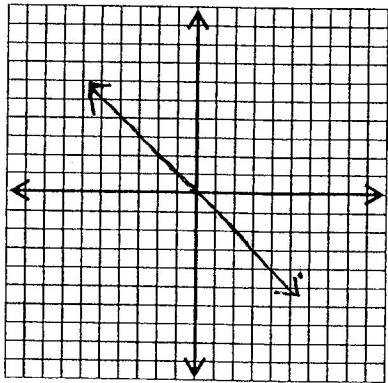


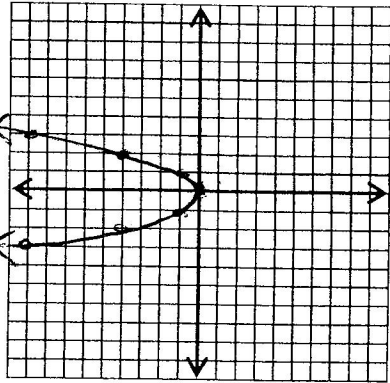
# Notes 1.3 - The Twelve Basic Functions and Their Properties

The Identity Function



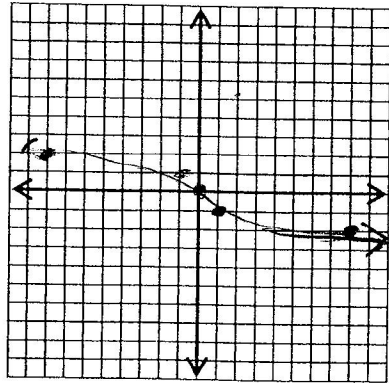
Function Rule  $f(x) = x$   
 Domain  $(-\infty, \infty)$   
 Range  $(-\infty, \infty)$   
 Continuous YES/NO  
 Type of Discontinuity ---  
 Increasing  $(-\infty, \infty)$   
 Decreasing ---  
 Constant ---  
 Bounded Above/Bounded Below/  
 Bounded/Unbounded ---  
 Upper Bound --- Lower Bound ---  
 Local Mins ---  
 Local Maxs ---  
 Absolute Min ---  
 Absolute Max ---  
 Odd/Even/Neither ---  
 Vertical Asymptotes ---  
 Horizontal Asymptotes ---

The Squaring Function



Function Rule  $f(x) = x^2$   
 Domain  $(-\infty, \infty)$   
 Range  $[0, \infty)$   
 Continuous YES/NO  
 Type of Discontinuity ---  
 Increasing  $(0, \infty)$   
 Decreasing  $(-\infty, 0)$   
 Constant ---  
 Bounded Above/Bounded Below/  
 Bounded/Unbounded ---  
 Upper Bound --- Lower Bound ---  
 Local Mins ---  
 Local Maxs ---  
 Absolute Min ---  
 Absolute Max ---  
 Odd/Even/Neither ---  
 Vertical Asymptotes ---  
 Horizontal Asymptotes ---

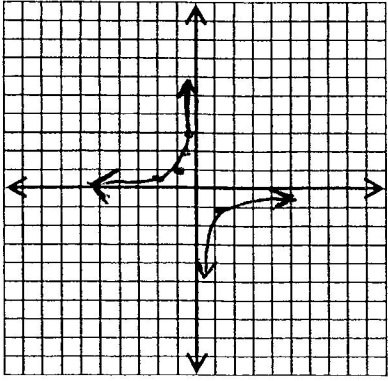
The Cubing Function



Function Rule  $f(x) = x^3$   
 Domain  $(-\infty, \infty)$   
 Range  $(-\infty, \infty)$   
 Continuous YES/NO  
 Type of Discontinuity ---  
 Increasing  $(-\infty, \infty)$   
 Decreasing ---  
 Constant ---  
 Bounded Above/Bounded Below/  
 Bounded/Unbounded ---  
 Upper Bound --- Lower Bound ---  
 Local Mins ---  
 Local Maxs ---  
 Absolute Min ---  
 Absolute Max ---  
 Odd/Even/Neither ---  
 Vertical Asymptotes ---  
 Horizontal Asymptotes ---

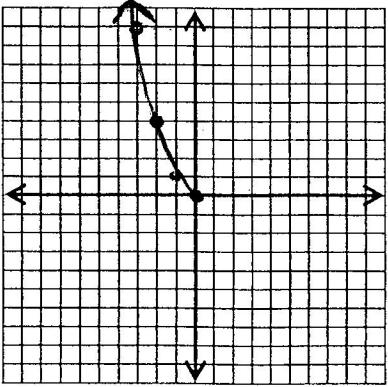
# Notes 1.3 - The Twelve Basic Functions and Their Properties

The Reciprocal Function



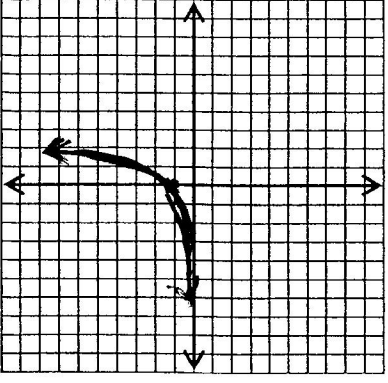
Function Rule  $f(x) = \frac{1}{x}$   
 Domain  $(-\infty, 0) \cup (0, \infty)$   
 Range  $(-\infty, 0) \cup (0, \infty)$   
 Continuous YES/NO NO  
 Type of Discontinuity infinite  
 Increasing —  
 Decreasing  $(-\infty, 0) \cup (0, \infty)$   
 Constant —  
 Bounded Above/Bounded Below/  
 Bounded/Unbounded Unbounded  
 Upper Bound — Lower Bound —  
 Local Mins —  
 Local Maxs —  
 Absolute Min —  
 Absolute Max —  
 Odd/Even/Neither Neither  
 Vertical Asymptotes  $x = 0$   
 Horizontal Asymptotes  $y = 0$

The Square Root Function



Function Rule  $f(x) = \sqrt{x}$   
 Domain  $[0, \infty)$   
 Range  $[0, \infty)$   
 Continuous YES/NO YES on its domain  
 Type of Discontinuity —  
 Increasing  $[0, \infty)$   
 Decreasing —  
 Constant —  
 Bounded Above/Bounded Below/  
 Bounded/Unbounded Bounded Below  
 Upper Bound — Lower Bound  $0$   
 Local Mins  $0$   
 Local Maxs —  
 Absolute Min  $0$   
 Absolute Max —  
 Odd/Even/Neither Neither  
 Vertical Asymptotes —  
 Horizontal Asymptotes —

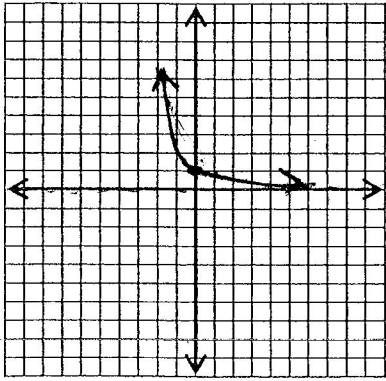
The Exponential Function



Function Rule  $f(x) = e^x$   
 Domain  $(-\infty, \infty)$   
 Range  $(0, \infty)$   
 Continuous YES/NO YES  
 Type of Discontinuity —  
 Increasing  $(-\infty, \infty)$   
 Decreasing —  
 Constant —  
 Bounded Above/Bounded Below/  
 Bounded/Unbounded Bounded Below  
 Upper Bound — Lower Bound h.a.  $y=0$   
 Local Mins —  
 Local Maxs —  
 Absolute Min —  
 Absolute Max —  
 Odd/Even/Neither Neither  
 Vertical Asymptotes —  
 Horizontal Asymptotes  $y = 0$

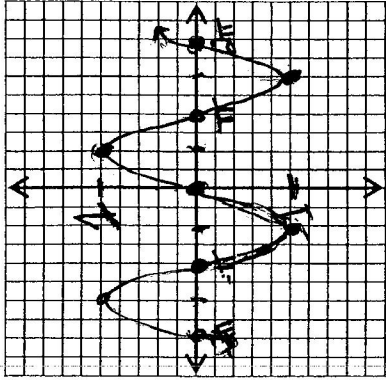
# Notes 1.3 - The Twelve Basic Functions and Their Properties

The Natural Logarithm Function



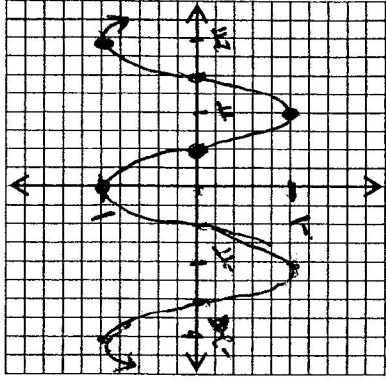
Function Rule  $f(x) = \ln x$   
 Domain  $(0, \infty)$   
 Range  $(-\infty, \infty)$   
 Continuous **YES** ~~NO~~ on its domain  
 Type of Discontinuity  $\text{---}$   
 Increasing  $(0, \infty)$   
 Decreasing  $\text{---}$   
 Constant  $\text{---}$   
 Bounded Above/Bounded Below/  
 Bounded ~~Unbounded~~  
 Upper Bound  $\text{---}$  Lower Bound  $\text{---}$   
 Local Mins  $\text{---}$   
 Local Maxs  $\text{---}$   
 Absolute Min  $\text{---}$   
 Absolute Max  $\text{---}$   
 Odd/Even/Neither **Neither**  
 Vertical Asymptotes  $X = 0$   
 Horizontal Asymptotes  $\text{---}$

The Sine Function



Function Rule  $f(x) = \sin x$   
 Domain  $(-\infty, \infty)$   
 Range  $[-1, 1]$   
 Continuous **YES** ~~NO~~  
 Type of Discontinuity  $\text{---}$   
 Increasing  $\text{lots}$   
 Decreasing  $\text{lots}$   
 Constant  $\text{---}$   
 Bounded Above/Bounded Below/  
 Bounded ~~Unbounded~~  
 Upper Bound  $1$  Lower Bound  $-1$   
 Local Mins  $-1$   
 Local Maxs  $1$   
 Absolute Min  $-1$   
 Absolute Max  $1$   
 Odd/Even/Neither **Neither**  
 Vertical Asymptotes  $\text{---}$   
 Horizontal Asymptotes  $\text{---}$

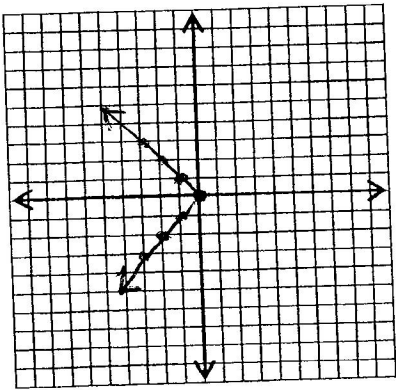
The Cosine Function



Function Rule  $f(x) = \cos x$   
 Domain  $(-\infty, \infty)$   
 Range  $[-1, 1]$   
 Continuous **YES** ~~NO~~  
 Type of Discontinuity  $\text{---}$   
 Increasing  $\text{lots}$   
 Decreasing  $\text{lots}$   
 Constant  $\text{---}$   
 Bounded Above/Bounded Below/  
 Bounded ~~Unbounded~~  
 Upper Bound  $1$  Lower Bound  $-1$   
 Local Mins  $-1$   
 Local Maxs  $1$   
 Absolute Min  $-1$   
 Absolute Max  $1$   
 Odd/Even/Neither **Neither**  
 Vertical Asymptotes  $\text{---}$   
 Horizontal Asymptotes  $\text{---}$

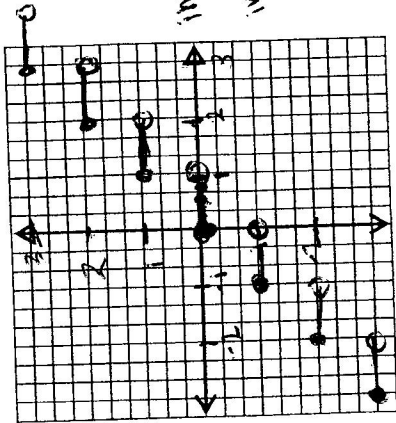
# Notes 1.3 - The Twelve Basic Functions and Their Properties

The Absolute Value Function



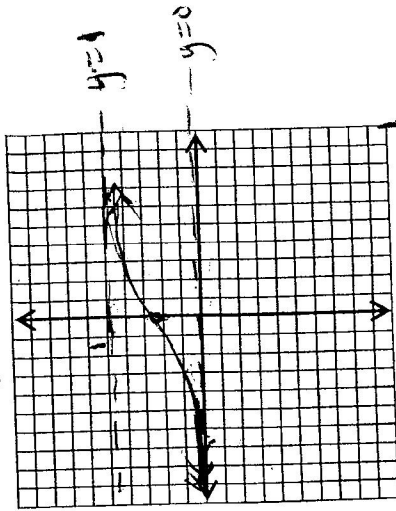
Function Rule  $f(x) = |x|$   
 Domain  $(-\infty, \infty)$   
 Range  $[0, \infty)$   
 Continuous **YES/NO**  
 Type of Discontinuity \_\_\_\_\_  
 Increasing  $(0, \infty)$   
 Decreasing  $(-\infty, 0)$   
 Constant \_\_\_\_\_  
 Bounded Above/Bounded Below/ Bounded/Unbounded \_\_\_\_\_  
 Upper Bound \_\_\_\_\_ Lower Bound \_\_\_\_\_  
 Local Mins \_\_\_\_\_  
 Local Maxs \_\_\_\_\_  
 Absolute Min \_\_\_\_\_  
 Absolute Max \_\_\_\_\_  
 Odd/Even/Neither \_\_\_\_\_  
 Vertical Asymptotes \_\_\_\_\_  
 Horizontal Asymptotes \_\_\_\_\_

The Greatest Integer Function



Function Rule  $f(x) = \lfloor x \rfloor$   
 Domain  $(-\infty, \infty)$   
 Range  $y \in \mathbb{Z} \leftarrow \text{integers } \{ \dots, -2, -1, 0, 1, 2, \dots \}$   
 Continuous **YES/NO**  
 Type of Discontinuity **jump**  
 Increasing \_\_\_\_\_  
 Decreasing \_\_\_\_\_  
 Constant  $\dots (-2, -1) \cup (-1, 0) \cup (0, 1) \dots$   
 Bounded Above/Bounded Below/ Bounded/Unbounded \_\_\_\_\_  
 Upper Bound \_\_\_\_\_ Lower Bound \_\_\_\_\_  
 Local Mins \_\_\_\_\_  
 Local Maxs \_\_\_\_\_  
 Absolute Min \_\_\_\_\_  
 Absolute Max \_\_\_\_\_  
 Odd/Even/Neither **Neither**  
 Vertical Asymptotes \_\_\_\_\_  
 Horizontal Asymptotes \_\_\_\_\_

The Logistic Function



Function Rule  $f(x) = \frac{1}{1 + e^{-x}}$   
 Domain  $(-\infty, \infty)$   
 Range  $(0, 1)$   
 Continuous **YES/NO**  
 Type of Discontinuity \_\_\_\_\_  
 Increasing  $(-\infty, \infty)$   
 Decreasing \_\_\_\_\_  
 Constant \_\_\_\_\_  
 Bounded Above/Bounded Below/ Bounded/Unbounded \_\_\_\_\_  
 Upper Bound  $y=1$  Lower Bound  $y=0$   
 Local Mins \_\_\_\_\_  
 Local Maxs \_\_\_\_\_  
 Absolute Min \_\_\_\_\_  
 Absolute Max \_\_\_\_\_  
 Odd/Even/Neither **Neither**  
 Vertical Asymptotes \_\_\_\_\_  
 Horizontal Asymptotes  $y=0, y=1$