel, perpendicular, diagonal line, plane

3. Handling the Content

(1) As for the content (1) in "A. Numbers and Calculations," cases when

large numbers are expressed by spliting them into 3-digit groups should be touched upon.

(2) As for the content (2)-c, (3) and (4) in "A. Numbers and Calculations," consideration should be given to enable pupils to do simple mental calculations. Also, consideration should be given to enable pupils to make use of mental calculation when doing the calculation using algorithms in column forms and doing estimation.

(3) As for the content (4)-d in "A. Numbers and Calculations," it should be dealt with that the quotient remains unchanged when the dividend and the divisor are multiplied or divided by the same number.

(4) As for the content (5)-c in "A. Numbers and Calculations," the case where a quotient of two integers is expressed as a decimal numbers should be included.

(5) As for the content (1)-a in "B. Quantities and Measurements," units"are"[a] and "hectare"[ha] should be touched upon.

(6) As for the content (2)-a in "C. Geometrical Figures," drawing sketches and nets should be dealt with.

(7) As for the content (4)-a in "D. Mathematical Relations," the examination of data without omissions and duplications should be dealt with.

[Grade 5]
1. Objectives
(1) To help pupils deepen their understanding of properties of integers. To help them deepen their understanding of the meaning of multiplication and division of decimal numbers as well as the meaning of addition and subtraction of fractions, explore ways of the calculation, and use the calculations.

(2) To help pupils determine the area of geometrical figures such as triangles and parallelograms and the volume of solid figures such as rectangular parallelepiped. To help them understand the average of measured value and the ratio of two quantities of different types.

(3) To help pupils deepen their understanding of plane figures, and to help them understand solid figures such as prisms.

(4) To help pupils investigate relationships between numbers/quantities. To help them investigate the features of data by using percentages and pie graphs.

2. Content
  A. Numbers and Calculations
    (1) To help pupils deepen their understanding of the properties of integers.
        a. To understand that, if a viewpoint is fixed, integers are classified into some subsets such as even numbers and odd numbers.
        b. To get to know divisors and multiples.
    (2) To help pupils deepen their understanding of integers and decimal numbers based on the concept of the numeration system, and to use the understanding efficiently in calculation and so on.
        a. To make numbers that are 10 or 100 times as much/many, or 1/10 or 1/100 of another number, and to investigate their relationships.
    (3) To help pupils deepen their understanding of the meaning of multiplication and division in decimal numbers, and use the calculations.
        a. Based on the understanding of calculations in cases when the multiplier and the divisor are integers, to understand the meaning of multiplication and division in cases where the multiplier and the divisor are decimal numbers.
        b. To explore ways of multiplication and division of decimal numbers and to do the calculations. Also, to understand the meaning of the size of the remainder.
        c. To understand that the same relationships and rules can be applied to the multiplication and division of decimal numbers as in the case of integers.
    (4) To help pupils deepen their understanding of fractions, understand the meaning of addition and subtraction of fractions with different denominators, and to use the calculations.
        a. To represent integers and decimals as fractions and to transform fractions into decimals.
        b. To understand that the results of division of integers can always be represented as a number when using fractions.
        c. To understand that a fraction obtained by multiplying or dividing the numerator and denominator of an existing fraction by the same number, has the same size as the existing fraction.
        d. To explore equivalence and size of fractions and summarize the

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comparison of sizes.

  e. To explore ways of addition and subtraction of fractions with different denominators, and to do the calculations.

  f. To understand the meaning of multiplication and division of fractions when multipliers and divisors are integers, explore ways of the calculations, and to do the calculations.

B. Quantities and Measurements

 (1) To help pupils determine the area of geometrical figures by calculation.

  a. To explore ways to determine the area of triangles, parallelograms, rhombuses, and trapezoids.

 (2) To help pupils understand the meaning of units and measurements of volume, and determine the volume by calculation.

  a. To get to know the units of volume (cubic centimeter [cm^3], cubic meter [cm^3]).

  b. To explore ways to determine the volume of cubes and rectangular parallelepiped.

 (3) To help pupils understand the measured value of quantities.

  a. To get to know the average of measured value.

 (4) To help pupils understand how to represent and compare quantities that are obtained as a ratio of two quantities of different types.

  a. To get to know size of per-unit quantities.

C. Geometrical Figures

 (1) Through activities such as observing and composing geometrical figures, to help pupils deepen their understanding of plane geometrical figures.

  a. To get to know polygons and regular polygons.

  b. To understand congruence of geometrical figures.

  c. To investigate and compose geometrical figures by finding the properties of geometrical figures.

  d. To understand the ratio of the circumference of a circle to its diameter.

 (2) Through activities such as observing and composing geometrical figures, to help pupils understand solid geometrical figures.

  a. To get to know prisms and cylinders.

D. Mathematical Relations

(1) To help pupils use tables to explore the relationships between two quantities as they vary simultaneously.

    a. To get to know proportional relationships in simple cases.

(2) To help pupils deepen their understanding of algebraic expressions that represent relationships between numbers/quantities, and pay attention to the correspondence between two numbers/quantities and the aspect of variation in the   relationships represented by a simple algebraic expression.

(3) To help pupils understand percentage.

(4) To help pupils gather and organize data according to their purposes, and represent them by using pie graphs and band graphs, and investigate features of data.

[Mathematical Activities]

(1) The content listed in "A. Numbers and Calculations," "B. Quantities and Measurements," "C. Geometrical Figures" and "D. Mathematical Relations" should be taught through, for example, the following mathematical activities:

    a. Activities to explore and explain the meaning and way of calculations of decimal numbers by using words, numbers, algebraic expressions, figures, diagrams and number lines.

    b. Activities to explore and explain ways to determine the area of triangles, parallelograms, rhombuses and trapezoids by using concrete objects, words, numbers, algebraic expressions, figures and diagrams.

    c. Activities to construct and make congruent figures.

    d. Activities to inductively think and explain that the sum of the three angles of a triangle is equal to 180 degrees. Activities to deductively think and explain that the sum of the four angles of a quadrangle is equal to 360 degrees.

    e. Activities to select and use tables and graphs according to one's purpose.

[Terms and Symbols]

greatest common divisor, least common multiple, reduction to a common denominator, reduction, base,   side face, proportion, %

3. Handling the Content

(1) As for the content (1)-b in "A. Numbers and Calculations," the greatest

common divisor and least common multiple should be dealt with in line with concrete situations without putting too much emphasis on the formality of obtaining them. Also, prime numbers should be touched upon in the process of studying divisors.

(2) As for the content (1)-d in "C. Geometrical Figures,"3.14 should be used for the ratio of the circumference of a circle to its diameter.

(3) As for the content (2)-a in "C. Geometrical Figures," drawing of sketches and nets should be dealt with.

(4) As for the content (3) in "D. Mathematical Relations," the representation of buai (Japanese expression of proportion) should be touched upon.

[Grade 6]

1. Objectives

(1) To help pupils deepen their understanding of the meaning of multiplication and division of fractions, explore ways of the calculations, and use the calculations.

(2) To help pupils determine the area of circles and the volume of solid figures such as prisms.   To help them understand speed and determine it.

(3) To help pupils understand reduced figures, enlarged figures and symmetric figures, and deepen their understanding of geometrical figures.

(4) To help pupils understand ratio and direct proportion, and use the idea of a function when exploring the relationships of numbers/quantities, and represent the relationships in algebraic expressions.   To help them explore the distribution of data and investigate it statistically.

2. Content

A. Numbers and Calculations

(1) To help students deepen their understanding of the meaning of multiplication and division of fractions, and use the calculations.

   a. To understand the meaning of multiplication and division when multipliers and divisors are fractions, based on the concept of such calculations in cases where multipliers and divisors are integers.

   b. To explore ways of multiplication and division of fractions, and to do the calculations.

c. With respect to multiplication and division of fractions, to understand that the same relationships and rules as integers can be applied.

(2) To help pupils consolidate their ability to calculate decimal numbers and fractions and extend their ability to use the calculations.

B. Quantity and Measurements

(1) To help pupils estimate the area of shapes in their surroundings by approximating them with familiar geometrical figures.

(2) To help pupils determine the area of geometrical figures by calculation.

a. To explore ways to determine the area of circles.

(3) To help pupils determine the volume of geometrical figures by calculation.

a. To explore ways to determine the volume of prisms and cylinders.

(4) To help pupils understand and determine speed.

(5) To help pupils understand the system of the metric units.

C. Geometrical Figures

(1) Through activities such as observing and composing geometrical figures, to help pupils deepen their understanding of plane geometrical figures.

a. To understand reduced figures and enlarged figures.

b. To understand symmetric figures.

D. Mathematical Relations

(1) To help pupils understand ratio.

(2) To help pupils explore the relationships of two numbers/quantities as they vary simultaneously.

a. To understand proportional relationships, and to explore their features by using algebraic expressions, tables and graphs.

b. To solve problems by using proportional relationships.

c. To get to know inversely proportional relationships.

(3) To help pupils deepen their understanding of algebraic expressions that represent the relationships of two numbers/quantities, and to use the algebraic expressions.

a. To represent relationships in algebraic expressions by using letters such as "a" and "x" instead of words, , , and so on, and to explore the relationships by substituting numbers for the letters.

(4) To help pupils determine the average of data and the distribution of data, and to explore and represent the data statistically.

    a. To get to know the average of data.

    b. To get to know the tables and graphs that represent frequency distribution.

(5) To help pupils analyze all the possible outcomes systematically for actual events.

[Mathematical Activities]

(1) The content listed in "A. Numbers and Calculations," "B. Quantities and Measurements," "C. Geometrical Figures" and "D. Mathematical Relations" should be taught through, for example, the following mathematical activities:

    a. Activities to explore and explain the meaning of calculation of fractions and ways of the calculation by using words, numbers, algebraic expressions, figures, diagrams and number lines.

    b. Activities to find units of quantities used in everyday life and investigate how they are related to the units that pupils have learned before.

    c. Activities to find reduced figures, enlarged figures and symmetric figures in everyday life.

    d. Activities to find two numbers/quantities that are in proportional relationships in everyday life and solve problems by using the proportional relationships.

[Terms and Symbols]

line symmetry, point symmetry,

3. Handling the Content

(1) As for the content (1) in "A. Numbers and Calculations," regarding division as multiplication by using reciprocals, and integrating multiplication and division of integers and decimal numbers into the calculations of fractions, should be dealt with.

(2) As for the content (2)-a in "B. Quantities and Measurements," 3.14 should be used for the ratio of the circumference of a circle to its diameter.

III. SYLLABUS DESIGN AND HANDLING THE CONTENT

1. In designing the syllabus, consideration should be given to the following:

(1) The content of each grade listed in Subsection II should, if necessary, continue to be taught in the following grades. In order to acquire and maintain basic proficiency in numbers, quantities and geometrical figures, instructions should be given in a planned manner by offering practices when necessary. Also, in order to smoothly link up the content of instructions of different grades, instructions should be repeated on an appropriate basis.

(2) It is necessary to ensure coordination between the teaching of the "A. Numbers and Calculations," "B. Quantities and Measurements," "C. Geometrical Figures," and "D. Mathematical Relations" in content of Subsection II for each grade.

(3) Since mathematical activities play important roles in consolidating the acquisition of basic and fundamental knowledge and skills, in improving the ability to think, judge and express themselves, and in finding the pleasure and significance of learning mathematics, mathematical activities should be taught throughout all grades with respect to the corresponding content listed in "A. Numbers and Calculations," "B. Quantity and Measurements," "C. Geometrical Figures," and "D. Mathematical Relations."

(4) Based on the objectives of moral education listed in Subsections I-2 of Chapter 1 "General Provisions" and in Subsection I of Chapter 3 "Moral Education", instructions concerning the content listed in Subsection II of Chapter 3 "Moral Education" should be given appropriately. The instructions should be in accordance with the characteristics of arithmetic and should be related to the period for moral education.

2. In the handling of the content listed in Subsection II, consideration should be given to the following:

(1) To help pupils develop rich sense of numbers, quantities and geometrical figures, estimate approximate size and shape, make proper judgments based on estimates, and devise effective ways of performing tasks.

(2) In order to develop the ability to think, judge and express themselves, instructions of the content in each grade should actively incorporate such learning activities as thinking by using words, numbers, algebraic expressions, figures, diagrams, tables and graphs, and explaining and communicating their thoughts among themselves.

（3）Terms and symbols indicated under the content for each grade have the purpose of clarifying the range and the extent of the content dealt with in each grade, so they must be included in teaching the content of other items as occasion demands, and must be taught to help pupils appreciate the value of thinking by using and representing them.

（4）Emphasis should be placed on solidifying the skill of paper-and-pencil calculation and pupils should be able to estimate the result of calculation in accordance with one's purpose and to appropriately make decisions on the method of calculation and the result. In teaching "A. Numbers and Calculations" of the Content for the lower grades, care must be taken to deepen pupils' understanding of the meaning of numbers and calculations through appropriate utilization of soroban or specific teaching aids, etc.

（5）It is necessary to appropriately use computers and so on, when necessary, in order to enrich pupils' sense of numbers, quantities and geometrical figures and to improve their ability to represent data by using tables and graphs.