

TACHS MATH CRAM SHEET

NUMBER BASICS

Rational Numbers

Integers

Whole Numbers

Natural Numbers

Each number system is a subset another.

A rational number is also a real number, a real number is also a complex number, etc.

Number Class	Definition	Examples
Natural Numbers	The number 1 or any number obtained by adding 1 to it one or more times.	1, 2, 3, 4, 5, ...
Whole Numbers	Whole numbers do not include fractions or decimal parts and is a positive integer or zero.	0, 1, 2, 3, 4, 5, ...
Integers	Any whole number or its opposite.	..., -5, -4, -3, -2, -1, 0, 1, 2, 3, 4, 5, ...
Rational Numbers	A number that can be expressed as a ratio or fraction.	• $\frac{2}{10.6}$ • $\frac{3}{10}$ • 2.957
Real Numbers	A number that has no imaginary part. All real numbers can be located on a number line.	• -92 • $\frac{5}{9}$ • $\sqrt{2}$
Complex Numbers	$a + bi$ where a and b are real numbers and i (imaginary number) is a formal square root of -1 ($i = \sqrt{-1}$, $i^2 = -1$)	• $-1 + 2i$ • $7 - 9i$ • $-6i$

Place Value

Place	thousands	hundreds	tens	ones	tenths	hundredths	thousandths
Value	1,000	100	10	1	0.1	0.01	0.001

METRIC CONVERSIONS

Metric units are multiples of 10s. To convert to a larger unit, divide numbers by base of 10s. To convert to a smaller unit, multiply numbers by base of 10s.

King	Henry	Died	By	Drinking	Chocolate	Milk
↓	↓	↓	↓	↓	↓	↓
kilo	hecto	deca	base	deci	centi	milli
↓	↓	↓	↓	↓	↓	↓
1,000.0	100.0	10.0	1.0	0.1	0.01	0.001
(10 ³)	(10 ²)	(10 ¹)	(10 ⁰)	(10 ⁻¹)	(10 ⁻²)	(10 ⁻³)
← larger units				smaller units →		

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DISTANCE

1 ft = 12 in
1 in = 2.54 cm
1 yd = 3 ft
1 m $\approx$ 3.28 ft $\approx$ 1.09 yd
1 mi = 5,280 ft $\approx$ 1.61 km

CAPACITY

1 oz $\approx$ 28.35 g
1 cup = 8 oz
2 cups = 1 pint
2 pints = 1 quart
4 quarts = 1 gallon
1 gallon $\approx$ 3.8 L

WEIGHT

1 lb = 16 oz
1 kg $\approx$ 2.2 lb $\approx$ 35.27 oz
1 t = 2,000 lb $\approx$ 907.19 kg

TEMPERATURE

$^{\circ}\text{F} = \frac{9}{5}(^{\circ}\text{C}) + 32$
 $^{\circ}\text{C} = \frac{9}{5}(^{\circ}\text{F}) - 32$

FACTORS

What is a factor?

A whole number is a factor of another whole number if it divides it evenly.

Greatest common factor (GCF)

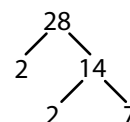
The greatest common factor of two or more whole numbers is the largest number that is a factor of them all.

7: 1, 7

28: 1, 2, 7, 14

GCF: 7

Factor Tree



MULTIPLES

What is a multiple?

A whole number is a multiple if it is the result of multiplying another whole number by an integer.

Least Common Multiple (LCM)

The least common multiple of two or more whole numbers is the smallest number that is a multiple of them all.

3: 3, 6, 9, 12, 15, 18, 21, 24

7: 7, 14, 21, 28, 35, 42, 49, 56

LCM: 21

Multiples of 3

x	1	2	3	4	5	6	7	8	multiplication
1	1	2	3	4	5	6	7	8	$3 \times 1 = 3$
2	2	4	6	8	10	12	14	16	$3 \times 2 = 6$
3	3	6	9	12	15	18	21	24	$3 \times 3 = 9$
4	4	8	12	16	20	24	28	32	$3 \times 4 = 12$
5	5	10	15	20	25	30	35	40	$3 \times 5 = 15$
6	6	12	18	24	30	36	42	48	$3 \times 6 = 18$
7	7	14	21	28	35	42	49	56	$3 \times 7 = 21$
8	8	16	24	32	40	48	56	64	$3 \times 8 = 24$

Multiples of 7

x	1	2	3	4	5	6	7	8	multiplication
1	1	2	3	4	5	6	7	8	$7 \times 1 = 7$
2	2	4	6	8	10	12	14	16	$7 \times 2 = 14$
3	3	6	9	12	15	18	21	24	$7 \times 3 = 21$
4	4	8	12	16	20	24	28	32	$7 \times 4 = 28$
5	5	10	15	20	25	30	35	40	$7 \times 5 = 35$
6	6	12	18	24	30	36	42	48	$7 \times 6 = 42$
7	7	14	21	28	35	42	49	56	$7 \times 7 = 49$
8	8	16	24	32	40	48	56	64	$7 \times 8 = 56$

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FRACTIONS

Proper Fraction

$\frac{1}{8}$ Numerator is less than the denominator

Improper Fraction

$\frac{8}{3}$ Numerator is greater than the denominator

Mixed Number

$3\frac{1}{8}$ Whole number and proper fraction together

Add or subtract fractions with different denominators

1. Change to equivalent fractions with common denominators using a scale factor
2. Add or subtract following the rules for fractions with the same denominators

$$\frac{A}{B} + \frac{C}{D} = \frac{AD}{BD} + \frac{BC}{BD} = \frac{AD + BC}{BD}$$

$$\frac{A}{B} - \frac{C}{D} = \frac{AD}{BD} - \frac{BC}{BD} = \frac{AD - BC}{BD}$$

Add or subtract fractions with the same denominators

1. Add or subtract the numerators
2. Keep the denominator the same
3. Simplify if possible

$$\frac{A}{B} + \frac{C}{B} = \frac{A + C}{B}$$

$$\frac{A}{B} - \frac{C}{B} = \frac{A - C}{B}$$

Multiply fractions

1. Multiply the numerators
2. Multiply the denominators
3. Simplify

$$\frac{A}{B} \times \frac{C}{D} = \frac{A \times C}{B \times D}$$

Divide fractions

1. Keep the first fraction as is
2. Change from division to multiplication
3. Flip the second fraction to its reciprocal
4. Follow multiplication of fractions rules

$$\frac{A}{B} \div \frac{C}{D} = \frac{A}{B} \times \frac{D}{C} = \frac{A \times D}{B \times C}$$

Convert Mixed Number

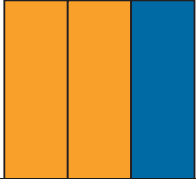
$$4\frac{2}{8} = \frac{(4 \times 8) + 2}{8} = \frac{34}{8} = \frac{17}{4}$$

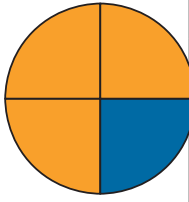
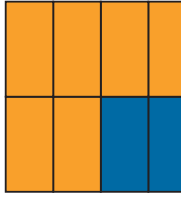
Keep the original denominator when converting a mixed number to an improper fraction.

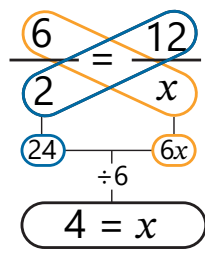
Simplify if needed.

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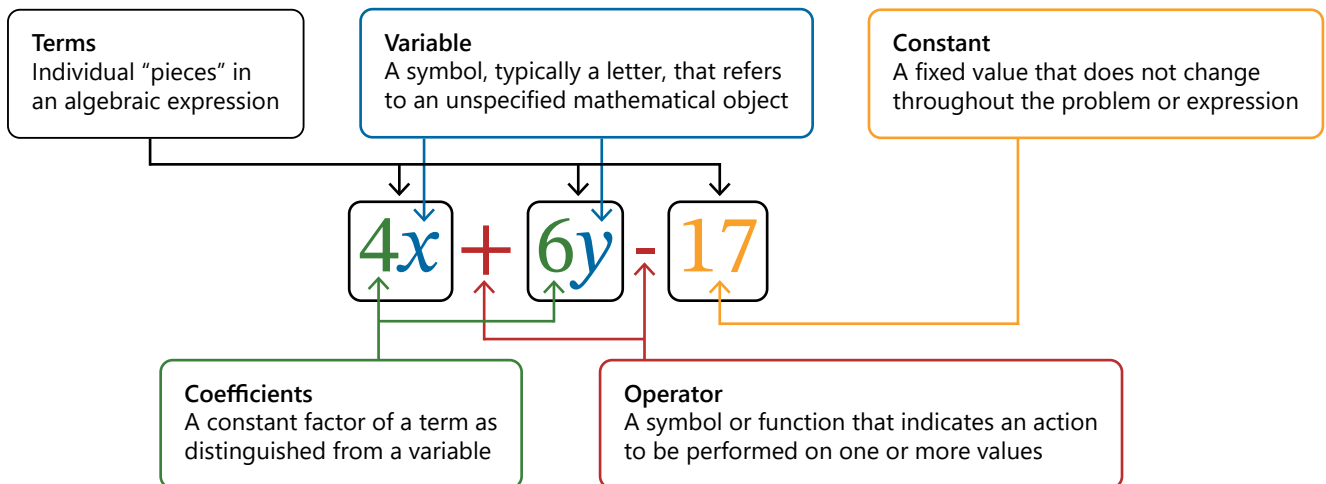
RATIOS AND PROPORTIONS

Ratios				
	Part to part		Part to whole	
	2:1	1:2	2:3	1:3
	2/1	1/2	2/3	1/3
	2 to 1	1 to 2	2 to 3	1 to 3

Proportions				
	3:4	=	6:8	
	3:4	::	6:8	
	3 is to 4	as	6 is to 8	

Calculating Proportions
$\frac{6}{2} = \frac{12}{?}$

$\frac{6}{2} = \frac{12}{4}$

ALGEBRAIC EXPRESSION



FOIL METHOD

Using the FOIL method on binomials: $(x + 2)$ and $(x - 3)$

F	Multiply the first terms of each binomial	$(x + 2)(x + (-3))$	$\rightarrow$	$(x)(x)$	$= x^2$
O	Multiply the outer terms	$(x + 2)(x + (-3))$	$\rightarrow$	$(x)(-3)$	$= -3x$
I	Multiply the inner terms	$(x + 2)(x + (-3))$	$\rightarrow$	$(2)(x)$	$= 2x$
L	Multiply the last terms of each binomial	$(x + 2)(x + (-3))$	$\rightarrow$	$(2)(-3)$	$= -6$

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SOLVING LINEAR EQUATIONS

1. Distribute

Distribute factors across terms in parentheses.

$$\begin{array}{c} 6x \\ \hline 2 \times (3x + 2) + 2x + 8 = 14 + 5x \\ \hline 4 \end{array}$$

Equivalent Equation

$$6x + 4 + 2x + 8 = 14 + 5x$$

2. Collect Terms

Check if there are like terms to combine.

$$\begin{array}{c} 8x \\ \hline 6x + 4 + 2x + 8 = 14 + 5x \\ \hline 12 \end{array}$$

Equivalent Equation

$$8x + 12 = 14 + 5x$$

3. Move Variables

Gather all x -terms on one side of the equation by performing inverse operations on both sides of the equation.

$$\begin{array}{c} 8x - 5x + 12 = 14 + 5x - 5x \\ \hline 3x \qquad \qquad \qquad 0 \end{array}$$

Equivalent Equation

$$3x + 12 = 14$$

4. Isolate

Isolate the variable by performing inverse operations on both sides of the equation

Operation	Inverse Operation
Addition +	- Subtraction
Subtraction -	+ Addition
Multiplication $\times$	$\div$ Division
Division $\div$	$\times$ Multiplication

Subtraction

$$\begin{array}{c} 3x + 12 = 14 \quad | -12 = 2 \\ \hline -12 = 0 \end{array}$$

Equivalent Equation

$$3x = 2$$

Division

$$\begin{array}{c} 3x = 2 \quad | \div 3 = \frac{2}{3} \\ \hline \div 3 = x \end{array}$$

Answer

$$x = \frac{2}{3}$$

5. Check

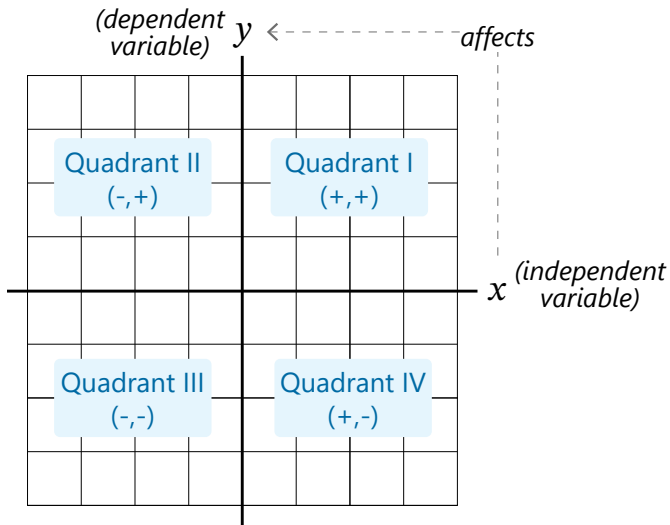
Substitute the solution back into the original equation to verify it works.

$$\begin{array}{c} 2 \times (3 \times \frac{2}{3} + 2) + 2 \times \frac{2}{3} + 8 \\ \hline \frac{52}{3} \end{array}$$

$$\begin{array}{c} 14 + 5 \frac{2}{3} \\ \hline \frac{52}{3} \end{array}$$

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SLOPE AND LINEAR EQUATIONS



Slope

$$\frac{y_2 - y_1}{x_2 - x_1} = \frac{\text{rise}}{\text{run}}$$

Slope Intercept Form

$$y = mx + b$$

m = slope
 b = y-intercept

Distance Formula

$$d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

Point-Slope Form

$$y - y_1 = m(x - x_1)$$

m = slope
 (x_1, y_1) = point coordinates

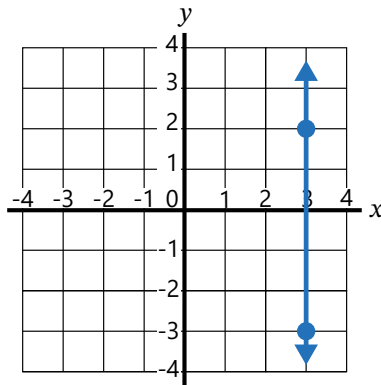
Midpoint Formula

$$\frac{x_1 + x_2}{2}, \frac{y_1 + y_2}{2}$$

Undefined Slope

$$m = \frac{-3 - 2}{3 - 3} = \frac{-5}{0}$$

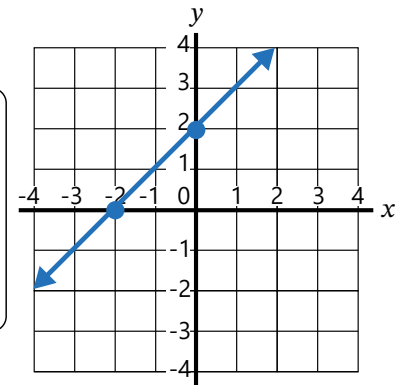
$m = \text{undefined}$



Positive Slope

$$m = \frac{2 - 0}{0 - (-2)} = \frac{2}{2}$$

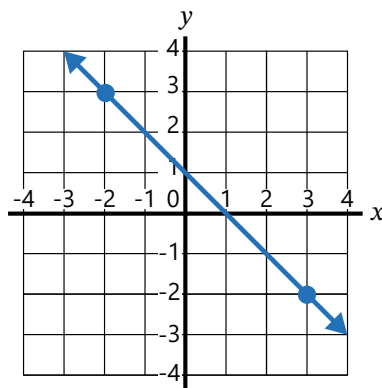
$m = 1$



Negative Slope

$$m = \frac{-2 - 3}{3 - (-2)} = \frac{-5}{5}$$

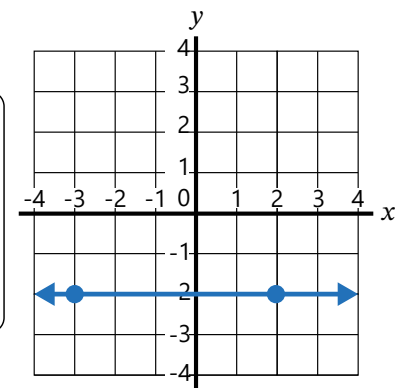
$m = -1$



Slope of Zero

$$m = \frac{-2 - (-2)}{-3 - 2} = \frac{0}{-5}$$

$m = 0$

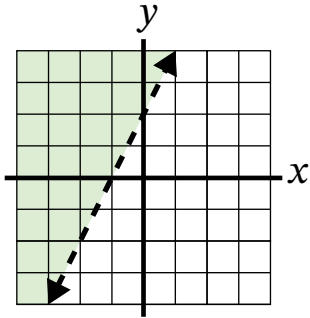


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GRAPHING LINEAR INEQUALITIES

Greater Than

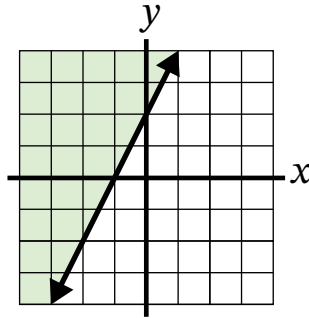
$>$



$$y > 2x + 2$$

Greater Than or Equal To

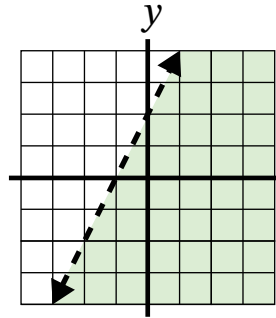
$\geq$



$$y \geq 2x + 2$$

Less Than

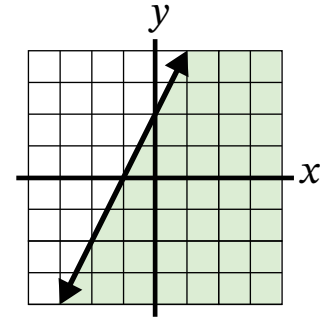
$<$



$$y < 2x + 2$$

Less Than or Equal To

$\leq$

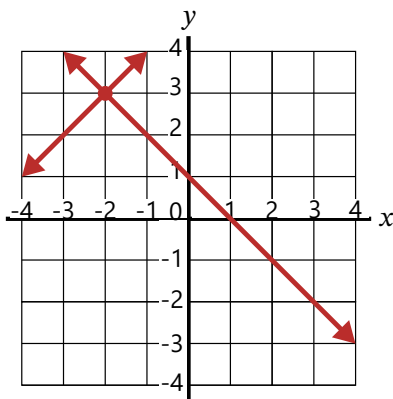


$$y \leq 2x + 2$$

SYSTEMS OF EQUATIONS

One Solution

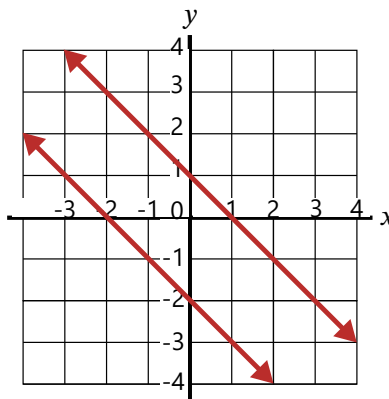
$$\begin{aligned} y &= -x + 1 \\ y &= x + 5 \end{aligned}$$



Consistent Independent

No Solutions

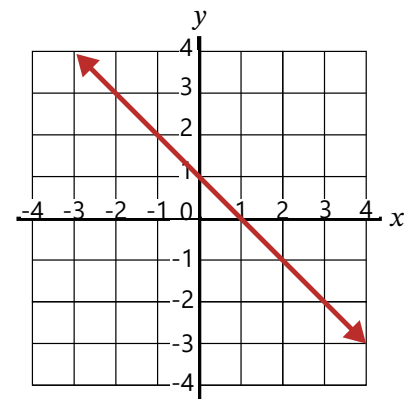
$$\begin{aligned} y &= -x + 1 \\ y &= -x - 2 \end{aligned}$$



Inconsistent

Infinitely Many Solutions

$$\begin{aligned} y &= -x + 1 \\ 3y &= -3x + 3 \end{aligned}$$



Consistent Dependent

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LINES



Line

a set of points that extends infinitely in two opposite directions



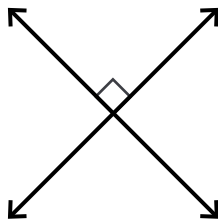
Segment

is a portion of a line that has definite endpoints



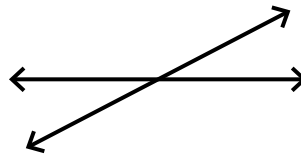
Ray

a portion of a line that extends infinitely from a single point on that line in one direction along the line



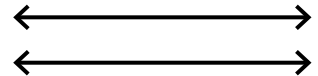
Perpendicular

lines that intersect at right angles



Intersecting

lines that have exactly one point in common

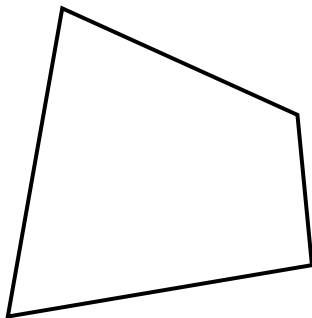


Parallel

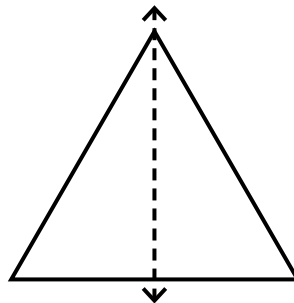
are lines in the same plane that have no points in common and never meet

LINE OF SYMMETRY

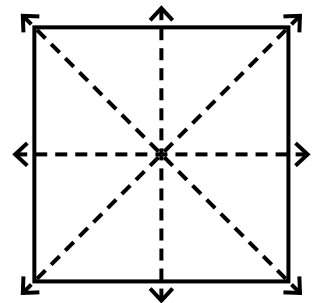
A line that divides a figure or object into congruent parts that are mirror images of each other across the line is called a line of symmetry. An object may have no lines of symmetry, one line of symmetry, or multiple lines of symmetry.



None



One



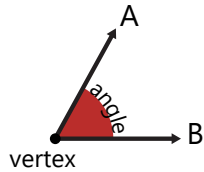
Multiple

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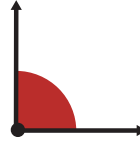
ANGLES

An angle is formed when two lines or line segments meet at a point.

A vertex is the point at which two segments or rays meet to form an angle.



Right



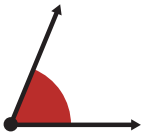
An angle with a degree measure of exactly 90°

Straight



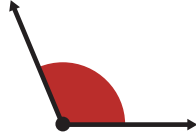
An angle with a degree measure of exactly 180°

Acute



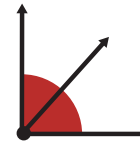
An angle with a degree measure less than 90°

Obtuse



An angle with a degree measure greater than 90° but less than 180°

Complementary



Two angles whose sum is exactly 90°

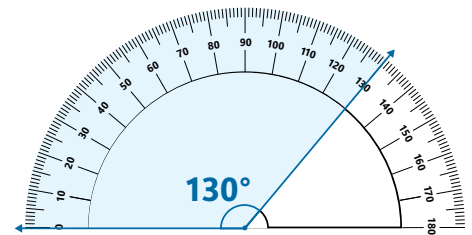
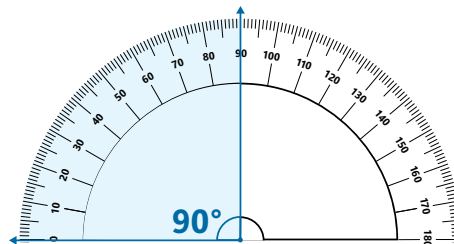
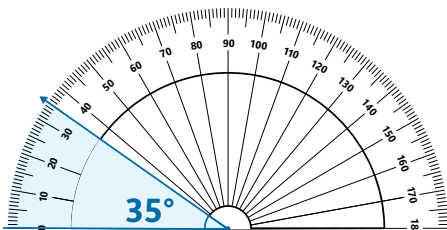
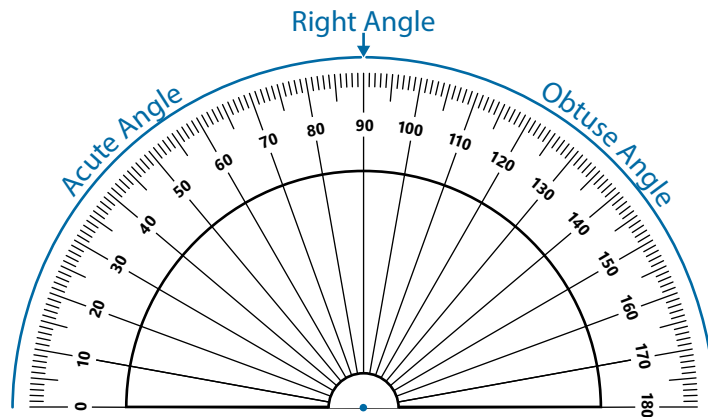
Supplementary



Two angles whose sum is exactly 180°

PROTRACTORS

A protractor is primarily used to measure how wide or narrow an angle is, in degrees (from 0° to 180°).

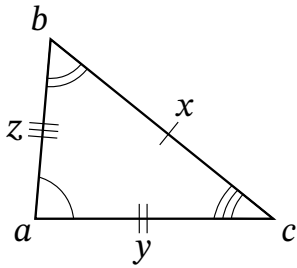


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POLYGONS

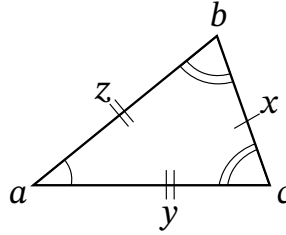
Triangles

The sum of the interior angles of any triangle is always 180 degrees.



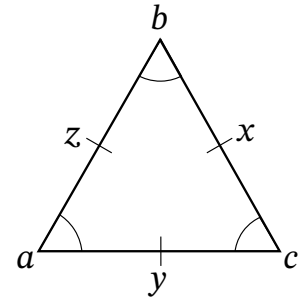
Scalene Triangle

No equal side lengths or angles



Isosceles Triangle

Two equal side lengths and angles

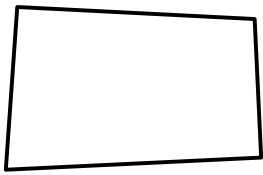


Equilateral Triangle

Three equal side lengths and angles

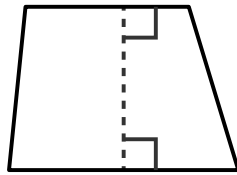
Quadrilaterals

The sum of the interior angles of any simple quadrilateral is always 360 degrees.



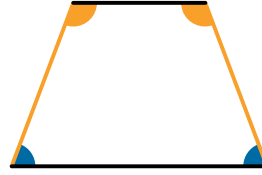
Trapezium

No sides are parallel and opposite angles are equal



Trapezoid

At least one pair of opposite sides are parallel



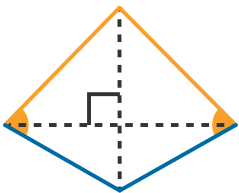
Isosceles Trapezoid

One pair of opposite sides are parallel, and the base angles are equal in measure



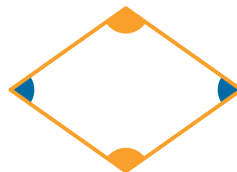
Parallelogram

Two pairs of parallel sides



Kite

Two pairs of adjacent sides are of equal length



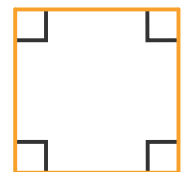
Rhombus

All four sides are of equal length and opposite angles are equal



Rectangle

All four angles are right angles

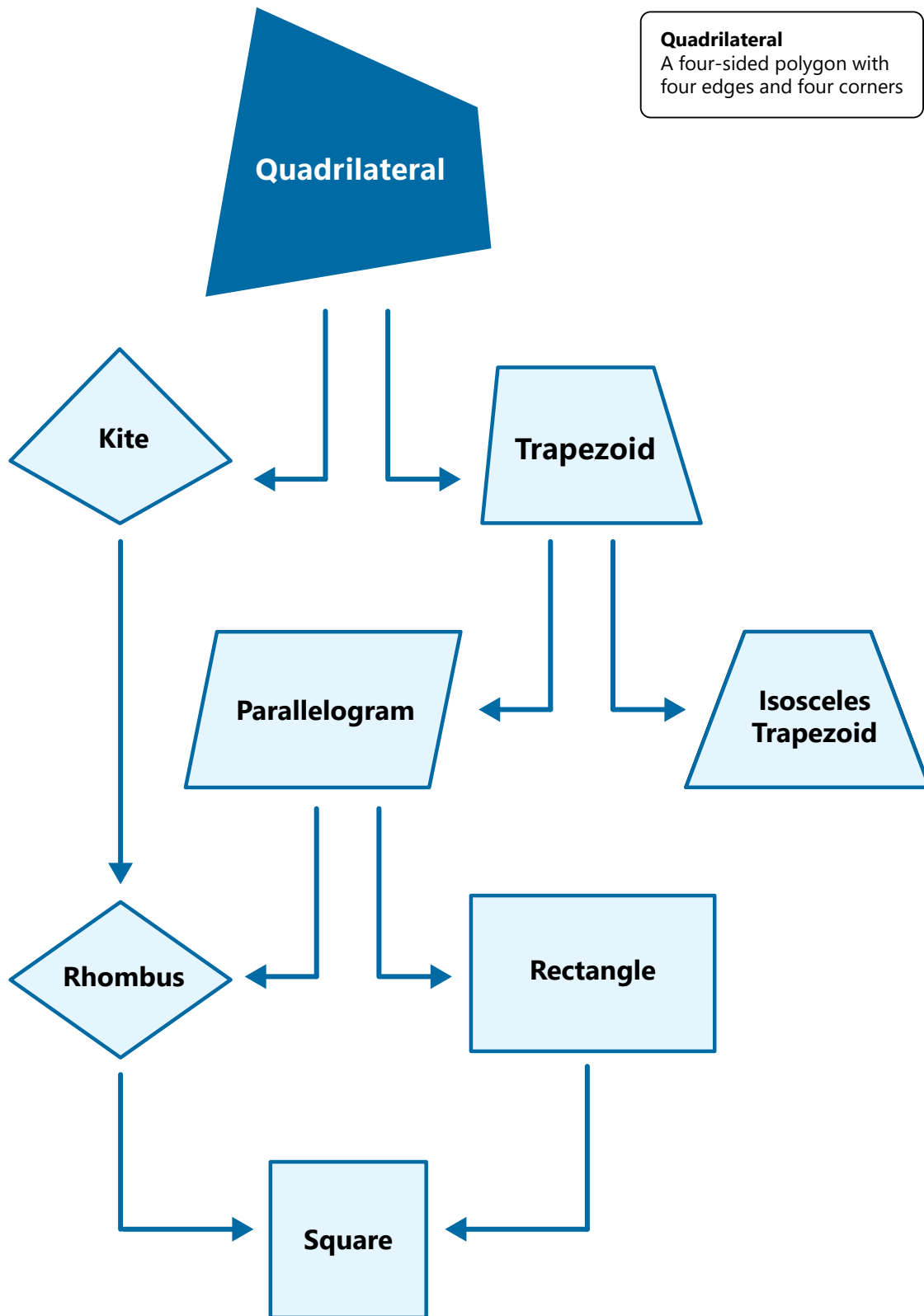


Square

All four sides are of equal length, and all four angles are right angles

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Quadrilateral Hierarchy



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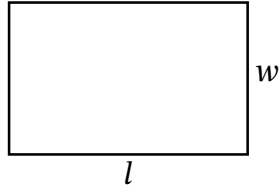
AREA

Square



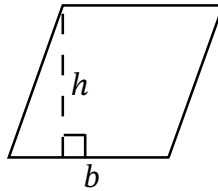
$$A = l^2$$

Rectangle



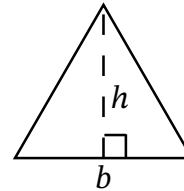
$$A = lw$$

Parallelogram



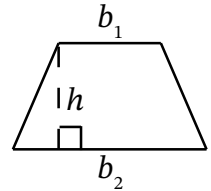
$$A = bh$$

Triangle



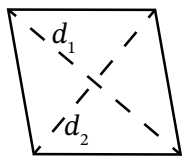
$$A = \frac{1}{2}bh$$

Trapezoid



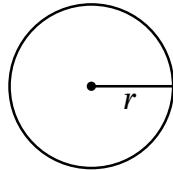
$$A = \frac{1}{2}(b_1 + b_2)h$$

Rhombus



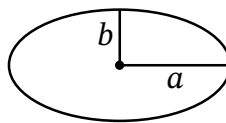
$$A = \frac{1}{2}(d_1 \times d_2)$$

Circle



$$A = \pi r^2$$

Ellipse



$$A = \pi ab$$

Perimeter

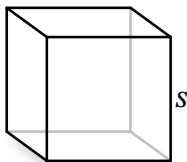
The sum of all sides of a shape

Circumference

The distance around a circle ($C=2\pi r$)

VOLUME AND SURFACE AREA

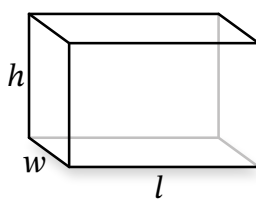
Cube



$$V = s^3$$

$$SA = 6s^2$$

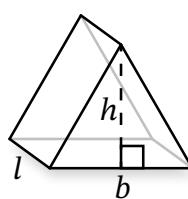
Rectangular Prism



$$V = l \times w \times h$$

$$SA = 2(lw + lh + hw)$$

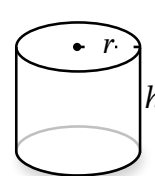
Triangular Prism



$$V = \frac{b \times h \times l}{2}$$

$$SA = lsa + 2(\text{area of base})$$

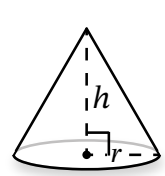
Cylinder



$$V = \pi r^2 h$$

$$SA = 2\pi r(r + h)$$

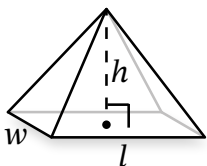
Cone



$$V = \frac{\pi r^2 h}{3}$$

$$SA = \pi rs + \pi r^2$$

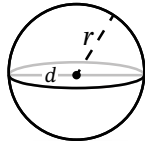
Rectangular Pyramid



$$V = \frac{l \times w \times h}{3}$$

$$SA = lsa + \text{area of base}$$

Sphere



$$V = \frac{4}{3}\pi r^3$$

$$SA = 4\pi r^2$$

LSA (Lateral Surface Area)

The sides of a three-dimensional shape, excluding any bases

Base

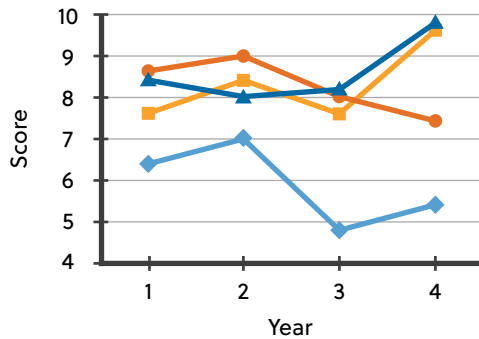
The face of a shape perpendicular to the direction height is measured

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CHARTS

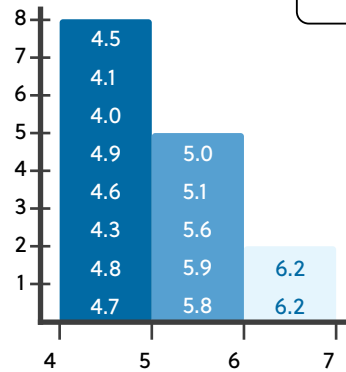
Line Graph

Shows trends in data collected over time



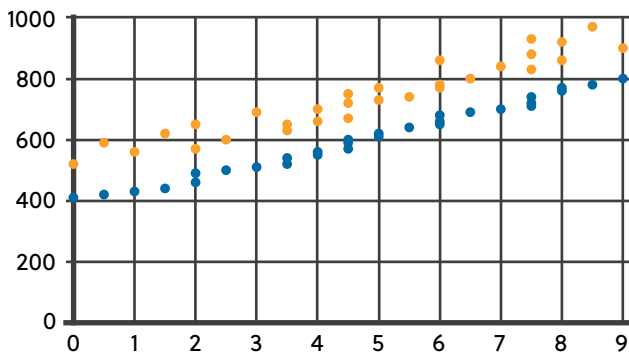
Histogram

Shows distribution of data collected over time.



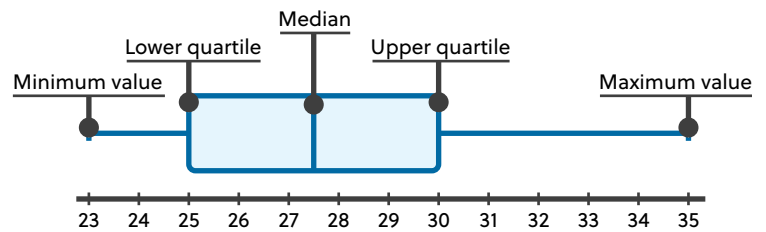
Scatter Plot

Shows relationship between two variables



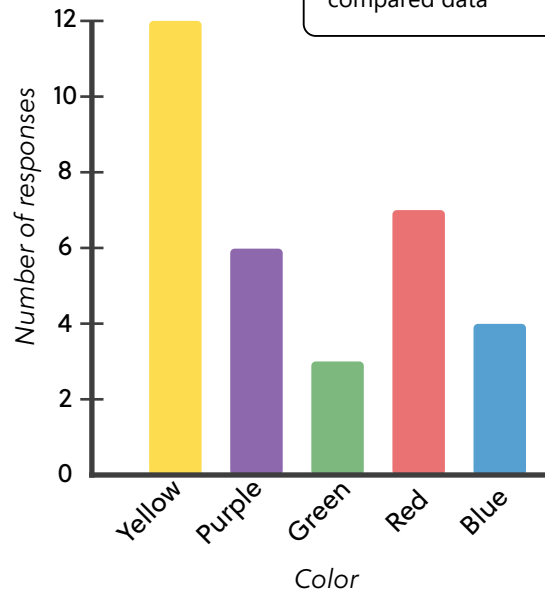
Box Plot

Shows statistical distribution



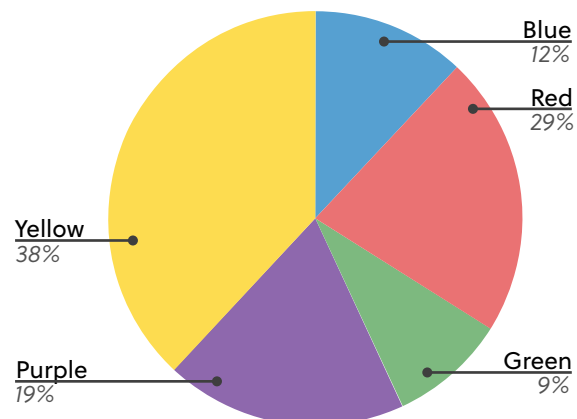
Bar Chart

Shows categorically compared data



Pie Chart

Shows proportional parts of data collected



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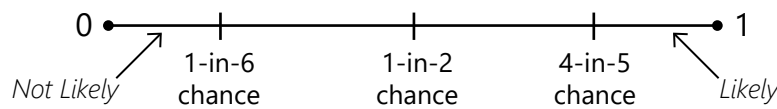
PROBABILITY

$$P(A) = \frac{\text{Number of acceptable outcomes}}{\text{Number of possible outcomes}}$$

Impossible Event
 $P(A) = 0$

The Probability of an Event
 $0 \leq P(A) \leq 1$

Certain Event
If $P(A) = 1$



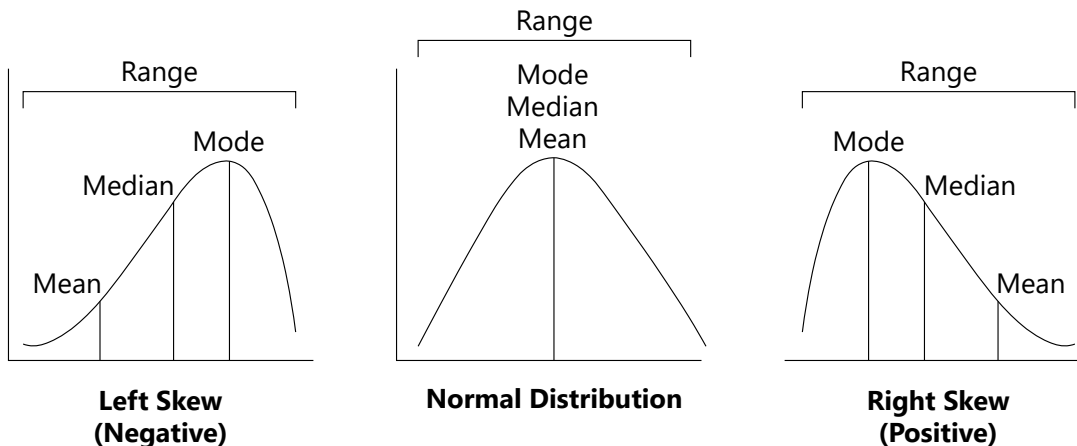
STATISTICS

Mean
 $\frac{\text{sum of all items}}{\text{total number of items}}$

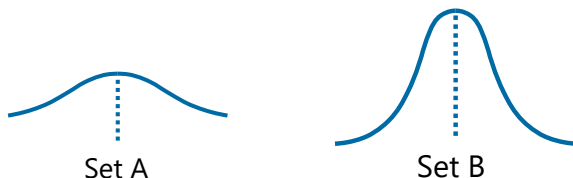
Range (Spread)
Distance between
smallest and largest item

Mode
Most/common item

Median
Middle item when ordered
from least to greatest



Greater spread equals greater deviation.



Margin of Error

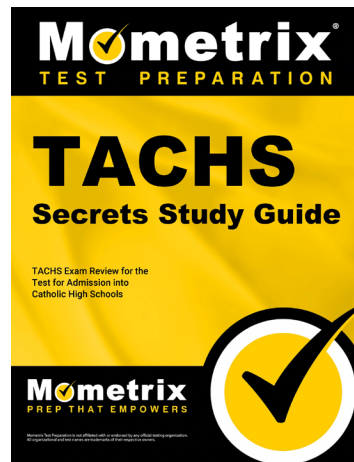
sample statistic $\pm$ margin of error with
confidence level of XX%

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ADDITIONAL FORMULAS

Formula Name	Formula
Geometric Sequence	$a_n = a_1 \times r^{n-1}$ a_n = the value of the nth term a_1 = the value of the initial term r = the common ratio n = the number of terms
Arithmetic Sequence	$a_n = a_1 + (n-1)d$ a_n = the value of the nth term a_1 = the value of the initial term n = the number of terms d = the common difference between terms

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