

**Changing: Polynomial in Standard Form  $\leftrightarrow$  Polynomial in Factored Form**

Example: Write  $(x - 1)(x + 3)(x + 4)$  as a polynomial in standard form.

$$(x - 1)(x + 3) \quad (x + 4)$$

$$(x^2 + 3x - 1x - 3) \quad (x + 4)$$

$$(x^2 + 2x - 3) \quad (x + 4)$$

$$(x^2 + 2x - 3)(x + 4)$$

$$\begin{array}{r} x^2 + 2x - 3 \\ \hline x + 4 \end{array}$$

$$+ 4x^2 + 8x - 12$$

$$\begin{array}{r} x^3 + 2x^2 - 3x \\ \hline \end{array}$$

$$x^3 + 6x^2 + 5x - 12$$

Example: Write  $(x + 2)(x - 2)(x - 5)$  as a polynomial in standard form.

Example: Write  $3x^3 - 18x^2 + 24x$  in factored form.

$$3x^3 - 18x^2 + 24x \quad \text{GCF} = 3x$$

$$3x(x^2 - 6x + 8)$$

$$3x(x - 2)(x - 4)$$

Write  $2x^3 + 8x^2 - 10x$  in factored form.

## Finding Zeros of a Polynomial Function

in factored form:  $y = (x - 2)(x + 1)(x - 3)$

$$0 = (x - 2)(x + 1)(x - 3)$$

$$\begin{aligned}x - 2 &= 0 \\ x &= 2\end{aligned}$$

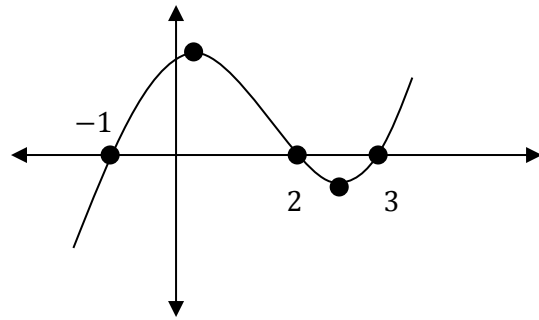
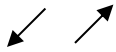
$$\begin{aligned}x + 1 &= 0 \\ x &= -1\end{aligned}$$

$$\begin{aligned}x - 3 &= 0 \\ x &= 3\end{aligned}$$

Graph of  $y = (x - 2)(x + 1)(x - 3)$

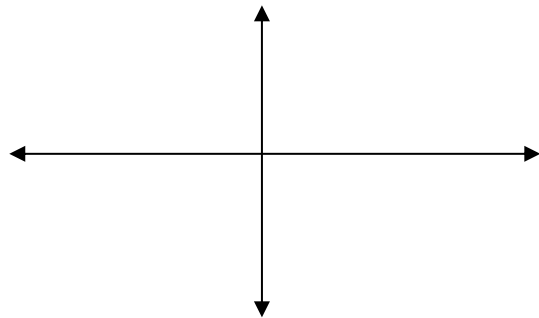
$$y = x^3 + \dots$$

end behavior



Graph of  $y = x(x + 5)(x - 2)$

end behavior



## Factor Theorem

The expression  $x - a$  is a linear factor of a polynomial if and only if the value  $a$  is a zero of the polynomial function.

Example: Write a polynomial function in standard form with zeros at 2, -3, and 0

$$f(x) = (x - 2)(x - (-3))(x - 0)$$

$$f(x) = (x - 2)(x + 3)(x)$$

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

$$f(x) = x^3 + x^2 - 6x$$

Example: Write a polynomial function in standard form with zeros at 1, -1, and 2

**Multiple Zero** – a zero that is repeated.

The *multiplicity* is the number of times the zero is repeated.

Example: Find any multiple zeros of  $f(x) = x^5 - 6x^4 + 9x^3$

$$f(x) = x^5 - 6x^4 + 9x^3 \qquad \text{GCF} = x^3$$

$$f(x) = x^3 (x^2 - 6x + 9)$$

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

$$f(x) = x^3 (x - 3)^2$$

Zeros:  $x = 0$   
multiplicity of 3

$x = 3$   
multiplicity of 2

Example: Find any multiple zeros of  $f(x) = 3x(x + 2)^4$