Warm Up

1) Find all the zeros of $x^3 - 3x^2 - 8x - 10 = 0$

2) Find a 3rd degree polynomial equation that has the given roots: 3 and $-4i$

3) Find a polynomial, in standard form, which represents the graph to the right.

cubic: $x = 2,\ x = -1,\ x = -1$

$x - 2 = 0 \quad x + 1 = 0 \quad x + 1 = 0$

$y = \boxed{(x-2)(x+1)}(x+1)$

FOIL

$y = (x^2 + x - 2x - 2)(x+1)$

$y = (x^2 - x - 2)(x+1)$

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

$y = x^3 - 3x - 2$

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Answers for Lesson 6-4 Exercises

Period 4

1. $-2, 1, 5$
2. $-1, 0, 3$
3. $0, 1$
4. $0, 8$
5. $0, -1, -2$
6. $0, -3.5, 1$
7. $0, -0.5, 1.5$
8. $-0.5, 0, 3$
9. $1, 7$
10. 4.8%
11. about 5.78 ft × 6.78 ft × 1.78 ft
12. $(x + 4)(x^2 - 4x + 16)$
13. $(x - 10)(x^2 + 10x + 100)$
14. $(5x - 3)(25x^2 + 15x + 9)$
15. $3, \frac{-3 \pm 3i\sqrt{3}}{2}$
16. $-4, 2 \pm 2i\sqrt{3}$
17. $5, \frac{-5 \pm 5i\sqrt{3}}{2}$
18. $-1, \frac{1 \pm i\sqrt{3}}{2}$
19. $\frac{1}{2}, \frac{-1 \pm i\sqrt{3}}{4}$
20. $-\frac{1}{2}, \frac{1 \pm i\sqrt{3}}{4}$

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21. $(x^2 - 7)(x - 1)(x + 1)$
22. $(x^2 + 10)(x^2 - 2)$
23. $(x^2 - 3)(x - 2)(x + 2)$
24. $(x - 2)(x + 2)(x - 1)(x + 1)$
25. $(x - 1)(x + 1)(x^2 + 1)$
44. $\pm 2\sqrt{2}, \pm 2i\sqrt{2}$
45. $\pm 5, \pm i\sqrt{2}$
46. $\pm 3i, \pm i\sqrt{3}$
47. $0, \pm 2, \pm 1$
48. $\pm\sqrt{10}, \pm i\sqrt{10}$
49. $0, \frac{1}{2} \pm \frac{\sqrt{265}}{10}$
54. $-3, -2, 2$
55. $-1, 3, 3$
56. $0, 1, 3$
57. $0, 0, 1, 6$
58. $\pm\sqrt{\frac{3}{2}}, \pm i$
59. $\pm\sqrt{2}, \pm i$

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Answers for Lesson 6-5 Exercises Period 6

1. $\pm 1, \pm 2; 1$
2. $\pm 1, \pm 2, \pm 3, \pm 6; 1, -2, -3$
3. $\pm 1, \pm 2, \pm 4; -1$
4. $\pm\frac{1}{2}, \pm 1, \pm 2, \pm 4, \pm$
5. $\pm 1, \pm 2, \pm 4, \pm 8, \pm$
7. $2, \pm i\sqrt{5}$
8. $5, \pm i\sqrt{7}$
9. $-3, 1, \frac{7}{2}$
10. $-5, \frac{1 \pm \sqrt{3}}{2}$
11. $\pm\frac{1}{2}, \pm 3$
12. $1, -2, \frac{1 \pm \sqrt{7}}{3}$
13. $-\sqrt{5}, \sqrt{13}$
14. $4 + \sqrt{6}, -\sqrt{3}$
15. $1 + \sqrt{10}, 2 - \sqrt{2}$
16. $1 - i, 5i$
17. $2 - 3i, -6i$
18. $4 + i, 3 - 7i$

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19. $x^3 - x^2 + 9x - 9 = 0$
20. $x^3 + 3x^2 - 8x + 10 = 0$
21. $x^3 - 2x^2 + 16x - 32 = 0$
22. $x^3 - 3x^2 - 8x + 30 = 0$
23. $x^3 - 6x^2 + 4x - 24 = 0$
24. $x^3 - x^2 + 2 = 0$
25. $\pm\frac{1}{12}, \pm\frac{1}{6}, \pm\frac{1}{4}, \pm\frac{1}{2}, \pm\frac{1}{3}, \pm\frac{2}{3}, \pm\frac{3}{4}, \pm 1, \pm\frac{3}{2}, \pm 2, \pm 3, \pm 6; \frac{1}{2}, \frac{3}{2}, \frac{2}{3}$

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6.6 Fundamental Theorem of Algebra

Theorem **Fundamental Theorem of Algebra**

If $P(x)$ is a polynomial of degree $n \geq 1$ with complex coefficients, then $P(x) = 0$ has at least one complex root.

Corollary

Including complex roots and multiple roots, an nth degree polynomial equation has exactly n roots; the related polynomial function has exactly n zeros.

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6.6 Fundamental Theorem of Algebra

1) Find all the roots of $x^4 + 2x^3 - x^2 - 8x - 12 = 0$

$p/q = \pm 3, \pm 4, \pm 6, \pm 2, \pm 1, \pm 12$

Remember: (Always check to see if you can factor first!)
LIST p/q ⇒ GRAPH ⇒
TEST ⇒ KNOCK DOWN TO QUADRATIC ⇒ SOLVE

2	1	2	−1	−8	−12 (4th deg)
	↓	2	8	14	12
−2	1	4	7	6	0 ✓ (3rd degree)
	↓	−2	−4	−6	
	1	2	3	0 ✓	(Quadratic)

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

$x = \dfrac{-2 \pm \sqrt{4 - 4(1)(3)}}{2(1)}$

$x = \dfrac{-2 \pm \sqrt{-8}}{2}$

$x = \dfrac{-2 \pm 2i\sqrt{2}}{2} = \boxed{-1 \pm i\sqrt{2}}$

$\boxed{\begin{array}{l} x = 2 \\ x - 2 \end{array}}$

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2) Find all the roots of $x^3 + 3x^2 + x + 3 = 0$

Remember: (Always check to see if you can factor first!)
LIST p/q ⇒ GRAPH ⇒
TEST ⇒ KNOCK DOWN TO QUADRATIC ⇒
SOLVE

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Homework

HW6.6 p. 343 #9 - 16 all, #32 - 36

Review Packet: DUE TUESDAY!

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Find all the zeros of each function.

9. $y = 2x^3 + x^2 + 1$

10. $f(x) = x^3 - 3x^2 + x - 3$

11. $g(x) = x^3 - 5x^2 + 5x - 4$

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

13. $y = x^4 - 6x^2 + 8$

14. $f(x) = x^4 - 3x^2 - 4$

15. $y = x^3 - 3x^2 - 9x$

16. $y = x^3 + 6x^2 + x + 6$

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32. Which number is a root of $f(x) = x^3 + 6x^2 + 9x$ that has multiplicity 1?
A. 3 **B.** 1 **C.** 0 **D.** -3

33. Three roots of a polynomial equation with real coefficients are 3, $5 - 3i$, and $-3i$. Which number MUST also be a root of the equation?
I. -3 **II.** $5 + 3i$ **III.** $3i$
F. II only **G.** I and II only **H.** II and III only **J.** I, II, and III

34. One root of the equation $x^3 + x^2 - 2 = 0$ is 1. What are the other two roots?
A. $1 \pm 2i$ **B.** $-1 \pm i$ **C.** $\pm 1 + 2i$ **D.** $\pm 1 - i$

35. A polynomial with real coefficients has 3, $2i$, and $-i$ as three of its zeros. What is the least possible degree of the polynomial?
F. 3 **G.** 4 **H.** 5 **J.** 6

36. How many times does the graph of $x^3 + 27$ cross the x-axis?
A. 0 **B.** 1 **C.** 2 **D.** 4

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