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Forms and Zeros of Polynomial Functions Class Work

Objective: *You will be able to rewrite polynomial expressions given their zeros and/or to determine their zeros, as well as the multiplicity of each.*

Factor each polynomial completely to determine its zeros, as well as the multiplicity of each.

1. $2x^2 + 3x - 14$

2. $2x^4 - 162$

3. $x^4(x^2 + 14)^3 - 196(x^2 + 14)^3$

4. $x^2(x - 8) - 64(x - 8)$

5. $2x^3 - 18x$

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6. $3x^5 - 27x^4 + 60x^3$

★ **Factor each polynomial completely to determine its zeros, as well as the multiplicity of each.**

1. $2x^2 + 3x - 14$

2. $2x^4 - 162$

3. $x^4(x^2 + 14)^3 - 196(x^2 + 14)^3$

4. $x^2(x - 8) - 64(x - 8)$

5. $2x^3 - 18x$

6. $3x^5 - 27x^4 + 60x^3$

★ State the zeros, as well as the multiplicity of each.
Also identify the y-intercept.

7. $(x - 1)^2(x + 3)(x^2 + 9)$

$x - 1 = 0$
$x = 1$
(M.2)

$x + 3 = 0$
$x = -3$
(M.1)

$x^2 + 9 = 0$
$\sqrt{x^2} = \sqrt{9}$
$x = 3i$ (M.1)
$x = -3i$ (M.1)

8. $(x + 5)^2(2x - 3)(x + 1)$

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9. $(x + 1)^3(x^2 + 25)(x^2 - 1)$

★ State the zeros, as well as the multiplicity of each.
Also identify the y-intercept.

7. $(x - 1)^2(x + 3)(x^2 + 9)$

8. $(x + 5)^2(2x - 3)(x + 1)$

9. $(x + 1)^3(x^2 + 25)(x^2 - 1)$

7. $x-1=0$ $x=1$ $(1,2)$ $x+3=0$ $x=-3$ $(1,1)$ $x^2+9=0$ $x^2=-9$ $x=3i$ $(1,1)$ $x=-3i$ $(1,1)$

y-int. Let $x=0$ $(-1)^2 \cdot 3 \cdot 9 = 27$ output $(0,27)$

★ State the zeros, as well as the multiplicity of each.
Also identify the y-intercept.

7. $(x - 1)^2(x + 3)(x^2 + 9)$

Let $x=0$ $(-1)^2 \cdot 3 \cdot 9 = 27$ output

y-int $(0, 27)$

8. $(x + 5)^2(2x - 3)(x + 1)$

9. $(x + 1)^3(x^2 + 25)(x^2 - 1)$

★ State the zeros, as well as the multiplicity of each.
Also identify the y-intercept.

7. $(x - 1)^2(x + 3)(x^2 + 9)$

8. $(x + 5)^2(2x - 3)(x + 1)$

$(5)^2 \cdot -3 \cdot 1$

9. $(x + 1)^3(x^2 + 25)(x^2 - 1)$

8. x = -5 (M.2) x = 3/2 (M.1) x = -1 (M.1)

y-int: (0, -75)

9. x = -1 (M.3) x = 5i (M.1) x = -5i (M.1) x = 1 (M.1)

x = -1 (M.1)

x = -1 (M.4)

$x^2 = 1$

$x = \pm 1$ $x = 1$ $x = -1$

y-int: (0, -25)

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★ Irrational/Imaginary Root Theorem:

*If 3i is a root, what must also be a root and why?

-3i b/c i represents a sqrt (√-1) always do ±√

*Given each root of a polynomial, determine another root.

a. -√2 √2

b. -8i 8i

c. 3 + 2i 3-2i

d. 2 - √3 2+√3

e. 4 - 3i 4+3i

★ Write a polynomial function for each situation, based on the zeros.
Write your functions in factored form, and then convert to standard form.
Make sure all coefficients are integers! ☺

10. Zeros: 2 (M.2) and -¾

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★ Irrational/Imaginary Root Theorem:

*If 3i is a root, what must also be a root and why?

-3i b/c i is a $\sqrt{}$ $(\sqrt{-1})$ and we ALWAYS put $\pm\sqrt{}$

*Given each root of a polynomial, determine another root.

a. $-\sqrt{2}$ $\sqrt{2}$

b. -8i 8i

c. 3 + 2i 3-2i

d. $2 - \sqrt{3}$ $2+\sqrt{3}$

e. 4 - 3i 4+3i

★ Write a polynomial function for each situation, based on the zeros. Write your functions in factored form, and then convert to standard form. Make sure all coefficients are integers! ☺

10. Zeros: 2 (M.2) and -¾

11. Zeros: -4, i, and ½

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12. Zeros: -1, 3, and -2i

13. Zeros: i, 4 (M.2) and $\frac{2}{3}$

$-i$

(x-zero) set up factors

$x-\frac{2}{3}=0$

$3x-2=0$

multiply $(x-i)(x+i)(x-4)(x-4)(3x-2)$

$(x^2+1)(x^2-8x+16)(3x-2)$

$(x^4-8x^3+16x^2 \quad x^2-8x+16)(3x-2)$

$(x^4-8x^3+17x^2-8x+16)(3x-2)$

$3x^5-2x^4-24x^4+16x^3$

$+51x^3-34x^2$

$-24x^2+16x$

$+48x-32$

$3x^5-26x^4+67x^3-58x^2+64x-32$

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12. Zeros: -1, 3, and -2i

13. Zeros: i, 4 (M.2) and $\frac{2}{3}$

$-i$

$x-\frac{2}{3}$

(x - root)

set up

$(x-i)(x+i)(x-4)(x-4)(3x-2)$

$(x^2+1)(x^2-8x+16)(3x-2)$

$(x^2+1)(3x-2)(x^2-8x+16)$

$(3x^3-2x^2+3x-2)(x^2-8x+16)$

$3x^5-24x^4+48x^3$

$-2x^4+16x^3-32x^2$

$3x^3-24x^2+48x$

$-2x^2+16x-32$

$3x^5-26x^4+67x^3-58x^2+64x-32$

★ Write a polynomial function for each situation, based on the zeros.
Write your functions in factored form, and then convert to standard form.
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10. Zeros: 2 (M.2) and -¾

11. Zeros: -4, i, and ½

12. Zeros: -1, 3, and -2i

13. Zeros: 3i, 4 (M.2) and $\frac{2}{3}$

11. $2x^4 + 7x^3 - 2x^2 + 7x - 4$

12. $x^4 - 2x^3 + x^2 - 8x - 12$

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★ **Real World Problem Solving**

14. At an airport, the sum of the length, width, and depth of a carry-on bag must not exceed 45 inches. Many carry-on luggage bags are designed in such a way that the depth is 5 inches shorter than the length. Zach is going to design a carry-on bag in order to meet these standards, and would like to maximize the volume, since he has a lot of luggage that he would like to carry-on for his vacation!

Determine the domain for the possible lengths Zach can use for the bag, as well as the maximum volume his carry-on bag can have, and the length he should use to design the bag so that volume is maximized.

Write an expression for each dimension, in terms of one variable:

Write a polynomial for the volume:

Graph to determine the domain of lengths (x) and maximum volume (y).

15. Karen has 12 inch by 10 inch piece of cardboard that she would like to use to create a box she can use to carry sandwiches to distribute to the homeless when she visits a city. She plans on cutting the same size square out of each corner of the cardboard, and then folding up the sides, and she would like the box to have as high of a volume as possible. Help Karen determine the best dimensions for the square that she should cut out of each corner, as well as the maximum volume that this will allow for.

height: x (amount cut out from each corner)

length: 12 - 2x

width: 10 - 2x

V = height * length * width

V = x(12 - 2x)(15 - 2x)

1.811 inches cut from each corner maximizes volume as 96.771 cubic inches

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Find your Match! You either have a polynomial in standard form, a polynomial in factored form, or the zeros of a polynomial. Find the person (or two people) who you belong with!

Zeros: -3 (M.2), and 2	$(x + 3)^2(x - 2)$	$x^3 + 4x^2 - 3x - 18$
Zeros: -2, ½, and 2	$(2x - 1)(x + 2)(x - 2)$	$2x^3 - x^2 - 8x + 4$
Zeros: -3, 3/2, and 3	$(2x - 3)(x - 3)(x + 3)$	$2x^3 - 3x^2 - 18x + 27$
Zeros: 3 (M.2), and ½	$(x - 3)^2(2x - 1)$	$2x^3 - 13x^2 + 24x - 9$
Zeros: -3 (M.2) & 2(M.2)	$(x + 3)^2(x - 2)^2$	$x^4 + 2x^3 - 11x^2 - 12x + 36$
Zeros: 3 (M.2), and 2	$(x - 3)^2(x - 2)$	$x^3 - 8x^2 + 21x - 18$
Zeros: -3 (M.2), and -3/2	$(x + 3)^2(2x + 3)$	$2x^3 + 15x^2 + 36x + 27$
Zeros: -3 (M.2), & 3 (M.2)	$(x + 3)^2(x - 3)^2$	$x^4 - 18x^2 + 81$