ALGEBRA

Arithmetic Operations

$$ab + ac = a(b + c)$$

$$\frac{\left(\frac{a}{b}\right)}{c} = \frac{a}{bc}$$

$$\frac{a}{b} + \frac{c}{d} = \frac{ad + bc}{bd}$$

$$\frac{ab + ac}{a} = b + c, \qquad a \neq 0$$

$$\frac{\left(\frac{a}{c}\right)}{\left(\frac{b}{c}\right)} = \frac{a}{b}$$

$$a\left(\frac{b}{c}\right) = \frac{ab}{c}$$

$$\frac{a}{\left(\frac{b}{c}\right)} = \frac{ac}{b}$$

$$\frac{a}{b} - \frac{c}{d} = \frac{ad - bc}{bd}$$

$$\frac{\left(\frac{a}{b}\right)}{\left(\frac{c}{d}\right)} = \frac{ad}{bc}$$

Exponent Properties

$$a^n a^m = a^{n+m}$$

$$\left(a^n\right)^m = a^{nm}$$

$$(ab)^n = a^n b^n$$

$$a^{-n} = \frac{1}{a^n}$$

$$\left(\frac{a}{b}\right)^{-n} = \left(\frac{b}{a}\right)^n = \frac{b^n}{a^n}$$

$$\frac{a^n}{a^m} = a^{n-m}$$

$$a^0 = 1, \qquad a \neq 0$$

$$\left(\frac{a}{b}\right)^n = \frac{a^n}{b^n}$$

$$\frac{1}{a^{-n}} = a^n$$

$$a^{\frac{n}{m}} = \left(a^{\frac{1}{m}}\right)^n = \left(a^n\right)^{\frac{1}{m}}$$

Properties of Radicals

$$\sqrt[n]{a} = a^{\frac{1}{n}}$$

$$\sqrt[m]{a^n} = a^{\frac{n}{m}}$$

$$\sqrt[m]{\sqrt[n]{a}} = \sqrt[mn]{a}$$

$$\sqrt[n]{ab} = \sqrt[n]{a}\sqrt[n]{b}$$

$$\sqrt[n]{\frac{a}{b}} = \frac{\sqrt[n]{a}}{\sqrt[n]{b}}$$

$\sqrt[n]{a^n} = a$, if n is odd $\qquad$ $\sqrt[n]{a^n} = |a|$, if n is even

Properties of Absolute Value

$$|a| = \begin{cases} a \text{ if } a \geq 0 \\ -a \text{ if } a < 0 \end{cases}$$

$$|a| \geq 0 \qquad |-a| = |a|$$

$$|ab| = |a||b| \qquad \left|\frac{a}{b}\right| = \frac{|a|}{|b|}$$

Distance Formula

If $P_1 = (x_1, y_1)$ and $P_2 = (x_2, y_2)$ are two points the distance between them is

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

Logarithms and Properties

Definition $\quad y = \log_b x$ is equivalent to $x = b^y$

Example: $\quad \log_5 125 = 3$ because $5^3 = 125$

$$\log_b b = 1 \qquad \log_b 1 = 0$$

$$\log_b b^x = x \qquad b^{\log_b x} = x$$

$$\log_b\left(x^p\right) = p \log_b x$$

$$\log_b(xy) = \log_b x + \log_b y$$

$$\log_b\left(\frac{x}{y}\right) = \log_b x - \log_b y$$

Special Logarithms

$\ln x = \log_e x$ $\quad$ natural log

where $e = 2.71828182...$

$\log x = \log_{10} x$ $\quad$ common log

$$\ln e = 1 \qquad \ln 1 = 0$$

$$\ln e^x = x \qquad e^{\ln x} = x$$

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Factoring Formulas

$a^2-b^2=(a-b)(a+b)$

$(a+b)^2=a^2+2ab+b^2$

$(a-b)^2=a^2-2ab+b^2$

$a^3-b^3=(a-b)(a^2+ab+b^2)$

$a^3+b^3=(a+b)(a^2-ab+b^2)$

$(a+b)^3=a^3+3a^2b+3ab^2+b^3$

$(a-b)^3=a^3-3a^2b+3ab^2-b^3$

Functions and Graphs

1. Constant Function

$y=a$ or $f(x)=a$

Graph is a horizontal line passing through the point $(0,a)$

2. Linear Function (LINE)

$y=mx+b$ or $f(x)=mx+b$

Graph is a line with a point $(0,b)$ and slope m.

Slope

Slope of the line containing two points (x_1,y_1) and (x_2,y_2) is $m=\dfrac{y_2-y_1}{x_2-x_1}=\dfrac{rise}{run}$

Point-Intercept form

The equation of the line with slope m and y-intercept $(0,b)$ is $y=mx+b$

Point-Slope form

The equation of the line with slope m and passing through the point (x_1,y_1) is $y-y_1=m(x-x_1)$

3. Quadratic Function (PARABOLA)

$y=a(x-h)^2+k$ or $f(x)=a(x-h)^2+k$

The graph is a parabola that opens up if $a>0$ or down if $a<0$ and has a vertex at (h,k).

4. Quadratic Function (PARABOLA)

$y=ax^2+bx+c$ or $f(x)=ax^2+bx+c$

The graph is a parabola that opens up if $a>0$ or down if $a<0$ and has a vertex at $\left(-\dfrac{b}{2a},f\left(-\dfrac{b}{2a}\right)\right)$.

Quadratic Formula

Solve $ax^2+bx+c=0,\ a\neq 0$

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

If $b^2-4ac>0$ - Two real solutions

If $b^2-4ac=0$ - Repeated real solution

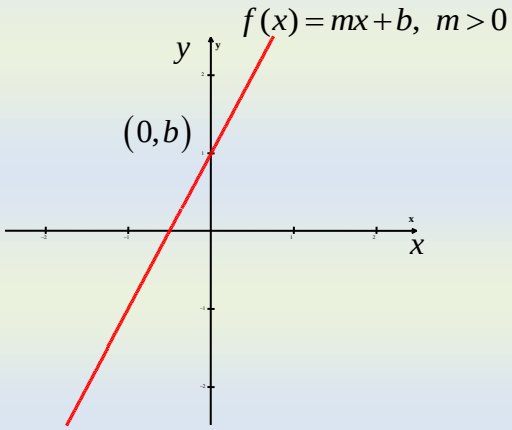
If $b^2-4ac<0$ - Two complex solutions

Square Root Property

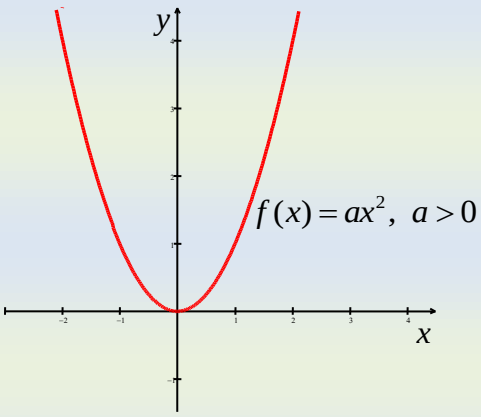
If $x^2=p$ then $x=\pm\sqrt{p}$

Graphs of Parent Functions

Linear Function $f(x)=mx+b$



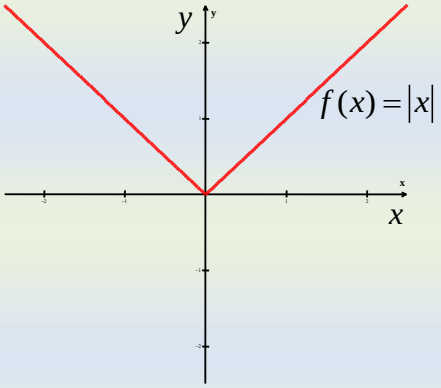
Quadratic Function $f(x)=ax^2$



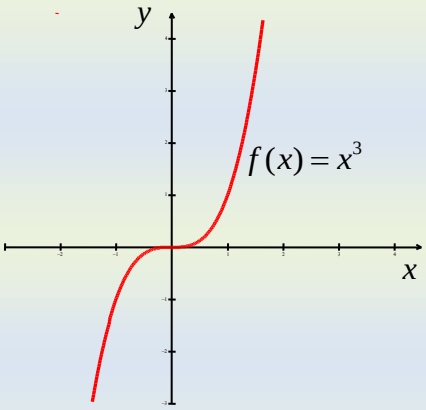
ALGEBRA

Graphs of Parent Functions

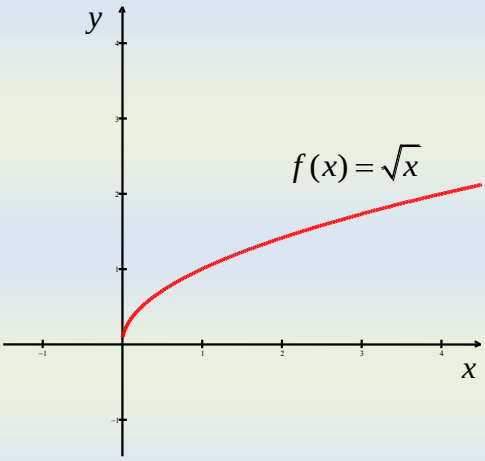
Absolute Value Function $f(x)=|x|=\begin{cases} x, & x\geq 0 \\ -x, & x<0 \end{cases}$



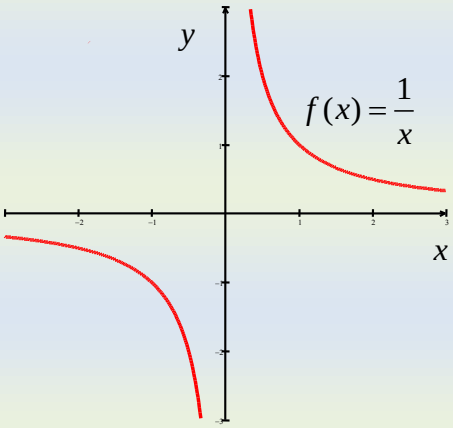
Cubic Function $f(x)=x^3$



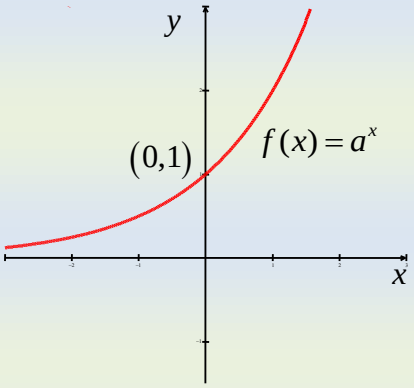
Square Root Function $f(x)=\sqrt{x}$



Rational (Reciprocal) Function $f(x)=\frac{1}{x}$



Exponential Function $f(x)=a^x,\ a>1,\ a\neq 1$



Logarithmic Function $f(x)=\log_a x,\ a>0,\ a\neq 1$