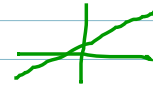


### Modeling Process

- identify & name the independent & dependent variables
- make assumptions that simplify the phenomenon
- use known equations
- derive mathematical conclusions
- interpret conclusions to predict real-world results
- Test predictions

### Linear Model - $y = f(x) = mx + b$

slope      y-coordinate of y-intercept

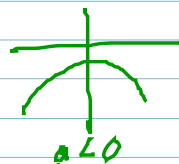
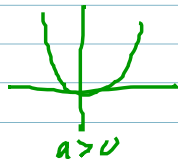


### Polynomial - $P(x) = a_n x^n + a_{n-1} x^{n-1} + a_{n-2} x^{n-2} + \dots + a_1 x + a_0$

$n \in \mathbb{N}$  ,  $a_i \in \mathbb{R}$  ,  $a_n \neq 0$   
|                      |  
degree              coefficient

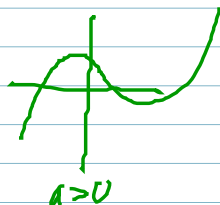
#### - Quadratic - $n = 2$

$$P(x) = ax^2 + bx + c, \quad a \neq 0$$



#### - cubic - $n = 3$

$$P(x) = ax^3 + bx^2 + cx + d, \quad a \neq 0$$

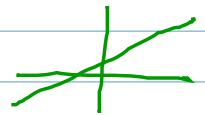


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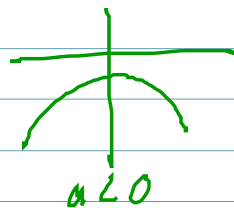
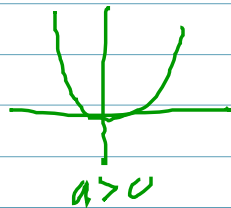


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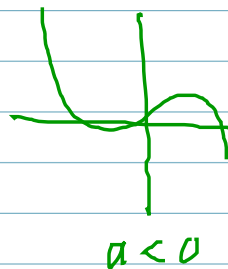
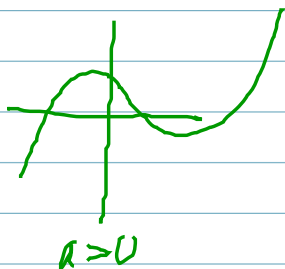
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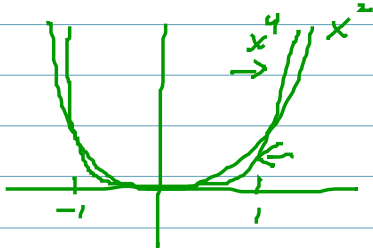
### - Cubic - $n = 3$

$$P(x) = ax^3 + bx^2 + cx + d, \quad a \neq 0$$

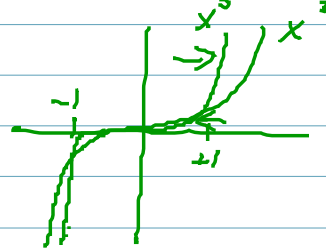


Power Function -  $f(x) = x^n$ ,  $n \in \mathbb{N}$

n = Even

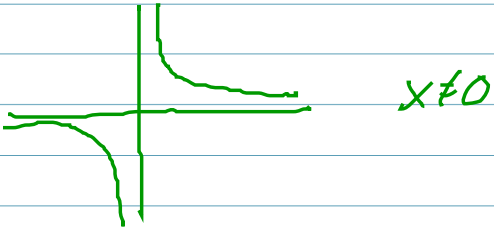


n = odd



$n = -1$ ,  $f(x) = \frac{1}{x}$

Reciprocal Function

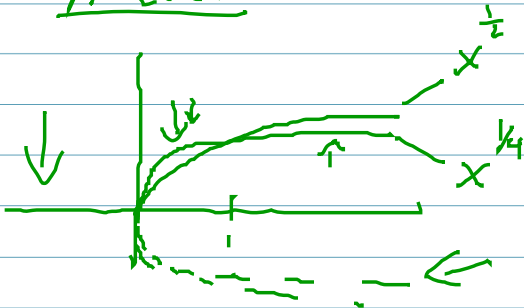


Hyperbola

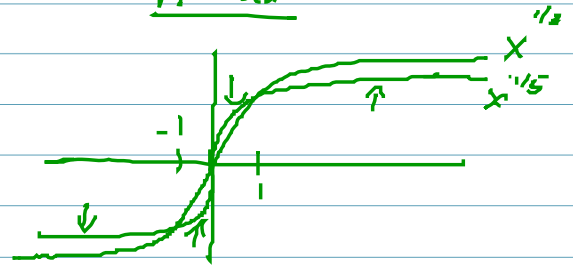
$n = \frac{1}{a}$ ,  $a \in \mathbb{N}$

Root Function  $f(x) = x^{1/a} = \sqrt[a]{x}$

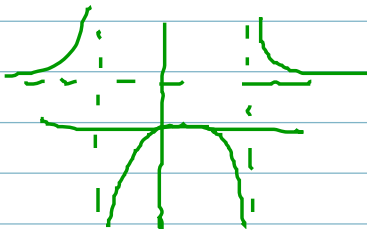
n = even



n = odd



Rational -  $f(x) = \frac{p(x)}{q(x)}$ ,  $p, q = \text{Polynomials}$ ,  $q(x) \neq 0$

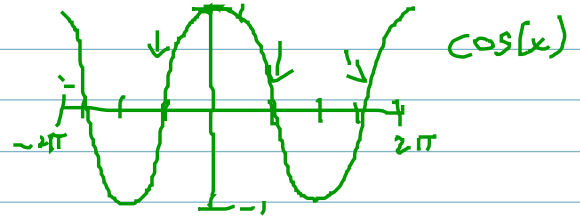
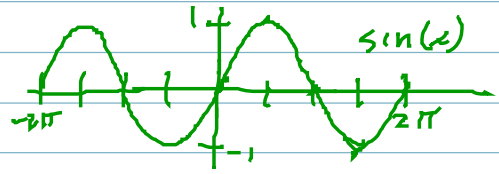


VA -  $q(x) = 0$   
 HA -  $\text{deg}(p) \leq \text{deg}(q)$

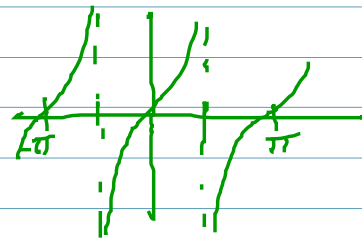
## Trigonometric

$$f(x) = \sin(x) = \sin(x + 2\pi)$$

$$g(x) = \cos(x) = \cos(x + 2\pi)$$



$$h(x) = \tan(x) = \frac{\sin(x)}{\cos(x)} = \tan(x + \pi)$$



$$f(x) = \csc(x) = \frac{1}{\sin(x)}$$

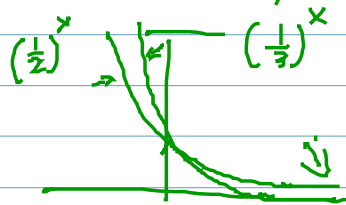
$$g(x) = \sec(x) = \frac{1}{\cos(x)}$$

$$h(x) = \cot(x) = \frac{1}{\tan(x)}$$

## Exponential - $f(x) = a^x$ , $a > 0, a \neq 1$



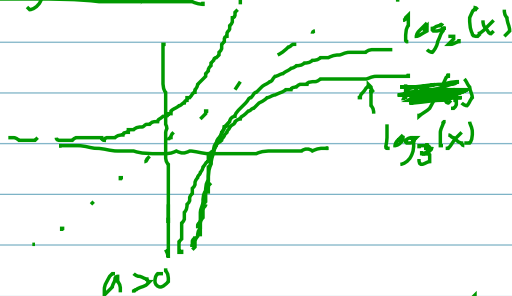
$a > 1$



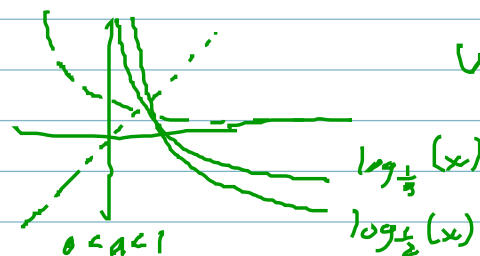
$0 < a < 1$

HA -  $y = 0$

## Logarithms - $f(x) = \log_a(x)$ , $a > 0, a \neq 1$



$a > 1$



$0 < a < 1$

VA -  $x = 0$

$$a^x = y \quad \text{iff} \quad \log_a(y) = x$$