

## Precalculus: Functions

### 1.2: Functions and Their Properties

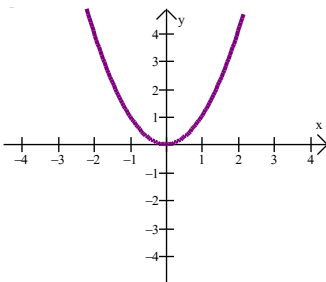
Functions: **Vertical line test**  
A relation where every input has exactly one output

Domain: **input (x-values)  $L \rightarrow R$**

Range: **output (y-values)  $B \rightarrow T$**

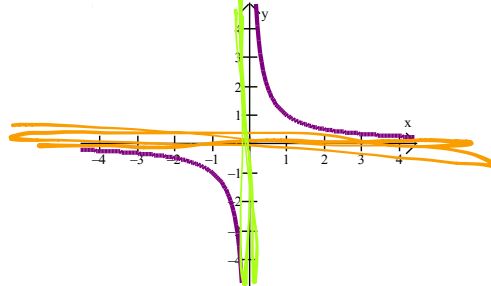
Example 1: State the domain and range of each function.

a)  $f(x) = x^2$



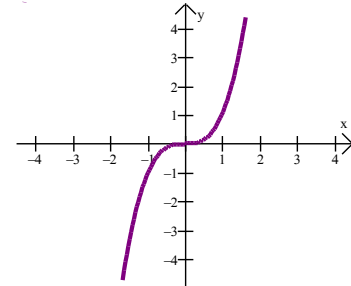
Domain:  $(-\infty, \infty) \mathbb{R}$   
Range:  $[0, \infty)$

b)  $f(x) = \frac{1}{x}$



Domain:  $(-\infty, 0) \cup (0, \infty)$   
Range:  $(-\infty, 0) \cup (0, \infty)$

c)  $f(x) = x^3$



Domain:  $(-\infty, \infty) \mathbb{R}$   
Range:  $(-\infty, \infty) \mathbb{R}$

#### Finding Domain Algebraically

1. Denominator cannot equal zero.
2. under a square root must be  $\geq 0$   
(not negative)

Example 2: Find the domain of each function algebraically. Confirm graphically.

a)  $f(x) = \sqrt{x-3}$

$$\begin{aligned} x-3 &\geq 0 \\ +3 & \quad +3 \\ \hline x &\geq 3 \end{aligned}$$

$[3, \infty)$

b)  $f(x) = \frac{6}{x+5}$

$$\begin{aligned} x+5 &\neq 0 \\ -5 & \quad -5 \\ \hline x &\neq -5 \end{aligned}$$

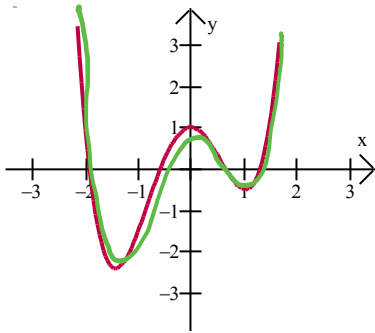
$(-\infty, -5) \cup (-5, \infty)$

c)  $f(x) = 4x^2 - x + 6$

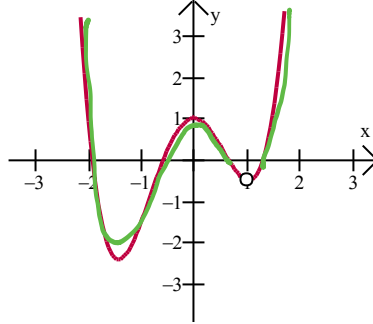
$(-\infty, \infty)$   
 $\mathbb{R}$

# Continuity

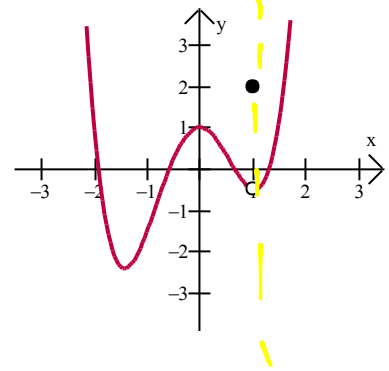
Continuous at all  $x$



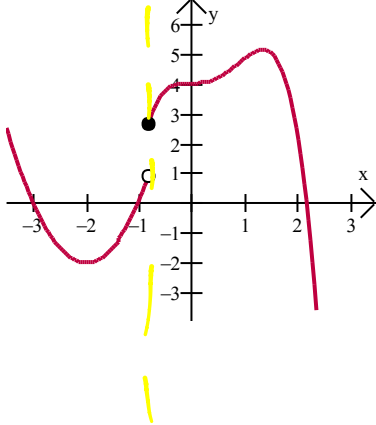
Removable discontinuity at  $x = 1$



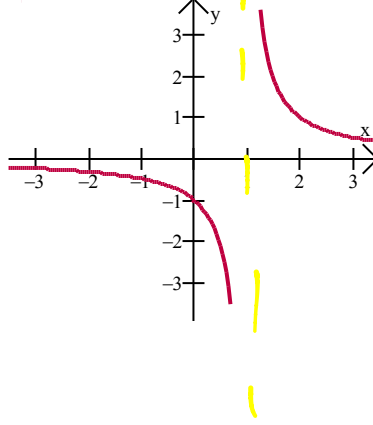
Removable discontinuity at  $x = 1$



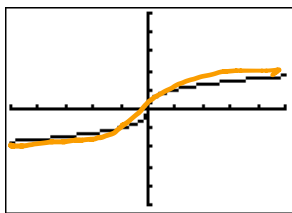
Jump discontinuity at  $x = 1$



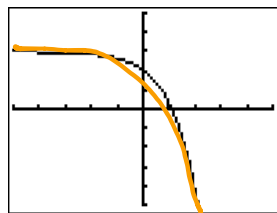
Infinite discontinuity at  $x = 1$



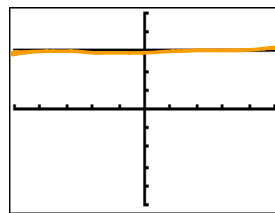
# Increasing and Decreasing Functions



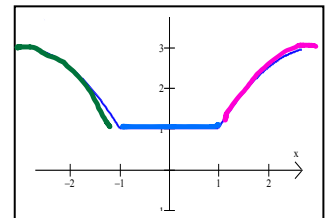
Always increasing



Always decreasing

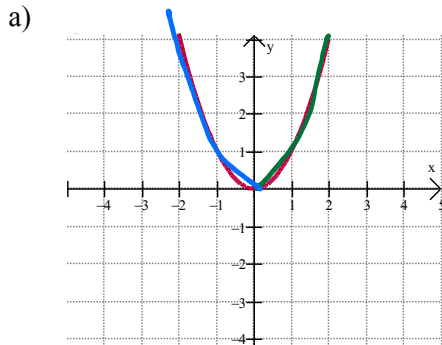


Constant

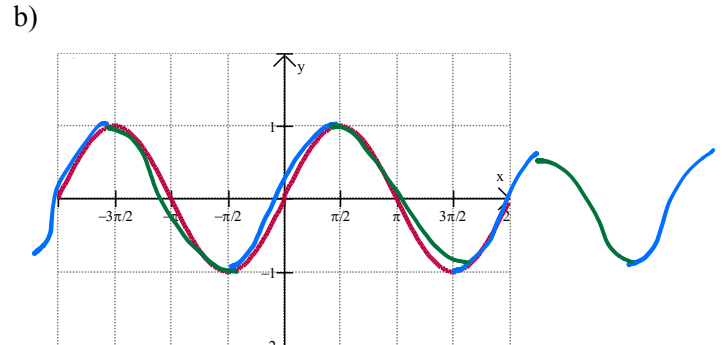


Decreasing:  $(-\infty, -1)$   
 Constant:  $(-1, 1)$   
 Increasing:  $(1, \infty)$

Example 3: Use the graph or table to determine where each function is increasing, decreasing or constant.



increasing:  $(0, \infty)$   
 decreasing:  $(-\infty, 0)$



c)

x	f(x)
-2	6
-1	8
0	12
1	9
2	3

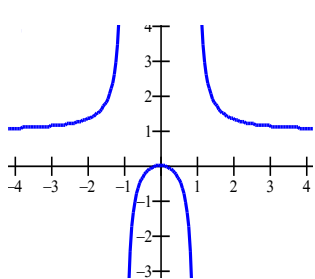
increasing:  $(-2, 0)$   
 decreasing:  $(0, 2)$

d)

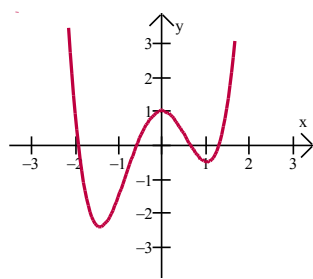
x	f(x)
3	-1
4	-4
5	-7
6	-5
7	0

increasing:  $(5, 7)$   
 decreasing:  $(3, 5)$

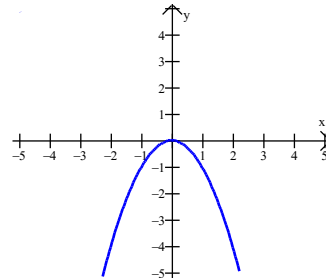
### Boundedness



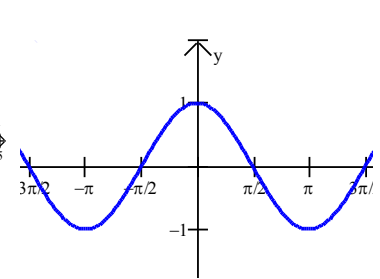
Not bounded above.  
 Not bounded below.



Not bounded above.  
 Bounded below.



Bounded above.  
 Not bounded below.



Bounded above.  
 Bounded below.