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6.3 Roots & Zeros of Polynomials

Warm-up	<p>Factor the following quadratic and solve. (Unit 4)</p> $3x^2 - 5x - 2 = 0$ <div style="display: flex; justify-content: space-around;"> <div style="text-align: center;"> $\begin{array}{r} -6x^2 \\ -6x \\ +1x \\ -5x \end{array}$ </div> <div> $3x^2 - 6x + 1x - 2 = 0$ $3x(x-2) + 1(x-2) = 0$ $(3x+1)(x-2) = 0$ $3x+1=0 \quad x-2=0$ $3x=-1 \quad x=2$ $x=-\frac{1}{3}$ </div> </div> <p style="color: red; text-align: right;">use zero product property</p>
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Zeros/Roots Solutions	<p>The value of <u>x</u> for which $f(x) = 0$</p> <p>The polynomial function of degree n can have <u>at the most</u> <u>n</u> zeros.</p> <p>An even degree polynomial can have <u>even</u> number of zeros/roots (counting duplicates) or no zeros.</p> <p>An odd degree polynomial can have <u>odd</u> number of zeros/roots.</p>
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Identifying Real number Zeros/Roots x values at x-intercept	
<p>1. $f(x) = x^3 + x^2 - 2x$</p> <p style="color: red;">Degree of 3 3 max zeros/roots</p> <p style="color: red;">Relative minimum: Turning points lower than nearby points</p> <p style="color: red;">Relative maximum: Turning point higher than nearby points ($\approx -1.2, \approx 2.1$)</p> <p>x-intercepts <u>$(-2, 0)$ $(0, 0)$ $(1, 0)$</u></p> <p>zeros <u>$-2, 0, 1$</u></p>	<p>2. $f(x) = (x+1)(x-1)^2(x-3)$</p> <p style="color: red;">Degree of 4 x^4</p> <p style="color: green;">quartic * 4 maximum roots</p> <p>x-intercepts <u>$(-1, 0)$ $(1, 0)$ $(3, 0)$</u></p> <p>zeros <u>$-1, 1, 3$</u> 3 roots</p>

Linear Factors

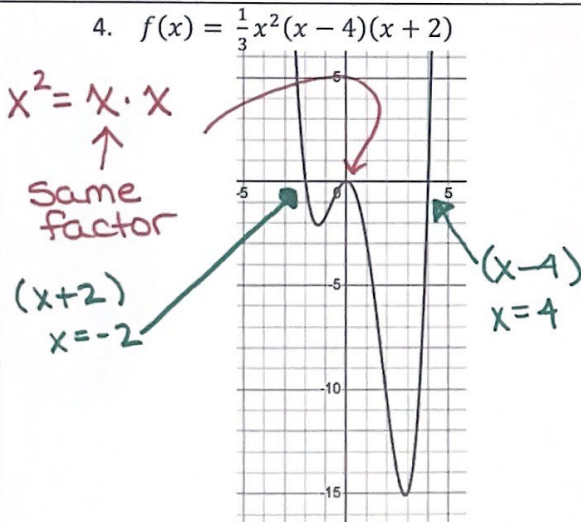
Linear Factors of a polynomial reveal its zeros. Linear factors can be found by writing a polynomial in factored form

3. $f(x) = x^3 - 2x^2 - 15x$ **cubic**
 $= x(x^2 - 2x - 15)$ ① check for GCF + factor out
 $= x(x-5)(x+3)$ ② factor quadratic

Factored form: $f(x) = x(x-5)(x+3)$
 Zero prod. prop. $x=0$ $x-5=0$ $x+3=0$
 $x=5$ $x=-3$
 Zeros 0, 5, -3

Multiplicity

The multiplicity of a zero is equal to the number of times is corresponding linear factors occurs in the factored form.



Zero/roots	Multiplicity	Effect
0	2	bounces off at root (touches)
4	1	passes through at root
-2	1	passes through at root

- If the multiplicity is an even number, touches (bounces off) at the zero.
- If the multiplicity is an odd number, it crosses the x-axis at the zero.

5. Write a polynomial function in standard form that represents this function.

A polynomial function has a zero/root of -6 (multiplicity 2) and $\frac{1}{3}$ (multiplicity of 1).

① factored form $f(x) = (x+6)^2(x-\frac{1}{3})$

② rewrite factors with fraction $x = \frac{1}{3}$ multiply by 3
 $3x = 1$

$3x - 1 = 0$

③ factored form $f(x) = (x+6)^2(3x-1)$

④ multiply factors
 $f(x) = (x^2 + 12x + 36)(3x - 1)$
 $= 3x^3 + 36x^2 + 108x - x^2 - 12x - 36$
 $f(x) = 3x^3 + 35x^2 + 96x - 36$