Table of Contents

A	B	C	D	E	F	G	H	I	J	K	L	M
N	O	P	Q	R	S	T	U	V	W	X	Y	Z

ABSOLUTE VALUE

The Basics – The absolute value of a quantity is never _____.   Simplify: $|7-9|$

Equations – Solve for n: $|2n-6| = 20$

Graphing – *Graph:*

Inequalities – *Solve for x:* $|2x+7| < 10$

ARITHMETIC

Number Theory

Fractions and Decimals

Percents

Money

BINOMIAL THEOREM

The Basics – How many terms in the expansion of $(a + b)^{56}$? Expand $(a + b)^9$ using Pascal's Triangle.
Advanced – Expanding binomials using Combinations; The Binomial Theorem in sigma notation

CIRCLES

Arithmetic Level – Definition of π. Given radius or diameter, find the circumerence and the area.
Algebra Level – Given area, find radius. Given circumference, find area.
Center at the Origin – Find the center and radius of $x^2 + y^2 = 12$.
Center off the Origin – Find the center and radius of $x^2 + y^2 - 8x + 6y = 3$.
Advanced – Find the equation of the circle if the endpoints of a diameter are the points $(-5, -2)$ and $(3, 4)$.
Conic Sections – The official definition of the circle and the derivation of its formula.

COMBINATIONS

Combinations – How many ways can 5 numbers be chosen in a lottery containing the numbers from 1 to 100?

COMPLETING THE SQUARE

Preparing – Solve for x: $(x + 14)^2 = 100$ *See Solving Quadratics by Taking Square Roots*
Find the *magic number*: $n^2 + 15n$

CONIC SECTIONS

The Circle – Use the definition of the circle with center (h, k) and radius r to create the formula

$$(x - h)^2 + (y - k)^2 = r^2.$$

The Parabola – This chapter is based on the definition: *A parabola is the set of points in the plane which are equidistant from a given point and a given line;* $y = \dfrac{1}{4p} x^2$;

Find the vertex, focus, and directrix of the parabola $y = 2x^2 - 8x + 5$.

The Ellipse – Find the center, the domain, and the range of the ellipse, and then graph it:
$$25x^2 + 9y^2 - 50x - 108y + 124 = 0.$$

CONSTANTS

Finding the Numbers – Find two numbers with a product of 16 and a difference of 6.

If I quadruple the number I'm thinking of, and subtract 8, the result is 40.

DISTANCE

Distance on the Line and in the Plane

What is the formula for finding the distance between the points a and b on the number line?

Use a triangle and the Pythagorean Theorem to find the distance between two points in the plane.

Use the Distance Formula to find the distance between two points in the plane.

DISTRIBUTIVE PROPERTY

The Basics – For any numbers, a(b + c) = ab + ac.

Simplify each expression: A. $3(4x + 5y - 7)$ B. $7(A \cdot 4)$ C. $2(x - 3) + 7x$

Multiplying Binomials – Simplify each expression: A. $(2x + 5)(x - 3)$ B. $(7n + 1)(7n - 1)$

C. $(4w - 3)^2$ D. Prove that $(x + y)^2 \neq x^2 + y^2$

Solving Equations – Solve for w: $8(5w - 1) - 6(-w - 5) = 5(8 - 4w) + 6(9 + 8w)$

DOMAIN

Domain — Find the domain of each function: $y = 3x^2 + 7$; $y = \sqrt{2 - 6x}$; $y = 7$; $y = \dfrac{2x - 4}{x^2 + 5x + 6}$

e

The Number e – New limit notation; Banking; Graphing

EXPONENTS

Introduction
More
The Five Laws
Negative
Fractional

FACTORIALS

Factorials

FORMULAS

Using – kilometers and miles; kinetic energy; Fahrenheit/Celsius

Solving – Solve for x: $\dfrac{bx+c}{c} - L = M$

Creating – Write as a formula: *Density is the quotient of mass and volume.*

FUNCTIONS

Tables and Mappings
Formulas and Graphs
Notation and Composition
Piecewise
Rational

GEOMETRY

An Introduction –

Squares and Circles – If the perimeter of a square is 44, what is its area?
If the area of a circle is 169π, what is its circumference?

Triangles and Perimeter – The third side of a triangle is 3 less than the first side, while the first side is 12 less than 2 times the second side. If the perimeter is 58, what is the length of each side?

Triangles and Angles – The second angle of a triangle is 38° less than 4 times the first angle. The third angle is 13° more than the second angle. What is the measure of each angle?

GRAPHING

Absolute Values – Graph: $y = |x - 6|$

HYPERBOLAS

Center at the Origin

INEQUALITIES

Inequalities – Express as an inequality: Your height, h, can be no taller than 48 inches.

Solve for y: $\dfrac{9-y}{-2} \geq -2$

Express as a double inequality: The score, s, must be between 100 pts and 300 pts, excluding the 100 and the 300.

Graphing in the Plane

INTERVAL NOTATION

Interval Notation – Convert the inequality $x < 4$ to a graph and to interval notation.

LIKE TERMS

Combining – Simplify: $3x + 7y - 9 - 2y - 13x + 14$

Equations – Solve for u: $3u - 7 + 8u - 1 = 9 - 2u + 12 - 6u$

LINES

Graphing
Intercepts
Slope - Rise Over Run
Slope - $\Delta y / \Delta x$
Creating the Line Equation $y = mx + b$
Finding $y = mx + b$ – Finding the equation of a line, includes rational slopes and y-intercepts
Point / Slope – $y - y_1 = m(x - x_1)$
Parallel and Perpendicular Lines
Graphing Revisited
Special Lines – Graph $x = 7$. What is the slope of $y = -9$? What line is perpendicular to $y = \pi$?

LOGARITHMS

Calculating Logarithms – Translate $\log_6 36 = 2$ to exponent form. Calculate: $\log_2\left(\dfrac{1}{8}\right)$.

Find the **pH** of a substance whose hydrogen ion concentration is 3.8×10^{-9}.

Log Functions – Find the domain: $y = \log(x^2 - 5x + 6)$.
Graph and specify the domain, intercepts, and relevant limits: $g(x) = \ln(2x - 6)$.
The sound produced by a plane engine has an intensity of 7.1×10^3 W/m^2.

Find the *decibel value* of this sound.

LOGIC

Logic – Implications; Negation, Converse, and Contrapositive; AND & OR; Definitions, Axioms, and Teorems; Examples and Counterexamples

LONG DIVISION

Dividing Polynomials – Divide: $\dfrac{10x^2 + 5x + 2}{5x}$ Divide: $\dfrac{14x^2 + 3x - 7}{2x - 1}$

MIDPOINT

Midpoint

MIXTURE PROBLEMS

Producing Widgets – The unit cost of red widgets is $6 and the unit cost of white widgets is $8. If the goal is to make 25 widgets for a total of $170, how many widgets of each color should we make?

Coins – The unit cost of red widgets is $6 and the unit cost of white widgets is $8. If the goal is to make 25 widgets for a total of $170, how many widgets of each color should we make?

Nuts – Trader Joe's has 4 lbs of walnuts which are priced at $24/lb. How many pounds of almonds which are priced at $10/lb should be mixed with the walnuts to get a mixture that will sell for $18/lb?

Peanut Palace has 28 lbs of walnuts which are priced at $19/lb, and mixes them with 12 lbs of almonds which are priced at $29/lb. Find the *unit price* of the mixture.

Percent, Part I – A chemist mixes 8 mL of a 37% glycerin solution with some 57% glycerin solution. If the final mixture is 49% glycerin, how many mL of the 57% glycerin solution were used?

A 63% acid solution is created by mixing 3 liters of an 87% acid solution with 12 liters of another acid solution. Find the concentration of the other acid solution.

Percent, Part II – A detective wants to mix some pure poison with some 20% poison solution. How many pounds of each substance must she use to get a 25-pound mixture that is 52% poison?

MODELING

Temperature Formulas – Derive the Temperature Formulas.

Linear Using Given Information – It costs $7.50 for the first mile of a taxi ride, and $3.25 per mile for each additional mile. If m represents the total miles traveled, write a formula for the total cost, C.

Using the Equation of a Line – Finding a linear function given data.

Quadratic Optimization – Using the vertex: If Profit $= -5x^2 + 3x + 10$, find the maximum profit.

MOTION PROBLEMS

Introduction – Moe traveled at a rate of 120 km/hr for 12 hours. Find Moe's distance.

Opposite Directions – Two joggers leave the same place and jog in opposite directions. The speed of one of the joggers is 9 mph more than 5 times the other. In 7 hours they are 357 miles apart. Find the speed of each jogger.

Pursuit – A rowboat leaves the harbor traveling 26 mph. Seven hours later a speedboat begins to pursue the rowboat at a speed of 39 mph. How many hours after the speedboat leaves the harbor will it catch up with the rowboat?

Round Trip – A helicopter traveled the hospital to the battlefield at a speed of 36 mph and returned at a speed of 24 mph. If the entire trip took 20 hours, find the travel times to and the battlefield.

Same Direction – Lucy and Ethyl leave the mall at the same time and head in the same direction. Ethyl's speed is 4 mph more than 4 times Lucy's speed. Four hours later Ethyl is 604 miles ahead of Lucy. Find the speeds of Lucy and Ethyl.

Two-Part Journey – A 556-mi trip took a total of 14 hours. The speed was 38 mph for the first part of the trip, and then increased to 42 mph for the rest of the trip. How many hours were traveled at each speed?

Problems Using Fractional Equations – Phil hikes up a 32-mile mountain trail. He then rents a pair of skis and skis back down the trail. His skiing speed is 8 mph faster than his hiking speed. If Phil spent a total of 6 hours on the trail, what were his hiking speed and his skiing speed?

Raya can go 9 miles upstream in her motorboat in the same time she can go 33 miles downstream. If the speed of her boat is 7 mph in still water, what is the rate of the current?

OPTIMIZATION

Optimization – A hard drive company found that the profit they make on their hard drive is given by the formula $P = -4h^2 + 200h + 1000$, where P is profit and h is the number of hard drives sold. Find the number of hard drives that the company needs to produce in order to **maximize** their profit. Also determine the maximum profit.

ORDER OF OPERATIONS

Order of Operations

PARABOLAS

Graphing – Graph $y = x^2 + 2x - 8$; use the graph to determine determine all the intercepts and the vertex.
Intercepts, Rational – Find all intercepts of the parabola $y = 15x^2 - 34x + 15$.
Intercepts, Irrational – Find all intercepts the parabola $y = -3x^2 + 5x - 1$.
Prove that the parabola $y = x^2 + x + 2$ has NO x-intercepts.
Vertex – Method: Averaging the x-coordinates, rational and irrational.

POLYNOMIALS

Polynomials

Dividing Polynomials – Divide: A. $\dfrac{10x^2 + 5x + 2}{5x}$ B. $\dfrac{14x^2 + 3x - 7}{2x - 1}$

PYTHAGOREAN THEOREM

Finding the Hypotenuse
Finding a Leg
With Radicals

QUADRATIC EQUATIONS

Factoring

Taking Square Roots – Solve for y by taking square roots: $(5y - 3)^2 = 50$

Quadratic Formula

Completing the Square

QUADRATIC FORMULA

Preparing – Verify that –5 and 2 are solutions of $x^2 + 3x - 10 = 0$.

Put $2x^2 = 4x + 3$ into standard form and determine the values of a, b, and c.

Evaluate the expression $\dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ for the values $a = 1$, $b = -5$, $c = 6$.

Deriving – Begin with $ax^2 + bx + c = 0$, *complete the square*, and end up with $x = \dfrac{-b \pm \sqrt{b^2 - 4ac}}{2a}$.

Rational Solutions

Irrational Solutions

Applications

RADICALS

Square Roots

Beyond Square Roots

More Operations

Advanced – Simplify: $\sqrt{288 a^{46} b^{19}}$; Simplify: $\sqrt[4]{\sqrt[3]{\sqrt{2}}}$

REAL NUMBERS

The Real Numbers

SCIENTIFIC NOTATION

Scientific Notation – Convert 23.95×10^{23} to a regular number; Convert 0.0045 to scientific notation.

SERIES

Series – Evaluate: $\displaystyle\sum_{k=2}^{5} (2k+1)$; Convert a series to sigma notation.

SETS

Sets – Elements and Subsets; the Null Set; Find the number of elements in a set (its *cardinality*); Union and Intersection; Find all subsets of a given set.

SEQUENCES

Sequences – *Find the 800th term of the sequence: 8, 11, 14, 17, 20, . . .*

SIGNED NUMBERS

Introduction
Adding and Subtracting
Multiplying and Dividing

SQUARE ROOTS

Square Roots – Name the two square roots of 17. Simplify: $\sqrt{288}$. *Simplify:* $\sqrt{-25}$

SYSTEMS OF EQUATIONS

UNIT CONVERSIONS

VARIABLES

Variables and Identities – Use an *example* to help verify that $(x + 5)(x - 5) = x^2 - 25$ *is* an identity. Use a *counterexample* to prove that $(x + 3)(x + 2) = x^2 + 6$ is *not* an identity.

VARIATION

Direct and Inverse Variation – The volume of a gas varies directly as its temperature, and inversely as its pressure. If the volume is 14 when the temperature is 9 and the pressure is 12, find the volume when the temperature is 5 and the pressure is 16.

VELOCITY

Average Velocity – *The position function is* $s(t) = t^3$. Find the *average velocity* from $t = 3$ to $t = 10$.

ZERO

The Number Zero

APPLICATIONS	***Investing in the Stock Market***	One part of a $41,500 investment is designed to be four times the other p
	Number Word Problems	I'm thinking of a number. If 7 is subtracted from the number, and then t
		Find a number given that 3 times the difference of the number and 1 is 1

CONSECUTIVE INTEGERS	*Linear*	Find four consecutive odd integers such that the largest is 3 less than tw
	Quadratic	Find four consecutive negative even integers such that the product of the
CONSTANTS	*Finding the Numbers*	Find two numbers with a product of 16 and a difference of 6. If I quadruple the number, and then subtract 8, the result is 40.
D	**D**	
DISTANCE, RATE, AND TIME	***Go to** Motion Problems*	

ELLIPSES	*The Ellipse (Center at the Origin)*	This chapter does <u>not</u> involve the *constant sum of the distances to 2 poin* Graph the following ellipse by plotting the four intercepts and four addit $$\frac{x^2}{25} + \frac{y^2}{9} = 1$$
EQUATIONS	*Introduction*	
	Distance and the Origin	
	Linear with Distributing	
	Absolute Value	
	Quadratics by Factoring	
	Quadratics by Taking Square Roots	

	Quadratics by Completing the Square	
	The Quadratic Formula, Rational Solutions	
	The Quadratic Formula, Irrational Solutions	
	Square Roots	
	Cubics and Quartics	
	Fractional	
	Exponential	Solve for x: $9^{4x-1} = 27$ Solve for a: $125^{-10a} = \dfrac{1}{25}$
EXPONENTIAL EQUATIONS	*Exponential Equations*	

EXPONENTIAL FUNCTIONS	*Exponential Functions*	
FACTORING	*The GCF (Greatest Common Factor)*	
	Quadratics – An Intro	
	Quadratics – The Real Deal	
	Complete Factoring	Reducing Fractions and Solving Quadratics
	Advanced Factoring	Factor each expression completely: $9a^4 - 37a^2 + 4$ $\qquad$ $x^2(u - w) - 100(u - w)$ $x^3 - 7x^2 - 9x + 63$ $\qquad$ $x^2 + 6x + 9 - y^2$
	Sum and Difference of Cubes	Long division Formula Find the cube roots (real and complex) of 8.

FORMULAS	Using	
	Solving	Solve for x: $\dfrac{bx+c}{c} - L = M$
	Creating	from English statements
FRACTIONAL EQUATIONS	Solving	Example of Solving See Motion (last part) for applications
FRACTIONS	Introduction	
	More	Signed fractions, Powers, Roots, and Equations
	Reducing with the GCF	
	Reducing Quadratics	Reduce: $\dfrac{m^2+10m+25}{m^2-25}$
	Adding and Subtracting, Part I	

	Adding and Subtracting, Part II	
	Multiplying and Dividing	
G	**G**	
GCF	*GCF - Equations and Formulas*	
GEOMETRY	*An Introduction*	
	Squares and Circles	If the perimeter of a square is 44, what is its area? If the area of a circle is 169π, what is its circumference?
	Triangles and Perimeter	The third side of a triangle is 3 less than the first side, while the first sid
	Triangles and Angles	The second angle of a triangle is 38° less than 4 times the first angle. Th

GRAPHING	*The Coordinate Plane*	This is also called the **Cartesian Plane**.
	From Graph to Equation	
GROWTH AND DECAY	*The Growth and Decay Formula*	Uses the formula: $A \ = \ A_0\, e^{kt}$ Assuming an initial population of 3,902, and a *growth* rate of 14% per ye Starting with 215 grams of plutonium, and assuming an annual *decay* ra
H	H	
I	I	

| **INTERCEPTS** | *Go to Lines or Parabolas* | move this to a separate section of links, along with things like *horizontal* |