Warm up

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

$g(x) = x - 2$

Find

$(f \circ g)x$

$F(g(x))$

$F(x-2) = (x-2)^3 + 2(x-2)$

$= x^3 - 6x^2 + 12x - 8 + 2x - 4$

$= x^3 - 6x^2 + 14x - 12$

$g(f(2))$

$F(2) = (2)^3 + 2(2)$

$= 8 + 4$

$= 12$

$g(12) = 12 - 2$

$= 10$

Questions From Homework

① d) $y = x^3 - 5x^2 + 4x$

Roots $(y=0)$

$0 = x^3 - 5x^2 + 4x$ ← Common Factor

$0 = x(x^2 - 5x + 4)$ ← Simple Trinomial $-1 \times -4 = 4$, $-1 + -4 = -5$

$0 = x(x-4)(x-1)$

$x = 0$ | $x - 4 = 0$, $x = 4$ | $x - 1 = 0$, $x = 1$

Questions From Homework

① e) $y = 6x^2 - 7x + 2$

- Roots $(y=0)$

Trinomial Decomposition

$-4 \times -3 = 12$
$-4 + -3 = -7$

$0 = 6x^2 - 7x + 2$

$0 = (6x^2 - 3x)(-4x + 2)$

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

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

$3x - 2 = 0$	$2x - 1 = 0$
$3x = 2$	$2x = 1$
$x = 2/3$	$x = 1/2$

Vertex (Complete the square)

$y = 6x^2 - 7x + 2$

$y - 2 = 6x^2 - 7x$

$\frac{7}{6} \times \frac{1}{2} = \left(\frac{7}{12}\right)^2 = \frac{49}{144}$

$y - 2 = 6\left(x^2 - \frac{7}{6}x\right)$

$y - 2 + \frac{294}{144} = 6\left(x^2 - \frac{7}{6}x + \frac{49}{144}\right)$

$y - 2 + \frac{49}{24} = 6\left(x - \frac{7}{12}\right)^2$

$y - \frac{48}{24} + \frac{49}{24} = 6(x - 7/12)^2$

$y = 6(x - 7/12)^2 - \frac{1}{24}$

$V = \left(\frac{7}{12}, \frac{-1}{24}\right)$ or $(0.58\bar{3}, -0.041\bar{6})$

Polynomial Functions

Polynomial - an algebraic expression consisting of two or more terms. A polynomial usually contains only one variable. Within each term the variable is raised to a non-negative integer power, and is multiplied by a constant. The simplest types of polynomials are binomials (two terms) and trinomials (three terms)

Degree of a Polynomial - the greatest power to which the variable is raised; for example, the degree of the trinomial $x^4 - 2x + 5$ **is 4**

A *polynomial* function with real coefficients can be represented by

$$y = f(x) = ax^n + bx^{n-1} + cx^{n-2} + \ldots + \square x^0$$

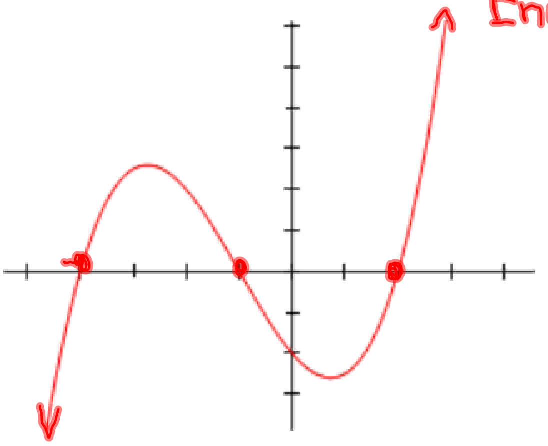
where *a, b, c, etc.* are real numbers. The shape of the graph of the function is affected by the value of *n (the Degree of the Polynomial)*, the values of the cooefficients, and whether the value of *a* is positive or negative.

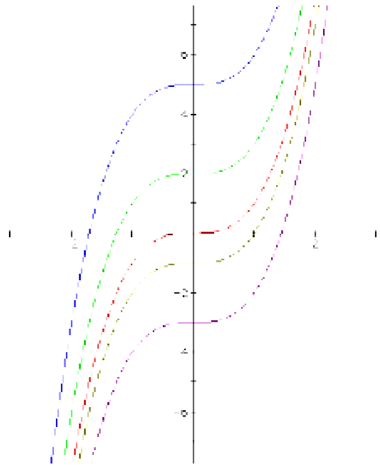
Cubic Functions

3rd degree Polynomials. ⟷ $y = ax^3 + bx^2 + cx + d$

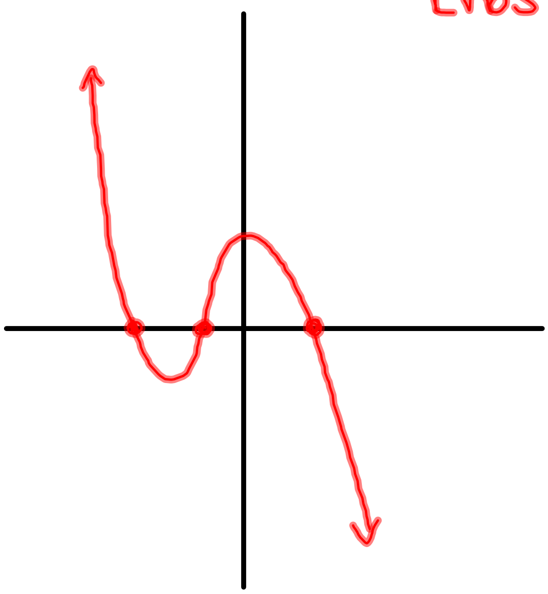
factored form $y = \underline{a}(x - r_1)(x - r_2)(x - r_3)$

a > 0 (Positive) Starts in Q3
Ends in Q1





a < 0 (Negative) Starts in Q2
Ends in Q4

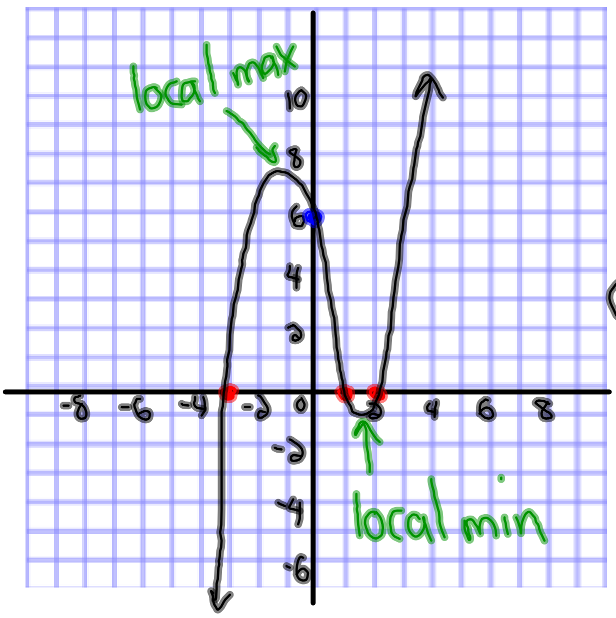


A cubic function has three roots. Either one or three of these roots will be real numbers. Any other roots are complex numbers. The number of *x-intercepts* on the graph of the corresponding cubic function *y= f(x)* depends on the nature of the roots.

Three different real roots

$a=1$

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



① Roots $(y=0)$

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

$x=-3, 1, 2$

② y int $(x=0)$

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

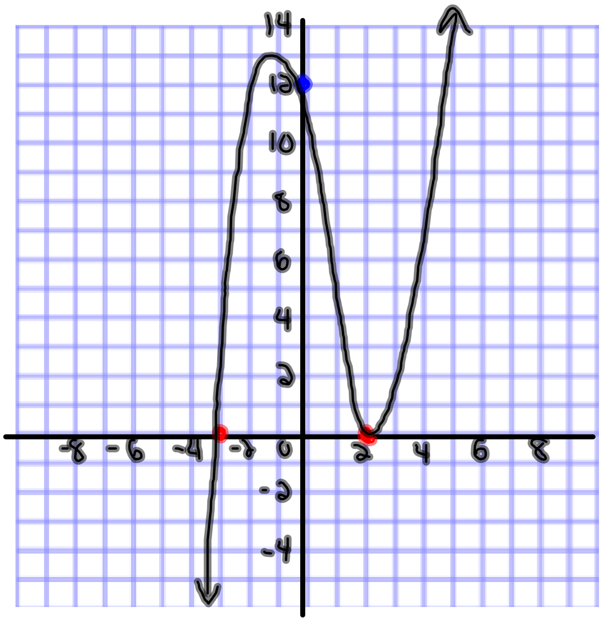
$y=(-1)(-2)(3)$

$y=6$

③ Degree → 3^{rd}

④ Stretch: $a=1$

Three real roots (2 are equal)



a=1

$$y=(x+3)(x-2)^2$$

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

① Roots $(y=0)$

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

$x=-3,2,2$ ← Double Root

② yint $(x=0)$

$y=(0+3)(0-2)^2$

$y=(3)(4)$

$y=12$

③ Degree $=3^{rd}$

④ Stretch: $a=1$

Three equal real roots

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

Local Maximum - is the highest point in its immediate region of *x-values.*
This may or may not be the greatest value of the function over its entire domain.

Local Minimum - is the lowest point in its immediate region of *x-values.*
This may or may not be the smallest value of the function over its entire domain.

Calculating Max and Min values on the TI-83

Homework