

Name _____

Accel Geom/Adv Alg

Date _____ Period _____

11.1/11.2 Finding Zeros

List the possible rational roots for the following polynomial functions.

1. $x^4 + 3x^3 - 2x^2 + 6x - 18$

$$\frac{p}{q} = \frac{\pm \{1, 2, 3, 6, 9, 18\}}{\pm 1}$$

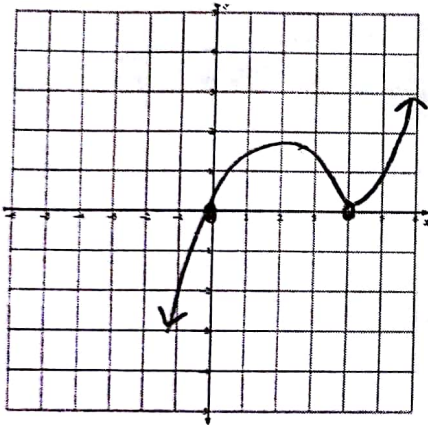
2. $3x^3 - 6x^2 + 12$

$$\frac{p}{q} = \frac{\pm \{1, 2, 3, 4, 6, 12\}}{\pm \{1, 3\}}$$

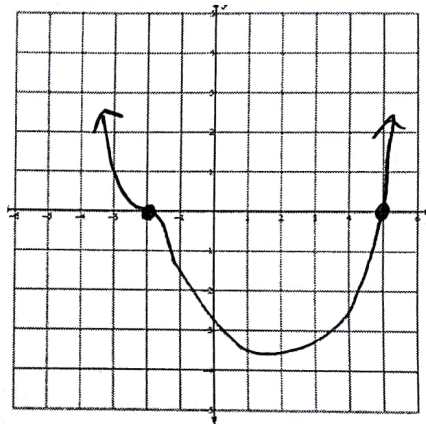
$$\pm \{1, 1/3, 2, 2/3, 3, 4, 4/3, 6, 12\}$$

Impress me! Sketch a graph of a polynomial function given the following zeros.

3. 4, 4, 0



4. -2, -2, -2, 5



Find the roots of the polynomial functions.

5. $-3x^3 + 3x^2 + 90x = 0$

$$-3x(x^2 - x - 30) = 0$$

$$-3x(x-6)(x+5) = 0$$

$$x = 0, 6, -5$$

6. $(12x^3 - 20x^2) + (21x - 35) = 0$

$$4x^2(3x-5) + 7(3x-5) = 0$$

$$(4x^2+7)(3x-5) = 0$$

$$4x^2+7=0$$

$$4x^2 = -7$$
$$\sqrt{x^2} = \sqrt{\frac{-7}{4}}$$

$$x = \pm \frac{i\sqrt{7}}{2}, 5/3$$

$$7. y = (x^3 + x^2)(3x - 3)$$

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

$$(x^2 - 3)(x+1) = 0$$

$$x = \pm\sqrt{3}, -1$$

$$8. x^5 + 3x^4 - 7x^3 = 0$$

$$x^3(x^2 + 3x - 7) = 0$$

$$x = \frac{-3 \pm \sqrt{9 - 4(1)(-7)}}{2(1)}$$

$$= \frac{-3 \pm \sqrt{37}}{2}, 0 \text{ mult. of } 3$$

$$9. f(x) = x^4 - 2x^2 - 15$$

$$(x^2 - 5)(x^2 + 3)$$

$$x = \pm\sqrt{5}, \pm i\sqrt{3}$$

$$10. y = 3x^3 + 5x^2 + x - 1$$

$$\frac{p}{q} = \frac{\pm 1}{\pm\{1, 3\}} = \pm\{1, \frac{1}{3}\}$$

$$\begin{array}{r|rrrr} -1 & 3 & 5 & 1 & -1 \\ & \downarrow & -3 & -2 & 1 \\ & 3 & 2 & -1 & 0 \end{array}$$

$$x = \frac{1}{3}, -1 \text{ mult. of } 2$$

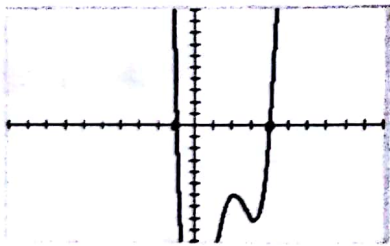
$$3x^2 + 2x - 1 = 0$$

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

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

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

$$11. f(x) = x^4 - 7x^3 + 13x^2 + x - 20$$



$$\begin{array}{r|rrrrr} -1 & 1 & -7 & 13 & 1 & -20 \\ & \downarrow & -1 & 8 & -21 & 20 \\ & 1 & -8 & 21 & -20 & 0 \end{array}$$

$$\begin{array}{r|rrrr} 4 & 1 & -8 & 21 & -20 & 0 \\ & \downarrow & 4 & -16 & 20 & \\ & 1 & -4 & 5 & 0 & \end{array}$$

$$x^2 - 4x + 5 = 0$$

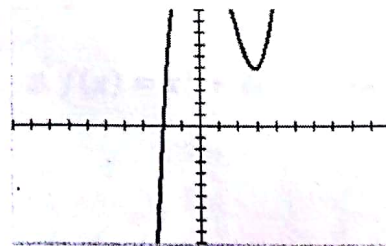
$$x^2 - 4x + \frac{4}{4} = -5 + \frac{4}{4}$$

$$\sqrt{(x-2)^2} = \sqrt{-1}$$

$$x - 2 = \pm i$$

$$x = 2 \pm i, -1, 4$$

$$12. x^3 - 4x^2 - 2x + 20 = 0$$



$$\begin{array}{r|rrrr} -2 & 1 & -4 & -2 & 20 \\ & \downarrow & -2 & 12 & -20 \\ & 1 & -6 & 10 & 0 \end{array}$$

$$x^2 - 6x + 10 = 0$$

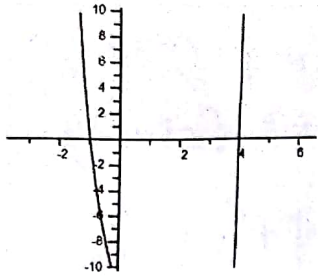
$$x^2 - 6x + \frac{9}{9} = -10 + \frac{9}{9}$$

$$\sqrt{(x-3)^2} = \sqrt{-1}$$

$$x - 3 = \pm i$$

$$x = 3 \pm i, -2$$

$$13. x^4 - 3x^3 - x^2 - 9x - 12 = 0$$

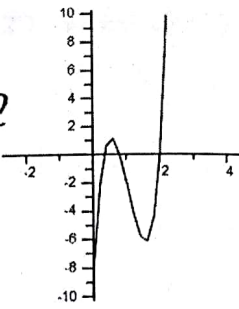


$$\begin{array}{r|rrrrr} -1 & 1 & -3 & -1 & -9 & -12 \\ & \downarrow & -1 & 4 & -3 & 12 \\ 4) & 1 & -4 & 3 & -12 & 0 \\ & \downarrow & 4 & 0 & 12 & \\ \hline & 1 & 0 & 3 & 0 & \end{array}$$

$$x^2 + 3 = 0$$

$$x = \pm i\sqrt{3}, -1.4$$

$$14. 15x^3 - 47x^2 + 38x - 8 = 0$$



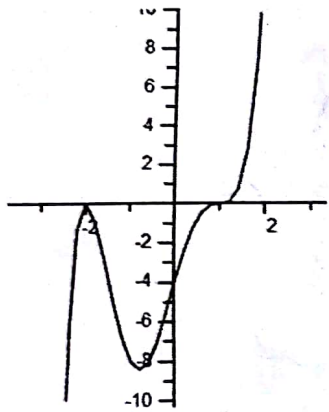
$$\begin{array}{r|rrrr} 2 & 15 & -47 & 38 & -8 \\ & \downarrow & 30 & -34 & 8 \\ \hline & 15 & -17 & 4 & 0 \\ 15x^2 - 17x + 4 = 0 \end{array}$$

$$x = \frac{17 \pm \sqrt{289 - 4(15)(4)}}{2(15)}$$

$$= \frac{17 \pm \sqrt{49}}{30} = \frac{17 \pm 7}{30}$$

$$= \left\{ \frac{4}{5}, \frac{1}{3}, 2 \right\}$$

$$15. f(x) = x^5 + x^4 - 5x^3 - x^2 + 8x - 4$$



$$x = -2 \text{ mult. of } 2, \\ 1 \text{ mult. of } 3$$

$$16. x^3 - 64x = 0$$

$$x(x^2 - 64) = 0$$

$$x(x+8)(x-8) = 0$$

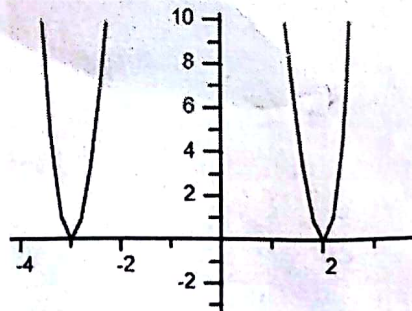
$$x = 0, \pm 8$$

$$17. x^4 - 5x^2 - 24 = 0$$

$$(x^2 - 8)(x^2 + 3) = 0$$

$$x = \pm 2\sqrt{2}, \pm i\sqrt{3}$$

$$18. f(x) = x^4 + 2x^3 - 11x^2 - 12x + 36$$



$$x = -3 \text{ mult. of } 2,$$

$$2 \text{ mult. of } 2$$

Write the simplest polynomial function with the given roots.

19. -2, 0, 4

$$x(x+2)(x-4) = 0$$

$$(x^2+2x)(x-4) = 0$$

$$x^3 - 4x^2 + 2x^2 - 8x = 0$$

$$x^3 - 2x^2 - 8x = 0$$

21. -1, -2i

$$x = -1 \quad x^2 = -2i^2$$

$$x^2 = -4i^2$$

$$(x+1)(x^2+4) = 0$$

$$x^3 + x^2 + 4x + 4 = 0$$

20. -3 (multiplicity of 3), 2/3

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

$$(x^2+6x+9)(3x^2+7x-6)$$

x^2	$3x^4$	$7x^3$	$-6x^2$
$6x$	$18x^3$	$42x^2$	$-36x$
9	$27x^2$	$63x$	-54

$$3x^4 + 25x^3 + 63x^2 + 27x - 54 = 0$$

22. $\sqrt{7}$, 5 (multiplicity of 2)

$$x^2 = \sqrt{7}^2 \quad x = 5 \quad x = 5$$

$$(x-5)(x-5)$$

$$x^2 = 7$$

$$(x^2-7)(x^2-10x+25)$$

x^2	x^4	$-10x^3$	$25x^2$
-7	$-7x^2$	$70x$	-175

$$x^4 - 10x^3 + 18x^2 + 70x - 175 = 0$$