# Day 1 - Long Division 

Objectives: SWBAT Factor and Divide Polynomials
Review:

1. $1 2 \longdiv { 5 0 2 }$
a. $4,543 \div 83$

## Polynomial Long Division

$$
x-3 \begin{array}{r}
2 x^{2}+x-5 \\
\frac{2 x^{3}-5 x^{2}-8 x+15}{2 x^{3}-6 x^{2}} \\
x^{2}-8 x \\
\frac{x^{2}-3 x}{-5 x+15} \\
\frac{-5 x+15}{\text { Remainder } 0}
\end{array}
$$

Divide the following expressions using polynomial long division.
3. $\left(x^{3}-6 x^{2}+9\right) \div(x-4)$
4. $\left(4 x^{4}+5 x^{2}-9 x+18\right) \div\left(x^{2}+2 x+4\right)$
5. $\left(3 x^{4}-5 x^{3}+4 x-6\right) \div\left(x^{2}-5\right)$
b) $\left(2 x^{3}-5 x^{2}-8 x+15\right) \div(x-3)$

## Day 2 - Synthetic Division

Objectives: SWBAT Factor and Divide Polynomials

## Synthetic Division

| Dividing Polynomials |  |  |  |
| :---: | :---: | :---: | :---: |
| Long Division | Synthetic Division |  |  |
| $2 x^{2}+x-5$ |  |  |  |
| $x - 3 \longdiv { 2 x ^ { 3 } - 5 x ^ { 2 } - 8 x + 1 5 }$ | 3 | $\begin{array}{llll}2 & -5 & -8\end{array}$ |  |
| $2 x^{3}-6 x^{2}$ |  | 63 |  |
| $x^{2}-8 x$ |  | $21-5$ | 0 Remainder |
| $x^{2}-3 x$ |  |  |  |
| $-5 x+15$ |  |  |  |
| $-5 x+15$ |  |  |  |
| Remainder 0 |  |  |  |

Divide the following expressions using synthetic division.

1. $\left(\mathrm{x}^{3}+4 \mathrm{x}^{2}-5 \mathrm{x}+3\right) \div(\mathrm{x}+2)$
2. $\left(2 x^{3}+3 x^{2}-6\right) \div(x-3)$
3. $\left(7 x^{2}-14 x+4\right) \div(x+2)$
a. $\left(3 x^{4}-7 x^{2}+14 x-9\right) \div(x-1)$

Day 3 - Apply the Remainder and Factor Theorems
Objectives: SWBAT Factor a polynomial given a factor

FACTOR THEOREM or Throw Me a Bone Theorem

Fundamental Rule of Algebra

Given polynomial $f(x)$ and a factor of $f(x)$ factor $f(x)$ completely.

1. $f(x)=x^{3}-6 x^{2}+5 x+12 ; x-4$

| How many Answers will <br> there be? | Will I need to do the X or <br> X Box in this example? |  |  |
| :--- | :--- | :--- | :--- | :--- |
| Synthetic Division | Factoring |  |  |
| Answer |  |  |  |

2. $y=x^{3}-9 x^{2}-4 x+36 ; x-4$

| How many Answers will <br> there be? | Will I need to do the X or <br> X Box in this example? |  |  |
| :--- | :--- | :--- | :--- | :--- |
| Synthetic Division | Factoring |  |  |
| Answer |  |  |  |

3. $f(x)=2 x^{3}+x^{2}-13 x+6 ;(2 x-1)$

| How many Answers will <br> there be? | Will I need to do the X or <br> X Box in this example? |  |  |
| :--- | :--- | :--- | :--- | :--- |
| Synthetic Division | Factoring |  |  |
| Answer |  |  |  |

a. $f(x)=2 x^{3}-11 x^{2}+3 x+36 ; x-3$

| How many Answers will <br> there be? | Will I need to do the X or <br> X Box in this example? |  |  |
| :--- | :--- | :--- | :--- | :--- |
| Synthetic Division | Factoring |  |  |
| Answer |  |  |  |

# Day 4 - Apply the Remainder and Factor Theorem to Solve for Zeros 

Objectives: SWBAT Factor a polynomial given a factor SWBAT Find all the zeroes of a polynomial given a zero

## FACTOR THEOREM



Given polynomial function $f(x)$ and a zero of $f(x)$, find the other zeros.

1. $f(x)=x^{3}-28 x-48 ; x=-2$

| How many Answers will there be? |  | Will I need to do the X or $\mathbf{X}$ Box in this example? |  |  |
| :---: | :---: | :---: | :---: | :---: |
| Synthetic Division | Factoring |  |  |  |
|  |  |  |  |  |
|  | Solving |  |  |  |
| Answer |  |  |  |  |

2. $y=x^{3}+5 x^{2}+2 x-8 ; x=-4$

| How many Answers will <br> there be? | Will I need to do the X or <br> X Box in this example? |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Synthetic Division | Factoring |  |  |
| Special Number |  |  |  |

3. $f(x)=x^{3}-28 x-48 ; x=-2$

a. $y=x^{3}+5 x^{2}+2 x-8 ; x=-4$

| How many Answers will <br> there be? |  | Will I need to do the X or <br> X Box in this example? |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Synthetic Division | Factoring |  |  |

## Synthetic Division with Fractions

4. $f(x)=2 x^{3}-18 x-x^{2}+9 ; x=\frac{1}{2}$

Given polynomial function $f(x)$ and a zero of $f(x)$, find the other zeros.

$$
f(x)=3 x^{3}-4 x^{2}-17 x+6 ; \frac{1}{3}
$$

| How many Answers will <br> there be? | Will I need to do the X or <br> X Box in this example? |  |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Xynthetic Division | Factoring |  |  |

# Day 7 - Apply the Rational Zero Theorem - Finding Lists of Zeros 

Objectives: SWBAT find the possible number of zeros without given a calculator
Leading Coefficient
Constant

## RATIONAL ZERO THEOREM

List the possible rational zeros $\boldsymbol{f}$ using the rational zero theorem.

1. $f(x)=x^{3}+2 x^{2}-11 x+12$
2. $f(x)=4 x^{4}-x^{3}-3 x^{2}+9 x-10$

Factors of the constant term:

Factors of the leading coefficient:

Possible rational zeros:
Possible rational zeros:

Simplified list of zeros:
Simplified list of zeros:

| Total <br> Number of <br> Possibilities | Total <br> Number of <br> Zeros |
| :---: | :---: |
|  |  |
|  |  |
|  |  |


| Total <br> Number of <br> Possibilities | Total <br> Number of <br> Zeros |
| :---: | :---: |
|  |  |
|  |  |
|  |  |

3. $f(x)=2 x^{3}+3 x^{2}-11 x-6$

Factors of the constant term:

Factors of the leading coefficient:

Possible rational zeros:

Simplified list of zeros:

| Total <br> Number of <br> Possibilities | Total <br> Number of <br> Zeros |
| :---: | :---: |
|  |  |
|  |  |
|  |  |
|  |  |

a. $f(x)=x^{4}-8 x^{3}+18 x^{2}-27$

Factors of the constant term:

Factors of the leading coefficient:

Possible rational zeros:

Simplified list of zeros:
$\left.\begin{array}{|c|c|}\hline \text { Total } & \text { Total } \\ \text { Number of } \\ \text { Possibilities } & \text { Number of } \\ \text { Zeros }\end{array}\right]$

## Day 8 - Apply the Rational Zero Theorem

Objectives: SWBAT find the zeros of polynomials (with an $\mathrm{a}=1$ ) without being given a factor

## STEPS TO FINDING ALL REAL ZEROS when $a=1$

1. List all possible $\qquad$ , aka $\qquad$ .
2. Test these $\qquad$ using $\qquad$ .
*HINT!!! You may have to do this more than once*
3. Repeat using $\qquad$ until the degree of the polynomial is $\qquad$ .
4. Factor the polynomial and solve.

Find all real zeros of the function.

1. $f(x)=2 x^{3}+3 x^{2}-11 x-6$

| How many Answers will <br> there be? |  | Will I need to do the X or <br> X Box in this example? |  |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| Possible <br> Solutions: | Simplified <br> List of <br> Zeros |  |  |
| Synthetic Division | Factoring |  |  |

2. $f(x)=10 x^{4}-11 x^{3}-42 x^{2}+7 x+12$

| How many Answers will <br> there be? |  | Will I need to do the X or <br> X Box in this example? |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Possible <br> Solutions: |  | Simplified <br> List of <br> Zeros |  |
| Synthetic Division | Factoring |  |  |

a. $h(x)=4 x^{3}-12 x^{2}-x+15$

| How many Answers will <br> there be? |  | Will I need to do the X or <br> X Box in this example? |  |
| :--- | :--- | :--- | :--- | :--- | :--- |
| Possible <br> Solutions: |  | Simplified <br> List of <br> Zeros |  |
| Synthetic Division | Factoring |  |  |

4. Cassie is building a wooden square sandbox for a local playground. She wants the volume of the box to be 16 cubic feet. She decides that the height of the box should be $x$ feet, and that she would like the length of each side of the square base to be three feet longer than the height. What dimensions should she build her sandbox?

## Day 9 - Find Rational Zeros via a Calculator

Objectives: SWBAT find the zeros of polynomials without being given a factor

## BEHAVIOR NEAR ZEROS

## Bounces



Find all the zeros from the graph below.
1.

2.

a.


Find the number of solutions or zeroes for each equation or function. Then look at the graph on a calculator decide how many real solutions and imaginary solutions there are.
3. $x^{3}+5 x^{2}+4 x+20=0$
b. $f(x)=x^{4}-8 x^{3}+18 x^{2}-27$

Number of Solutions: $\qquad$
Number of Real Solutions: $\qquad$
Number of Solutions: $\qquad$
Number of Real Solutions: $\qquad$
Number of Imaginary Solutions: $\qquad$ Number of Imaginary Solutions: $\qquad$

Use a Calculator to help you find all the zeros, and then prove they are zeros algebraically.
4. $2 x^{4}+x^{3}-3 x^{2}-x+1$
c. $x^{4}+8 x^{3}+16 x^{2}$

