Parent Guide to the Standards
11th Grade
Mathematics – Algebra II

This guide provides a summary of the mathematics skills that your child will learn by the end of eleventh grade in mathematics in the state of Kansas. This guide will also give some examples of the eleventh grade mathematics so you can assist your child. To view the standards in their entirety, please go to:

http://bit.ly/KS-Math-Standards

The Mathematics Standards are divided into two sections. The first section is the same for every grade level from Prekindergarten to 12th Grade and is described below. The Standards for Mathematical Practice address *how* mathematics is to be taught and *how* the students are to engage with the mathematics. The second section outlines the content at each grade level.

Standards for Mathematical Practice — 11

1. Make sense of problems and persevere in solving them.
2. Reason abstractly and quantitatively.
3. Construct viable arguments and critique the reasoning of others.
4. Model with mathematics.
5. Use appropriate tools strategically.
6. Attend to precision
7. Look for and make use of structure.
8. Look for and express regularity in repeated reasoning.

Your child will be taught skills that will encourage critical thinking and problem solving. Some examples include:

- Students in 11th grade mathematics extend their previous learning of functions to include logarithmic, square root, cube root, and exponential functions.
- Students relate arithmetic of rational numbers to rational expressions.
- Students justify their conclusions, communicate them to others, and respond to the arguments of others.
- Students solve real-world problems using algebraic skills and routinely reflect on whether the results make sense.
- Students make assumptions and approximations to simplify complicated problems, making revisions when necessary.
- Students identify appropriate types of functions to model a situation, adjusting the parameters to improve the model.
- Students make connections between zeros of polynomial functions and solutions of polynomial equations.

Content Standards for Mathematics — 11

The specific skills and content your child will be taught come from the content standards. The conceptual categories are listed below with some examples of the mathematics at the 11th grade level.

Number and Quantity:

- Rewrite expressions involving radicals and rational exponents using the properties of exponents.
- Perform arithmetic operations with complex numbers and solve quadratic equations that have complex solutions.
- Perform operations on matrices and use matrices in applications.

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Algebra:

- Complete the square to reveal maximum and minimum values in a quadratic expression and to transform quadratic equations.
- Factor higher degree polynomials, including the patterns for sum and difference of cubes.
- Solve radical and rational exponent equations and inequalities.
- Solve quadratic equations, including those with complex solutions.
- Represent and solve equations and inequalities graphically.

Functions:

- Graph square root, cube root, polynomial, exponential, and logarithmic functions.
- Use factoring and completing the square to show zeros, extreme values, and symmetry of the graphs of quadratic functions.
- Construct and compare linear, quadratic, and exponential models and solve problems.

Statistics and Probability:

- Compute (using technology) and interpret the correlation coefficient of a linear fit.
- Distinguish between correlation and causation.

Samples of Math Applications

11

11th grade students expand the concepts of exponents from previous learning to include rational exponents. In more advanced courses, rational exponents will be extended to irrational exponents by means of exponential and logarithmic functions.

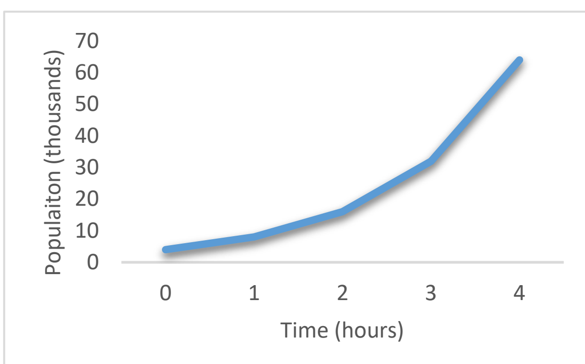
Example: A biology student is studying bacterial growth and is surprised to find that the population of the bacteria doubled every hour.

a) Complete the following table and plot the data.

Hours into study	0	1	2	3	4
Population (thousands)	4				

Solution:

Hours into study	0	1	2	3	4
Population (thousands)	4	8	16	32	64



b) Write an equation for P, the population of the bacteria (in thousands), as a function of t, time (in hours), and verify that it produces correct populations for $t = 1, 2, 3,$ and 4.

Solution: $P = 4(2)^t$

This equation can be found using repeated multiplication: $4(2)^1 = 8, 4(2)^2 = 16, 4(2)^3 = 32, 4(2)^4 = 64$, etc.

c) The student wants to complete the table shown, but she has only measured every hour. She notes that the population increased by the same factor each hour, and reasons that this factor should hold over each half-hour interval as well. Decide what constant factor she should multiply the population by each half hour in order to produce consistent results and use this multiplier to complete the table.

Hours into study	0	$\frac{1}{2}$	1	$\frac{3}{2}$	2	$\frac{5}{2}$	3
Population (thousands)	4						

Solution: Let x be the multiplier for the half-hour time interval. Moving forward a full hour in time has the effect of multiplying the population by x^2, and since the population is doubling each hour, $x^2 = 2$. Therefore, the student needs to multiply by $\sqrt{2}$ every half hour.

Hours into study	0	$\frac{1}{2}$	1	$\frac{3}{2}$	2	$\frac{5}{2}$	3
Population (thousands)	4	5.567	8	11.314	16	22.627	32

Careers That Use Math Concepts

"Employment of mathematical science occupations is projected to grow 27.9 percent from 2016 to 2026, much faster than the average for all occupations, resulting in about 50,400 new jobs."

Michael Rieley, "Big data adds up to opportunities in math careers," Beyond the Numbers: Employment & Unemployment, vol. 7, no. 8 (U.S. Bureau of Labor Statistics, June 2018), https://www.bls.gov/opub/btn/volume-7/big-data-adds-up.htm

Why Must I Learn Math?

Here's a Math Guide!
http://www.mathguide.com/issues/whymath.html#6

Projectile Motion

Example:
An object is launched at 24.5 feet per second (ft/s) from a 117.6-foot platform. The equation for the object's height h (in feet) at time t seconds after launch is $h(t) = -4.9t^2 + 24.9t + 117.6$. When does the object strike the ground?

Solution: The height of the object when it strikes the ground is 0 feet, therefore $h(t) = 0$.

$0 = -4.9t^2 + 24.5t + 117.6$

$0 = t^2 - 5t - 24$ → divide both sides by -4.9

$0 = (t-8)(t+3)$ → factor

$t - 8 = 0 \text{ or } t + 3 = 0$ → Zero Product Property

$t = 8 \text{ or } t = -3$

The solutions are $t = 8$ and $t = -3$, but $t = -3$ does not make sense in the context of this problem and is, therefore, an extraneous solution.

The object strikes the ground after 8 seconds.

Real-Life Application

Example: A construction company has 120 feet of fencing materials to build a rectangular fence around the back yard of a new house (the house will serve as one side of the yard). Find the dimensions that will maximize the area of the fenced-in region.

Solution: Perimeter of a fence: $P = l + 2w$

$120 = l + 2w$

$l = 120 - 2w$

Area of a rectangle: $A = lw$

$A = (120 - 2w)w$

$A = 120w - 2w^2$

$A = -2w^2 + 120w$

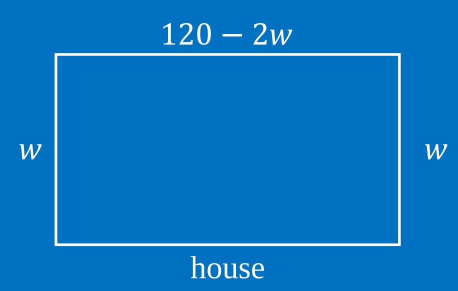
$A = -2(w^2 - 60w)$

$A = -2(w^2 - 60w + 900) + 1800$

$A = -2(w - 30)^2 + 1800$

$\text{Vertex} = (30, 1800)$

$w = 30, l = 60$



A width of 30 ft and length of 60 ft will yield a maximum area of 1800 ft^2 for the fenced-in yard.

Compound Interest

Example:
A couple wants to purchase a home. How much money would they need to deposit in a bank account that earns 4.8% annual interest, compounded monthly, so that they will have a down payment of $10,000 in 5 years (they will not be making additional contributions to the account over the 5-year period).

Solution: $\text{final amount} = (\text{initial amount}(1 + \text{monthly interest})^{\text{number of monthly compoundings}})$

OR

$$A = P\left(1 + \frac{r}{n}\right)^{nt}$$

$$10{,}000 = x\left(1 + \frac{0.048}{12}\right)^{12 \cdot 5}$$

$$10{,}000 = x(1 + .004)^{60}$$

$$\frac{10{,}000}{(1.004)^{60}} = x$$

$$x = \$7870.05$$

They will need to deposit $7,870.05 to have $10,000 in their bank account in 5 years.

Careers that Use Algebra

The Houston Chronicle
https://work.chron.com/list-careers-use-algebra-14592.html

Helpful Websites:

- ✓ Kansas Math Standards – http://bit.ly/KS-Math-Standards
- ✓ Illustrative Mathematics – https://www.illustrativemathematics.org/content-standards/tasks/
- ✓ Math Planet – https://www.mathplanet.com/education/algebra-2
- ✓ Khan Academy Algebra Help – https://www.khanacademy.org/math/algebra2
- ✓ Patrick Just Math Tutorials – http://patrickjmt.com/
- ✓ Desmos Online Graphing Calculator – https://www.desmos.com/calculator