Math Pedia

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Chapter 1

Whole Numbers to 1000

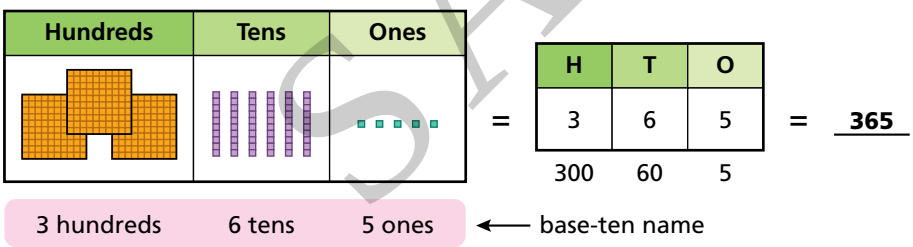
1.1 Writing Whole Numbers to 1000

You can use base-ten materials (such as $100 bills, $10 bills, and loonies) or drawings to understand how to write three-digit numbers. You will also learn to write two-digit numbers in words.

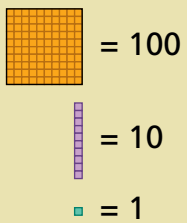
Grasping the Place Value Concept

Place value: the value of a digit in a number is based on its position; for example, in the number 365, the digit 3 in the hundreds place means 300.

Place Value Chart



Base-ten Blocks



Writing Numbers in Words

Try to identify the spelling pattern in each group of numbers.

From 11 to 19:

eleven	fifteen	nineteen
twelve	sixteen	
thirteen	seventeen	
fourteen	eighteen	

Multiples of 10:

twenty	fifty	eighty
thirty	sixty	ninety
forty	seventy	

Application

① *A cashier is counting the money in the cash register. There are 2 hundred-dollar bills and 17 rolls of loonies, with 10 loonies in each roll. The cashier records a total of $217. Is the cashier's record correct? Explain.*

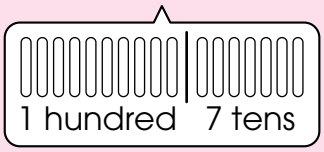
Solution:

2 hundred-dollar bills = 2 hundreds

1 roll of loonies = 1 ten

17 rolls of loonies = 17 tens = 1 hundred 7 tens

Add them.
3 hundreds 7 tens
= 300 and 70
= 370



The cashier's record is not correct. The total amount should be $370, not $217.

② *Melissa helped clean the blackboard, but she erased some useful information by accident. Use the clues left on the blackboard to help Melissa rewrite the information.*

Solution:

*w*nty -six students

It must be either twe**nty** or seve**nty**.

"Seventy-six" cannot be correct because that would mean there are too many students in the class.

So, the answer must be twenty-six.

1.2 Counting Forward by 1's, 2's, 5's, 10's, 25's, and 100's

When you skip count, start at 0. Once you understand the concept of skip counting, start at various numbers to develop your skills.

Here are 3 tools to help you skip count:

1 A hundreds chart

Count by 2's from 64.

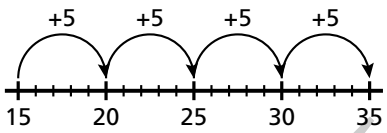
61	62	63	64	65	66	67	68	69	70
71	72	73	74	75	76	77	78	79	80
81	82	83	84	85	86	87	88	89	90
91	92	93	94	95	96	97	98	99	100

64, 66, 68, 70, 72...

The coloured numbers run in columns on the hundreds chart.

2 A number line

Count by 5's from 15.



15, 20, 25, 30, 35

Add 5 each time to get the next number.

3 Coins

Count by 10's.

4 dimes make 40¢.

Count by 2's

Start at
- an even number: the digit in the ones place must be 0, 2, 4, 6, or 8.
  e.g. 14, 16, 18, 20, 22...
- an odd number: the digit in the ones place must be 1, 3, 5, 7, or 9.
  e.g. 247, 249, 251, 253, 255...

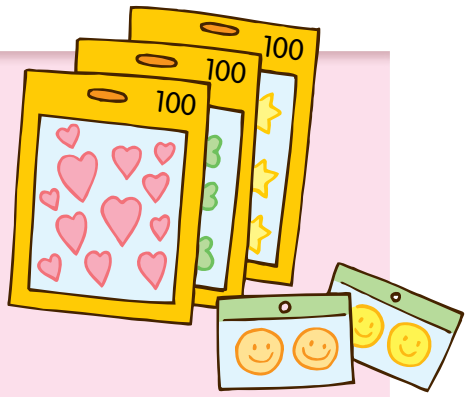
Count by 5's

Start at
- a multiple of 5: the digit in the ones place must be 0 or 5.
  e.g. 65, 70, 75, 80...
- any number: the digit in the ones place repeats alternately.
  e.g. 132, 137, 142, 147...

Count by 10's, 100's, 25's

- e.g. 214, 224, 234, 244... ← The digit in the tens place goes up by 1 each time.
- e.g. 214, 314, 414, 514... ← The digit in the hundreds place goes up by 1 each time.
- e.g. 150, 175, 200, 225... ← The core pattern is 00, 25, 50, and 75.

Application



① *Julia has 298 stickers in a box. If she buys 3 packs with 100 stickers each and 2 sheets with 2 stickers each, how many stickers will she have in total? Show Julia how to use skip counting to find the answer.*

Solution:

Way 1

Count by 100's (3 times).

298 → 398 → 498 → 598

Count by 2's (2 times).

598 → 600 → 602

Julia has 602 stickers.

Way 2

Add 2 stickers to 298 first.

298 + 2 = 300 ← It makes it easier to count from 300.

Count by 100's (3 times).

300 → 400 → 500 → 600

Add the 2 remaining stickers to 600 to get the answer 602.

② *Look at the coins that Kevin has. Help Kevin use skip counting to find the total value of his coins.*

Solution:

1st Group the coins: 5 quarters, 3 dimes, 2 nickels.

2nd Count by 25's for the quarters (5 times).

0 → 25 → 50 → 75 → 100 → 125

3rd Count by 10's for the dimes (3 times).

125 → 135 → 145 → 155

4th Count by 5's for the nickels (2 times).

155 → 160 → 165

Kevin has 165¢.

Chapter 2

Addition and Subtraction

2.1 Adding and Subtracting Using Mental Strategies

In this unit, you will learn various mental addition and subtraction strategies.

Mental Addition

Way 1 Splitting and Adding

1st Split the numbers into tens and ones.

54 + 49

50 + 4 — 40 + 9

2nd Add the tens. Then add the ones.

50 + 40 = 90

4 + 9 = 13

3rd Add the total tens and ones.

90 + 13 = 103

So, 54 + 49 = **103** .

Way 2 Making a Friendly Number

Make one of the numbers a friendly number, which is a multiple of 10. Then add.

54 + 49

−1 +1 Make 49 friendly (add 1 to 49, so subtract 1 from 54).

53 + 50 = 103

So, 54 + 49 = **103** .

Mental Subtraction

Way 1 Counting Forward

e.g. 91 − 68 = ?

1st Count forward by 10's from 68 to 91.

68 (10) 78 (10) **88** (over 91; stop at 88) ~~98~~

Counted **20**

2nd Count forward by 1's.

88 (1) 89 (1) 90 (1) 91

Counted **3**

3rd Add how much you counted.

20 + 3 = 23

So, 91 − 68 = **23** .

Way 2 Making a Friendly Number

Make the second number friendly. Then subtract.

91 − 68

+2 +2

93 − 70 = 23

So, 91 − 68 = **23** .

Application

A toy truck is $24 and a teddy bear is $38. I bought both and got some change.

If she paid with $20 bills only, how many bills did she use? What was her change?

Solution:

Total cost: $24 + $38 = $62

Number of $20 Bills	Total Value	
1	20	
2	40	
3	60	
4	80	✔ enough to pay

Change: $80 – $62 = $18

She used 4 $20 bills and got $18 in change.

2.2 Adding and Subtracting Four-digit Numbers

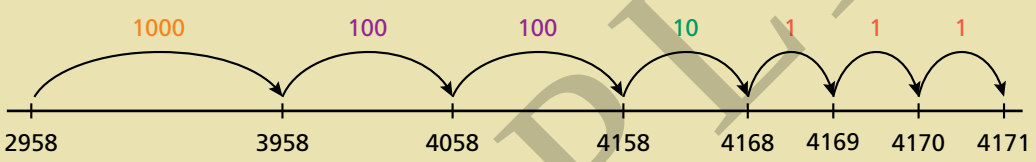
This unit builds upon your existing knowledge of number lines, base-ten blocks, and vertical addition. You will apply these three approaches to add and subtract numbers up to 10 000.

Addition

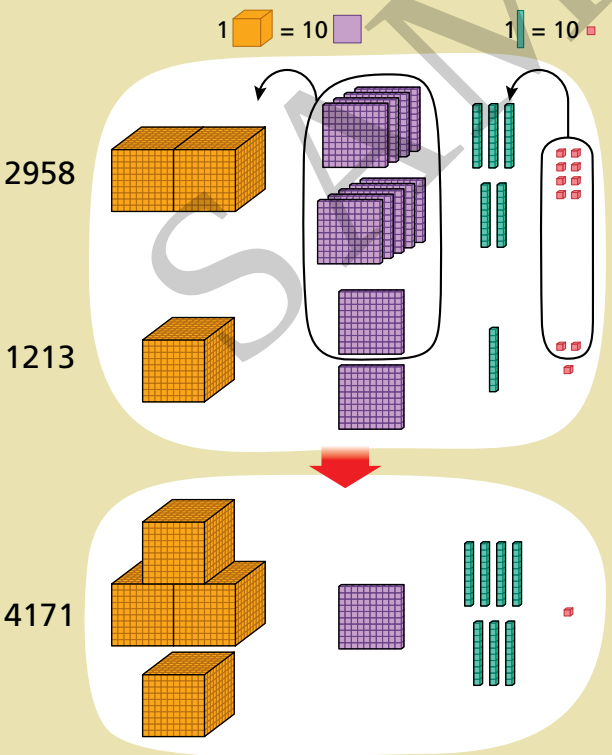
e.g. 2958 + 1213 = ?

Using a Number Line

Think 1213 = 1000 + 100 + 100 + 10 + 1 + 1 + 1



Using Base-ten Blocks



Using Vertical Addition

1st Align the digits.

2nd Add the ones, tens, hundreds, and then the thousands.

$$\begin{array}{r} {\scriptstyle 1\quad\quad 1\quad\quad} \\ 2\ 9\ 5\ 8 \\ +\ 1\ 2\ 1\ 3 \\ \hline 4\ 1\ 7\ 1 \end{array}$$

9 + 2 = 11
carry 1 to thousands

8 + 3 = 11
carry 1 to tens

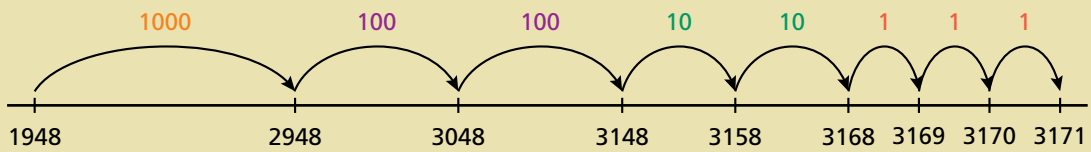
So, 2958 + 1213 = **4171** .

Subtraction

Using a Number Line

e.g. 3171 – 1948 = ?

Think Count from 1948 to 3171 by 1000's, 100's, 10's, and 1's.

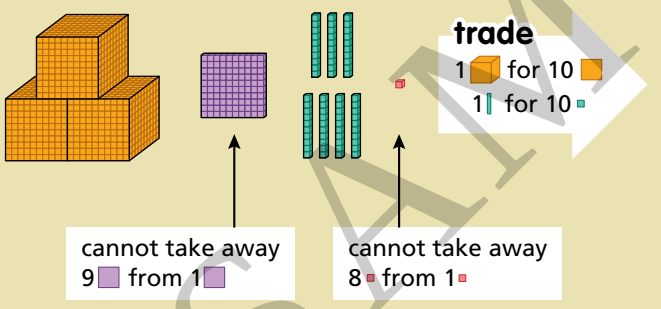


Total counted: 1223

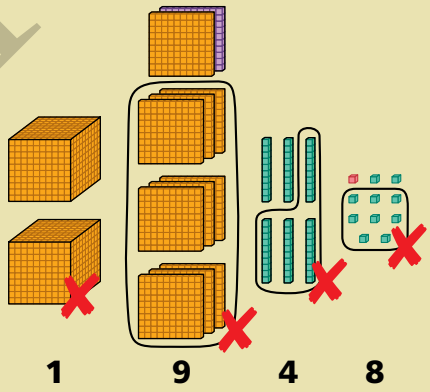
Using Base-ten Blocks

e.g. 3171 – 1948 = ?

3171



3171 – 1948



Using Vertical Subtraction

e.g. 3171 – 1948 = ?

1st Align the digits.

2nd Subtract the ones, tens, hundreds, and then the thousands.

$$\begin{array}{r} {}^{2}\cancel{3}\ 1\ {}^{6}\cancel{7}\ 1 \\ -\ 1\ 9\ 4\ 8 \\ \hline 1\ 2\ 2\ 3 \end{array}$$

borrow 1 from the thousands; 11 – 9 = 2

borrow 1 from the tens; 11 – 8 = 3

So, 3171 – 1948 = **1223** .

Chapter 3

Fractions and Decimals

3.1 Identifying Fractions and Mixed Numbers

You should be able to use standard fractional notation to represent fractions and understand the terms denominator (the bottom number) and numerator (the top number). In this unit, you will learn how to identify the three types of fractions and convert between improper fractions and mixed numbers.

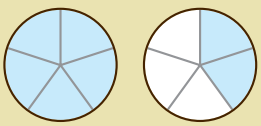
Three Types of Fractions

Proper Fraction
(numerator < denominator)

e.g. 

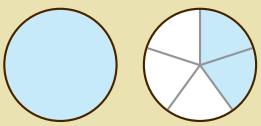
$\frac{2}{5}$

Improper Fraction
(numerator ≥ denominator)

e.g. 

$\frac{7}{5}$

Mixed Number
(a whole number + a proper fraction)

e.g. 

$1\frac{2}{5}$

A proper fraction is the only type of fraction that describes amounts that are less than 1.

Improper Fractions ⇄ Mixed Numbers

Improper fractions and mixed numbers are 2 different ways to represent the same number.

Improper Fractions → Mixed Numbers

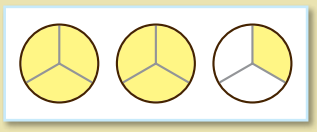
- using division

e.g. $\frac{7}{3}$

$$3\overline{)7}\quad \begin{array}{l} 2 \text{ (whole number)} \\ 6 \\ \hline 1 \text{ (numerator)} \end{array}$$

(denominator = 3)

$$= 2\frac{1}{3}$$



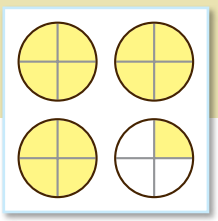
Mixed Numbers → Improper Fractions

- using multiplication and addition

e.g. $3\frac{1}{4} = \frac{3 \times 4 + 1}{4}$ (whole number, denominator, numerator)

$$= \frac{12 + 1}{4}$$

$$= \frac{13}{4}$$



Application

Help Jason fill in the missing numbers for each pair consisting of a mixed number and an improper fraction.

Solution:

Mixed numbers and improper fractions share the same denominator.

1st Pair

$\square\frac{5}{6}$ and $\frac{11}{\square}$

same denominator, $\square = 6$

$\square\frac{5}{6}$ and $\frac{11}{6}$ Try $\square = 1$

$6 \times \square + 5$ So, $6 \times 1 + 5 = 11$. ✔

The first pair is $1\frac{5}{6}$ and $\frac{11}{6}$.

2nd Pair

$3\frac{4}{\square}$ and $\frac{\square}{5}$

same denominator, $\square = 5$

$3\frac{4}{5}$ and $\frac{\square}{5}$ So, $\square$ 19. ✔

$3 \times 5 + 4 = 19$

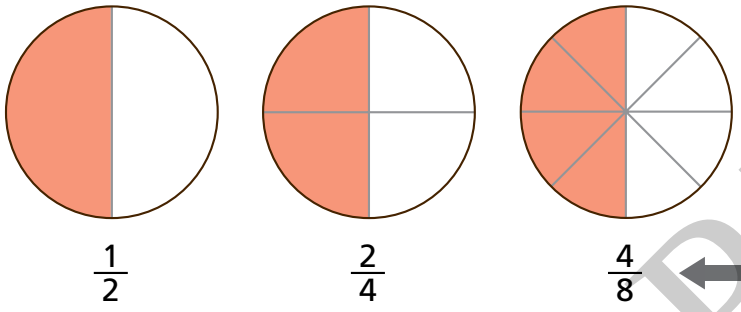
The second pair is $3\frac{4}{5}$ and $\frac{19}{5}$.

3.2 Finding Equivalent Fractions

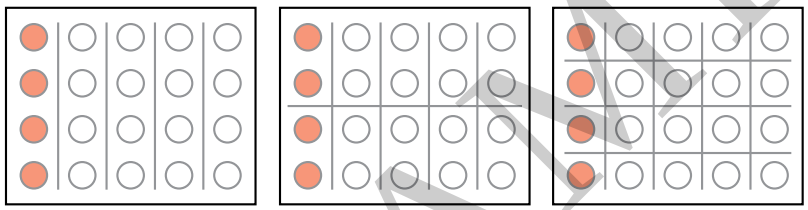
Equivalent fractions are fractions that represent the same parts of a whole or group. You can use pictures to "visualize" the concept initially. Once you grasp the idea, you can try to make equivalent fractions using multiplication and division.

Finding Equivalent Fractions in Three Ways

- by drawing

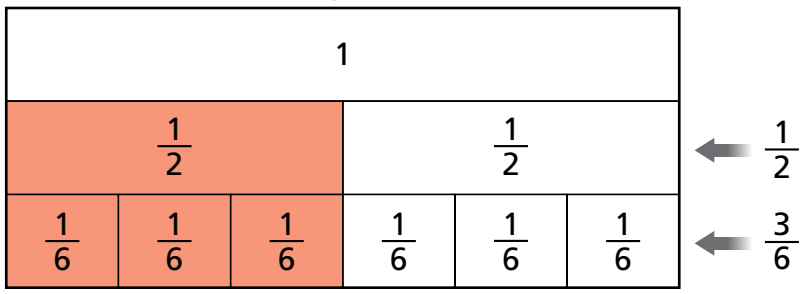


$\frac{1}{2}$ $\frac{2}{4}$ $\frac{4}{8}$ These are all equivalent fractions.



$\frac{1}{5}$ $\frac{2}{10}$ $\frac{4}{20}$ These are all equivalent fractions.

- using fraction strips



$\frac{1}{2}$ and $\frac{3}{6}$ are equivalent fractions.

Chapter 5

Measurement

5.1 Area of Rectangles

In this unit, you will review the methodology of finding the area of a rectangle. You will also learn how to convert between squared units.

Finding Area of Rectangles and Squares

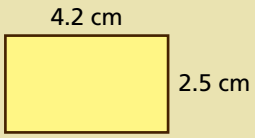
You should be familiar with finding the area of a rectangle using the formula below.

Area of a rectangle = length x width

A square is a special type of rectangle that has all sides equal.

Area of a square = length x length

e.g. Find the area of the rectangle.

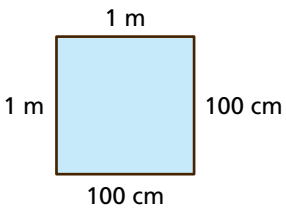


4.2 x 2.5 = 10.5

The area of the rectangle is **10.5 cm²**.

Converting m² into cm²

To understand the relationship between m^2 and cm^2, consider a square with side lengths of 1 m (or 100 cm).



Area in m^2 = 1 m x 1 m
= **1 m^2**

Area in cm^2 = 100 cm x 100 cm
= **10 000 cm^2**

1 m^2 = 10 000 cm^2

e.g. Convert 0.2 m^2 into cm^2.

0.2 = 2000
1 2 3 4

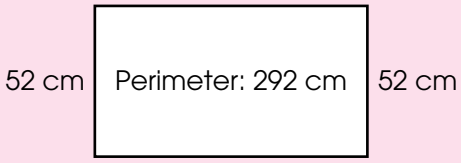
So, 0.2 m^2 = **2000 cm^2**.

Application

The perimeter of this board is 292 cm and its width is 52 cm. What is the area of the board?

Solution:

To find the area of a rectangle, both length and width are needed. The width is given, but the length needs to be found. Find the length of the rectangle using its perimeter and width.



perimeter width

Length = (292 – 52 – 52) ÷ 2
= 188 ÷ 2
= 94 (cm)

Area = 94 × 52
= 4888 (cm^2)

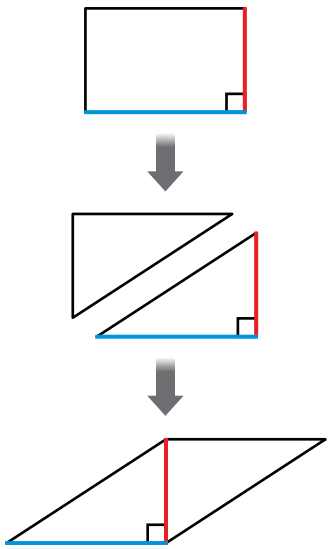
So, the area of the board is 4888 cm^2.

5.2 Area of Parallelograms

In this unit, you will relate the area of rectangles to the area of parallelograms. You will learn how the formula for the area of a parallelogram is derived from the formula for the area of rectangles.

Finding Area of a Parallelogram

To understand how to find the area of a parallelogram, you should consider the area of a rectangle.



Area of ▭ = length x width

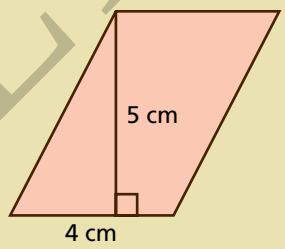
Cut the ▭ into 2 identical ◿.

Combine them to form a ▱. Note that the total area stays the same.

The area of the ▱ is the same as the area of the original ▭. However, instead of length and width, the two sides are called base and height in a parallelogram.

Area of a parallelogram = base x height

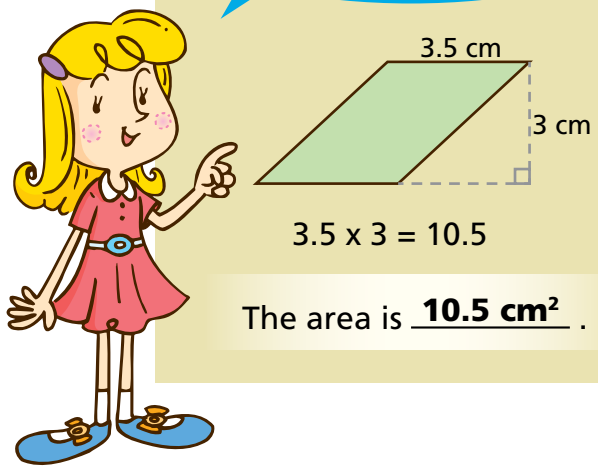
e.g. Find the area of the parallelogram.



4 x 5 = 20

The area is **20 cm²** .

Sometimes the height needs to be measured outside of the parallelogram.

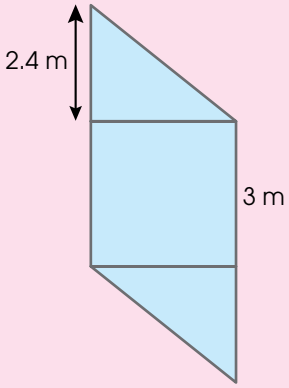


3.5 x 3 = 10.5

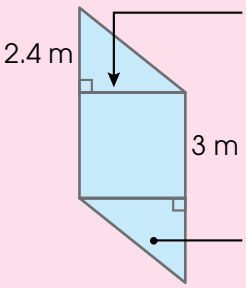
The area is **10.5 cm²** .

Application

The parallelogram is made up of two identical triangles and a square with a side length of 3 m. What is the area of the parallelogram?



Solution:



All sides of a square are equal, so the base of the triangle is 3 m.

This has the same area as the other triangle.

Area of two triangles:

$(3 \times 2.4 \div 2) \times 2$

$= 3.6 \times 2$

$= 7.2\ (m^2)$

Area of square:

3×3

$= 9\ (m^2)$

Total area:

$7.2 + 9$

$= 16.2\ (m^2)$

The area of the parallelogram is 16.2 m^2.

Chapter 11
Algebra

11.1 Algebraic Expressions

In this unit, you will learn to formulate algebraic expressions and evaluate algebraic expressions by substituting variables with different values.

Formulating an Algebraic Expression

An algebraic expression is a number sentence that consists of variables, numbers, and operations, where variables represent unknowns.

Steps

1st Identify the unknown and assign a letter to it.

2nd Find out how the other quantities relate to the unknown.

3rd Write a number sentence to represent the relationships.

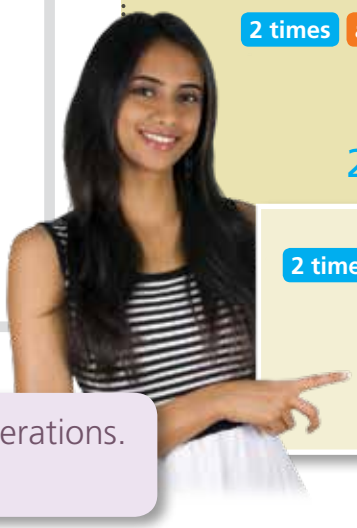
e.g. Write "2 times a number and add 3" as an algebraic expression.

2 times | a number | and | add 3

$2 \times n + 3$

2 times | the sum of a number and 3

$2 \times (n + 3)$



Be careful with the order of operations. Add brackets when necessary.

It is common practice to omit the multiplication sign in multiplication problems that involve variables.

e.g. $2 \times n + 3 \rightarrow 2n + 3$

$2 \times (n + 3) \rightarrow 2(n + 3)$

Evaluating an Algebraic Expression

To evaluate an algebraic expression, substitute the variable with its value into the expression. Then do the calculations.

e.g. Evaluate $2n + 3$ when $n = 1$.

$$\begin{aligned} & 2n + 3 \\ &= 2 \times 1 + 3 \quad \leftarrow \text{Substitute 1 for } n. \\ &= 5 \end{aligned}$$

Evaluate $2n + 3$ when $n = 3$.

$$\begin{aligned} & 2n + 3 \\ &= 2 \times 3 + 3 \\ &= 9 \end{aligned}$$

As you can see in the examples, the value of an expression depends on the value that the variable represents. Evaluate the expression with different values of n.

A variable can take on different values. Therefore, the value of an expression can differ depending on the value that the variable represents.

Application

The regular price of snorkelling gear rentals will increase by $\$d$. Eva plans to go snorkelling 10 times. She is debating whether she should buy the 10-day pass or a set of snorkelling gear that costs $196. What increase in rental price will make buying a set of snorkelling gear worthwhile?

Solution:

Cost of a new 10–day pass: $(22.5 + d) \times 10 \times (1 - 20\%)$

$= (22.5 + d) \times 10 \times 0.8$

$= (22.5 + d) \times 8$

Use the guess-and-check method to find out what increase in price would result in a rental cost of $196.

Guess d	Check
1	$(22.5 + 1) \times 8 = 188$
2	$(22.5 + 2) \times 8 = 196$ ✔

It will be worthwhile for Eva to buy a set of snorkelling gear if the increase in price is $2 or more.

11.2 Algebraic Equations

In this unit, you will build upon your knowledge of the previous unit and apply it to model real-life scenarios as algebraic equations. You will also solve for unknown variables using different strategies.

Formulating an Algebraic Equation

Formulating an algebraic equation is similar to formulating an algebraic expression. Therefore, make sure that you are familiar with the previous unit before starting this unit.

e.g. Write an equation that represents the scenario.

Kelly made 12 Popsicles. She made 4 more than half of the number I made. How many Popsicles did I make?

Let p be the number of Popsicles Janice made.

$$p \div 2 + 4 = 12$$

$p \div 2 + 4$: 4 more than half of p

12: no. of Popsicles Kelly made

Solving an Algebraic Equation

Way 1 Using the Guess-and-check Method

e.g. $a + 8 = 12$

Guess		Check
$a = 2$	$2 + 8 = 10$	✘
$a = 3$	$3 + 8 = 11$	✘
$a = 4$	$4 + 8 = 12$	✔

Way 2 Using an Algorithm

To solve for a variable, isolate it by performing the opposite operation on both sides of an equation.

e.g.

$$\begin{aligned} a + 8 &= 12 \\ a + 8 - 8 &= 12 - 8 \\ a &= 4 \end{aligned}$$

← Isolate a by subtracting 8 from both sides.

e.g.

$$\begin{aligned} 7k &= 14 \\ 7k \div 7 &= 14 \div 7 \\ k &= 2 \end{aligned}$$

← Isolate k by dividing both sides by 7.

Chapter 10
Data Management

10.1 Analyzing Graphs

Once data is represented in a graph, information can be interpreted and inferred from it. In this unit, you will learn to determine whether or not a measure of central tendency is a good representation of a set of data. You will also identify trends in graphs, including scatter plots.

Choosing Representative Measures of Central Tendency

As you should know, there are three measures of central tendency.

- **Mean**: the sum of a set of data values divided by the number of data values
- **Median**: the middle value in a set of data that is ordered from least to greatest
- **Mode**: the value(s) in a set of data that occur(s) most often

Depending on the data being analyzed, there might only be one measure of central tendency that is a good representation of a set of data.

e.g. Is the mean a good representation of the score?

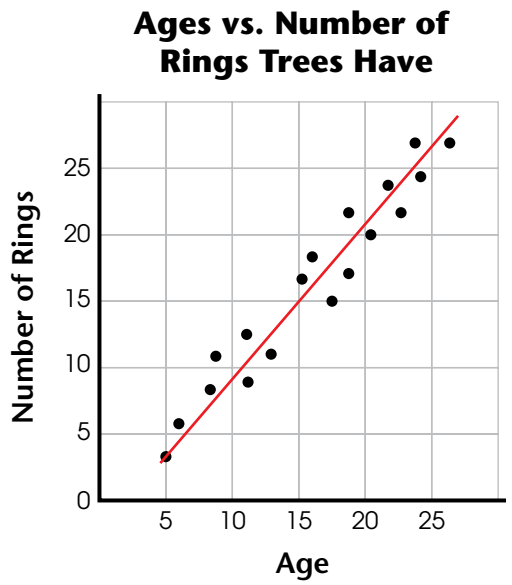
Game	1	2	3	4	5	6	7	8	9	10
Score	2	5	21	68	68	78	86	86	86	86

Mean: 58.6 Median: 73 Mode: 86

The mean score is 58.6. However, the mean might not be a good representation because most scores are in the 68 to 86 range.

Describing Trends

You should be familiar with describing trends presented in bar graphs and line graphs. At this level, you will identify trends in scatter plots.

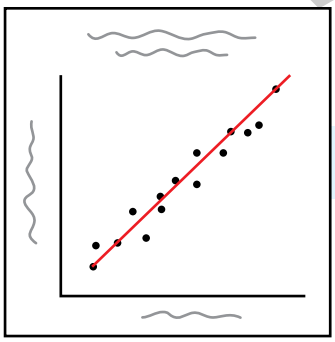


The points on a scatter plot show the relationship between two sets of data. The example on the left shows the relationship between the ages of trees and the number of rings they have. You should see that as the ages of trees increase, the number of rings they have also increases.

A line of best fit is a straight line that best represents the data on a scatter plot. The red line in the example is the line of best fit. According to this line, a tree that is 15 years old has 15 rings.

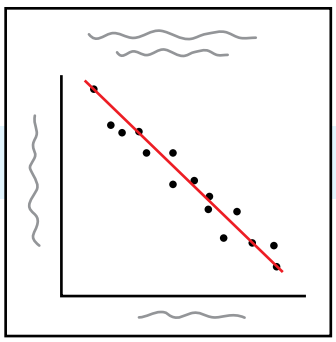
Here are the three types of trends in a scatter plot.

Increasing Trend



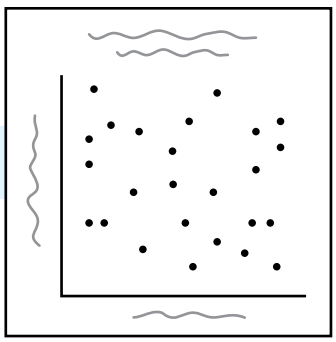
As one set of data increases, the other set increases as well.

Decreasing Trend



As one set of data increases, the other set decreases.

No Trend



There is no correlation between the two sets of data.

10.2 Representing Data in Graphs

In this unit, you will identify the source and the type of a set of data. You will learn to organize a set of data before representing it in graphs, including histograms and scatter plots.

Identifying the Sources and Types of Data

Being able to identify the source and type of data will help you choose the most appropriate method to organize and graph a set of data.

Primary Data

a set of data that is collected by conducting a survey or an experiment

Secondary Data

a set of data from other sources such as books and websites

Sample

a set of data from a representative group that represents the entire population

Census

an entire population that is examined

Discrete Data

data that includes only whole numbers

Continuous Data

data that includes any numerical values including fractions and decimals

e.g. Identify the source and types of the set of data.

Joshua found some data on a website (secondary data). It is from an experiment for a study on growth rates of a virus at room temperature.

Temperature	20°C	21°C	22°C	23°C	24°C
Growth Rate	12.5%	10.8%	10.2%	9.5%	8.9%

(continuous data)

Since it is impossible to conduct the experiment on all viruses, this set of data must be from a **sample**.

Organizing a Set of Data into Intervals

After data is gathered, the next step is to organize it so that information can be derived and represented meaningfully in a graph. You have already learned to organize data in a stem-and-leaf plot. At this level, you will learn to organize data into intervals.

Steps

1st Find the range of the values.

2nd Determine the appropriate number of intervals to have.

3rd Create a table and organize the data into correct intervals.

Remember these rules when determining the number of intervals.

- The range of each interval must be the same.
- Each data value must only be present in one interval.
- No data value can fall on the boundary of any two intervals.

e.g. Organize this set of data.

12.5	20.1	17.3	8.4
25.1	21.3	16.2	18.5
2.1	22.4	4.2	15.2

Think Range: 25.1 – 2.1 = 23

It is appropriate to have 4 intervals each with a range of 6.

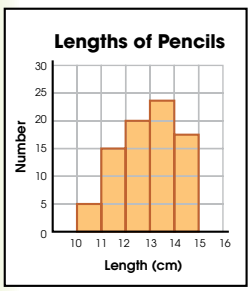
Intervals	Frequency
2 – 7.9	2
8 – 13.9	2
14 – 19.9	4
20 – 25.9	4

Representing Data in Histograms and Scatter Plots

You should be able to determine the most appropriate graph for a set of data. At this level, you will be introduced to two types of graphs: histograms and scatter plots.

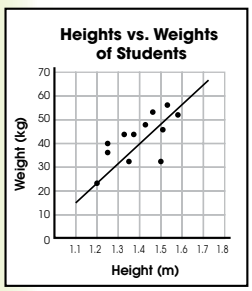
Histogram

- similar to bar graphs except for having no space between the bars
- suitable for data that is continuous



Scatter Plot

- similar to line graphs except the points are not connected
- suitable for comparing two sets of data



acute angle – an angle between 0° and 90°

acute triangle – a triangle that contains only acute angles

addition – a mathematical operation that represents combining two or more numbers; the opposite of subtraction

alternate angles – a pair of angles on opposite sides of a transversal in a "Z" shape; if the transverse lines are parallel, then the angles are equal

angle bisector – a line that cuts an angle into equal halves

area – the size of space contained by a shape

associative property – a property of addition and multiplication that allows numbers to be regrouped without changing the answer

axis – a line in a graph that denotes the quantities depicted; plural form: axes

bar graph – a type of graph in which the length of a bar represents the quantity in a category

base – (geometry) the side of a polygon or the face of a 3-D figure considered the "bottom" and is perpendicular to the height; (exponent) the number which is multiplied by itself

BEDMAS – a mnemonic device to help remember the order of operations; it stands for Brackets, Exponents, Division, Multiplication, Addition, and Subtraction

bias – a representation or interpretation of data that leads to misleading conclusions

bisector – a line that cuts something into two equal halves

capacity – a measure of how much liquid a container can hold; measured in litres and its related units

cardinal directions – the four main points of a compass: north, east, south, and west

Cartesian coordinate plane – a system to determine the location through a horizontal x-axis and a vertical y-axis

census – a collection of data from an entire population

centre – the point that is the same distance from every point on a circle

circle graph – a type of graph in which the size of a slice represents the quantity in a category

circumference – the perimeter of a circle

clockwise – the direction of rotation that follows the hands of a clock

coefficient – a numeric factor of a variable

commutative property – a property of addition and multiplication that allows numbers to be reordered without changing the answer

complementary angles – two angles that have a sum of 90°

complementary events – two events that have no outcome(s) in common and together account for all possible outcomes

composite number – a number that has more than two factors; it has factors other than 1 and itself

congruent shapes – two or more shapes that are identical; they are the same size and shape but can be of differing orientation

consecutive interior angles – a pair of angles on the same side of a transversal in a "C" shape; if the transverse lines are parallel, then the angles are supplementary

continuous data – a type of data that can include any numerical values, including decimals and fractions