ACT Connections

2017 Kansas Mathematics Standards and ACT Mathematics Subtest

February 5, 2019

Introduction

To reach our goal, it is essential that administrators, educators, parents, and students know that all grade levels play an important part in ensuring postsecondary success.

This document provides a snapshot of the academic skills students need in order to meet or exceed expectations for college and career readiness as assessed by the ACT. The document also highlights important connections between ACT College and Career Readiness Standards and the 2017 Kansas Mathematics Standards.

Notes

- The KAP assessment measures student progress annually, while the ACT is a summative assessment used by postsecondary institutions and employers to measure college and career readiness.
- The ACT consists of four multiple-choice subtests (English, mathematics, reading, and science) and an optional writing test.
- The development of the academic skills necessary to be successful on the ACT extends across all grade levels.
- This document is not focused on test preparation; instead, it highlights the progression of learning across grade levels and the connections between Kansas expectations for what students should know in mathematics each year and ACT expectations for what students should know by the end of high school.
- This document highlights some of the connections between the 2017 Kansas Mathematics Standards and the ACT assessment, but it is not an exhaustive document.

Suggestions for Use

The intent of this guide is to provide districts, schools, and teachers with a starting point for aligning instruction across content areas and grade levels to support student success on both Kansas Assessment Program (KAP) and the ACT. While this document focuses on standards in mathematics, teachers of all content areas play an essential role in preparing students for postsecondary success.

By providing this basic overview of the connections between our 2017 Kansas Mathematics Standards and ACT College and Career Readiness Standards, we believe that Kansas educators will be better equipped to align their curriculum planning, pacing, and daily instruction to ensure student success.

In addition to utilizing the overview, we recommend that districts and schools take the following next steps:

- **Make the connections real.** Instructional supervisors and content experts can utilize the following worksheets to chart when and where students are exposed to ACT standards within their current curriculum.
    - Mathematics Curriculum Review Worksheet

- **Ensure all educators—from elementary to high school—understand when and where the standards they teach connect to ACT standards.**
    - Once teachers understand how their standards connect to ACT College and Career Readiness Standards, it is important to understand how students' knowledge and skills are developed over time.
    - If teachers throughout K–12 are making explicit connections between the standards they teach and the ACT, they can make students and parents aware of their progress toward college and career readiness well before they take the official ACT exam.

- **Provide targeted support to students based on their current progress.**
    - Ideas for Progress in College and Career Readiness: On their website, ACT, Inc. provides lists of recommended instructional activities organized according to skills tested in each subject area and grouped by score ranges *(e.g., 1–12, 13–15, 16–19, etc.)*.
    - By matching required skills to scores in specific ranges on the ACT, teachers can understand how their content and grade-level standards impact students' ability to progress toward college and career readiness.

Frequently Asked Questions

KAP & ACT Alignment

1. **What is the purpose or goal of the ACT?**
The ACT is a nationally recognized benchmark assessment for college and career readiness that provides a snapshot of a student's K-12 academic career. The ACT assesses students' cumulative knowledge from grades K-12, while end-of-year tests, like KAP, assess content in specific grades and subjects more deeply. By taking the ACT, students gain valuable information on their readiness for postsecondary education and the workforce. A student's ACT results can be used for the following:
    - Admission to postsecondary education
    - Opportunities for scholarships *(e.g., HOPE scholarship, ASPIRE award, etc.)*
    - Placement into postsecondary coursework (including remedial, non-credit bearing courses)
    - Indicator of postsecondary readiness.

2. **What is the purpose or goal of KAP?**
KAP mathematics assessment assesses and provides information on a student's mastery of the 2017 Kansas Mathematics Standards at each grade level. The test deeply evaluates a student's content knowledge and skills in mathematics because it is specific to grade level. This assessment is designed to provide educators, parents, and students with a clear picture of our students' progress toward postsecondary success by measuring students' critical thinking and problem-solving abilities, not just basic memorization skills.

3. **Why does improving ACT scores matter?**
The desire to improve ACT average is rooted in improving postsecondary and career readiness for all Kansas students. This goal reflects the reality that Kansas students will enter a workforce that

requires some type of postsecondary training. With a composite score of 21 or higher, students are predicted to be more successful in both college and career.

4. **How are the KAP and ACT designed differently?**
KAP is comprised of English language arts, math, and science. These tests are taken in three to four subparts over multiple days near the end of the course. Questions are designed in multiple formats *(e.g., multiple choice, multiple select, evidence-based selected response, written response, technology-enhanced items, etc.)*, allowing students to demonstrate their depth of knowledge and conceptual understanding of grade-level.

The ACT is a survey assessment that consists of four multiple-choice tests and one optional open-ended writing test. The four subtests include English, reading, mathematics, and science. The ACT allows students to demonstrate their breadth of knowledge and provides a culminating view of a student's entire academic career. The skills and knowledge assessed on the ACT are introduced as early as kindergarten.

The table on the next pages provides a side-by-side comparison for mathematics.

Subject	ACT	KAP
Math	ACT measures how quickly and accurately a student can recall a wide variety of surface-level math skills and procedures that have been taught over a student's entire academic career. Questions are multiple choice and designed to assess specific mathematical skills. This is a 60-question, 60-minute test designed to assess math skills students have typically acquired in courses taken up through grade 12. For example, students will be assessed on fourth grade skills, seventh grade skills, and high school skills all intertwined within the same assessment. Students may use a calculator on the entire math portion of the ACT.	KAP is designed to measure how deeply students have mastered the math content taught in a single academic school year. It is a measure of mastery of a small portion of the math continuum a student learns during his/her scholastic career. Questions are designed in multiple formats to allow demonstration of conceptual understanding and to provide an opportunity for students to show their deep understanding of grade- level mathematical concepts. Additionally, students are expected to demonstrate that they have a firm grasp of the procedural and computational fluency expectations embedded within their grade-level 2017 Kansas Mathematics Standards. There are calculator-permitted sections and calculator-prohibited sections on KAP.

5. **How are the ACT and KAP aligned?**
Each test assesses a unique set of standards. While these standards overlap in places, the ACT assesses skills and knowledge from a student's full educational career, while KAP assesses a singular grade or course in math, English language arts, and science.

6. **Are the state standards aligned to ACT expectations?**
   The ACT standards are encompassed within the 2017 Kansas Mathematics Standards, ensuring that students who show strong growth and achievement on KAP will also be well prepared to meet the college- and career-readiness benchmarks on the ACT.

   Mastery of the 2017 Kansas Mathematics Standards prepares a student to be successful on the ACT assessment. Of the approximate 180 ACT math standards, all are addressed in the 2017 Kansas Mathematics Standards. The expectation for the ACT math assessment is that students should be able to quickly and accurately answer a wide variety of surface-level math questions, many of which are grounded in the computational and procedural fluency expectations embedded in the Kansas math standards. By stressing conceptual understanding at all levels, the Kansas math standards are designed to prepare students not only to master this wide array of mathematical skills but also to retain conceptual knowledge from year to year.

7. **Can we use KAP to compute ACT score projections?**
   Yes, our KIDS system uses a student's historical KAP performance to project his or her ACT composite scale score. Similarly, the KIDS model will incorporate student performance on KAP to calculate ACT projections.

8. **Why do we need both the ACT and KAP?**
   KAP assesses a student's deep understanding of the 2017 Kansas Mathematics Standards, whereas the ACT holistically measures a student's college and career readiness based on a host of interrelated and/or comprehensive standards. KAP is necessary to measure mastery of more specific skills related to a specific grade level and measure progress within a subject, guide instruction, provide information for course/grade placement, and provide appropriate remediation/enrichment opportunities for students. In other words, KAP measures depth of knowledge, while the ACT measures breadth of knowledge.

9. **How should I be preparing my students for both the ACT and KAP in the limited time I have?**
   While the types of questions on the ACT differ from the types of questions on KAP, the content is very similar. The best way teachers can prepare students for both KAP and the ACT is by implementing high quality instruction every day. Strong, student-centered instruction that is aligned to the 2017 Kansas Mathematics Standards is strong preparation for both KAP and the ACT. While students will benefit from regular practice and familiarity with the format of the ACT exam, the skills that they need to do well (strong reading fluency, comprehension, and stamina; strong critical thinking and analytical skills in math, including algebra and geometry) are encompassed in both assessments. Though the content is not fundamentally different, the tests are designed differently; KAP tests depth, while the ACT tests breadth.

   English and math ACT questions are based on skills and standards taught from elementary school through high school. This means that students who have a strong foundation in math and reading and who consistently perform well on KAP will use the same skills to perform well on the ACT. Additionally, all academic areas have a crucial part to play in preparing students for ACT success. Science and social studies teachers at all grade levels should be preparing students to read text in their content areas.

Math teachers at all levels should be aware of ACT benchmarks that are addressed within their grade level, some as early as the second grade. The key to preparing students for both assessments is an initial understanding of the differences in both format and purpose of these two exams, and strategically integrating the differences, while teaching the 2017 Kansas Mathematics Standards.

ACT Mathematics Test

Connections with 2017 Kansas Mathematics Standards

Questions & Answers

1. **What determines student success on the ACT mathematics subtest?**
   The mathematics skills assessed on the ACT extend across all grade levels. The ACT College and Career Readiness Standards for mathematics are a combination of skills taught beginning as early as second grade and extending throughout a student's fourth year high school mathematics course. The student needs instruction focused on developing a content-rich, conceptual understanding of mathematics at all grade levels in order to attain a score of 21 or higher. Additionally, students need to have developed a strong foundation in procedural and computational fluency. To be successful on the ACT mathematics subtest, students need to develop an understanding of the following:
   - *Which* math ideas are most important and why they are important
   - *Which* ideas are useful in a specific context for problem solving
   - *Why and how* certain key ideas aid in problem solving, which reminds us of the systematic progression of math (and the need to work on a high logical plane in problem-solving situations)
   - *How and why* an idea or procedure is mathematically defensible and when it is most efficient to use a procedure
   - *How* to flexibly adapt previous experience to new problem-solving situations

2. **What is the structure of the ACT mathematics test?**
   The ACT mathematics test is a 60-minute test with 60 questions that are designed to assess the mathematical skills students have acquired across the entirety of their mathematical academic career and the efficiency in which they are able to access and apply those skills. The test presents multiple- choice questions that require a student to use reasoning skills grounded in both procedural and computational fluency to solve practical problems in mathematics. In preparation for the ACT mathematics test, it is essential to have survey-level knowledge of basic formulas and computational skills, but recall of complex formulas and extensive computation is not required.

3. **When should we begin preparing students for the ACT mathematics subtest?**
   The ACT mathematics questions are based on skills and standards taught from elementary school through high school. This means that students who have a strong foundation in

mathematics and who consistently perform well in each grade level will use the same skills to perform well on the ACT. Therefore, all academic grades have a crucial part to play in preparing students for ACT mathematics success.

Please note: This document is intended to highlight connections between 2017 Kansas Mathematics Standards and the ACT mathematics test, but it is not an exhaustive document that details every connection.

While the 2017 Kansas Mathematics Standards are organized by conceptual category, domains, and clusters, the ACT College and Career Readiness Standards are organized by reporting category and score range.

ACT Score Range	ACT Standard Coding
13-15	200
16-19	300
20-23*	400
24-27	500
28-32	600
33-36	700

**The benchmark score for the ACT math subtest is 22. Many of the skills a student needs to master this benchmark is embedded in* the 2017 Kansas Mathematics Standards in *grades 6-8. In the middle grades, students develop an understanding of quantities, operations with rational numbers, and basic algebraic thinking. These skills are anchored in concepts introduced in earlier grades (such as fractions). Reinforcing these foundational connections as students continue into specific conceptual courses in high school (such as algebra or geometry) is necessary for students to be successful on the foundational skills that define the readiness benchmark.*

Big Picture of 2017 Kansas Mathematics Standards Concepts, K–12

Mathematics is broken into domains, which are the buckets of main concepts that students learn over the course of time. As previously mentioned, success on the ACT is dependent upon the **entirety of a student's mathematics career from elementary school through high school.** The following chart shows how the domains within the current 2017 Kansas Mathematics Standards build on one another. In the chart below, you will see which math domains students are learning holistically throughout a given year and how the math domains build on one another across a student's academic career.

2017 Kansas Mathematics Standards Domain Learning Progressions

<table>
<tr><th>K</th><th>1</th><th>2</th><th>3</th><th>4</th><th>5</th><th>6</th><th>7</th><th>8</th><th>HS</th></tr>
<tr><td>Counting and Cardinality</td><td colspan="9"></td></tr>
<tr><td colspan="6">Number and Operations in Base Ten</td><td colspan="2">Ratios and Proportional Relationships</td><td></td><td rowspan="2">Number & Quantity</td></tr>
<tr><td colspan="3"></td><td colspan="3">Number and Operations - Fractions</td><td colspan="3">The Number System</td></tr>
<tr><td colspan="6" rowspan="2">Operations and Algebraic Thinking</td><td colspan="3">Expressions and Equations</td><td>Algebra</td></tr>
<tr><td colspan="2"></td><td>Functions</td><td>Functions</td></tr>
<tr><td colspan="9">Geometry</td><td>Geometry</td></tr>
<tr><td colspan="6">Measurement and Data</td><td colspan="3">Statistics and Probability</td><td>Statistics & Probability</td></tr>
</table>

The domains of the ACT College and Career Readiness Standards for math are similar to the domains of the 2017 Kansas Mathematics Standards: geometry, statistics and probability, number and quantity, algebra, and functions. Standards unique to the ACT are assigned to each category and can be found here: [ACT Mathematics College and Career Standards].

Side-by-Side Example: Number and Quantity Strand
Connectivity between the ACT and 2017 Kansas Mathematics Standards

Multiple 2017 Kansas Mathematics Standards are embedded within a single ACT College and Career Readiness Standard for mathematics. The following chart highlights a small, representative sample of connections between selected ACT standards and the 2017 Kansas Mathematics Standards in the Number and Quantity domain. **This is for illustrative purposes only, as students should be consistently exposed to all 2017 Kansas Mathematics Standards to be successful on the ACT mathematics subtest.**

This example illustrates how the ACT mathematics subtest assesses the entirety of a student's academic career in mathematics. Even though students take the ACT in high school, if building blocks are left out—even in the early grades—students are less prepared to be successful on this important measure of college and career readiness.

ACT Readiness Standards	2017 Kansas Mathematics Standards
Number and Quantity (N) Questions in this category test students' ability to understand and reason with numerical quantities in many forms in the real and complex number systems.	
N 201. Perform one-operation computation with whole numbers and decimals.	**2.NBT.5** Fluently (efficiently, accurately, and flexibly) add and subtract within 100 using strategies based on place value, properties of operations, and/or the relationship between addition and subtraction *(e.g. composing/decomposing by like base-10 units, using friendly or benchmark numbers, using related equations, compensation, number line, etc.)*. **3.OA.7** Fluently (efficiently, accurately, and flexibly) multiply and divide with single digit multiplications and related divisions using strategies *(e.g. relationship between multiplication and division, doubles, double and double again, half and then double, etc.)* or properties of operations. **3.NBT.2** Fluently (efficiently, accurately, & flexibly) add and subtract within 1000 using strategies *(e.g. composing/decomposing by like base-10 units, using friendly or benchmark numbers, using related equations, compensation, number line, etc.)* and algorithms (including, but not limited to: traditional, partial-sums, etc.) based on place value, properties of operations, and/or the relationship between addition and subtraction. **4.NBT.4** Fluently (efficiently, accurately, and flexibly) add and subtract multi-digit whole numbers using an efficient algorithm (including, but not limited to: traditional, partial-sums, etc.), based on place value understanding and the properties of operations. **4.OA.3** Solve multi-step word problem posed with whole numbers and having whole number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using situation equations and/or solution equations with a letter or symbol standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. **5.NBT.5** Fluently (efficiently, accurately, and flexibly) multiply multi-digit whole numbers using an efficient algorithm *(ex., traditional, partial products, etc.)* based on place value understanding and the properties of operations. **5.NBT.7** Add, subtract, multiply, and divide decimals to hundredths, using concrete models or drawings and strategies based on place value, properties of operations, and/or the relationship between addition and subtraction; relate the strategy to a written method and explain the reasoning used. **6.NS.2** Fluently (efficiently, accurately, and flexibly) divide multi-digit numbers using an efficient algorithm. **6.NS.3** Fluently (efficiently, accurately, and flexibly) add, subtract, multiply, and divide multi-digit decimals using an efficient algorithm for each operation.

N 202. Recognize equivalent fractions and fractions in lowest terms	**3.NF.3** Explain equivalence of fractions, and compare fractions by reasoning about their size (it is a mathematical convention that when comparing fractions, the whole is the same size). **3.NF.3a** Understand two fractions as equivalent (equal) if they are the same size, or the same point on a number line. **3.NF.3b** Recognize and generate simple equivalent fractions, *(e.g.* $\frac{1}{2}=\frac{2}{4}, \frac{4}{6}=\frac{2}{3}$*.)* Explain why the fractions are equivalent, e.g. by using a visual fraction model. **3.NF.3c** Express whole numbers as fractions, and recognize fractions that are equivalent to whole numbers. *Examples: Express 3 in the form* $3=\frac{3}{1}$*; recognize that* $\frac{6}{1}=6$*; locate* $\frac{4}{(4)}$ *and 1 at the same point of a number line diagram.* **4.NF.1** Explain why a fraction a/b is equivalent to a fraction $\left(\frac{(n\cdot a)}{(n\cdot b)}\right)$ by using visual fraction models, with attention to how the number and size of the parts differ even though the two fractions themselves are the same size. Use this principle to recognize and generate equivalent fractions.
N 302. Identify a digit's place value	**2.NBT.1** Understand that the three digits of a three-digit number represent amounts of hundreds, tens, and ones; *(e.g. 706 equals 7 hundreds, 0 tens, and 6 ones.)* **4.NBT** Generalize place value understanding for multi-digit whole numbers. (Limited to whole numbers less than or equal to 1,000,000.) Use place value understanding and properties of operations to perform multi-digit arithmetic. **5.NBT** Understand the place value system. Perform operations with multi-digit whole numbers and with decimals to hundredths.
N 404. Understand absolute value in terms of distance	**6.NS.7c** Explain the absolute value of a rational number as its distance from 0 on the number line; interpret absolute value as magnitude for a positive or negative quantity in a real-world situation. *For example, for an account balance of –30 dollars, write |-30|=30 to describe the size of the debt in dollars.* **7.NS.1b** Show p+q as the number located a distance |q| from p, in the positive or negative direction depending on whether q is positive or negative.
N 603. Apply number properties involving positive/negative numbers	**6.NS.5** Understand positive and negative numbers to describe quantities having opposite directions or values *(e.g. temperature above/below zero, elevation above/below sea level, credits/debits, positive/negative electric charge)*; **6.NS.5a** Use positive and negative numbers to represent quantities in real-world contexts, **6.NS.5b** Explaining the meaning of 0 in each situation. **6.NS.6a** Recognize opposite signs of numbers as indicating locations on opposite sides of 0 on the number line; recognize that the opposite of the opposite of a number is the number itself, *(e.g. -(-3)=3,)* and that 0 is its own opposite. **7.NS.1** Represent addition and subtraction on a horizontal or vertical number line diagram. **7.NS.1a** Describe situations in which opposite quantities combine to make 0. Show that a number and its opposite have a sum of 0 (are additive inverses). *For example, show zero-pairs with two-color counters.* **7.NS.1b** Show p+q as the number located a distance |q| from p, in the positive or negative direction depending on whether q is positive or negative. **7.NS.1c** Model subtraction of rational numbers as adding the additive inverse, p-q=p+(-q). **7.NS.1d** Model subtraction as the distance between two rational numbers on the number line where the distance is the absolute value of their difference. **7.NS.1e** Apply properties of operations as strategies to add and subtract rational numbers. **7.NS.2a** Describe how multiplication is extended from positive rational numbers to all rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (-1)(-1)=1 and the rules for multiplying signed numbers. **7.NS.2b** Explain that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. Leading to situations such that if p and q are integers, then $-\left(\frac{p}{q}\right)=\frac{(-p)}{q}=\frac{p}{(-q)}$. **7.NS.2c** Apply properties of operations as strategies to multiply and divide rational numbers. **7.NS.3** Solve and interpret real-world and mathematical problems involving the four operations with rational numbers. (Computations with rational numbers extend the rules for manipulating fractions to complex fractions.)

N 606. Multiply two complex numbers	**N.CN.2 (11)** Use the relation $i^2 = -1$ and the commutative, associative, and distributive properties to add, subtract, and multiply complex numbers.

ACT Readiness Standards	2017 Kansas Mathematics Standards
Algebra (A) Questions in this category test students' ability to solve, graph, and model multiple types of expressions. Students will see but are not limited to linear, polynomial, radical, and exponential relationships.	
A 401. Evaluate algebraic expressions by substituting integers for unknown quantities	**3.OA.4** Determine the unknown whole number in a multiplication or division equation by using related equations. *For example, determine the unknown number that makes the equation true in each of the equations 8·?=48; 5=■÷3; 6 X 6=___.* **6.EE.4** Understand solving an equation or inequality as a process of answering a question: which values from a specified set, if any, make the equation or inequality true? Use substitution to determine whether a given number in a specified set makes an equation or inequality true.
A 406. Exhibit knowledge of slope	**6.RP.3a** Make tables of equivalent ratios relating quantities with whole-number measurements, find the missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?* **7.RP.2a** Determine whether two quantities are in a proportional relationship, *e.g. by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin.* **7.RP.2b** Analyze a table or graph and recognize that, in a proportional relationship, every pair of numbers has the same unit rate (referred to as the "m"). **8.EE.5** Use similar triangles to explain why the slope (m) is the same between any two distinct points on a non-vertical line in the coordinate plane and extend to include the use of the slope formula ($m=(y_1-y_1)/(x_2-x_1)$) when given two coordinate points (x_1, y_1) and (x_2, y_2)). Generate the equation y=mx for a line through the origin (proportional) and the equation y=mx+b for a line with slope m intercepting the vertical axis at y-intercept b (not proportional when b≠0). **F.IF.6 (9/10/11)** Calculate and interpret the average rate of change of a function (presented symbolically or as a table) over a specified interval. Estimate the rate of change from a graph. **(9/10)** limited to linear functions. ★
A 505. Add, subtract, and multiply polynomials.	**A.APR.1 (9/10)** Add, subtract, and multiply polynomials.
AF 603. Interpret and use information from graphs in the coordinate plane	**8.F.4** Construct a function to model a linear relationship between two quantities. Determine the rate of change and initial value of the function from a description of a relationship or from two (x, y) values, including reading these from a table or from a graph. Interpret the rate of change and initial value of a linear function in terms of the situation it models, and in terms of its graph or a table of values. **8.F.5** Describe qualitatively the functional relationship between two quantities by analyzing a graph *(e.g. where the function is increasing or decreasing, linear or nonlinear)*. Sketch a graph that exhibits the qualitative features of a function that has been described verbally. **A.REI.8 (all)** Understand that the graph of an equation in two variables is the set of all its solutions plotted in the coordinate plane, often forming a curve (which could be a line).

	F.IF.4 (all) For a function that models a relationship between two quantities, interpret key features of expressions, graphs and tables in terms of the quantities, and sketch graphs showing key features given a description of the relationship. Key features include: intercepts; intervals where the function is increasing, decreasing, positive, or negative; relative maximums and minimums; symmetries; end behavior; and periodicity. ★ **F.IF.7** Graph functions expressed symbolically and show key features of the graph, by hand in simple cases and using technology for more complicated cases. ★ **F.IF.7a (9/10)** Graph linear, quadratic and absolute value functions and show intercepts, maxima, minima and end behavior. ★ **F.IF.7b (11)** Graph square root, cube root, and exponential functions. ★ **F.IF.7c (11)** Graph logarithmic functions, emphasizing the inverse relationship with exponentials and showing intercepts and end behavior. ★ **F.IF.7d (+)** Graph piecewise-defined functions, including step functions. ★ **F.IF.7e (11)** Graph polynomial functions, identifying zeros when suitable factorizations are available, and showing end behavior. ★ **F.IF.7f (+)** Graph rational functions, identifying zeros and asymptotes when suitable factorizations are available, and showing end behavior. ★ **F.IF.7g (+)** Graph trigonometric functions, showing period, midline, and amplitude. ★

ACT Readiness Standards	2017 Kansas Mathematics Standards
Functions (F) Questions in this category test students' knowledge of function definition, notation, representation, and application. Students will see but are not limited to linear, radical, piecewise, polynomial, and logarithmic functions.	
F 201/301. Extend a given pattern by a few terms for patterns that have a constant increase or decrease/factor between terms	**2.NBT.2** Count within 1000; skip-count by 2s, 5s, 10s, and 100s; explain and generalize the patterns. **3.OA.9** Identify arithmetic patterns (including patterns in the addition table or multiplication table), and explain them using properties of operations (See Table 5). *For example, observe that 4 times a number is always even, and explain why 4 times a number can be decomposed into two equal addends.* **4.OA.5** Generate a number or shape pattern that follows a given rule. Identify apparent features of the pattern that were not explicit in the rule itself. *For example, given the rule "Add 3" and the starting number 1, generate terms in the resulting sequence and observe that the terms appear to alternate between odd and even numbers. Explain informally why the numbers will continue to alternate in this way.* **6.RP.3a** Make tables of equivalent ratios relating quantities with whole-number measurements, find the missing values in the tables, and plot the pairs of values on the coordinate plane. Use tables to compare ratios. Solve unit rate problems including those involving unit pricing and constant speed. *For example, if it took 7 hours to mow 4 lawns, then at that rate, how many lawns could be mowed in 35 hours? At what rate were lawns being mowed?*
AF 402. Perform straightforward word- to-symbol translations.	**3.OA.8** Solve two-step word problems using any of the four operations. Represent these problems using both situation equations and/or solution equations with a letter or symbol standing for the unknown quantity (refer to Table 1 and Table 2 and standard 3.OA.3). Assess the reasonableness of answers using mental computation and estimation strategies including rounding. This standard is limited to problems posed with whole numbers and having whole-number answers. **4.OA.3** Solve multi-step word problem posed with whole numbers and having whole number answers using the four operations, including problems in which remainders must be interpreted. Represent these problems using situation equations and/or solution equations with a letter or symbol standing for the unknown quantity. Assess the reasonableness of answers using mental computation and estimation strategies including rounding. **6.EE.2a** Write expressions that record operations with numbers and with letters standing for numbers. *For example, express the calculation "Subtract y from 5" as 5-y.* **6.EE.5** Use variables to represent numbers and write expressions when solving a real-world or mathematical problem; understand that a variable can represent an unknown number, or, depending on the purpose at hand, any number in a specified set. **7.EE.4** Use variables to represent quantities in a real-world or mathematical problem, and construct two-step equations and inequalities to solve

	problems by reasoning about the quantities. **7.EE.4a** Solve word problems leading to equations of the form px + q = r, and p(x + q) = r where p, q, and r are specific rational numbers. Solve equations of these forms fluently (efficiently, accurately, and flexibly). Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?* **7.EE.4b** Solve word problems leading to inequalities of the form px + q > r or px + q < r where p, q, and r are specific rational numbers and p > 0. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100.* Write an inequality for the number of sales you need to make, and describe the solutions.
F 502. Find the next term in a sequence described recursively	**F.IF.3 (9/10/11)** Recognize patterns in order to write functions whose domain is a subset of the integers. **(9/10)** Limited to linear and quadratic. *For example, find the function given {(-1,4),(0,7),(1,10),(2,13)}.* **F.BF.2 (+)** Write arithmetic and geometric sequences and series both recursively and with an explicit formula, use them to model situations, and translate between the two forms. ★ **F.BF.1b (11)** Determine an explicit expression, a recursive function, or steps for calculation from a context.
F 706. Use trigonometric concepts and basic identities to solve problem	**F.TF.7 (+)** Use inverse functions to solve trigonometric equations that arise in modeling contexts; evaluate the solutions using technology, and interpret them in terms of the context. ★ **F.TF.8 (+)** Prove the Pythagorean identity $sin^2(\theta) + cos^2(\theta) = 1$ and use it to find $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ given $\sin(\theta)$, $\cos(\theta)$, or $\tan(\theta)$ and the quadrant.

ACT Readiness Standards	2017 Kansas Mathematics Standards
Geometry (G) Questions in this category test students' knowledge of shapes and solids, such as congruence and similarity relationships or surface area and volume measurements, understanding composition of objects, solving for missing values, and using trigonometric ratios and equations.	
G 203. Perform common conversions of money and of length, weight, mass, and time within a measurement system (e.g., dollars to dimes, inched to feet, and hours to minutes)	**2.MD.7** Tell and write time from analog and digital clocks to the nearest five minutes. **2.MD.8** Solve word problems involving dollar bills, quarters, dimes, nickels, and pennies, using $ and ¢ symbols appropriately (Do not use decimal point, if showing 25 cents, use the word cents or ¢). *For example: If you have 2 dimes and 3 pennies, how many cents do you have?* **3.MD.1** Tell and write time to the nearest minute using a.m. and p.m. and measure time intervals in minutes. Solve word problems involving addition and subtraction of time intervals in minutes, *(e.g. by representing the problem on a number line diagram.)* **4.MD.1** Know relative sizes of measurement units within one system of units including km, m, cm; kg, g; lb, oz; l, ml; hr, min, sec. Within a single system of measurement, express measurements in a larger unit in terms of a smaller unit. Record measurement equivalents in a two-column table. *For example, know that 1 ft is 12 times as long as 1 in. Express the length of a 4 ft snake as 48 in. Generate a conversion table for feet and inches listing the number pairs (1, 12), (2, 24), (3, 36), …* **4.MD.2** Use the four operations to solve word problems (See Table 1 and Table 2) involving distances, intervals of time, liquid volumes, masses of objects, and money, including problems involving simple fractions or decimals, and problems that require expressing measurements given in a larger unit in terms of a smaller unit. Represent measurement quantities using diagrams such as number line diagrams that feature a measurement scale. **5.MD.1** Convert among different-sized standard measurement units within a given measurement system *(e.g. convert 5 cm to 0.05 m)*, and use these conversions in solving multi-step, real world problems.

G 301. Exhibit some knowledge of the angles associated with parallel lines	**4.G.1** Draw points, lines, line segments, rays, angles (right, acute, obtuse, straight, reflex), and perpendicular and parallel lines. Identify these in two-dimensional figures. **4.G.2** Classify two-dimensional figures based on the presence or absence of parallel or perpendicular lines, or the presence or absence of angles (right, acute, obtuse, straight, reflex). Recognize and categorize triangles based on angles (right, acute, obtuse, and equiangular) and/or sides (scalene, isosceles, and equilateral). **G.CO.10 (9/10)** Construct arguments about parallelograms using theorems. Theorems include: opposite sides are congruent, opposite angles are congruent, the diagonals of a parallelogram bisect each other, and conversely, rectangles are parallelograms with congruent diagonals. (Building upon prior knowledge in elementary and middle school.) **G.GPE.7 (9/10)** Prove the slope criteria for parallel and perpendicular lines and use them to solve geometric problems *(e.g. find the equation of a line parallel or perpendicular to a given line that passes through a given point)*.
G 501. Use several angle properties to find an unknown angle measure	**8.G.3** Recognize angle measure as additive. When an angle is decomposed into non-overlapping parts, the angle measure of the whole is the sum of the angle measures of the parts. Solve addition and subtraction problems to find unknown angles on a diagram in real world and mathematical problems, *e.g. by using an equation with a symbol for the unknown angle measure.* **8.G.4** Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and use them to solve simple equations for an unknown angle in a figure. **8.G.5** Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.* **G.CO.7 (9/10)** Construct arguments about lines and angles using theorems. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent; points on a perpendicular bisector of a line segment are exactly those equidistant from the segment's endpoints. (Building upon standard in 8th grade Geometry.) **G.CO.8 (9/10)** Construct arguments about the relationships within one triangle using theorems. Theorems include: measures of interior angles of a triangle sum to 180°; base angles of isosceles triangles are congruent; the segment joining midpoints of two sides of a triangle is parallel to the third side and half the length; the medians of a triangle meet at a point; angle sum and exterior angle of triangles.
G 506. Compute the area of triangles and rectangles when one or more additional simple steps are required	**3.MD.7** Measure areas by counting unit squares (square cm, square m, square in, square ft, and non-standard square units). **3.MD.8** Relate area to the operations of multiplication and addition **3.MD.8a** Find the area of a rectangle with whole-number side lengths by tiling it, and show that the area is the same as would be found by multiplying the side lengths. **3.MD.8b** Multiply side lengths to find areas of rectangles with whole-number side lengths in the context of solving real world and mathematical problems, and represent whole-number products as rectangular areas in mathematical reasoning. **3.MD.8c** Use tiling to show in a concrete case that the area of a rectangle with whole-number side lengths a and b + c is the sum of a·b and a·c. Use area models to represent the distributive property in mathematical reasoning (Supports 3.OA.5) **4.MD.3** Apply the area and perimeter formulas for rectangles in real world and mathematical problems explaining and justifying the appropriate unit of measure. *For example, find the width of a rectangular room given the area of the flooring and the length, by viewing the area formula as a multiplication equation with an unknown factor.* **6.G.1** Find the area of all triangles, special quadrilaterals (including parallelograms, kites and trapezoids), and polygons whose edges meet at right angles (rectilinear figure polygons) by composing into rectangles or decomposing into triangles and other shapes; apply these techniques in the context of solving real-world and mathematical problems.
G 604. Apply basic trigonometric	**8.G.8** Apply the Pythagorean Theorem to determine unknown side lengths in right triangles in real-world and mathematical problems in two and three dimensions. *For example: Finding the slant height of pyramids and cones.* **G.SRT.8 (9/10)** Explain and use the relationship between the sine and cosine of complementary angles.

ratios to solve right-triangle problems	**G.SRT.9 (9/10)** Use trigonometric ratios and the Pythagorean Theorem to solve right triangles in applied problems. ★

ACT Readiness Standards	2017 Kansas Mathematics Standards
	Statistics and Probability (S) Questions in this category test students' knowledge of center and spread of distribution, data collection methods, relationships in bivariate data, and probability calculations
S 201. Calculate the average of a list of positive whole numbers	**6.SP.2** Analyze a set of data collected to answer a statistical question with a distribution which can be described by its center (mean, median and/or mode), spread (range and/or interquartile range), and overall shape (cluster, peak, gap, symmetry, skew (data) and/or outlier). **6.SP.5c** Giving quantitative measures of center (mean, median and/or mode) and variability (range and/or interquartile range), as well as describing any overall pattern and any striking deviations from the overall pattern with reference to the context in which the data were gathered. **S.ID.1 (9/10)** Use statistics appropriate to the shape of the data distribution to compare center (median, mean) and spread (interquartile range, standard deviation) of two or more different data sets.
S 403. Determine the probability of a simple event	**7.SP.5** Express the probability of a chance event as a number between 0 and 1 that represents the likelihood of the event occurring. (Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around $\frac{1}{2}$ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.) **7.SP.6** Collect data from a chance process (probability experiment). Approximate the probability by observing its long-run relative frequency. Recognize that as the number of trials increase, the experimental probability approaches the theoretical probability. Conversely, predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.* **7.SP.8** Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation. **7.SP.8a** Know that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. **7.SP.8b** Represent sample spaces for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language *(e.g. "rolling double sixes")*, identify the outcomes in the sample space which compose the event. **7.SP.8c** Design and use a simulation to generate frequencies for compound events. *For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?*
S 502. Manipulate data from tables and charts	**4.MD.4** Make a data display (line plot, bar graph, pictograph) to show a set of measurements in fractions of a unit $\left(\frac{1}{2}, \frac{1}{4}, \frac{1}{8}\right)$. Solve problems involving addition and subtraction of fractions by using information presented in the data display. *For example, from a line plot find and interpret the difference in length between the longest and shortest specimens in an insect collection.* **8.SP.1** Construct and interpret scatter plots for bivariate measurement data to investigate patterns of association between two quantities. Describe patterns such as clustering, outliers, positive or negative association, linear association, and nonlinear association.
S 605. Recognize the concepts of conditional and joint probability expressed in	**S.ID.4 (9/10)** Summarize categorical data for two categories in two-way frequency tables. Interpret relative frequencies in the context of the data (including joint, marginal, and conditional relative frequencies). Recognize possible associations and trends in the data. **S.CP.4 (+)** Construct and interpret two-way frequency tables of data when two categories are associated with each object being classified. Use the two-way table as a sample space to decide if events are independent and to approximate conditional probabilities. *For example, collect data from a random sample of students in your school on their favorite subject among math, science, and English. Estimate the probability that a randomly selected student from your school will favor science given that the student is in tenth grade. Do the same for other subjects and compare the results.*

real-world contexts	**S.CP.5 (+)** Recognize and explain the concepts of conditional probability and independence in everyday language and everyday situations. *For example, compare the chance of having lung cancer if you are a smoker with the chance of being a smoker if you have lung cancer.* **S.CP.6 (+)** Find the conditional probability of A given B as the fraction of B's outcomes that also belong to A, and interpret the answer in terms of the model.

Side-by-Side Example: Strand Comparison Chart
Connectivity between the ACT Domains and 2017 Kansas Mathematics Standards Domains

Multiple standards from the 2017 Kansas Mathematics Standards are embedded within a single ACT College and Career Readiness Standard for mathematics. The following chart shows the connection and overlap between the domains of the 2017 Kansas Mathematics Standards and the domains of ACT standards. **The navy blue areas indicate where 2017 Kansas Mathematics Standards overlap with ACT standards within each domain.**

Side-by-Side Example: Domain Comparison Chart