

Mathematics Checklist

Pre-Algebra and Elementary Algebra

Definitions

1. Integers

- A. Integer - An integer is any positive whole number, zero, or its negative equivalent. For example, some integers are -4, -3, -2, -1, 0, 1, 2, 3, and 4.
- B. Positive integer - A positive integer is a whole number greater than zero.
- C. Odd integer - An integer that is not divisible by 2. For example, -3, 5, and 27 are odd integers.
- D. Even integer - An integer that is divisible by 2. Examples of even integers include -18, 2, and 10.
- E. Consecutive integer - Consecutive integers are integers that fall in order. For example, 1, 2, 3, 4, 5 are consecutive integers.
- F. Nonnegative integer - Nonnegative integers include zero and the positive whole numbers.
- G. Digit - Digits include 0, 1, 2, 3, 4, 5, 6, 7, 8, and 9.

2. Fractions

- A. Numerator - In a fraction, the upper portion is the numerator. For instance, in the fraction x/y , x is the numerator.
- B. Denominator - In a fraction, the lower portion is the denominator. In the fraction x/y , y is the denominator.
- C. Common Denominator - A common denominator is any nonzero number that is a multiple of the denominators of both fractions. Common denominators must be established before adding or subtracting fractions.
- D. Remainder - The term remainder refers to the whole number left over when a number is divided into equal sets. For example, when the number 14 is divided into sets of 4, the remainder is 2.

3. Exponents

- A. Exponent - An exponent represents repeated multiplication of the same factor. For example, 3^2 is exponential notation for $3 * 3$. The superscript 2, called the exponent, indicates how many times the number 3, called the base is used as a factor.
- B. Base - The number that is multiplied by itself according to the exponent. For instance, 4 is the base in the term 4^2 .
- C. Power - The term power is another term used to describe the exponent. Three raised to the 4th power can be written as 3^4 .
- D. Reciprocal - Also referred to as the multiplicative inverse, the reciprocal produces a product of 1 when multiplied by the original number. For example, the reciprocal of 5 is $1/5$, and the reciprocal of $2/3$ is $3/2$.

4. Roots

- A. Radical - A symbol that indicates the root of a number. $\sqrt{\quad}$ indicates the positive square root of a number. $\sqrt[3]{\quad}$ indicates a cube root; $\sqrt[4]{\quad}$ indicates a fourth root; and so on.
- B. Square of a Number - The square of a number is the product of the number multiplied by itself. For instance, the square of the number 5 is $5 * 5 = 25$.
- C. Square Root of a Number - The square root of a given number is one of two equal factors of a number. For example, 6 is the square root of 36, because $6 * 6 = 36$. The other square root of 36 is -6 because $-6 * (-6) = 36$.

- D. Cube of a Number - The cube of a given number is the product produced by multiplying the given number by itself three times. For example, the cube of the number 3 is $3 * 3 * 3 = 27$.
- E. Cube Root of a Number - The cube root of a number is one of three equal factors of a number. For instance, 2 is the cube root of 8, because $2 * 2 * 2 = 8$.

5. Average

- A. Average - Also known as the mean, the average of a set of numbers is determined by finding the sum of the numbers in the set and then dividing by the total count of numbers within the original set.
- B. Mean - Equivalent to the average, the mean of a set of numbers is determined by finding the sum of the numbers in the set and then dividing by the total count of numbers within the original set.
- C. Mode - The mode is the value that occurs most often in a set of numbers.
- D. Median - When a set of numbers is arranged in order from smallest to largest (or vice versa), the median is the middle value in the set of numbers.

6. Number Properties

- A. Real Number - A real number is any number that is either rational or irrational.
- B. Rational Number - A rational number is any fraction, x/y , where x and y are integers and y is not equal to zero.
- C. Irrational Number - An irrational number is a real number that cannot be written as a fraction, x/y , where x and y are integers and y is not equal to zero. Examples of irrational numbers include $\sqrt{5}$ and π .
- D. Imaginary Number - For instance, the square root of a negative number is considered to be an imaginary number.
- E. Factor - A number that can be divided into another specific number without a remainder. For example, 3 is a factor of 12 because $12/3 = 4$.
- F. Divisor - A quantity by which a number is being divided. For example, 4 is the divisor in the following example: $8/4 = 2$.
- G. Prime Factor - A prime factor is a prime number that can be divided into another number without a remainder.
- H. Prime Number - A prime number is a whole number greater than 1, that can be divided only by itself and the number 1. Examples of prime numbers include 2, 3, 5, 7, 11, and 13.
- I. Multiple - A multiple of a specific number is the number that emerges when the given number is multiplied by an integer. For example, 8 is a multiple of 4, because $4 * 2 = 8$.
- J. Least Common Multiple - The least common multiple is the smallest number that is a multiple of two or more numbers. For instance, common multiples of 2 and 5 include 10, 20, 30, and 40. The least common multiple of 2 and 5 is 10.
- K. Greatest Common Factor - The greatest common factor of two numbers is the largest number that is a factor of both numbers. For example, 7 is the greatest common factor of 14 and 21.

7. Probability

- A. Probability of an event - The probability of an event is the likelihood that the specific event will, in fact, occur. A probability takes on values that are greater than or equal to zero and less than or equal to one.

Laws and Formulas

Order of Operations

- (1) All work inside parentheses.
- (2) All work involving powers.
- (3) All multiplication and division from left to right.
- (4) All addition and subtraction from left to right.

Laws of Exponents

$$(x^a)(x^b) = x^{a+b}$$

$$x^a/x^b = x^{a-b}$$

$$(x^a)^b = x^{ab}$$

$$(xy)^a = x^a y^a$$

$$(x/y)^a = x^a/y^a$$

Laws of Square Roots—X and Y are positive or zero

$$(\sqrt{x})(\sqrt{y}) = \sqrt{xy}$$

$$\sqrt{x}/\sqrt{y} = \sqrt{x/y}$$

Intermediate Algebra and Coordinate Geometry

Definitions

1. Intermediate Algebra

- A. Absolute value - The absolute value of a number x is written as $|x|$. The absolute value of a negative number is its positive equivalent. For example, the absolute value of -10 is 10.
- B. Inequality - An inequality is an expression relating two quantities that are not equal. For example, $7x < 5$ is an inequality. Inequalities are written as less than ($<$), less than or equal to (\leq), greater than ($>$), or greater than or equal to (\geq).
- C. Negative Exponent - A negative exponent indicates that the base, raised to the absolute value of the original power, should be placed in the denominator of the factor. For example, $2^{-3} = 1/2^3$
- D. Zero Exponent - Any number raised to a zero exponent is equal to 1, by definition. For instance, $24^0 = 1$.
- E. Minimum Value of an Equation - The minimum value of an equation is the equation's lowest possible value.
- F. Maximum Value of an Equation - The maximum value of an equation is the equation's highest possible value.
- G. Factors of an Equation - Factors of an equation are terms that, when multiplied together, produce the original equation.
- H. Quadratic Equation -
$$\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

2. Coordinate Geometry

- A. Slope - The slope of a line is the change in the y value (also known as the rise) divided by the change in the x value (known as the run).
- B. Y-Intercept - The y-intercept is the y-value where a given line crosses the y-axis.
- C. Slope-Intercept Form of a Straight Line - Slope-intercept form of a straight line is written as $y = mx + b$, where m is the slope of the line and b is the y-intercept.
- D. Origin - The origin is the point on the coordinate plane where both x and y are equal to zero. The origin is the point where the x and y axes intersect.
- E. Distance between two points - The distance between two points can be found using the equation $\sqrt{(x_1 - x_2)^2 + (y_1 - y_2)^2}$.
- F. Circle - A circle is a set of points on a plane that are each a specific distance from a given point. The equation for a circle is $(x - h)^2 + (y - k)^2 = r^2$, where (h, k) is the center of the circle and r is the length of the circle's radius.
- G. Parabola - A parabola is a quadratic function of the form $y = ax^2 + bx + c$, where the a-term does not equal zero.
- H. Ellipse - An ellipse is described by the equation $x^2/a^2 + y^2/b^2 = 1$. In this equation, the x-intercepts are $\pm\sqrt{a}$ and the y-intercepts are $\pm\sqrt{b}$.

Laws and Formulas

Point A (x_1, y_1) and Point B (x_2, y_2)

Slope of the line (m) passing through Point A and Point B:

$$m = \frac{y_2 - y_1}{x_2 - x_1}$$

Slope intercept form of a straight line:

$$y = mx + b \text{ where slope} = m \text{ and y-intercept} = b$$

Midpoint C(x, y) of Point A and Point B has coordinates as follows:

$$x = (x_1 + x_2)/2 \text{ and } y = (y_1 + y_2)/2$$

Plane Geometry and Trigonometry

Definitions

1. Lines and Angles

- A. Acute angle - An acute angle measures between 0° and 90° .
- B. Obtuse angle - An obtuse angle measures between 90° and 180° .
- C. Complementary angle - A complementary angle completes a 90° -degree angle. For example, a 40° -degree angle is complementary to a 50° -degree angle because, together, they sum to a 90° -degree angle.
- D. Supplementary angle - A supplementary angle completes a 180° -degree or straight angle. For example, a 60° -degree angle is supplementary to a 120° -degree angle because together, they sum to a 180° -degree angle.
- E. Vertical angle - A vertical angle is formed by the intersection of two lines.
- F. Bisect an angle - To bisect an angle is to divide the angle into two equal angles. For example, bisecting a 90° angle would produce two 45° angles.
- G. Perpendicular Line - A perpendicular line is a line that meets another line at a perpendicular or 90° angle.

2. Parallel Lines

- A. Parallel Lines - Parallel lines are lines that have the same slope.
- B. Transversal - A transversal is a straight line that intersects other straight lines in different points.
- C. Alternate interior angles - When two parallel lines are cut by a transversal, opposite or alternate interior angles are of the same measure.

3. Triangles

- A. Area - The area of a triangle is found by multiplying the length of the triangle's base by half of the triangle's height. The equation for the area of a triangle may be written as: $A = (1/2)bh$, where b is the base measure and h is the triangle's height.
- B. Base - The base of a triangle may be any of the triangle's sides.
- C. Height or altitude - The height of a triangle is the perpendicular distance from the base of the triangle to the vertex opposite the base.
- D. Equilateral - An equilateral triangle has three sides of equal length. Additionally, all three angles measure 60° .
- E. Isosceles - An isosceles triangle has two sides of equal length.
- F. Right Triangle - A right triangle has a 90° angle.
- G. Hypotenuse - The hypotenuse is the longest side of a right triangle. The hypotenuse is always across from the triangle's right angle.
- H. Leg - A triangle's leg is one of the two sides that meets the base.
- I. Congruent triangles - Congruent triangles are triangles that are the same size and shape, having equal side and angle measures.
- J. Perimeter - The distance around the triangle, found by adding the three side lengths together.

4. Quadrilaterals

- A. Quadrilateral - A quadrilateral is a 4-sided closed figure or a 4-sided polygon.
- B. Parallelogram - A parallelogram is a quadrilateral with opposite sides being parallel and of equal length.
- C. Rectangle - A rectangle is a parallelogram with 4 right angles.
- D. Square - A square is a rectangle with 4 sides of equal length.

- E. Diagonal - A diagonal is a line that extends between two opposite angles of a quadrilateral.
- F. Area - The formula for the area of a quadrilateral is $A = bh$, where b is the length of the base and h is figure's height, perpendicular to the base.
- G. Perimeter - The perimeter of a quadrilateral is the distance around the outline of the figure. The perimeter may be found by adding the lengths of each of the four sides constituting the quadrilateral.

5. Circles

- A. Arc - An arc is a portion of the actual circle extending from one point on the circle to another point on the circle. An example of an arc would be a semicircle.
- B. Center - The center of a circle is the point in the middle of the circle that is equidistant from every point along the circle.
- C. Chord - A chord is a line segment that extends through the circle and has two endpoints on the circle.
- D. Circumference - The circumference is the distance around a circle. The equation for circumference is $C = 2\pi r$, where r is the length of the circle's radius.
- E. Diameter - The diameter of a circle is the longest possible chord, passing through the circle's center. The diameter is twice the length of the radius.
- F. Radius - The radius is the line segment that extends from the circle's center to any point along the circle. The radius is half the length of the diameter.
- G. Semi-Circle - A semi-circle is half of a circle, formed by dividing the circle along its diameter.
- H. Pi - Constant for every circle, pi is the ratio of the circumference of a circle to the circle's diameter. Pi is designated as π and is equal in value to $22/7$. Pi may typically be estimated as 3.14.
- I. Tangent to a circle - A line that is tangent to a circle is a line that meets the given point on the circle, forming a 90° angle with the circle's radius.

6. Other Figures

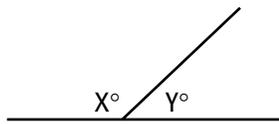
- A. Cube - A cube is a 3-dimensional figure with 6 congruent, square faces.
- B. Rectangular solid - A rectangular solid is a 3-dimensional figure formed by 6 rectangles coming together at 90° angles.
- C. Volume - Volume is the measure of the amount of space filled by a 3 dimensional figure.
- D. Polygon - A polygon is a closed figure made up of line segments. Examples of polygons include triangles and quadrilaterals.

7. Trigonometry

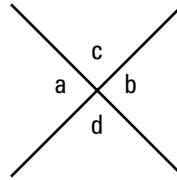
- A. Sine - The sine of an angle is equal to the length of the angle's opposite side divided by the length of the hypotenuse. The sine of angle x is typically abbreviated as $\sin x$.
- B. Cosine - The cosine of an angle is equal to the length of the side adjacent to the angle divided by the length of the hypotenuse. The cosine of angle x is typically abbreviated as $\cos x$.
- C. Tangent - The tangent of an angle is equal to the length of the angle's opposite side divided by the length of the side adjacent to the angle. The tangent of angle x is typically abbreviated as $\tan x$.
- D. Secant - The secant of an angle is equal to the inverse of the angle's cosine. The secant of angle x is typically abbreviated as $\sec x$.
- E. Cosecant - The cosecant of an angle is equal to the inverse of the angle's sine. The cosecant of angle x is typically abbreviated as $\csc x$.
- F. Cotangent - The cotangent of an angle is equal to the inverse of the angle's tangent. The cotangent of angle x is typically abbreviated as $\cot x$.

Laws and Formulas

Straight Lines



$$x^\circ + y^\circ = 180^\circ$$

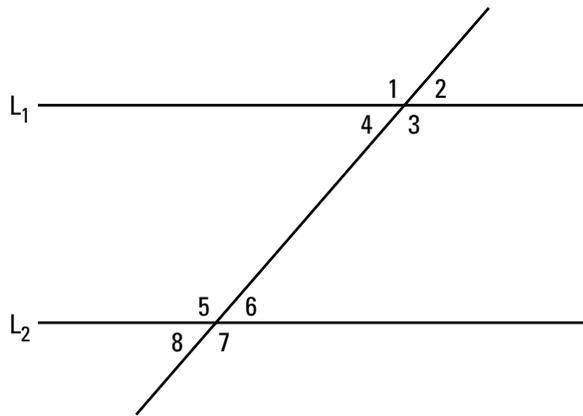


Vertical Angles

$$a = b$$

$$c = d$$

Parallel Lines



$$L_1 \parallel L_2$$

$$1=3=5=7$$

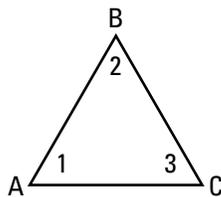
$$2=4=6=8$$

Triangles

The sum of the three angles of any triangle equals 180° .

$$\text{Area} = 1/2 (\text{base})(\text{height}), A = 1/2 b h$$

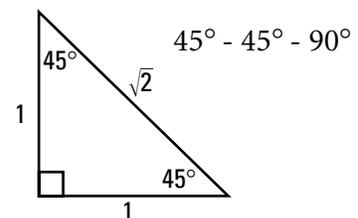
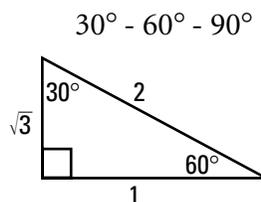
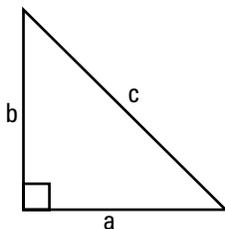
Isosceles



$$AB = BC$$

$$\text{Angle } 1 = \text{Angle } 3$$

Right Triangle



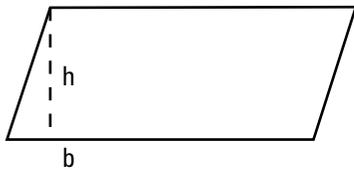
$$\text{Area} = 1/2 (\text{base})(\text{height}) = 1/2 a b$$

$$\text{Pythagorean Theorem: } a^2 + b^2 = c^2$$

Quadrilaterals

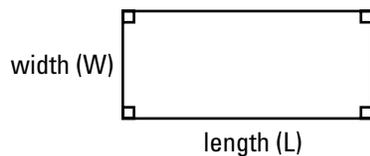
The sum of the four angles of any quadrilateral equals 360° .

Parallelogram



$$\text{Area} = bh$$

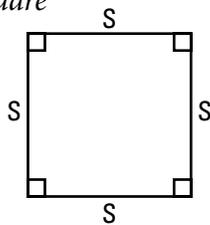
Rectangle



$$\text{Perimeter (P)} = 2L + 2W$$

$$\text{Area (A)} = LW$$

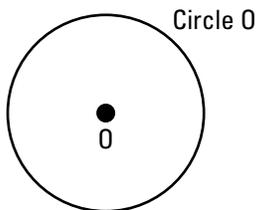
Square



$$\text{Perimeter (P)} = 4S$$

$$\text{Area (A)} = S^2$$

Circles



$$\text{Circumference (C)} = 2\pi r = \pi d$$

$$\text{Area (A)} = \pi r^2$$

Entire circle measures 360°

Semi-circle measures 180°

Solids

Rectangular Solid

$$\text{Volume} = LWH$$

Cube

$$\text{Volume} = S^3$$

Trigonometry

Right triangles may be solved by trigonometric means by interpreting the definitions as ratios of the lengths of the sides.

$$\sin A = \frac{\text{length of side opposite } A}{\text{length of hypotenuse}}$$

$$= \frac{\text{opp}}{\text{hyp}}$$

$$\cos A = \frac{\text{length of side adjacent to } A}{\text{length of hypotenuse}}$$

$$= \frac{\text{adj}}{\text{hyp}}$$

$$\tan A = \frac{\text{opp}}{\text{adj}}$$

$$\csc A = \frac{\text{hyp}}{\text{opp}}$$

$$\sec A = \frac{\text{hyp}}{\text{adj}}$$

$$\cot A = \frac{\text{adj}}{\text{opp}}$$

