

## Asymptotes

**Vertical Asymptotes** occur where the denominator of the fraction equals zero.

Ex.

$$f(x) = \frac{3}{x^2 - x - 12}$$

$$x^2 - x - 12 = 0$$

$$(x - 4)(x + 3) = 0$$

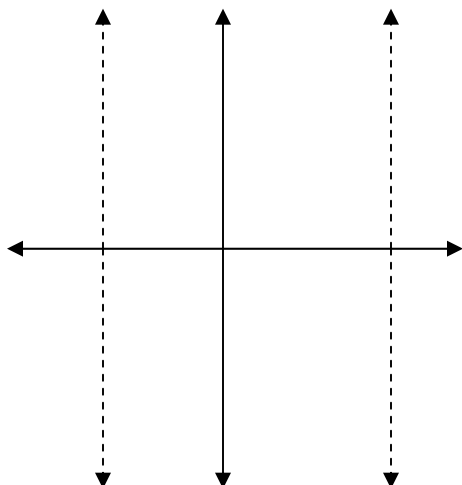
$$x - 4 = 0$$

$$\underline{x = 4}$$

$$x + 3 = 0$$

$$\underline{x = -3}$$

Vertical asymptotes:  $x=4$  and  $x=-3$ .



## Horizontal Asymptotes:

There are 3 rules to follow for Horizontal Asymptotes depending on the exponents in the numerator and denominator:

**1.** If the highest exponent in the numerator is **less than** the highest exponent in the denominator, then the Horizontal Asymptote is  **$y = 0$** .

Ex.  $f(x) = \frac{3x^3 + 9x - 2}{2x^4 - 8x^3 + 4x^2}$       The 3 exponent in the numerator is **less than**  
the 4 exponent in the denominator.  
Horizontal Asymptote:  **$y = 0$**

**2.** If the highest exponent in the numerator is **equal to** the highest exponent in the denominator, then the Horizontal Asymptote is the **ratio** of the 2 coefficients.

Ex.  $f(x) = \frac{3x^4 + 9x - 2}{2x^4 - 8x^3 + 4x^2}$       The 4 exponent in the numerator is **equal to**  
the 4 exponent in the denominator.  
Horizontal Asymptote:  **$y = \frac{3}{2}$**

**3.** If the highest exponent in the numerator is **greater than** the highest exponent in the denominator, then there is **no Horizontal Asymptote**.

Ex.  $f(x) = \frac{3x^5 + 9x - 2}{2x^4 - 8x^3 + 4x^2}$       The 5 exponent in the numerator is **greater**  
**than** the 4 exponent in the denominator.  
Horizontal Asymptote: **None**

