Math-3

Lesson 2-6 Zeroes of "NICE" 3rd Degree Polynomials

Find the zeroes of the following 3rd degree Polynomial

 $y = x^3 + 5x^2 + 4x$ Set y = 0

 $0 = x^3 + 5x^2 + 4x$ Factor out the common factor.

$$0 = x(x^2 + 5x + 4)$$

Factor the quadratic

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

0, -1, -4

Identify the zeroes

"Nice" 3rd Degree Polynomial (with no constant term)

$$y = 3x^3 + 12x^2 - 36x$$

It has no <u>constant</u> term so it can easily be factored into 'x' times a quadratic factor.

$$y = 3x(x^2 + 4x - 12)$$

If the quadratic factor is "nice" we can factor that into 2 binomials. y = 3x(x+6)(x-2)x = 0, -6, 2

> This is now "intercept form" so we can "read off" the x-intercepts. What are they?

Find the Zeroes

$$y = x^3 - 6x^2 - 16x$$

$$y = x^3 + 4x^2 - 12x$$

$$y = 2x^3 - 6x^2 - 30x$$

Find the Zeroes

$$y = x^3 + 6x^2 - 4x$$

$$y = x^3 + 4x^2 - 11x$$

$$y = 2x^3 - 16x^2 + 14x$$

"Nice" 3rd Degree Polynomial (with no constant term)

$$y = x^{3} + 6x^{2} + 4x + 0$$

$$0 = x^{3} + 6x^{2} + 4x$$

It has no <u>constant</u> term so it can easily be factored into 'x' times a quadratic factor. $0 = x(x^2 + 6x + 4)$

<u>*What if*</u> the quadratic factor is not factorable?

$$x = \frac{-b}{2a} = \frac{-(6)}{2(1)}$$
$$x = -3$$

$$y = f(-3) = (-3)^2 + 6(-3) + 4$$
$$y = -5$$

Convert the quadratic factor into vertex form and solve.

$$D = (x+3)^2 - 5$$

$$x = -3 \pm \sqrt{5}$$

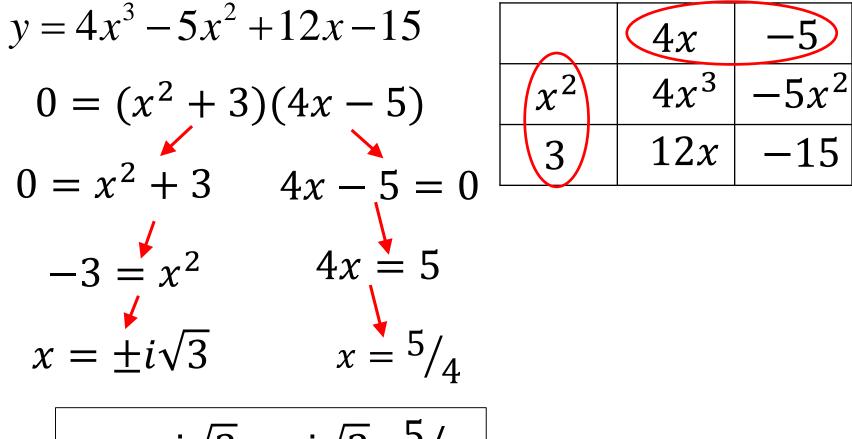
Zeroes: x = 0, -3

Factor the following "nice" 3rd degree polynomials then find the "zeroes" of the polynomial.

 $y = 3x^3 - 24x^2 + 6x$ $y = x^3 + 5x^2 - 14x$ $0 = 3x(x^2 - 8x + 2)$ $0 = x^3 + 5x^2 - 14x$ $\mathbf{X} = \mathbf{0}$ $x = \frac{-b}{2a} = \frac{-(-8)}{2(1)}$ x = 4 $0 = x(x^2 + 5x - 14)$ 0 = x(x+7)(x-2)0. -7. 2 $y = f(4) = (4)^2 - 8(4) + 2$ y = -14 $0 = (x - 4)^2 - 14$

$$x = 4 \pm \sqrt{14}$$

Find the zeroes using "box factoring"

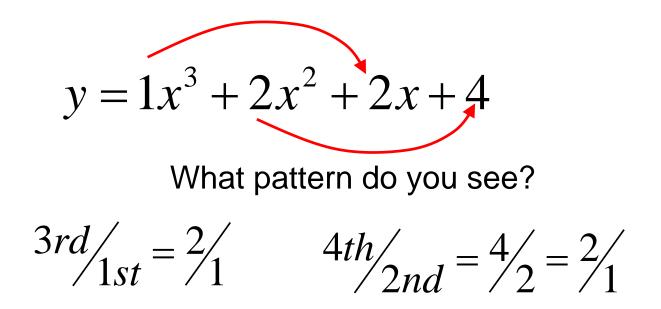


$$x = i\sqrt{3}, -i\sqrt{3}, \frac{5}{4}$$

Box Factoring works for "Nice" 3rd Degree Polynomial

$$y = ax^3 + bx^2 + cx + d$$

This has the constant term, but it has a very useful feature:



If we divide the coefficients of the 1st and 3rd terms, and the coefficient of the 2nd term and the constant, we get the <u>same number</u>.

"factor by grouping" if it has this nice pattern.

$$y = 1x^3 + 2x^2 + 2x + 4$$

Group the 1st and last pair of terms with parentheses.

$$y = (x^3 + 2x^2) + (2x + 4)$$

Factor out the common term from the first group.

$$y = x^2(x+2) + (2x+4)$$

Factor out the common term from the last group.

$$y = x^{2}(x+2) + 2(x+2)$$

Common factor of (x + 2)

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

These two binomials are now common factors of

 x^2 and 2

Factor out the common binomial term.

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

x = -2, i\sqrt{2}, -i\sqrt{2}

Apply the <u>Complex Conjugates Theorem</u>

An easier method is "box factoring" (if it has this nice pattern).

$$y = 1x^3 + 2x^2 + 2x + 4$$

These 4 terms are the *numbers in the box*.

Find the *common factor* of the 1st row.

Fill in the rest of the box.

Rewrite in intercept form.

 $y = 1x^3 + 2x^2 + 2x + 4$

$$y = (x^{2} + 2)(x + 2)$$

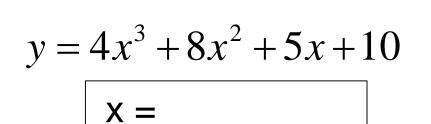
Find the "zeroes." $0 = (x^{2} + 2)(x + 2)$
 $0 = x^{2} + 2$ $0 = x + 2$
 $x = \pm i\sqrt{2}$

Find the zeroes using "box factoring"

X =

X =

$$y = 2x^3 + 3x^2 + 4x + 6$$



$$y = -6x^3 + 7x^2 - 18x + 21$$

What have we learned so far?

"Nice" <u>Common Factor</u> 3rd degree polynomial: $y = x^3 + 3x^2 + 2x = x(x^2 + 3x + 2)$ = x(x+1)(x+2)

"Nice" <u>Factor by box 3rd degree polynomial</u>:

