

Arithmetic Skills Checklist

This checklist is to help you know when you are ready to move on from arithmetic to algebra.

Prerequisites for Algebra:

1. Mastery of basic arithmetic skills and their application to verbal problems.
2. Enough mental maturity to be able to handle abstract reasoning. (In algebra you will not just be “carrying out” arithmetic operations, you will be reasoning about the operations themselves, recognizing relationships in real-world situations, and applying rules to transform and “solve” equations.

To use this checklist:

- Pick a topic to master.
- Read/ask/practice (as needed) to understand and be able to perform each skill.
- When you have mastered it, demonstrate the skill to a knowledgeable adult and have them check it off and initial it.
- When you have completed a skill sheet, go back over the topics for an oral exam / review. You need to demonstrate mastery.

Format:

(initials) Description of skill to be mastered

To master these topics, look at the check list for guidance, then go to any of the many resources available in textbooks, libraries, or on the internet, or ask anyone who understands the topic and can explain it to you.

Learning your basic arithmetic operations is not an impossible task. It is spread over several years during elementary school, but if you learned no mathematics beyond counting in elementary school, you could easily learn all of it in a single year as a 7th or 8th grade student. You have the advantage of a more mature brain, now, so concepts that might have been difficult for you earlier in life can be mastered more easily now. The main difficulty is usually the fear and self-doubt that has built up over the years, especially if you have experienced repeated failure trying to learn it before.

Some of the topics in this checklist are taught / reviewed in [The Grandpa Project](#), sometimes using non-standard techniques you might find useful or interesting even if you know the basic skill already.

Whole Numbers

Whole Number Skills

	Count through any range of numbers (e.g. from 990 past 1000)
	Name any whole number (in words) up to a 15 digit number
	Write any named number in digit form (through trillions)
	Multiply any whole number by 10, 100, 1000, etc.
	How many thousands in a million; millions in a billion; etc.
	Know how to write any dollar amount in words (for writing a check)
	Identify the place value of any digit (in a number up to trillions)
	Place the commas correctly in large numbers
	Recognize key words in word problems that indicate addition
	Recognize key words in word problems that indicate subtraction
	Recognize key words in word problems that indicate multiplication
	Recognize key words in word problems that indicate division
	Show the meaning of addition and subtraction using piles of objects
	Show the meaning of addition and subtraction using lengths end-to-end
	Show the meaning of addition and subtraction using steps forward and backward
	Show the meaning of addition and subtraction when pouring water
	Show the meaning of multiplication and division with piles of objects
	Show the meaning of multiplication and division with lengths end-to-end
	Show the meaning of multiplication and division with rows of objects
	Show the meaning of multiplication and division with areas of rectangles
	Know the addition combinations from $0 + 0$ to $9 + 9$
	Know the multiplication combinations from 0×0 to 12×12
	Demonstrate mastery of the multiplication combinations using the Learn 'em Forwards and Backwards , program found on the Math Without Borders web site.
	Know the squares of all the whole numbers through 16
	Add any two whole numbers (with carrying)
	Add a column of 5 or more multi-digit whole numbers
	Subtract any whole number from any larger whole number, with borrow or carry.
	Learn to Subtract without Borrowing .
	Be able to multiply any 4-digit number by any 3-digit number
	Be able to divide any 4-digit number by any 2-digit number (if it comes out even)
	Be able to divide any 4-digit number by any 2-digit number (with remainder)
	Round off any whole number to the number of digits specified
	Round off any whole number to the place value specified
	Know conversions within the English system (in, ft, mi; tsp, tbs,qt, gal; oz, lb)
	Know conversions within the Metric system (mm, cm, m, km; ml, l; gr, kg)
	Know the relationships among units of time; days in year; days in each mo; leap yr
	Know when to count/measure starting with 0 or starting with 1

Fractions

Fraction Skills

	Identify simple fractions ($1/2$, $1/4$, $1/3$, $1/8$) on a pie chart
	Identify simple fractions ($1/2$, $1/4$, $1/3$, $1/8$) on a bar graph
	Identify primary fraction-of-an-inch marks on ruler ($1/2$, $1/4$, $1/8$, $1/16$, $1/32$, etc.)
	Identify simple fractions of common cooking measures (frac. of teaspoon, cup, etc.)
	Arrange simple fractions ($1/2$, $1/3$, $1/4$, $1/5$, etc.) in order of increasing size
	Describe the relation between fractions with same denominator: $1/8$, $3/8$, $5/8$, etc
	Identify all fraction-of-an-inch marks on a ruler ($1/2$, $1/4$, $3/4$, $1/8$, $3/8$, $5/8$, $7/8$, etc.)
	Identify the numerator and denominator of a fraction
	Explain the meaning of the denominator
	Explain the meaning of the numerator
	Explain the meaning of writing a whole number (e.g. 5) as a fraction (e.g. $5/1$)
	Explain the meaning of a fraction when numerator and denominator are equal ($5/5$)
	Explain the meaning of a ratio
	Express ratios in different forms (e.g. 2 to 3, 2:3, $2/3$)
	Solve simple proportion problems: $2/5 = x/15$ (2 is to 5 as <u>what</u> is to 15?)
	Be able to express the remainder of a division problem as fraction.
	Define a "rational" number
	Show how to multiply any two fractions
	Show how to change division by a fraction into multiplication by a fraction
	Find equivalent fractions by multiplying top and bottom by the same number
	Reduce fractions by dividing out common factors from top and bottom
	Show how to convert a mixed number (e.g. $2\frac{1}{4}$) to a pure fraction ($9/4$)
	Show how to convert an "improper fraction" (e.g. $9/4$) to a mixed number
	Show how to multiply and divide mixed numbers by converting them to fractions
	Show how to add and subtract fractions with equal denominators
	Show how to add and subtract mixed numbers with equal denominator fractions
	Show how to factor a number into its prime factors (e.g. $12 = 2 \times 2 \times 3$)
	Find the greatest common factor between two numbers
	Use the greatest common factor to find the least common multiple of two numbers
	Find the least common denominator of two fractions
	Convert two fractions into equivalent fractions with equal denominators
	Show how to add any two fractions using least common denominators
	Subtract any smaller fraction from a larger one
	Add any two mixed numbers by converting the fractions to the same denominator
	Subtract mixed numbers where the second fraction is smaller
	Subtract mixed numbers where the second fraction is larger using borrowing
	Compare the size of two fractions (using common denominators)

Decimals

Decimal Skills

	Show where the "invisible decimal" is in a whole number
	Name the place values to the right of the decimal point
	"Read" any number that includes several digits to the right of the decimal
	Write any number with decimal fractions based on hearing the number
	Know the decimal equivalents of $\frac{1}{2}$, $\frac{1}{3}$, $\frac{2}{3}$, $\frac{1}{4}$, $\frac{3}{4}$, $\frac{1}{5}$... $\frac{4}{5}$, $\frac{1}{8}$... $\frac{7}{8}$
	Explain the meaning of the decimal places in money
	Show how to give the proper coins to equal any given decimal dollar amount
	Show how to line up numbers with decimal points for addition or subtraction
	Explain how to deal with "overhanging" digits on the left or the right
	Multiply any decimal number by 10, 100, or 1000 in your head
	Divide any decimal number by 10, 100, or 1000 in your head
	Explain why the rule for multiplying whole numbers by 10 no longer works
	Show how to place the decimal point in the answer of any multiplication problem
	Show how to place the decimal point in the answer of any division problem
	Show how to express the remainder of a division problem as a decimal fraction
	Show how to convert any fraction (written as a ratio) to a decimal fraction
	Show how to represent an infinitely repeating decimal
	Show how to convert any terminating decimal as a fraction
	Show how to convert any infinitely repeating decimal as a fraction
	Demonstrate how to enter decimal numbers on a calculator and do computations
	Describe when to round off results of calculator computations
	Compare the relative sizes of fractions and decimals by converting to decimals

Percents

Percent Skills

<input type="checkbox"/>	_____	What is the meaning of “per”?
<input type="checkbox"/>	_____	What is the meaning of “cent”? (What are some words base on the root, “cent”?)
<input type="checkbox"/>	_____	Describe the meaning of percent
<input type="checkbox"/>	_____	Convert decimal numbers expressed in hundredths as percents
<input type="checkbox"/>	_____	Convert percents to decimals
<input type="checkbox"/>	_____	Convert a decimal number with more than two decimal places to percent
<input type="checkbox"/>	_____	Do percent computations by doing the equivalent decimal computations
<input type="checkbox"/>	_____	Explain what is meant by “percent more than”
<input type="checkbox"/>	_____	Use “percent more than” to compute taxes and tips
<input type="checkbox"/>	_____	Explain what is meant by “percent less than”
<input type="checkbox"/>	_____	Use “percent less than” to compute discounts
<input type="checkbox"/>	_____	Explain what computation is appropriate for figuring “percent of”
<input type="checkbox"/>	_____	Given any fraction (or any ratio) express it as an equivalent percent

Scientific Notation

Scientific Notation Skills

	Explain the difficulty of multiplying numbers with 15 or more digits
	Explain the difficulty of multiplying numbers with 15 or more digits on a calculator
	Write any large number (e.g. 12,500,000,000,000,000) in scientific notation
	Write any tiny number (e.g. 0.000000000000000125) in scientific notation
	Convert any number in scientific notation to standard notation
	Multiply any two numbers expressed in scientific notation
	Divide any two numbers expressed in scientific notation
	Explain how to adjust the exponent to add or subtract numbers in sci. notation
	Add or subtract any numbers in scientific notation
	Show how to enter numbers in scientific notation into a scientific calculator
	Correctly interpret answers given in scientific notation from a calculator result
	Know the powers of 10 that correspond to thousands, millions, billions, and trillions
	Know the prefixes that indicate thousands, millions, billions, and trillions
	Interpret the prefixes deca, hecto, kilo, mega, giga, and terra as powers of 10
	Interpret the prefixes deci, centi, milli, micro, nano, and pico as powers of 10
	Figure in your head such questions as "how many kilowatts in a megawatt?"
	Figure in your head such questions as "how many micrograms in a milligram?"
	Figure in your head such questions as "how many millivolts in a kilovolt?"

Measurement and Geometry

Measurement and Basic Geometry Skills

	Place a ruler correctly to measure the length of an object
	Read a length from a ruler accurate to the nearest 8 th of an inch
	Read a length from a ruler accurate to the nearest 16 th of an inch
	Read a metric ruler or meter stick accurate to the nearest mm
	Given a length in inches, ft, yd, or mi, express the length in terms of the other units
	Given a length in mm, cm, m, or km, express the length in terms of the other units
	Measure area in square units, where the units are inches, feet, yd, or miles
	Measure area in square units, where the units are mm, cm, m km
	Measure volumes with English “measures of capacity”: tsp, tbs, oz, cup, pt, qt, gal
	Measure volumes with metric “measures of capacity”: liters, ml
	Measure volumes in cubic units, where the units are inches, feet, yd, mi
	Measure volumes in cubic units, where the units are mm, cm, m, km
	Compute the areas of rectangular regions, such as floors, walls, etc.
	Compute the volumes of 3-D rectangular regions such as a classroom
	Measure the area of an irregular region using a grid
	Learn and apply area formulas for parallelograms, triangles, and trapezoids
	Give the <i>definition</i> of π (not the decimal or fractional approximation of π)
	Watch at least the first video of The Pi Series , on understanding π .
	Watch all three videos of The Pi Series to understand how π can be calculated.
	Give a decimal approximation of π to the nearest 100 th
	Give a fractional approximation of π and estimate its accuracy.
	Know how to compute with π on a calculator that has a π key
	Given the radius, diameter, or circumference of a circle, compute the other two
	Know and apply the formula for the area of a circle
	Given either the radius or diameter of a circle, compute the area
	Know the definitions of a prism, pyramid, cylinder, cone, and sphere
	Know and apply the formula for the volume of any prism or cylinder
	Know and apply the formula for the volume of any pyramid or cone
	Know and apply the formula for the volume of a sphere
	Explain how doubling the dimensions of a figure affects lengths, areas, and volume
	Explain how tripling the dimensions of a figure affects lengths, areas, and volume
	What is the sum of the angles of any triangle?
	What is the sum of the angles of any quadrilateral? Pentagon? Hexagon? Etc.
	Explain the meaning of “square root.”
	Find the square roots of 1, 4, 9, 16, 25, 36, 49, 64, 81, and 100.
	Use a calculator to find the square root of 2, 3, 5, or any other positive number.
	Explain why you cannot find the square root of a negative number.
	Use the Pythagorean theorem (and a calculator) to find the diagonal of a rectangle