Overview

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 competed 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 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 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 $0 \times 0$ to $12 \times 12$
- 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 numerator
- Explain the meaning of the denominator
- 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 what is to 15?)
- Be able to express the remainder of a division problem as a 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. 2¼) 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 = 2x2x3)
- 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 1/2, 1/3, 2/3, 1/4, 3/4, 1/5...4/5, 1/8...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

- What is the meaning of “per”?
- What is the meaning of “cent”? (What are some words base on the root, “cent”?)
- Describe the meaning of percent
- Convert decimal numbers expressed in hundredths as percents
- Convert percents to decimals
- Convert a decimal number with more than two decimal places to percent
- Do percent computations by doing the equivalent decimal computations
- Explain what is meant by “percent more than”
- Use “percent more than” to compute taxes and tips
- Explain what is meant by “percent less than”
- Use “percent less than” to compute discounts
- Explain what computation is appropriate for figuring “percent of”
- Given any fraction (or any ratio) express it as an equivalent percent
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. 12,500,000,000,000,000,000) 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\textsuperscript{th} of an inch
- Read a length from a ruler accurate to the nearest 16\textsuperscript{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
- Given the definition of \( \pi \) (not the decimal or fractional approximation of \( \pi \))
- Watch at least the first video of The Pi Series, on understanding \( \pi \).
- Watch all three videos of The Pi Series to understand how \( \pi \) can be calculated.
- Give a decimal approximation of \( \pi \) to the nearest 100\textsuperscript{th}
- Give a fractional approximation of \( \pi \) and estimate its accuracy.
- Know how to compute with \( \pi \) on a calculator that has a \( \pi \) 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?
- Use the Pythagorean theorem (and a calculator) to find the diagonal of a rectangle