
Warm-Up

1. Evaluate the following polynomial

$$f(n) = n^4 + 11n^3 + 30n^2 - n + 3 \text{ at } n = -6$$

$x = -3$ Root

2. Verify that $(x+3)$ is a factor of the polynomial

$$f(x) = 3x^3 + 7x^2 - 7x - 3$$

Then find all factors and zeros

Homework

Monday's Quiz

The following topics of Polynomials

- End Behavior
- Long Division
- Evaluating Using Remainder Theorem
- Factor Theorem
- Finding all factors and zeros
- Rational Root Theorem

Objective

Today we will...

- Apply the RATIONAL ROOT THEOREM
to find all zeros of polynomials

Agenda

- Notes/Examples
- Practice
- Exam

Rational Root Theorem

- Method for finding all POSSIBLE roots of a polynomial

Possible roots: $\frac{p}{q}$

P: Factors of the constant

q: Factors of the leading coefficient

Find the Possible Roots:

1. $f(x) = 4x^3 + 3x^2 + 16x + 12$

P: 1, 2, 3, 4, 6, 12

Q: 1, 2, 4

Possible roots: $\pm 1, \frac{1}{2}, \frac{1}{4}, 2, 3, \frac{3}{2}, \frac{3}{4}, 4, 6, 12$

2. $f(x) = 5x^3 - 4x^2 + 25x - 20$

P: 1, 2, 4, 5, 10, 20

Q: 1, 5

Possible Roots: $\pm 1, \frac{1}{5}, 2, \frac{2}{5}, 4, \frac{4}{5}, 5, 10,$
20,

Find all Factors and Zeros

Ex. 1 $f(x) = 4x^3 + 3x^2 - 4x - 3$

P: 1, 3
q: 1, 2, 4

Possible Roots: $\pm 1, \frac{1}{2}, 3, \frac{1}{4}, \frac{3}{2}, \frac{3}{4}$

$$\begin{array}{r} \boxed{1} & 4 & 3 & -4 & -3 \\ & & \frac{3}{4} & -\frac{4}{7} & -\frac{3}{3} \\ \hline & 4 & 7 & 3 & \boxed{0} \end{array} \text{ Yes}$$

$$(x-1)(4x^2+7x+3)$$

$$(x-1)(4x^2+4x+3x+3)$$

$$(x-1) 4x(x+1) + 3(x+1)$$

$$(x-1)(4x+3)(x+1) \text{ Factors}$$

$$x = 1, -1, -\frac{3}{4}$$

Zeros
Roots
Solutions

$$\text{Ex. 2 } f(x) = x^3 + 7x^2 - 4x - 28$$

$$P : 1, 2, 4, 7, 14, 28$$

$$Q : 1$$

Possible Roots: $\pm 1, \pm 2, \pm 4, \pm 7, \pm 14, \pm 28$

<u>(1)</u> $\begin{array}{r} 1 & & 1 & 7 & -4 & -28 \\ & & 1 & 8 & 4 & 4 \\ \hline & & 1 & 8 & 4 & -24 \end{array} \text{ NO}$	<u>(-1)</u> $\begin{array}{r} -1 & & 1 & 7 & -4 & -28 \\ & & -1 & -6 & 10 \\ \hline & & 1 & 6 & -10 & -18 \end{array} \text{ NO}$
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<u>(2)</u> $\begin{array}{r} 2 & & 1 & 7 & -4 & -28 \\ & & 2 & 18 & 28 \\ \hline & & 1 & 9 & 14 & 0 \end{array} \text{ Yes}$
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$$(x-2)(x^2 + 9x + 14)$$

$$(x-2)(x+7)(x+2) \text{ Factors}$$

$$x = 2, -7, -2$$

zeros
roots
solutions

Ex. 3 $f(x) = x^3 + 2x^2 - 11x - 12$

