## Synthetic Division

Synthetic division is a shortcut for polynomial division.

It only works for linear binomials. i.e. (x + 2) (2x - 3)

Divide:  $(2x^2 + 7x + 9) \div (x + 2)$ 

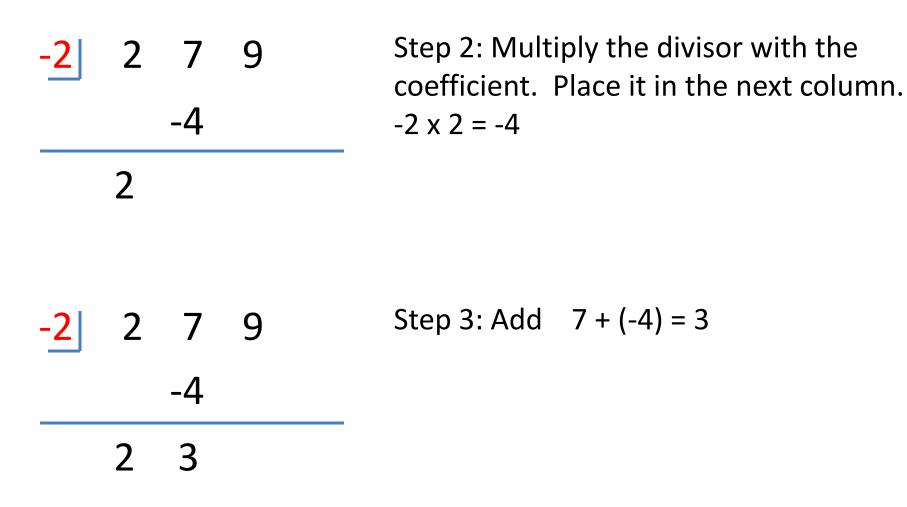
Divide:  $(2x^2 + 7x + 9) \div (x + 2)$ 

**-2** 2 7 9

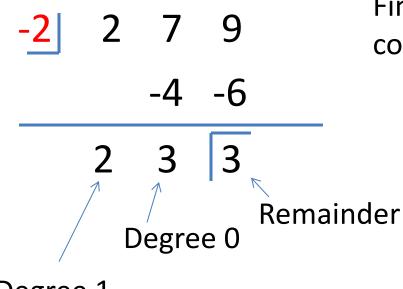
Write the coefficients of the dividend (including 0 placeholders if needed) Use the opposite sign of the number in the divisor.

-2 2 7 9 Step 1: Bring down the first coefficient

2



-2	2	7	9	Step 4: Multiply the divisor with the new coefficient. Place it in the next			
		-4	-6	column.			
	2	3		$-2 \times 3 = -6$			
-2	2	7	9	Step 5: Add 9 + (-6) = 3			
		-4	-6	This last number is the remainder.			
	2	3	3				



Final answer: put a variable with correct degree on each coefficient.

Degree 1

Solution: 
$$2x + 3 + \frac{3}{x+2}$$

Divide:  $(3x^4 - x^3 + 5x - 1) \div (x - 3)$ 

Write the coefficients of the dividend (including 0 placeholders if needed) Use the opposite sign of the number in the divisor.

## **3 3 -1 0 5 -1** Step 1: Bring down the first coefficient

3

3	3	-1	0	5	-1	coefficient. Place it in the next column.
		9				3 x 3 = 9
	3					
3	3	-1 9	0	5	-1	Step 3: Add -1 + 9 = 8
	3	8				

 3
 -1
 0
 5
 -1
 Repeat steps 2 and 3 as necessary

 9
 24
 72
 231

 3
 8
 24
 77
 230

3 -1 0 5 -1 Write final answer with correct 9 24 72 231 degrees. 3 8 24 77 230 Degree 0 Remainder Degrée 3 Degree 2 Degree 1 Solution:  $3x^3 + 8x^2 + 24x + 77 + \frac{230}{2}$  $\chi - 3$ 

Divide: 
$$(3x^2 + 9x - 2) \div (3x - 1)$$

The divisor must have a leading coefficient of 1. Divide it by 3.

Divide:  $(3x^2 + 9x - 2) \div (x - 1/3)$ 1/3 3 9 -2 1  $3\frac{1}{3}$ 3 10  $1\frac{1}{3}$ Use synthetic division like normal.

Solution: 
$$3x + 10 + \frac{1\frac{1}{3}}{x - \frac{1}{3}}$$

Note: the remainder is over the new divisor.

**Factor Theorem:** A binomial is a factor of a polynomial (like (x - 2)(x - 4) are factors of  $x^2 - 6x + 8$ ) if synthetic division has a remainder of zero.

(x - 2) is <u>**not**</u> a factor of the polynomial.

Is x = -4 a solution to the polynomial P(x) =  $x^3 + 2x^2 - 3x + 20$ ?

If x = -4 is a solution, then (x + 4) must be a factor. Use the factor theorem.

x = -4 is a solution to P(x).

<u>**Remainder Theorem:</u>** Synthetic division can evaluate a function's value (i.e. f(3)). The answer is the remainder.</u>

Note: you do not use the opposite sign of the #

If 
$$P(x) = 3x^4 - 25x^2 + 4$$
, find  $P(-3)$ 

P(-3) = 22