Algebra I

**Vocabulary Word Wall Cards**

Mathematics vocabulary word wall cards provide a display of mathematics content words and associated visual cues to assist in vocabulary development. The cards should be used as an instructional tool for teachers and then as a reference for all students. **The cards are designed for print use only.**

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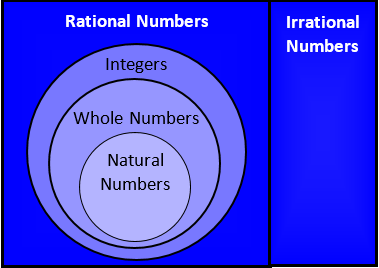
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Real Numbers

The set of all rational and irrational numbers



|  |  |
| --- | --- |
| **Natural Numbers** | {1, 2, 3, 4 …} |
| **Whole Numbers** | {0, 1, 2, 3, 4 …} |
| **Integers** | {… -3, -2, -1, 0, 1, 2, 3 …} |
| **Rational Numbers** | the set of all numbers that can be written as the ratio of two integers with a non-zero denominator  (e.g., , -5, , , ) |
| **Irrational Numbers** | the set of all nonrepeating, nonterminating decimals  (e.g, , , -.23223222322223…) |

# Absolute Value

|5| = 5 |-5| = 5

-6 -5 -4 -3 -2 -1 0 1 2 3 4 5 6

**5 units**

**5 units**

The distance between a number

and zero

# Order of Operations

|  |  |
| --- | --- |
| Grouping Symbols | ( )  { }  [ ] |
| Exponents | *an* |
| Multiplication  Division | **Left to Right** |
| Addition  Subtraction | **Left to Right** |

# Expression

A representation of a quantity that may contain numbers, variables or operation symbols

*x*

-

34 + 2*m*

*ax*2 + *bx* + *c*

3(*y* + 3.9)2 –

# Variable

2(*y* + )

9 + *x* = 2.08

*d* = 7*c* - 5

*A* = π *r* 2

# Coefficient

(-4) + 2*x*

-7

*ab* –

π*r*2

# Term

3*x* + 2*y* – 8

3 terms

-5*x*2 – *x*

2 terms

*ab*

1 term

# Scientific Notation

*a* x 10*n*

and *n* is an integer

Examples:

|  |  |
| --- | --- |
| Standard Notation | Scientific Notation |
| 17,500,000 | 1.75 x 107 |
| -84,623 | -8.4623 x 104 |
| 0.0000026 | 2.6 x 10-6 |
| -0.080029 | -8.0029 x 10-2 |
| (4.3 x 105) (2 x 10-2) | (4.3 x 2) (105 x 10-2) =  8.6 x 105+(-2) = 8.6 x 103 |
|  | = |

# Exponential Form

exponent

*an*= *a∙a∙a∙a*…, *a*≠0

*n* factors

base

Examples:

|  |
| --- |
| 2 ∙ 2 ∙ 2 = 23 = 8 |
| *n* ∙ *n* ∙ *n* ∙ *n* = *n*4 |
| 3∙3∙3∙x∙x = 33x2 = 27x2 |

# Negative Exponent

*a-n* = , *a* ≠ 0

Examples:

|  |
| --- |
| 4-2 = = |
| = = = |
| (2 – *a*)-2 = , *a* |

# Zero Exponent

*a*0 = 1, *a* ≠ 0

Examples:

|  |
| --- |
| (-5)0 = 1 |
| (3*x* + 2)0 = 1 |
| (*x*2*y-*5*z*8)0 = 1 |
| 4*m*0 = 4 ∙ 1 = 4 |
|  |

# Product of Powers Property

*am*∙ *a*n = *am + n*

Examples:

|  |
| --- |
| *x*4 ∙ *x*2= *x*4+2 = *x*6 |
| *a*3 ∙ *a* = *a*3+1 = *a*4 |
| *w*7 ∙ *w*-4= *w*7 + (-4) = *w*3 |

# Power of a Power Property

(*am*)*n* = *am* ***·*** *n*

Examples:

(*y*4)2 = *y*4∙2 = *y*8

(*g*2)-3 = *g*2∙(-3) = *g*-6 =

# Power of a Product Property

(*ab*)*m* = *am* · *bm*

Examples:

(-3*a*4*b*)2 = (-3)2∙(*a*4)2∙*b*2 = 9*a*8*b*2

# = = Quotient of Powers Property

= *am – n*, *a* ≠0

Examples:

= = = *x*

= = *y*2

= *a*4-4 = *a*0 = 1

# Power of Quotient Property

= *b*≠0

Examples:

= =

= = = ∙ = =

# Polynomial

|  |  |  |
| --- | --- | --- |
| **Example** | **Name** | **Terms** |
| 7  6*x* | monomial | 1 term |
| 3*t* – 1  12*xy*3 + 5*x*4*y* | binomial | 2 terms |
| *2x*2 + 3*x* – 7 | trinomial | 3 terms |

|  |  |
| --- | --- |
| **Nonexample** | **Reason** |
| 5*mn* – 8 | variable exponent |
| *n*-3 + 9 | negative exponent |

# Degree of a Polynomial

|  |  |  |
| --- | --- | --- |
| Polynomial | Degree of  Each Term | Degree of Polynomial |
| -7*m*3*n*5 | -7*m*3*n*5  degree 8 | 8 |
| 2*x*+ 3 | 2*x* degree 1  3 degree 0 | 1 |
| 6*a*3 + 3*a*2*b*3 – 21 | 6*a*3 degree 3  3*a*2*b*3 degree 5  -21 degree 0 | 5 |

The largest exponent or the largest sum of exponents of a term within a polynomial

# Leading Coefficient

The coefficient of the first term of a polynomial written in descending order of exponents

Examples:

7*a*3 – 2*a*2 + 8*a* – 1

-3*n*3 + 7*n*2 – 4*n* + 10

16*t* – 1

# Add Polynomials

(Group Like Terms – Horizontal Method)

Example:

(2*g*2 + 6*g* – 4) + (*g*2 – *g*)

= 2*g*2 + 6*g* – *4* + *g*2 – *g*

(Group like terms and add)

= (2g2 + g2) + (6g – g) – 4

= 3g2 + 5g – 4

# Add Polynomials

(Align Like Terms –   
Vertical Method)

Example:

(2*g*3 + 6*g2* – 4) + (*g*3 – *g* – 3)

(Align like terms and add)

2*g*3 + 6*g*2 – 4

+  *g*3 – *g* – 3

# 3*g*3 + 6*g*2 – *g* – 7Subtract Polynomials

(Group Like Terms - Horizontal Method)

Example:

(4*x*2 + 5) – (-2*x*2 + 4*x* -7)

(Add the inverse.)

= (4*x*2 + 5) + (2*x*2 – 4x +7)

= 4*x*2 + 5 + 2x2 – 4*x* + 7

(Group like terms and add.)

= (4*x*2 + 2*x*2) – 4*x* + (5 + 7)

= 6x2 – 4*x* + 12

# Subtract Polynomials

(Align Like Terms -

Vertical Method)

Example:

(4*x*2 + 5) – (-2*x*2 + 4*x* -7)

(Align like terms then add the inverse   
and add the like terms.)

4*x*2 + 5 4*x*2 + 5

–(-2*x*2  + 4*x* – 7) + 2*x*2 – 4*x* + 7

6*x*2 – 4*x* + 12

# Multiply Binomials

Apply the distributive property.

(*a* + *b*)(*c* + *d*) =

*a*(*c* + *d*) + *b*(*c* + *d*) =

*ac* + *ad* + *bc* + *bd*

Example: (*x* + 3)(*x* + 2)

= (*x* + 3)(*x* + 2)

= *x*(*x* + 2) + 3(*x* + 2)

= x2 + 2*x* + 3*x* + 6

= *x*2 + 5*x* + 6

# Multiply Polynomials

Apply the distributive property.

(*x* + 2)(3*x*2 + 5*x* +1)

(*x* + 2)( 3*x*2 + 5*x* +1)

= *x*(3*x*2 + 5*x* +1) + 2(3*x*2 + 5*x* +1)

= *x*·3*x*2 + *x*·5*x* + *x*·1 + 2·3*x*2 + 2·5*x* + 2·1

= 3*x*3 + 5*x*2 + *x* + 6*x*2 + 10*x* + 2

= 3*x*3 + 11*x*2 + 11*x* + 2

Multiply Binomials

(Model)

Apply the distributive property.

Example: (*x* + 3)(*x* + 2)

*x* + 3

*x* + 2

1 =

*x* =

Key:

*x*2 =

*x*2 + 2*x* + 3*x* + = *x*2 + 5*x* + 6

6

# Multiply Binomials

(Graphic Organizer)

Apply the distributive property.

Example: (*x* + 8)(2*x* – 3)

= (*x* + 8)(2*x* + -3)

2*x* + -3

*x* + 8

|  |  |
| --- | --- |
| 2*x*2 | -3*x* |
| 16*x* | -24 |

2*x*2 + 16*x* + -3*x* + -24 = 2*x*2 + 13*x* – 24

# Multiply Binomials

(Squaring a Binomial)

(*a* **+** *b*)2 = *a*2 **+** **2***ab* + *b*2

(*a* **–** *b*)2 = *a*2 **–** **2***ab* + *b*2

Examples:

(3*m* + *n*)2 = 9*m*2 **+ 2**(3*m*)(*n*) + *n*2

= 9*m*2 + 6*mn* + *n*2

(*y* – 5)2 = *y*2 **– 2**(5)(*y*) + 25

= *y*2 – 10*y* + 25

# Multiply Binomials

# (Sum and Difference)

(*a* + *b*)(*a* – *b*) = *a*2 – *b*2

Examples:

(2*b* + 5)(2*b* – 5) = 4*b*2 – 25

(7 – *w*)(7 + *w*) = 49 – *w*2

# Factors of a Monomial

The number(s) and/or variable(s) that are multiplied together to form a monomial

|  |  |  |
| --- | --- | --- |
| **Examples:** | **Factors** | **Expanded Form** |
| 5*b*2 | 5∙*b2* | 5∙*b∙b* |
| 6*x*2*y* | 6∙*x*2∙*y* | 2∙3∙*x∙x∙y* |
|  | ∙*p*2∙*q*3 | ·(-5)∙*p∙p*∙*q∙q∙q* |

# Factoring

# (Greatest Common Factor)

Find the greatest common factor (GCF) of all terms of the polynomial and then apply the distributive property.

Example: 20*a*4 + 8*a*

2 ∙ 2 ∙ 5 ∙ *a ∙ a ∙ a ∙ a* + 2 ∙ 2 ∙ 2 ∙ *a*

common factors

GCF = 2 ∙ 2 ∙ a = 4*a*

20*a*4 + 8*a* = 4*a*(5*a*3+ 2)

# Factoring

# (By Grouping)

For trinomials of the form

# Example:

ac = 3 • 4 = 12

Find factors of ac that add to equal b

12 = 2 • 6 2 + 6 = 8

Factor out a common binomial

Group factors

Rewrite as +

# Factoring

# (Perfect Square Trinomials)

*a*2 **+ 2***ab* + *b*2 = (*a* **+** *b*)2

*a*2 **– 2***ab*+ *b*2 = (*a* **–** *b*)2

Examples:

*x*2 **+** 6*x* +9 = *x*2 **+ 2**∙3∙*x* +32

= (*x* **+** 3)2

4*x*2 **–** 20*x* + 25 = (2*x*)2 **– 2**∙2*x*∙5 + 52 = (2*x* **–** 5)2

# Factoring

# (Difference of Squares)

*a*2 – *b*2 = (*a* + *b*)(*a* – *b*)

Examples:

*x*2 – 49= *x*2 – 72 = (*x* + 7)(*x* – 7)

4 – *n*2 = 22 – *n*2 = (2 – *n*) (2 + *n*)

9*x*2 – 25*y*2 = (3*x*)2 – (5*y*)2

= (3*x* + 5*y*)(3*x* – 5*y*)

# Difference of Squares (Model)

*a*2 – *b*2 = (*a* + *b*)(*a* – *b*)

*b*

*a*

*a*

*b*

*a*2 – *b*2

*a*(*a* – *b*)+ *b*(*a* – *b*)

(*a + b*)(*a* – *b*)

*b*

*a*

*a – b*

*a – b*

*a* + *b*

*a – b*

# Divide Polynomials

(Monomial Divisor)

Divide each term of the dividend by the monomial divisor

Example:

(12*x*3 – 36*x*2 + 16*x*) ÷ 4*x*

=

= +

= 3*x*2 – 9*x* + 4

# Divide Polynomials (Binomial Divisor)

Factor and simplify

Example:

(7*w*2 + 3*w* – 4) ÷ (*w* + 1)

=

=

= 7*w* – 4

# Square Root

radical symbol

radicand or argument

Simplify square root expressions.

Examples:

= = = 3*x*

- = -(*x* – 3) = -*x* + 3

Squaring a number and taking a square root are inverse operations.

# Cube Root

index

radicand or argument

radical symbol

Simplify cube root expressions.

Examples:

= = 4

= = -3

= *x*

Cubing a number and taking a cube root are inverse operations.

# Simplify Numerical Expressions Containing

Square or Cube Roots

Simplify radicals and combine like terms where possible.

Examples:

# Add and Subtract Monomial Radical Expressions

Add or subtract the numerical factors of the like radicals.

Examples:

|  |
| --- |
|  |
|  |
|  |

# Product Property of Radicals

The nth root of a product equals

the product of the nth roots.

*a* ≥ 0 and *b* ≥ 0

Examples:

|  |
| --- |
| = ∙ = 2 |
| = ∙ = *a* |
| = = ∙ = 2 |

# Quotient Property

of Radicals

The nth root of a quotient equals the quotient of the nth roots of the numerator and denominator.

*a* ≥ 0 and *b* ˃ 0

Example:

= = , *y* ≠ 0

# Zero Product Property

If *ab* = 0,

then *a* = 0 or *b* = 0.

Example:

(*x* + 3)(*x* – 4) = 0

(*x* + 3) = 0 or (*x* – 4) = 0

*x* = -3 or *x* = 4

The solutions or roots of the polynomial equation are -3 and 4.

# Solutions or Roots

*x*2 + 2*x* = 3

Solve using the zero product property.

*x*2 + 2*x* – 3 = 0

(*x* + 3)(*x* – 1) = 0

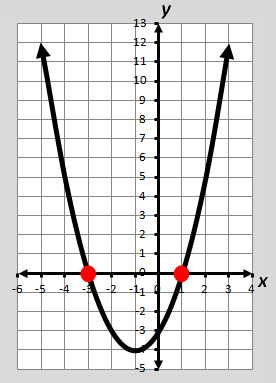
*x* + 3 = 0 or *x* – 1 = 0

*x* = -3 or *x* = 1

The solutions or roots of the polynomial equation are -3 and 1.

# Zeros

The zeros of a function *f*(x) are the values of x where the function is equal to zero.



*f(x)* = *x*2 + 2*x* – 3

Find *f*(*x*) = 0.

0 = *x*2 + 2*x* – 3

0 = (*x* + 3)(*x* – 1)

*x* = -3 or *x* = 1

The zeros of the function *f(x)* = *x*2 + 2*x* – 3   
are -3 and 1 and are located at the   
*x*-intercepts (-3,0) and (1,0).

The zeros of a function are also the solutions or roots of the related equation.

# *x*-Intercepts

The *x*-intercepts of a graph are located where the graph crosses the x-axis and where *f*(*x*) = 0.

*f(x)* = *x*2 + 2*x* – 3

0 = (*x* + 3)(*x* – 1)

0 = *x* + 3 or 0 = *x* – 1

*x* = -3 or *x* = 1

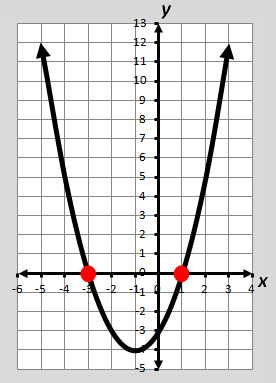
The zeros are -3 and 1.

The *x*-intercepts are:

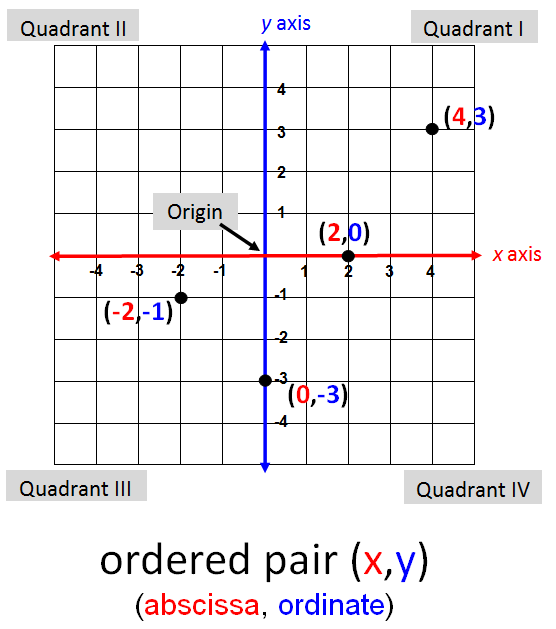
-3 or (-3,0)

and

1 or (1,0)



# Coordinate Plane



# Literal Equation

A formula or equation that consists primarily of variables

Examples:

*Ax* + *By* = *C*

*A* =

*V* = *lwh*

*F* = *C* + 32

# *A =* π*r2*Vertical Line

*x* = *a*

(where *a* can be any real number)

Example: *x* = -4

***y***

***x***

# Horizontal Line

Vertical lines have undefined slope.

*y* = *c*

(where *c* can be any real number)

Example: *y* = 6

***y***

***x***

# 

Horizontal lines have a slope of 0.

# Quadratic Equation

(Solve by Factoring)

*ax*2 + *bx* + *c* = 0

*a* **≠** 0

Example solved by factoring:

|  |  |
| --- | --- |
| *x*2 – 6*x* + 8 = 0 | Quadratic equation |
| (*x* – 2)(*x* – 4) = 0 | Factor |
| (*x* – 2) = 0 or (*x* – 4) = 0 | Set factors equal to 0 |
| *x* = 2 or *x* = 4 | Solve for x |

Solutions to the equation are 2 and 4.

Solutions are {2, 4}

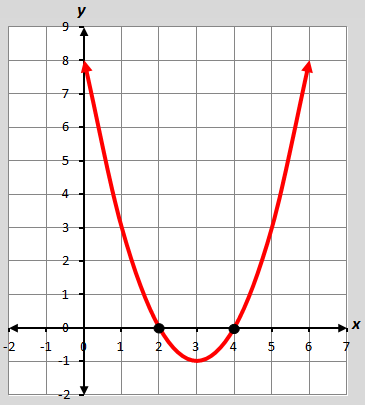
# Quadratic Equation

(Solve by Graphing)

*ax*2 + *bx* + *c* = 0

*a* ≠ 0

Examplesolved by graphing:

*x*2 – 6*x* + 8 = 0

Quadratic Equation

Solutions to the equation are the *x*-coordinates

{2, 4} of the points where the function crosses the *x*-axis.

Graph the related function

*f*(*x*) = *x*2 – 6*x* + 8.

(Number/Type of Real Solutions)

*ax*2 + *bx* + *c* = 0, *a* **≠** 0

|  |  |  |
| --- | --- | --- |
| **Examples** | **Graph of the related function** | **Number and Type of Solutions/Roots** |
| *x*2 – *x* = 3 |  | **2 distinct Real roots**  (crosses *x*-axis twice) |
| *x*2 + 16 = 8*x* |  | **1 distinct Real root with a multiplicity of two (double root)**  (touches *x*-axis but does not cross) |
| *x*2 – 2*x* + 3 = 0 |  | **0 Real roots** |

# Inequality

An algebraic sentence comparing two quantities

|  |  |
| --- | --- |
| **Symbol** | **Meaning** |
| < | less than |
| **≤** | less than or equal to |
| **>** | greater than |
| **≥** | greater than or equal to |
| **≠** | not equal to |

Examples: -10.5 ˃ -9.9 – 1.2

8 < 3*t* + 2

*x* – 5*y* ≥ -12

x ≤ -11

*r* **≠** 3

# Graph of an Inequality

|  |  |  |
| --- | --- | --- |
| **Symbol** | **Example** | **Graph** |
| < ; **>** | *x* < 3 |  |
| **≤** ; **≥** | -3 **≥** *y* |  |
| **≠** | *t* **≠** -2 |  |

# Transitive Property of Inequality

|  |  |
| --- | --- |
| If | Then |
| *a* **<** *b* and *b* **<** *c* | *a* **<** *c* |
| *a* **>** *b* and *b* **>** *c* | *a* **>** *c* |

Examples:

If 4*x* < 2*y* and 2*y* < 16,

then 4*x* < 16.

If *x* > *y* – 1 and *y* – 1 > 3,

then *x* > 3.

# Addition/Subtraction Property of Inequality

|  |  |
| --- | --- |
| If | Then |
| *a* > *b* | *a* + *c* > *b* + *c* |
| *a* **≥** *b* | *a* + *c* **≥** *b* + *c* |
| *a* < *b* | *a* + *c* < *b* + *c* |
| *a* **≤** *b* | *a* + *c* **≤** *b* + *c* |

Example:

*d* – 1.9 **≥** -8.7

*d* – 1.9 + 1.9 **≥** -8.7 + 1.9

# *d* **≥** -6.8Multiplication Property of Inequality

|  |  |  |
| --- | --- | --- |
| **If** | **Case** | **Then** |
| *a* < *b* | *c* > 0, positive | *a*c **<** *bc* |
| *a* > *b* | *c* > 0, positive | *ac* **>** *bc* |
| *a* < *b* | *c* < 0, negative | *ac* **>** *bc* |
| *a* > *b* | *c* < 0, negative | *ac* **<** *bc* |

Example: If *c* = -2

5 > -3

5(-2) < -3(-2)

-10 < 6

# Division Property of Inequality

|  |  |  |
| --- | --- | --- |
| **If** | **Case** | **Then** |
| *a* < b | *c* > 0, positive | **<** |
| *a* > b | *c* > 0, positive | **>** |
| *a* < b | *c* < 0, negative | **>** |
| *a* > b | *c* < 0, negative | **<** |

Example: If *c* = -4

-90 **≥** -4*t*

**≤**

# 22.5 **≤** *t*Linear Equation

(Standard Form)

*Ax* + *By* = *C*

(*A*, *B* and *C* are integers; *A* and *B* cannot both equal zero)

***y***

Example:

-2*x* + *y* = -3

***x***

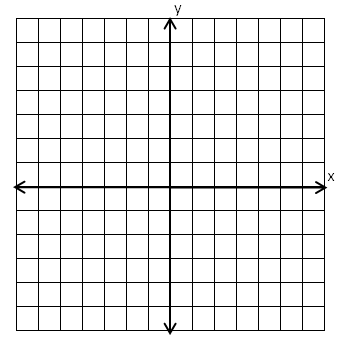
# The graph of the linear equation is a straight line and represents all solutions (*x, y*) of the equation.

# Linear Equation (Slope-Intercept Form)

*y* = *mx* + *b*

(slope is *m* and *y*-intercept is *b*)

Example: *y* = *x* + 5



**(0,5)**

**-4**

**3**

*m* =

*b* = 5

# Linear Equation (Point-Slope Form)

*y* – *y*1 = *m*(*x* – *x*1)

where *m* is the slope and (*x*1,*y*1) is the point

Example:

Write an equation for the line that passes through the point (-4,1) and has a slope of 2.

*y* – 1 = 2(*x* – (-4))

*y* – 1 = 2(*x* + 4)

*y* = 2*x* + 9

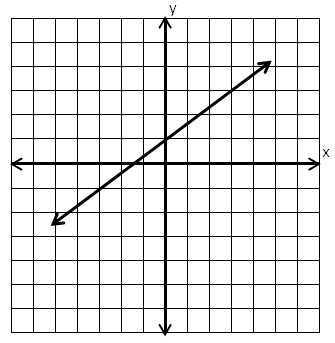
# Equivalent Forms of a Linear Equation

Forms of a Linear Equation

|  |  |
| --- | --- |
| Example |  |
| Slope-Intercept  *y* = *mx* + *b* |  |
| Point-Slope  *y – y*1 = *m(x – x1)* |  |
| Standard  *Ax* + *By= C* |  |

# Slope

A number that represents the rate of change in *y* for a unit change in *x*



Slope =

**3**

**2**

The slope indicates the   
steepness of a line.

# Slope Formula

The ratio of vertical change to

horizontal change

**A**

**B**

(*x*1, *y*1)

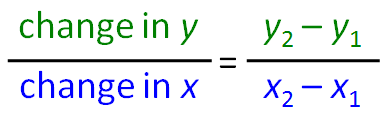
(*x*2, *y*2)

***x*2 – *x*1**

***y*2 – *y*1**

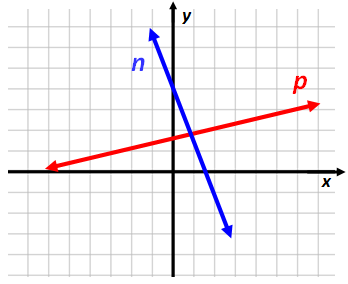
***x***

***y***



slope = *m* =

# Slopes of Lines



Line ***p***

has a positive slope.

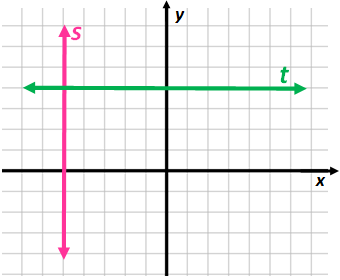
Line ***n***

has a negative slope.

Vertical line ***s*** has an undefined slope.

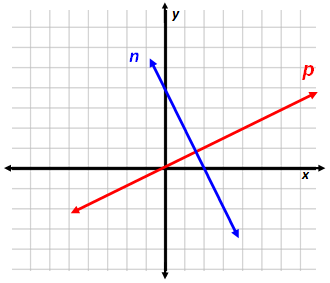
Horizontal line ***t***

has a zero slope.



# Perpendicular Lines

Lines that intersect to form a right angle



Perpendicular lines (not parallel to either of the axes) have slopes whose product is -1.

Example:

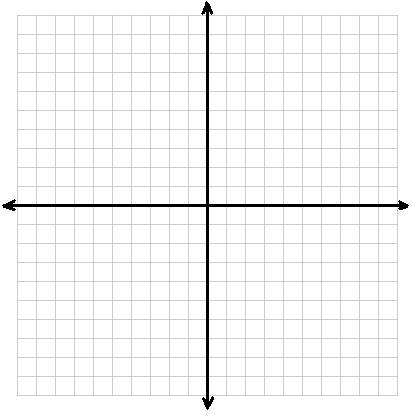
The slope of line *n* = -2. The slope of line *p* = .

-2 ∙ = -1, therefore, *n* is perpendicular to*p*.

# Parallel Lines

Lines in the same plane that do not intersect are parallel.

Parallel lines have the same slopes.



***y***

***x***

***b***

***a***

Example:

The slope of line *a* = -2.

The slope of line *b* = -2.

-2 = -2, therefore, *a* is parallel to*b*.

# Mathematical Notation

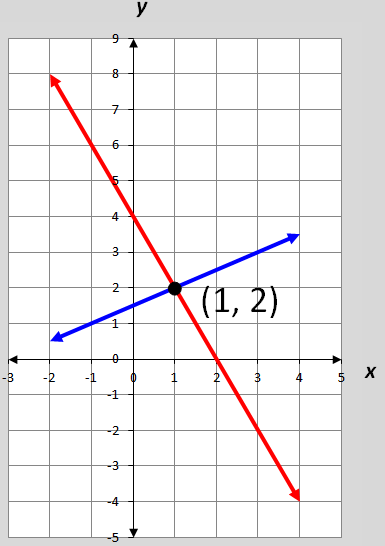
|  |  |
| --- | --- |
| **Equation/Inequality** | **Set Notation** |
|  |  |
|  |  |
|  |  |
|  |  |
| Empty (null) set | { } |
| All Real Numbers |  |

System of Linear Equations

# (Graphing)

-*x* + 2*y* = 3

2*x* + *y* = 4



The **solution**,

(1, 2), is the only ordered pair that satisfies both equations

(the point of intersection).

# System of Linear Equations

# (Substitution)

*x* +4*y* = 17

*y* = *x* – 2

Substitute *x* – 2 for *y* in the first equation.

*x* + 4(*x* – 2) = 17

*x* = 5

Now substitute 5 for *x* in the second equation.

*y* = 5 – 2

*y* = 3

The **solution** to the linear system is (5, 3),

the ordered pair that satisfies both equations.

# System of Linear Equations

# (Elimination)

-5*x* – 6*y* = 8

5*x* + 2*y* = 4

Add or subtract the equations to eliminate one variable.

-5*x* – 6*y* = 8

+ 5*x* + 2*y* = 4

-4*y* = 12

*y* = -3

Now substitute -3 for *y* in either original equation to find the value of *x*, the eliminated variable.

-5*x* – 6(-3) = 8

*x* = 2

The solution to the linear system is (2,-3), the ordered pair that satisfies both equations.

# System of Linear Equations

# (Number of Solutions)

|  |  |  |
| --- | --- | --- |
| **Number of Solutions** | **Slopes and**  ***y*-intercepts** | **Graph**  *x*  *y* |
| One solution | Different slopes | *x*  *y* |
| No solution | Same slope and  different -intercepts | *x*  *y* |
| Infinitely many solutions | Same slope and  same *y*-intercepts |  |

# Graphing Linear Inequalities

|  |  |
| --- | --- |
| Example | Graph |
| *y* ≤ *x* + 2 | ***x***  ***y*** |
| *y* > -*x* – 1 | ***x***  ***y*** |

The graph of the solution of a linear inequality is a half-plane bounded by the graph of its related linear equation. Points on the boundary are included unless the inequality contains only < or >.

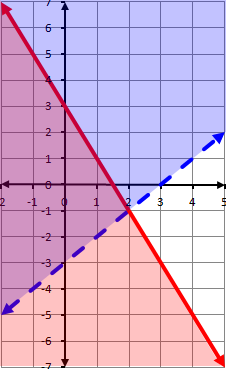
# System of Linear Inequalities

Solve by graphing:

*y* **>** *x* – 3

*y* **≤** -2*x* + 3

***y***



The solution region contains all ordered pairs that are solutions to both inequalities in the system.

(-1,1) is one of the solutions to the system located in the solution region.

***x***

# Dependent and

# Independent Variable

***x****,* independent variable

(input values or domain set)

***y****,* dependent variable

(output values or range set)

Example:

*y* = 2*x* + 7

# Dependent and

# Independent Variable

(Application)

Determine the distance a car will travel going 55 mph.

|  |  |
| --- | --- |
| *h* | *d* |
| 0 | 0 |
| 1 | 55 |
| 2 | 110 |
| 3 | 165 |

*d* = 55*h*

independent

dependent

# Graph of a Quadratic Equation

*y* = *ax*2 + *bx* + *c*

*a* ≠ 0

Example:

*y*

*y* = *x*2 + 2*x* – 3

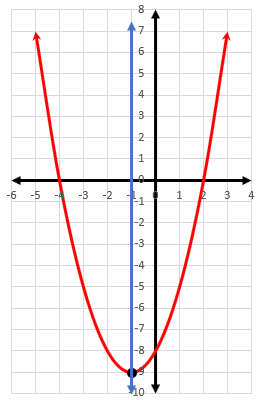
line of symmetry

*x*

vertex

The graph of the quadratic equation is a curve (parabola) with one line of symmetry and one vertex.Vertex of a Quadratic Function

For a given quadratic *y* = *ax*2+ *bx* + *c*, the vertex (*h*, *k*) is found by computing   
*h* = and then evaluating *y* at *h* to find *k*.

Example:

The vertex is (-1,-9).

Line of symmetry is .

Quadratic Formula

Used to find the solutions to any quadratic equation of the form,

*f*(*x*) = *ax*2 + *bx* + *c*

*x* =

Example:

# Relation

A set of ordered pairs

Examples:

|  |  |
| --- | --- |
| *x* | *y* |
| -3 | 4 |
| 0 | 0 |
| 1 | -6 |
| 2 | 2 |
| 5 | -1  Example 2 |

Example 1

{(0,4), (0,3), (0,2), (0,1)}

Example 3

# Function

(Definition)

A relationship between two quantities in which every input corresponds to exactly one output

*y*

*x*

2

4

6

8

10

10

7

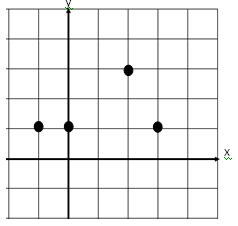
5

3

A relation is a function if and only if each element in the domain is paired with a unique element of the range.

# Functions

(Examples)



|  |  |
| --- | --- |
| *x* | *y* |
| 3 | 2 |
| 2 | 4 |
| 0 | 2 |
| -1 | 2 |

# Domain

Example 4

{(-3,4), (0,3), (1,2), (4,6)}

Example 3

Example 2

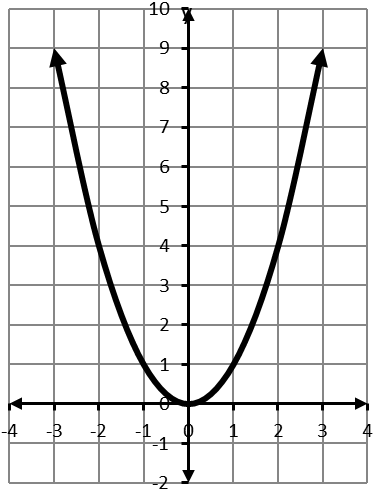
Example 1

***x***

***y***

A set of input values of a relation

Examples:



***f(x)***

***x***

|  |  |
| --- | --- |
| input | output |
| ***x*** | ***g*(*x*)** |
| **-2** | **0** |
| **-1** | **1** |
| **0** | **2** |
| **1** | **3** |

# Range

The **domain** of *g*(*x*) is {**-2, -1, 0, 1**}.

The **domain** of *f*(*x*) is **all real numbers**.

A set of output values of a relation

Examples:

***f(x)***

|  |  |
| --- | --- |
| input | output |
| ***x*** | ***g*(*x*)** |
| **-2** | **0** |
| **-1** | **1** |
| **0** | **2** |
| **1** | **3** |

***x***

The **range** of *f*(*x*) is **all real numbers greater than or equal to zero**.

The **range** of g(x) is {**0, 1, 2, 3**}.

# Function Notation

*f(x)*

*f(x)* is read

“the value of *f* at *x*” or “*f* of *x*”

Example:

*f(x)* = -3*x* + 5, find *f(2).*

*f(2)* = -3(2) + 5

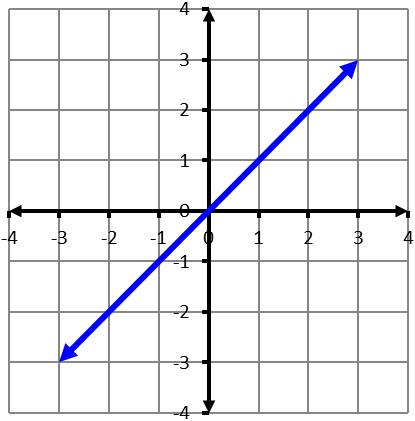
*f(2)* = -6 + 5

*f(2)* = -1

Letters other than *f* can be used to name functions, e.g., *g*(*x*) and *h(x*)

# Parent Functions

(Linear, Quadratic)

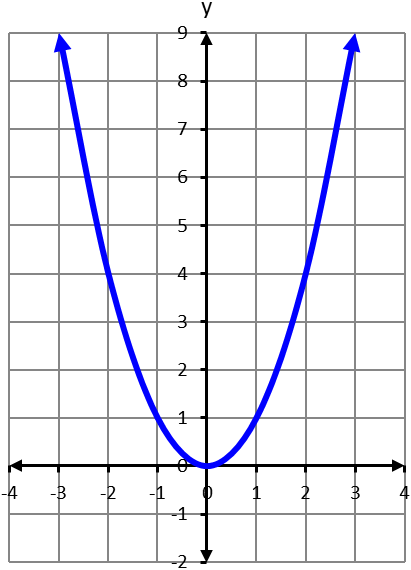


*y*

*x*

Linear

*f(x)* = *x*



*y*

*x*

Quadratic

*f(x)* = *x*2

# Transformations of Parent Functions

(Translation)

Parent functions can be transformed to create other members in a family of graphs.

|  |  |  |
| --- | --- | --- |
| **Translations** | ***g*(*x*) = *f*(*x*) + *k***  is the graph of *f*(*x*) **translated** **vertically** – | ***k*** units **up** when ***k* > 0**. |
| ***k*** units **down** when ***k* < 0**. |
| ***g*(*x*) = *f*(*x* − *h*)**  is the graph of *f*(*x*) **translated horizontally** – | ***h*** units **right** when ***h* > 0**. |
| ***h*** units **left** when ***h* < 0**. |

# Transformations of Parent Functions

(Reflection)

Parent functions can be transformed to create other members in a family of graphs.

|  |  |  |
| --- | --- | --- |
| **Reflections** | ***g*(*x*) = -*f*(*x*)**  is the graph of *f*(*x*) – | **reflected** over the ***x*-axis**. |
| ***g*(*x*) = *f*(-*x*)**  is the graph of *f*(*x*) – | **reflected** over the ***y*-axis**. |

# Transformations of Parent Functions

(Vertical Dilations)

Parent functions can be transformed to create other members in a family of graphs.

|  |  |  |
| --- | --- | --- |
| **Dilations** | ***g*(*x*) = *a* · *f*(*x*)**  is the graph of *f*(*x*) – | **vertical dilation** (stretch)  if ***a* > 1**.  Stretches away  from the *x*-axis |
| **vertical dilation** (compression) if **0 < *a* < 1**.  Compresses toward  the *x*-axis |

# 

# Linear Function

(Transformational Graphing)

Translation

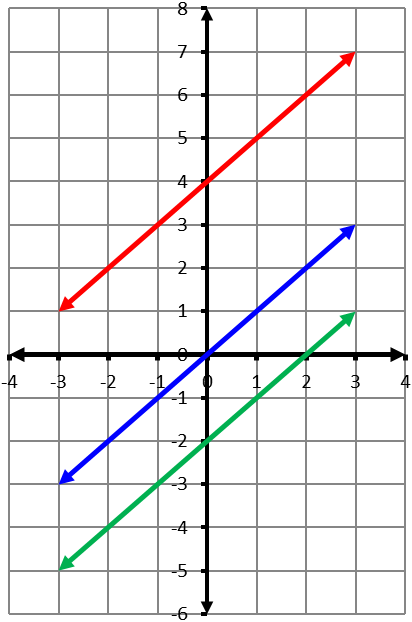
*g(x)* = *x* + *b*

Examples:

*f(x)* = *x*

*t(x)* = *x* + 4

*h(x)* = *x* – 2



***y***

***x***

Vertical translation of the parent function, *f(x)* = *x*

# Linear Function

(Transformational Graphing)

Vertical Dilation (*m* > 0)

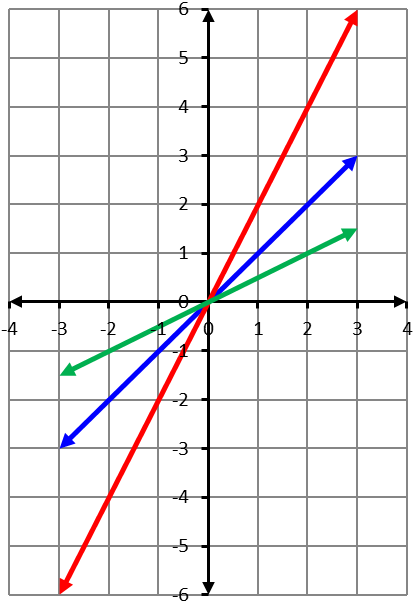
*g(x)* = *mx*

Examples:

*f(x)* = *x*

*t(x)* = 2*x*

*h(x)* = *x*



***y***

***x***

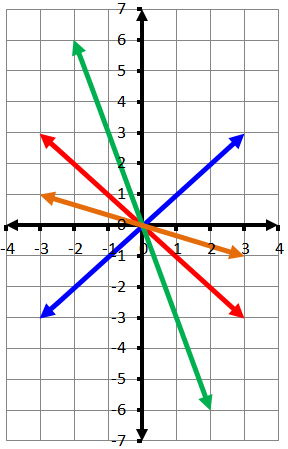
# Vertical dilation (stretch or compression) of the parent function, *f(x)* = *x* Linear Function

(Transformational Graphing)

Vertical Dilation/Reflection (*m* < 0)

*g(x)* = *mx*

***y***



Examples:

*f(x)* = *x*

*t(x)* = -*x*

*h(x)* = -3*x*

*d(x)* = -*x*

***x***

# Vertical dilation (stretch or compression) with a reflection of *f(x)* = *x* Quadratic Function

(Transformational Graphing)

Vertical Translation

*h(x)* = *x*2 + *c*

***y***

Examples:

*f(x)* = *x*2

*g(x)* = *x*2 + 2

*t(x)* = *x*2 – 3

***x***

# Vertical translation of *f(x)* = *x*2Quadratic Function

(Transformational Graphing)

Vertical Dilation (*a*>0)

*h(x)* = *ax*2

***y***

***x***

Examples:

*f(x)* = *x*2

*g(x)* = 2*x*2

*t(x)* = *x*2

# Vertical dilation (stretch or compression) of *f(x)* = *x*2Quadratic Function

(Transformational Graphing)

Vertical Dilation/Reflection (*a*<0)

*h(x)* = *ax*2

***y***

Examples:

*f(x)* = *x*2

*g(x)* = -2*x*2

*t(x)* = *x*2

***x***

# Vertical dilation (stretch or compression) with a reflection of *f(x)* = *x*2Quadratic Function

(Transformational Graphing)

Horizontal Translation

*h(x)* = (*x* ± *c*)2

***y***

Examples:

*f(x)* = *x*2

*g(x)* = (*x* + 2)2

*t(x)* = (*x* – 3)2

***x***

Horizontal translation of *f(x)* = *x*2

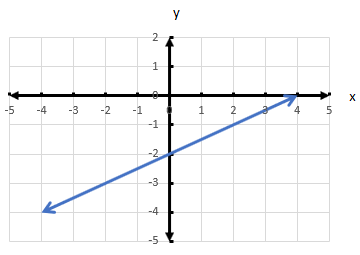
# Multiple Representations of Functions

Equation

Table

|  |  |
| --- | --- |
|  |  |
| -2 | -3 |
| 0 | -2 |
| 2 | -1 |
| 4 | 0 |

Graph



Words

*y* equals one-half *x* minus 2

# Direct Variation

*y* = *kx* or *k* =

constant of variation, *k* ≠ 0

***y***

Example:

*y* = 3*x* or 3 =

|  |  |
| --- | --- |
| *x* | *y* |
| -2 | -6 |
| -1 | -3 |
| 0 | 0 |
| 1 | 3 |
| 2 | 6 |

**x**

3 =

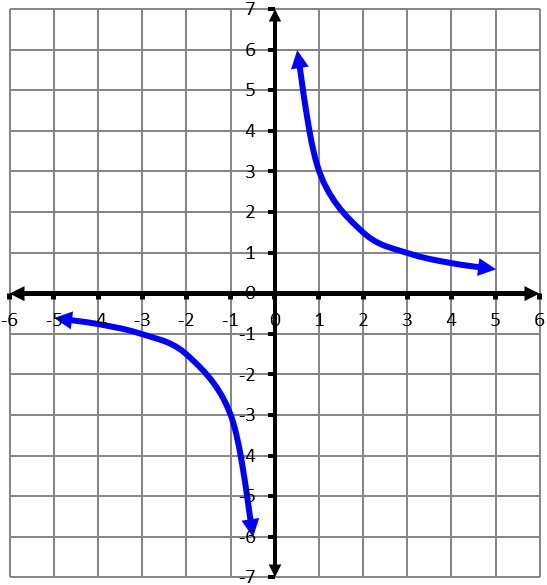
The graph of all points describing a direct variation is a line passing through the origin.

# Inverse

# Variation

*y* = or *k* = *xy*

constant of variation, *k* ≠ 0



**x**

***y***

Example:

*y* = or *xy* = 3

The graph of all points describing an inverse variation relationship are two curves that are reflections of each other.

# Scatterplot

Graphical representation of the relationship between two numerical sets of data

***x***

***y***

# Positive Linear Relationship (Correlation)

In general, a relationship where the dependent (*y*) values increase as independent values (*x*) increase

***x***

***y***

# Negative Linear Relationship (Correlation)

In general, a relationship where the dependent (*y*) values decrease as independent (*x*) values increase.

***x***

***y***

# No Linear Relationship (Correlation)

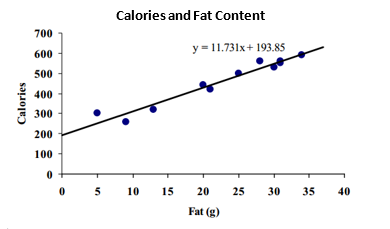
No relationship between the dependent (*y*) values and independent (*x*) values.

**x**

**y**

# Curve of Best Fit

(Linear)

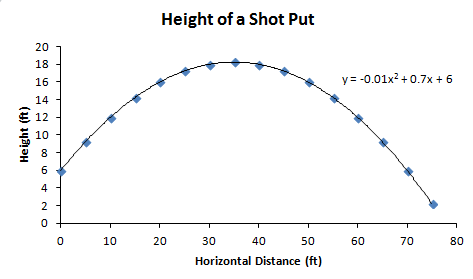


Equation of Curve of Best Fit

= 11.731x + 193.85

# Curve of Best Fit

(Quadratic)



Equation of Curve of Best Fit

= -0.01x2 + 0.7x + 6

# Outlier Data

# (Graphic)

