## 3.1 Zeros of a Polynomial

## Objectives:

- I can find the zeroes of a polynomial by using the factor theorem, remainder theorem, and rational roots theorem

- | know the difference between a zero 3 a factor

# Divide the following polynomials

Identify the zeros of the following and explain what that FACTOR FORM f(x) = (x+2)(x-1)(x+3) looks like Factor: DIVIDES EVENLY INTO POLY.) (X = 1 ZERD: WHAT MAKES A FACTOR = 0 links like
Write the function in the 12 | 1 - 3 CRC Write the function in standard form and state the relationship between the degree and zeros of the function  $f(x) = X_3 + 3X_5 + X_5 + 3x - 5x - 6$   $(X_5 + X - 5)(x + 3)$ f(x) = X3+4x2+x-6 Degree =# of zeros

### Remainder Theorem.

For a polynomial p(x) and a number a, the remainder on division by x - a is p(a), so p(a) = 0 if and only if (x - a) is a factor of p(x)

## Factor Theorem:

If the remainder in p(x) = (x - a)q(x) + p(a) is 0, then p(x) = (x - a)q(x), which tells you that (x - a) is a factor of p(x).

Conversely, if (x - a) is a factor of p(x), then you can write p(x) as p(x) = (x - a)q(x), and when you divide p(x) by (x - a), you get the quotient q(x) with a remainder of 0.

Remainder = 0 - Is a factor Remainder = 0 - Not a factor Determine whether the given binomial is a factor of the polynomial p(x). If so, find the remaining factors of p(x).

 $(B) p(x) = x^4 - 4x^3 - 6x^2 + 4x + 5; (x+1)$  -4 -6 + 4 + 5 -5 -6 + 4 + 5

1-5-150

yes, (x+1) is a factor

So,  $p(x) = x^3 - 4x^3 - 6x^2 + 4x + 5 =$ 

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**Example 3** Determine whether the given binomial is a factor of the polynomial p(x). If so, find the remaining factors of p(x).

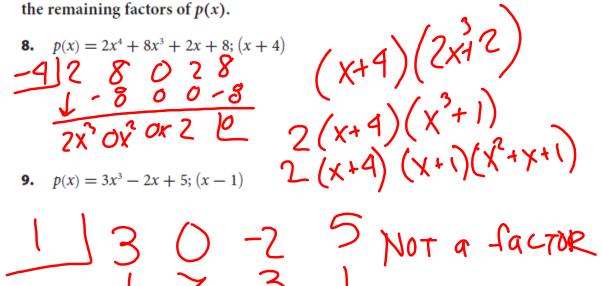
$$\begin{bmatrix} -3 \\ 1 \\ 3 \\ -3 \end{bmatrix}$$
  $\begin{bmatrix} 3 \\ -4 \\ -12 \\ 12 \\ 0 \\ -4 \end{bmatrix}$   $\begin{bmatrix} 12 \\ 0 \\ 0 \\ 0 \end{bmatrix}$ 

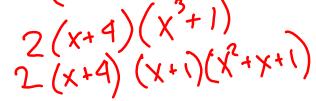
$$yes, (x+3) is a factor  $f(x) = (x+3)(x+3)(x-2)$   
 $f(x) = (x+3)(x+2)(x-2)$   
 $f(x) = (x+3)(x+2)(x-2)$$$

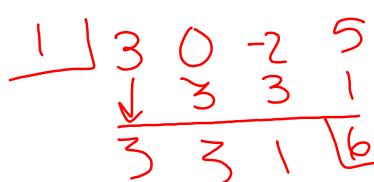
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#### Your Turn

Determine whether the given binomial is a factor of the polynomial p(x). If it is, find the remaining factors of p(x).







## Rational Root Theorem:

If all coefficients are integers and the constant is not 0, then all possible rational roots are:

$$x = \pm \frac{\text{factors of constant}}{\text{factors of, leading coefficient}}$$

$$|S^{\dagger}| \text{(oefficient in Standard form)}$$

Find the rational zeros of the polynomial function; then write the function as a product of factors.

the function as a product of factors.

$$f(x) = x^{3} + 2x^{2} - 19x - 20$$

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$$f(x) = x^{$$

POSSIBLE: +1) +2, +4, +5, +10, +20

Find the rational zeros of the polynomial function; then write the function as a product of factors.

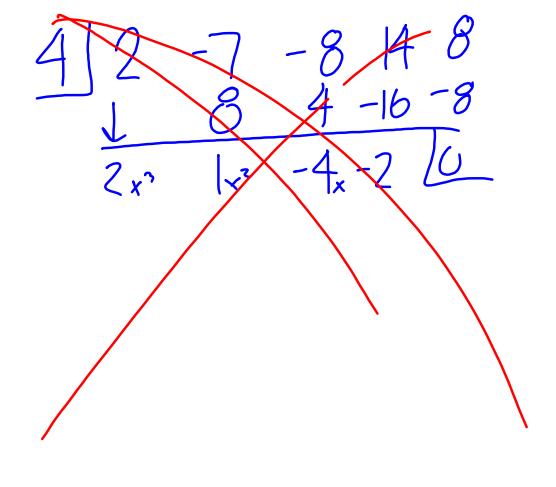
$$f(x) = x^{4} - 4x^{3} - 7x^{2} + 22x + 24$$

$$PhSSIBLE: \pm \frac{1}{5} \pm \frac{1}{2}, \pm \frac{1}{3}, \pm \frac{1}{4} \pm \frac{1}{6}, \pm$$

Find all the zeros 
$$f(x) = x^3 - 2x^2 - 8x$$

$$(x^{2}-2x-8)$$
  $-\frac{8}{4/2}$   
 $(x-4)(x+2)$ 

Find all the zeros of:  $2x^4 - 7x^3 - 8x^2 + 14x + 8$ 



Find all the zeros of: 
$$f(x) = x^3 + x^2 - 14x + 6$$
 $5 \mid 1 - 14 \mid 6$ 
 $3 \mid 2 - 6$ 
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 $3 \mid 2 - 6$ 
 $4 \mid 2 \mid 4 \mid 2 \mid 2 \mid 1 = -1$ 
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Find the polynomial function with a leading coefficient of 2 that has the given degree and zeros: degree 3, zeros -2, 4, 1					

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