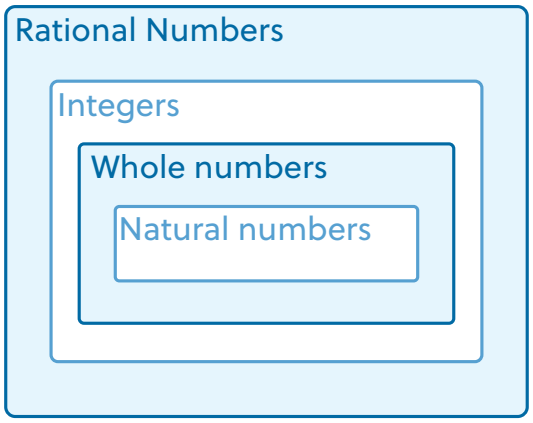
ACT® MATH CRAM SHEET

NUMBER CLASSIFICATION

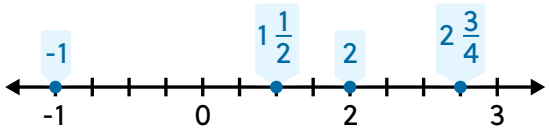


Each number system is a subset another.

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

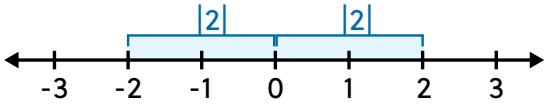
Number Class	Definition	Examples
Natural numbers	The number 1 or any number obtained by adding 1 to it one or more times.	1, 2, 3, 4, 5, ...
Whole Numbers	Whole numbers do not include fractions or decimal parts and is a positive integer or zero.	0, 1, 2, 3, 4, 5, ...
Integers	Any whole number or its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

NUMBER LINES



Standard Number Line
Number lines may have a point for zero and may show negative numbers on the left side of the line.

Any positive numbers are placed on the right side of the line.



Absolute Value
Absolute value is the distance away from zero a number is on the number line. It is always positive and is written $|x|$.

For example, the absolute value of 2 is written as |2|.

MATHEMATICAL SYMBOLS

Phrase	Symbol
equal, is, was, will be, has, costs, gets to, is the same as, becomes	=
times, of, multiplied by, product of, twice, doubles, halves, triples	×
divided by, per, ratio of/to, out of	÷
plus, added to, sum, combined, and, more than, totals of	+
subtracted from, less than, decreased by, minus, difference between	−
what, how much, original value, how many, a number, a variable	x, n, etc.

Lesser Known Symbols

The Golden Ratio: φ
Inifinity: ∞
Euler's Number: e
Universal Quantifier: ∀
Membership Sign: ∈

ACT® MATH CRAM SHEET

PERCENTS, FRACTIONS, AND DECIMALS

Percent Increase

$$\left(\frac{\text{new value} - \text{original value}}{\text{original value}}\right) \times 100$$

Percent Decrease

$$\left(\frac{\text{original value} - \text{new value}}{\text{original value}}\right) \times 100$$

Percent to Fraction/Decimal

$$\frac{\text{Percentage}}{100}$$

Fraction to Decimal

$$\frac{\text{numerator}}{\text{denominator}}$$

Fraction to Percent

$$\left(\frac{\text{numerator}}{\text{denominator}}\right) \times 100$$

Decimal to Fraction

$$\frac{\text{decimal}}{1} \times \frac{10^n}{10^n}$$

n is the number of places behind the decimal point

Decimal to Percent

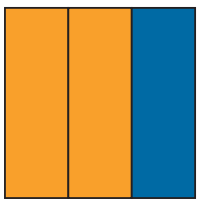
decimal × 100

RATIOS AND PROPORTIONS

Ratios of Two Items

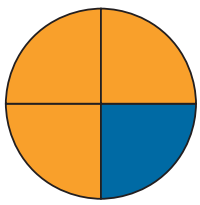
Items	Ratio	Fraction	Written	Simplified Ratio
6 oranges, 8 apples	6:8	$\frac{6}{8}$	6 oranges to 8 apples	3:4
8 trains, 14 cars	8:14	$\frac{8}{14}$	8 trains to 14 cars	4:7
4 feet, 3 feet	4:3	$\frac{4}{3}$	4 feet to 3 feet	4:3

Ratios

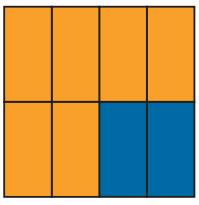


Part to part		Part to whole	
2:1	1:2	2:3	1:3
2/1	1/2	2/3	1/3
2 to 1	1 to 2	2 to 3	1 to 3

Proportions



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



Calculating Proportions

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

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

$24 \quad 6x$

$\div 6$

$4 = x$

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

ACT® MATH CRAM SHEET

FACTORS

What is a factor?

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

Greatest common factor (GCF)

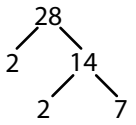
The greatest common factor of two or more whole numbers is the largest number that is a factor of them all.

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

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

Multiples of 7

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

PERMUTATION AND COMBINATION

n = the number of objects available
r = the number of objects selected

Permutation
An arrangement of a specific number of a set of objects in a specific order.

$$_nP_r = \frac{n!}{(n-r)!}$$

Combination
No restrictions regarding the order of the elements.

$$_nC_r = \frac{n!}{r!(n-r)!}$$

$$_nC_r = \frac{_nP_r}{r!}$$

ACT® MATH CRAM SHEET

SCIENTIFIC NOTATION

The coefficient must be greater than or equal to 1 and less than 10

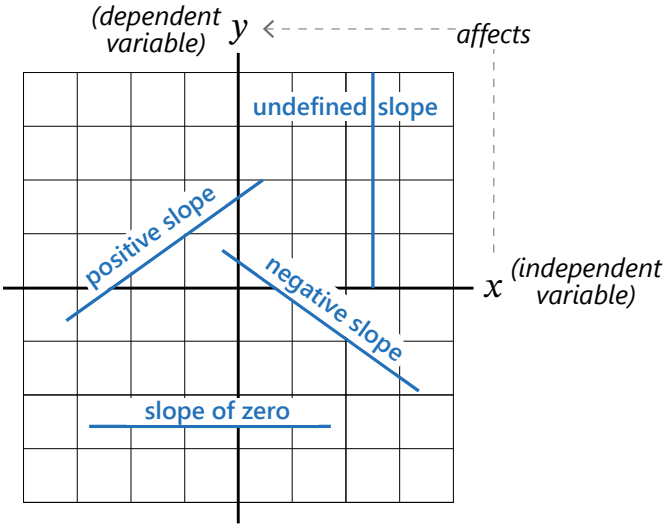
Scientific Notation	Moving The Decimal	New Number
1×10^{0}	1	1
1.3×10^{1}	1 . 3	13
1.34×10^{2}	1 . 3 4	134
7.38×10^{9}	7 . 3 8 0 0 0 0 0 0 0	7,380,000,000
1×10^{-1}	0 1 .	0.1
1×10^{-2}	0 0 1 .	0.01
5.5×10^{-7}	0 0 0 0 0 0 0 5 . 5	0.00000055

RULES OF EXPONENTS

Property	Description
$a^1 = a$	Any number to the power of 1 is equal to itself
$1^n = 1$	The number 1 raised to any power is equal to 1
$a^0 = 1$	Any number raised to the power of 0 is equal to 1
$a^n \times a^m = a^{n+m}$	Add exponents to multiply powers of the same base number
$a^n \div a^m = a^{n-m}$	Subtract exponents to divide powers of the same base number
$(a^n)^m = a^{n \times m}$	When a power is raised to a power, the exponents are multiplied
$(a \times b)^n = a^n \times b^n$	Multiplication operations inside parentheses can be raised to a power
$(a \div b)^n = a^n \div b^n$	Division operations inside parentheses can be raised to a power
$a^{-n} = 1/a^n$	A negative exponent is the same as the reciprocal of a positive exponent

ACT® MATH CRAM SHEET

SLOPE AND LINEAR EQUATIONS



Slope

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

Slope Intercept Form

$y = mx + b$

m = slope
b = y-intercept

Distance Formula

$d = (x_2 - x_1)^2 + (y_2 - y_1)^2$

Point-Slope Form

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

m = slope
(x_1, y_1) = point coordinates

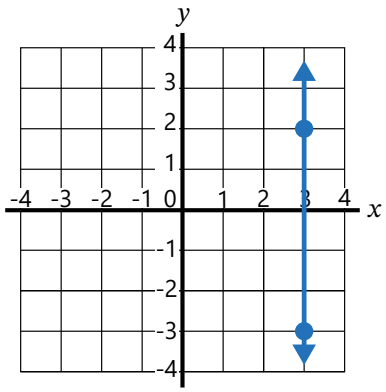
Midpoint Formula

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

Undefined Slope

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

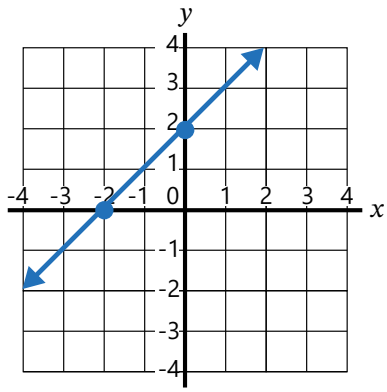
m = undefined



Positive Slope

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

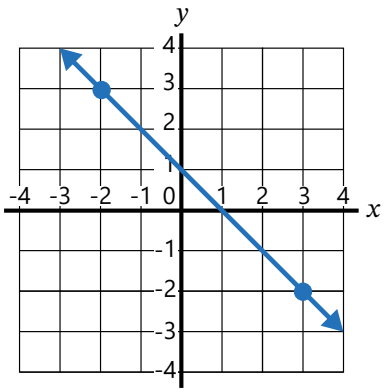
m = 1



Negative Slope

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

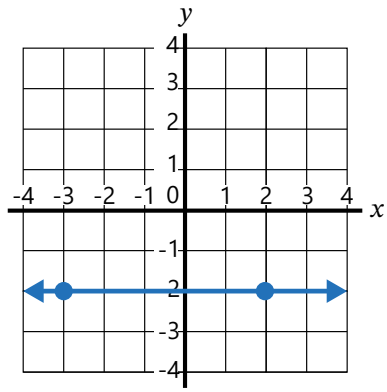
m = -1



Slope of Zero

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

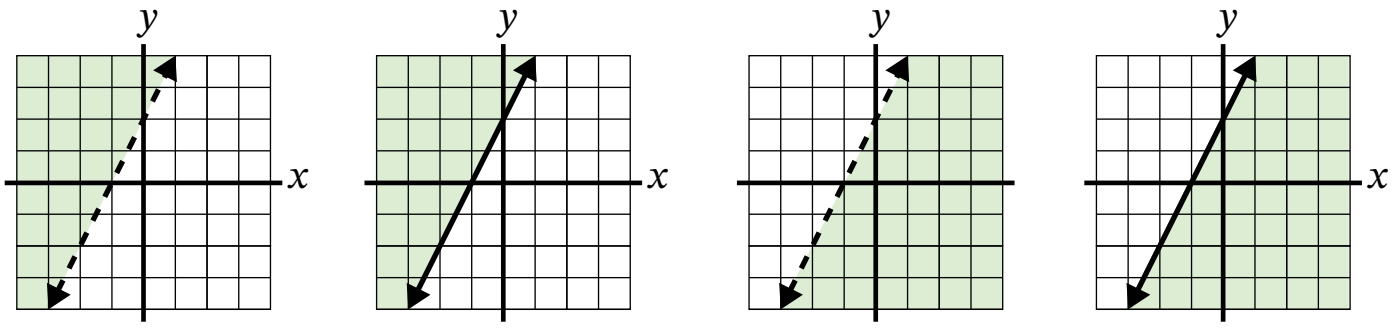
m = 0



ACT® MATH CRAM SHEET

GRAPHING LINEAR EQUATIONS

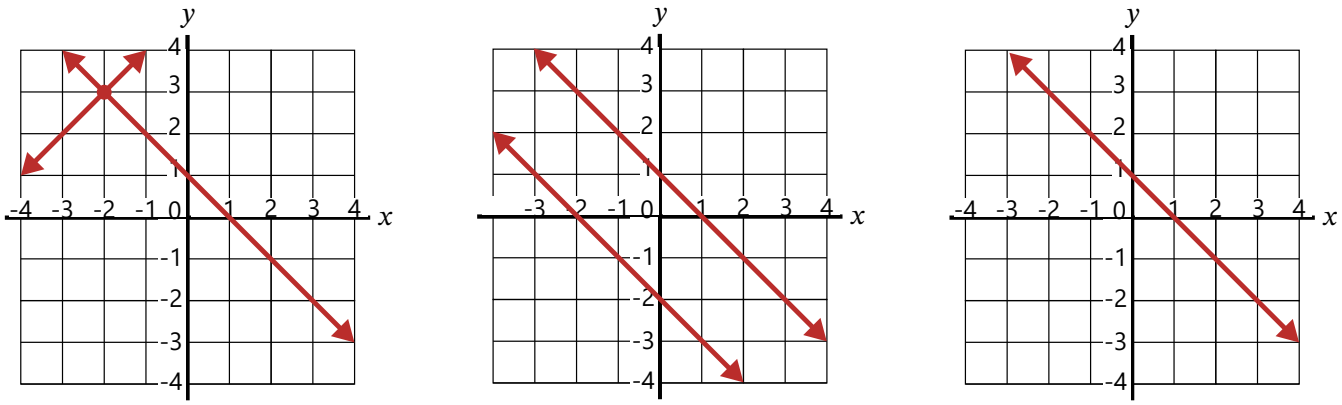
Greater Than	Greater Than or Equal To	Less Than	Less Than or Equal To
$>$	$\geq$	$<$	$\leq$



$y > 2x + 2$	$y \geq 2x + 2$	$y < 2x + 2$	$y \leq 2x + 2$

SYSTEMS OF EQUATIONS

One Solution	No Solutions	Infinitely Many Solutions
$y = -x + 1$ $y = x + 5$	$y = -x + 1$ $y = -x - 2$	$y = -x + 1$ $3y = -3x + 3$



Consistent Independent | *Inconsistent* | *Consistent Dependent*

QUADRATIC EQUATION

An equation where the variable x represents an unknown number, and a, b, and c represent known numbers, where $a \neq 0$

Quadratic Formula: Standard Form

$$ax^2 + bx + c = 0$$

Quadratic Formula: Equivalent Form

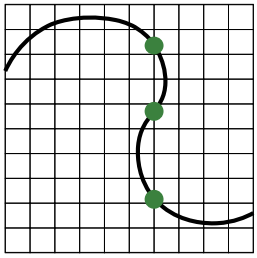
$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

ACT® MATH CRAM SHEET

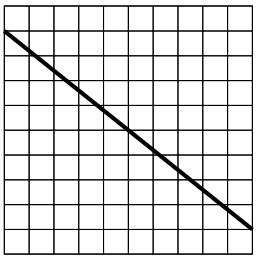
FUNCTIONS

Function	Formula
Constant Functions	$f(x) = b$, where the slope is zero
The Identity Function	$f(x) = x$, where the output value and input value are the same and the line passes through the origin
Linear Functions	$f(x) = mx + b$
The Squaring Function	$f(x) = x^2$, where the vertex is at the origin
Quadratic Functions	$f(x) = ax^2 + bx + c$
Polynomial Functions	$f(x) = a^n x^n + a^{n-1}x^{n-1} + \ldots + a_2x^2 + a_1x + a_0$
Rational Functions	$f(x) = P(x)/Q(x)$, where $p(x)$ and $q(x)$ are polynomials and $q(x) \neq 0$
The Square Root Function	$f(x) = \sqrt{x}$

A function is a relation between a set of inputs and a set of outputs where each input is related to exactly one output.



Not a function



Function

Composites

The composite of two functions f and g, simply means that the output of the second function is used as the input of the first.

$$(f \circ g)(x) = f(g(x))$$
and
$$(g \circ f)(x) = g(f(x))$$

It's important to note that the process is not always commutative like addition or multiplication expressions. It can be commutative, but most often this is not the case.

$f(x) = 5x + 4$	
$f(g(x))$	$= f(x - 2)$
	$= 5(x - 2) + 4$
	$= 5x - 10 + 4$
	$= 5x - 6$

$g(x) = x - 2$	
$g(f(x))$	$= g(5x + 4)$
	$= (5x + 4) - 2$
	$= 5x - 2$

Transformations of Functions

Function Notation	Transformation Types	Coordinate Point Change
$f(x) + d$	vertical translation up d units	$(x,y) \rightarrow (x,y + d)$
$f(x) - d$	vertical translation down d units	$(x,y) \rightarrow (x,y - d)$
$f(x + c)$	horizontal translation left c units	$(x,y) \rightarrow (x - c,y)$
$f(x - c)$	horizontal translation right c units	$(x,y) \rightarrow (x + c,y)$
$-f(x)$	reflect over x-axis	$(x,y) \rightarrow (x,-y)$
$f(-x)$	reflect over y-axis	$(x,y) \rightarrow (-x,y)$

ACT® MATH CRAM SHEET

MATRICES

Matrix Definition
A matrix (plural: matrices) is a rectangular array of numbers or variables, often called elements, which are arranged in columns and rows

Scalar
A number

$$11$$

Vector
A list of numbers

$$\begin{bmatrix} 0 \\ 3 \\ -2 \\ 11 \end{bmatrix} \quad \begin{bmatrix} 1 & 0 & -1 \end{bmatrix}$$

Matrix
An array of numbers

$$\begin{bmatrix} 1 & 0 & -1 \\ 2 & 3 & 4 \\ 0 & -2 & 5 \\ 10 & 11 & 8 \end{bmatrix}$$

Matrix Addition or Subtraction

$$n\begin{bmatrix} a & b \\ c & d \\ e & f \end{bmatrix} \pm \begin{bmatrix} g & h \\ i & j \\ k & l \end{bmatrix} = \begin{bmatrix} a \pm g & b \pm h \\ c \pm i & d \pm j \\ e \pm k & f \pm l \end{bmatrix}$$

Scalar Multiplication

$$n\begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix} = \begin{bmatrix} na & nb & nc \\ nd & ne & nf \end{bmatrix}$$

Matrix Multiplication

$$\begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix}\begin{bmatrix} g & h \\ i & j \\ k & l \end{bmatrix} = \begin{bmatrix} ag + bi + ck & ah + bj + cl \\ dg + ei + fk & dh + ej + fl \end{bmatrix}$$

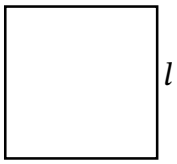
ADDITIONAL FORMULAS

Formula Name	Formula
Simple Interest	$I = Prt$ (I = interest, P = principal, r = rate, t = time)
Distance Formula	$d = rt$ (d = distance, r = rate, t = time)
Total Cost	total cost = (units) × (unit price)
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	$a_n = a_1 + (n\text{-}1)d$ 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

ACT® MATH CRAM SHEET

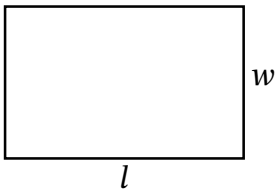
AREA

Square



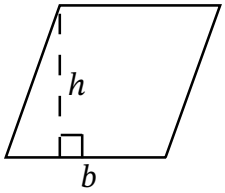
$A = l^2$

Rectangle



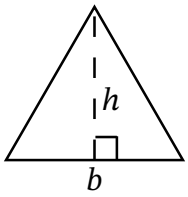
$A = lw$

Parallelogram



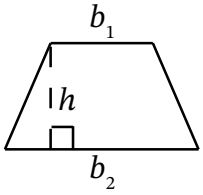
$A = bh$

Triangle



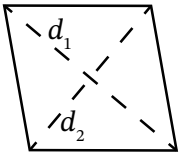
$A = \frac{1}{2}bh$

Trapezoid



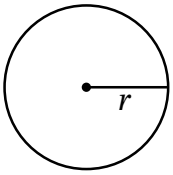
$A = \frac{1}{2}(b_1 + b_2)h$

Rhombus



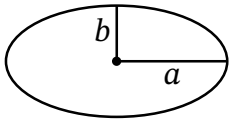
$A = \frac{1}{2}(d_1 \times d_2)$

Circle



$A = \pi r^2$

Ellipse



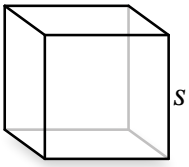
$A = \pi ab$

Perimeter
The sum of all sides of a shape

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

VOLUME AND SURFACE AREA

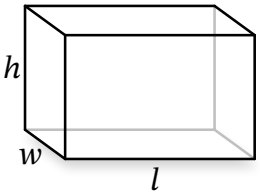
Cube



$V = s^3$

$SA = 6s^2$

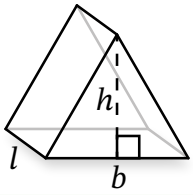
Rectangular Prism



$V = l \times w \times h$

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

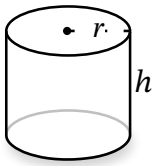
Triangular Prism



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

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

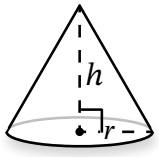
Cylinder



$V = \pi r^2 h$

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

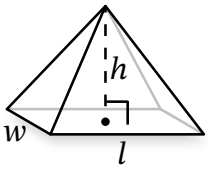
Cone



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

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

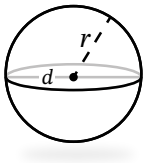
Rectangular Pyramid



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

$SA = lsa + area\ of\ base$

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

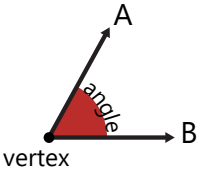
Base
The face of a shape perpendicular to the direction height is measured

ACT® MATH CRAM SHEET

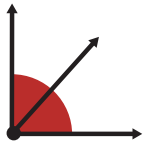
ANGLES

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.



Complementary

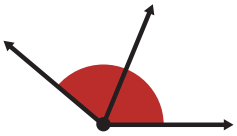


Two angles whose sum is exactly 90°

Supplementary

Two angles whose sum is exactly 180°

Adjacent



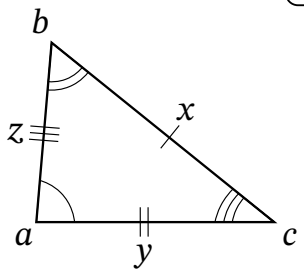
Two angles that have the same vertex and share a side

Vertical

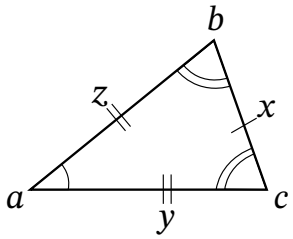
Angles that are not adjacent due to sharing a vertex and have no common side

TRIANGLES

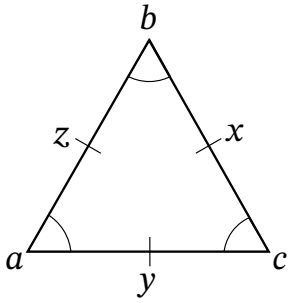
The sum of the interior angles of any triangle is always 180 degrees.



Scalene Triangle
No equal side lengths or angles

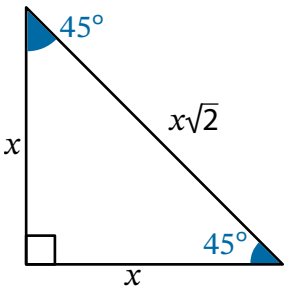


Isosceles Triangle
Two equal side lengths and angles

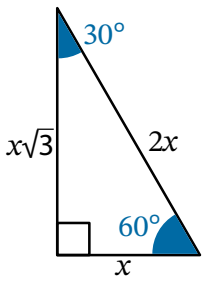


Equilateral Triangle
Three equal side lengths and angles

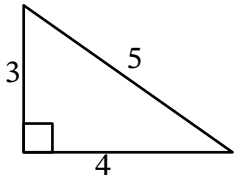
Special Right Triangles



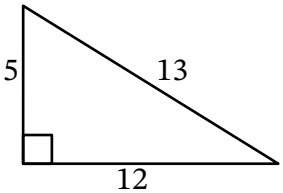
45-45-90



30-60-90



3-4-5



5-12-13

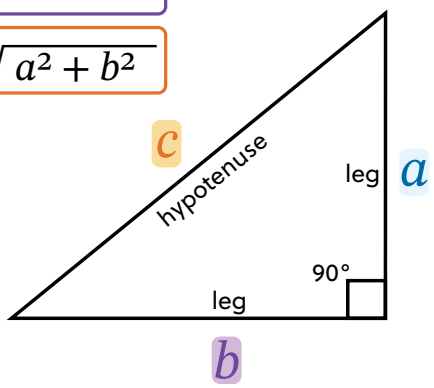
Pythagorean Theorem

$$c^2 = a^2 + b^2$$

$$a = \sqrt{c^2 - b^2}$$

$$b = \sqrt{c^2 - a^2}$$

$$c = \sqrt{a^2 + b^2}$$



ACT® MATH CRAM SHEET

TRIGONOMETRY

SOHCAHTOA

SOH	$\sin(\theta) = \frac{\text{opposite}}{\text{hypotenuse}}$
CAH	$\cos(\theta) = \frac{\text{adjacent}}{\text{hypotenuse}}$
TOA	$\tan(\theta) = \frac{\text{opposite}}{\text{adjacent}}$

CHOSHACAO

CHO	$\csc(\theta) = \frac{\text{hypotenuse}}{\text{opposite}}$
SHA	$\sec(\theta) = \frac{\text{hypotenuse}}{\text{adjacent}}$
CAO	$\cot(\theta) = \frac{\text{adjacent}}{\text{opposite}}$

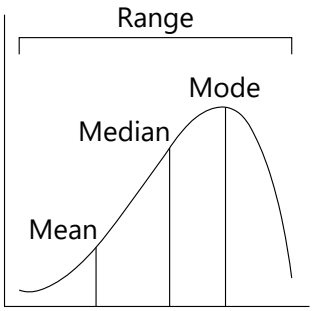
STATISTICS

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

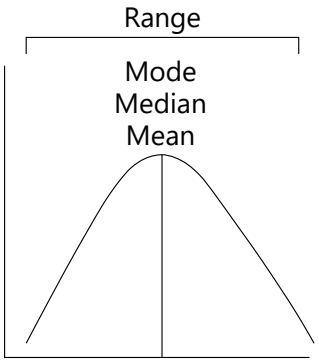
Range (Spread)
Distance between smallest and largest item

Mode
Most/common item

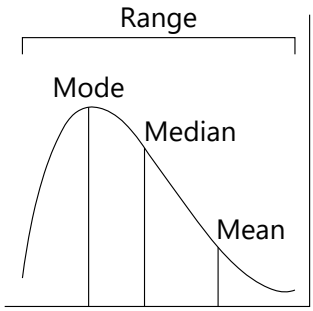
Median
Middle item when ordered from least to greatest



Left Skew (Negative)



Normal Distribution



Right Skew (Positive)

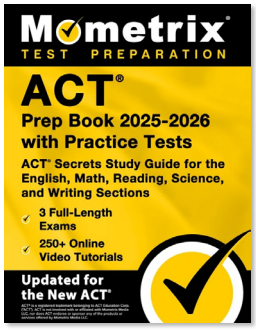
Greater spread equals greater deviation.

Margin of Error
sample statistic ± margin of error with confidence level of XX%

ACT® MATH CRAM SHEET

Need more resources? Scan the QR codes below to check out test prep materials from Mometrix that are specifically designed to help you ace the ACT.

You can also visit https://www.mometrix.com/academy/act-practice-test/ to take a ACT practice test.



ACT Study Guide

ACT Flashcards

1,500+
Practice Questions

300+
Review Videos

80+
Study Lessons

360+
Flashcards