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 7^{th} or 8^{th} 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 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 x 0 to 12 x 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

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 what 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. 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)

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

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 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 *definition* 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.
☐	_____	Use the Pythagorean theorem (and a calculator) to find the diagonal of a rectangle