Divide and Conquer!

Main Ideas/Questions	Notes/Examples
WARM-UP	**Directions:** Use long division to find each quotient. **1.** $101,952 \div 59$ **2.** $5,467 \div 13$ **This same concept can be applied to dividing polynomials!**
DIVIDING POLYNOMIALS with Long Division	**Directions:** Divide using long division. **3.** $(x^3 + 4x^2 - 16x + 8) \div (x - 2)$ **4.** $(3x^3 + 2x^2 - 37x + 12) \div (x + 4)$

POLYNOMIAL LONG DIVISION

example:
$f(x) = x^3 - 2x^2 - 3x + 10$

Real zero @ x=-2

start

2 multiply $x^2 - 4x + 5$

1 what's missing? $(x + 2) \overline{)\, x^3 - 2x^2 - 3x + 10}$ $(x+2)$

3 subtract $- x^3 + 2x^2$ **4** bring down

5 repeat steps $-4x^2 - 3x$

$- \quad -4x^2 - 8x$

Quadratic Formula will find imaginary zeros $5x + 10$

$- \quad 5x + 10$

0

$f(x) = (x + 2)(x^2 - 4x + 5)$

5. $(2x^3 + 5x^2 - 19x - 42) \div (2x + 7)$ **6.** $(x^4 + 3x^3 + 4x^2 + 24x - 32) \div (x^2 + 8)$

NONZERO REMAINDERS

JUST LIKE WITH LONG DIVISION FROM THE WAY BACK, YOUR REMAINDER BECOMES A FRACTION.

$$\frac{remainder}{divisor}$$

7. $(3x^3 + 7x^2 + 2x + 3) \div (x + 1)$

$$
\begin{array}{r}
3x^2 + 4x - 2 \\
x+1 \overline{\smash{)}\ 3x^3 + 7x^2 + 2x + 3} \\
-(3x^3 + 3x^2) \\
\hline
4x^2 + 2x \\
-(4x^2 + 4x) \\
\hline
-2x + 3 \\
-(-2x - 2) \\
\hline
5
\end{array}
$$

$$\boxed{3x^2 + 4x - 2 + \frac{5}{x+1}}$$

8. $(6x^3 - 13x^2 + 12x + 6) \div (3x - 2)$
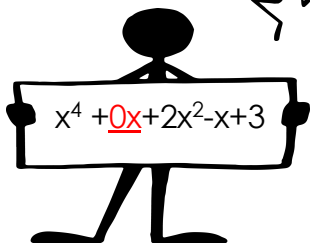
9. $(x^4 - 5x^3 + x^2 + 20x - 10) \div (x^2 - x - 5)$

Missing powers

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

$?$ $?$ $?$

X^3 VALUE IS MISSING!

USE A ZERO FOR IT!

$x^4 + \underline{0x} + 2x^2 - x + 3$

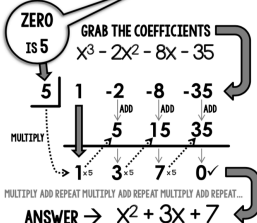**When a power is missing in the dividend, use a zero to fill in the missing term.**

10. $(x^4 - 64x^2 + 9x - 80) \div (x - 8)$

11. $(12x^3 + 4x^2 + 4) \div (x + 1)$

DIVIDING POLYNOMIALS

SYNTHETIC DIVISION

EXAMPLE:

Divide:
$x^3 - 2x^2 - 8x - 35$
by $(x - 5)$.

ZERO IS 5

GRAB THE COEFFICIENTS
$x^3 - 2x^2 - 8x - 35$

$$\begin{array}{c|cccc} 5 & 1 & -2 & -8 & -35 \\ & & 5 & 15 & 35 \\ \hline & 1 & 3 & 7 & 0 \checkmark \end{array}$$

ADD   ADD   ADD

MULTIPLY

$\times 5$ $\times 5$ $\times 5$

MULTIPLY ADD REPEAT MULTIPLY ADD REPEAT MULTIPLY ADD REPEAT...

ANSWER → $x^2 + 3x + 7$

STEPS
1: write the known zero in the house
2: list out the coefficients
3: bring down the 1st coefficient
4: multiply the 1st coefficient by house number
5: write the product under the 2nd coefficient
6: add down
7: repeat
8: use final numbers to write polynomial
9: use the Quadratic Formula to find the other zeros

NONZERO REMAINDERS

MISSING POWERS

Synthetic divison is a shortcut method to divide polynomials.
This method only works when dividing by a binomial with a coefficient of 1.

Directions: Divide using synthetic division.

12. $(x^3 - x^2 - 27x - 28) \div (x + 4)$

13. $(3x^3 - 22x^2 + 37x - 10) \div (x - 2)$

14. $(x^3 + x^2 - 22x - 1) \div (x + 5)$

15. $(4x^3 - 16x^2 + 20x - 16) \div (x - 3)$

16. $(x^3 - 49x + 120) \div (x + 8)$

17. $(x^4 - 9x^3 - 1) \div (x - 9)$