

AP Calculus

1.0 - Discontinuities, Holes, and Vertical Asymptotes

A **discontinuity** is any kind of _____ in the graph of a function.

Polynomial and **Linear** functions are always “well-behaved” → they have no _____.

WHY? Because they are _____.

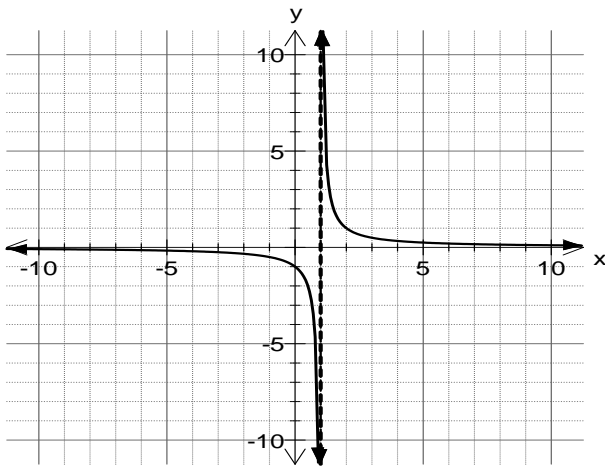
Rational functions are not defined for _____ → their graphs will have discontinuities!!

We will investigate 2 types of discontinuities: i) _____

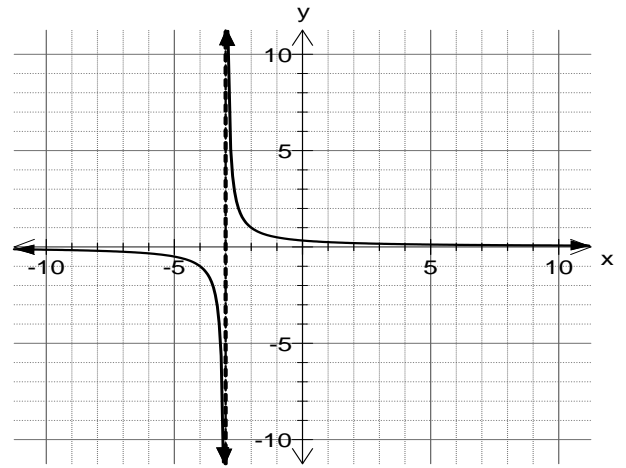
ii) _____

Consider the following graphs of rational functions, and complete the attached table.

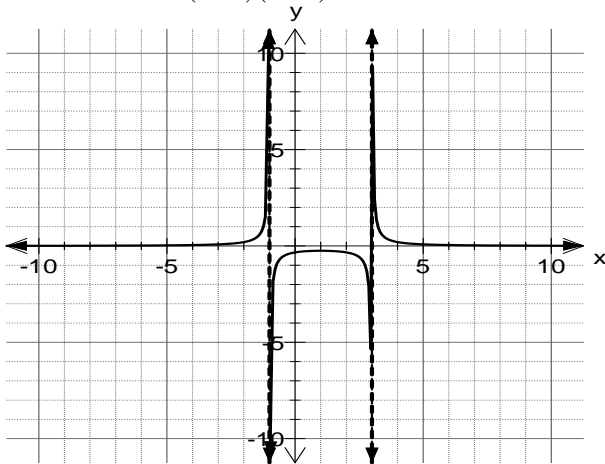
$$A(x) = \frac{1}{x-1}$$



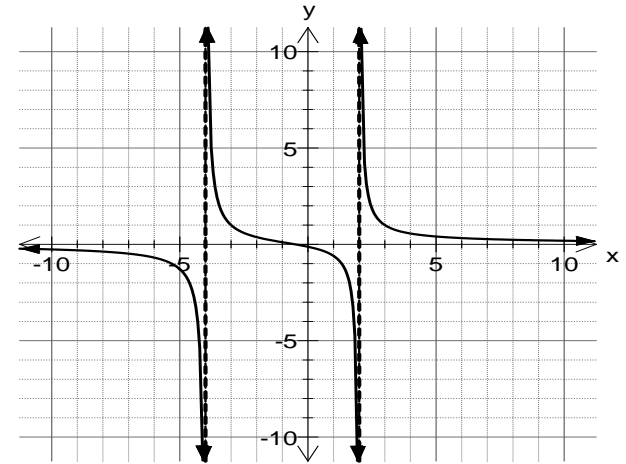
$$B(x) = \frac{1}{x+3}$$



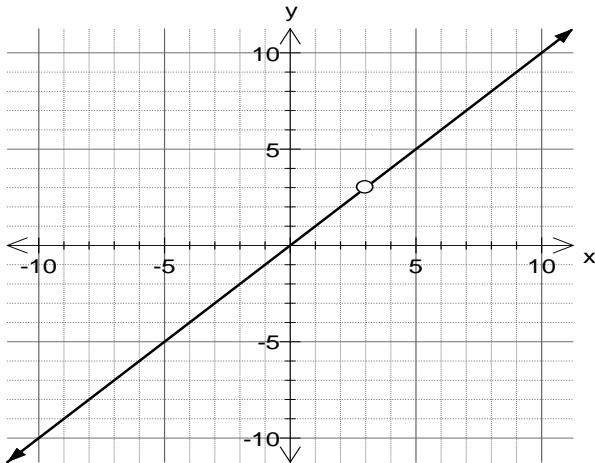
$$C(x) = \frac{1}{(x+1)(x-3)}$$



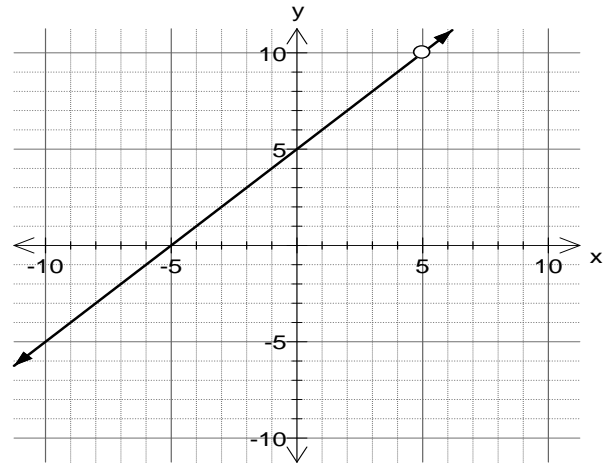
$$D(x) = \frac{2x+1}{x^2+2x-8}$$



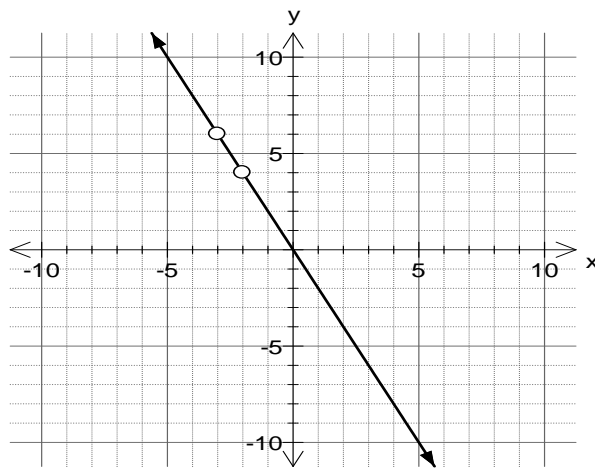
$$E(x) = \frac{x^2 - 3x}{x - 3}$$



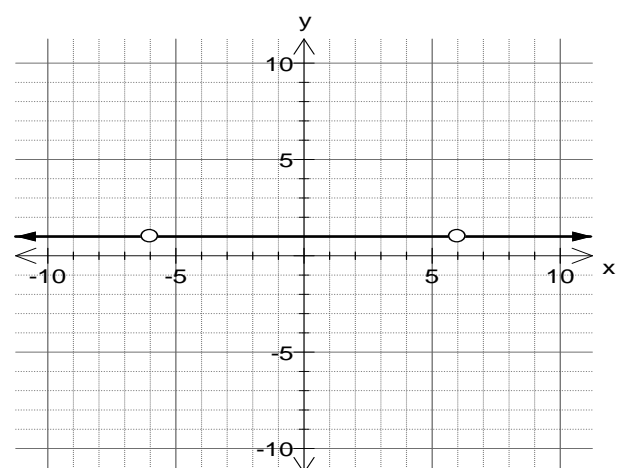
$$F(x) = \frac{x^2 - 25}{x - 5}$$



$$G(x) = \frac{-2x^3 - 10x^2 - 12x}{x^2 + 5x + 6}$$



$$H(x) = \frac{x^2 - 36}{x^2 - 36}$$



Conclusions

If $f(x)$ has a *discontinuity* at $x = c$, then:

1. $x = c$ will be a _____ of $f(x)$.
2. $f(c)$ will be _____ \rightarrow either: $f(c) =$ _____ or $f(c) =$ _____
 - a. If $f(c) =$ _____ then $f(x)$ will have a _____ discontinuity.
 - b. If $f(c) =$ _____ then $f(x)$ will have a _____ discontinuity.

NOTE: Before searching for any discontinuities of $f(x)$, you should completely _____ both the numerator and the denominator!!

$f(x)$	Restrictions on x	x coordinate of each discontinuity (c)	Value of function for each $x=c$	Type of discontinuity at $x=c$	Simplified function	Any common factors dividing out?
$A(x) = \frac{1}{x-1}$						
$B(x) = \frac{1}{x+3}$						
$C(x) = \frac{1}{(x+1)(x-3)}$						
$D(x) = \frac{2x+1}{x^2+2x-8}$						
$E(x) = \frac{x^2-3x}{x-3}$						
$F(x) = \frac{x^2-25}{x-5}$						
$G(x) = \frac{-2x^3-10x^2-12x}{x^2+5x+6}$						
$H(x) = \frac{x^2-36}{x^2-36}$						

Further Practice

Determine the x -coordinate(s) of any holes or VA for each of the following functions:

1. $f(x) = \frac{x+2}{x^2+7x+12}$

2. $f(x) = \frac{x^2+10x}{x^2-100}$

3. $f(x) = \frac{2x^2+x}{2x^2-3x-2}$