Warm up - Review

1) Write in standard form then classify by degree and number of terms: $(x - 5)^2 + 3x - x^2 + 4x^3$

2) Factor (if not already factored), find the zeros, and state the end behavior. State the multiplicity and sketch:
a) $f(x) = 8x^3 + 12x^2 - 20x$
b) $y = (x - 5)^2(x + 4)^3$

3) Write a polynomial in standard form with the given zeros: 5, 0, and -3

4) On your calculator, find the relative max and relative min. Round to two decimals.
$y = 6x^3 + 11x^2 - 35x$

Graph

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Answers for Lesson 6-3 Exercises

1. $x - 8$	**2.** $3x - 5$
3. $x^2 + 4x + 3$, R 5	**4.** $2x^2 + 5x + 2$
5. $3x^2 - 7x + 2$	**6.** $9x - 12$, R -32
7. $x - 10$, R 40	**8.** $x^2 + 4x + 3$
9. no	**10.** yes
37. $x^2 + 4x + 5$	**38.** $x^3 - 3x^2 + 12x - 35$, R 109
39. $x^4 - x^3 + x^2 - x + 1$	**40.** $x + 4$
41. $x^3 - x^2 + 1$	**42.** no

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6.3 Part 2
Synthetic Division

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Synthetic Division

- A simplified way to divide polynomials
- Can only be used when dividing by a LINEAR FACTOR

IE, $x-3$ or $3x-2$ or $x+7$

- Be careful to place 0's for "space savers"

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Let's use a HW problem.

#13 $(x^3 + 3x^2 - x - 3) \div (x - 1)$

$x - 1 = 0$

$x = 1$

Why?

What was your answer when you divided?

Let's try synthetic division for that same problem.

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Divide Using Synthetic Division

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

Step 1
- Put the **zero** in the box.

Step 2
- Write coefficients of the ploynomial.

Step 3
- Bring down 1st coefficient

Step 4
- Multiply and Add

1	1	3	−1	−3
		1	4	3
	1	4	3	0

$1x^2 + 4x + 3$ Remainder

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Divide Using Synthetic Division.
Write the resulting polynomial.

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

$x+1=0$
$x=-1$

$$\begin{array}{c|cccc} -1 & 1 & -2 & 1 & 4 \\ & & -1 & 3 & -4 \\ \hline & 1 & -3 & 4 & \boxed{0} \end{array}$$ ← Remainder

$1x^2 - 3x + 4$

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Use synthetic division and the given factor to factor the polynomial completely.

$x^3 - 4x^2 - 7x + 10 \div (x - 5)$

$x - 5 = 0$
$x = 5$

$$\begin{array}{c|cccc} 5 & 1 & -4 & -7 & 10 \\ & & 5 & 5 & -10 \\ \hline & 1 & 1 & -2 & \boxed{0} \end{array}$$ ← Remainder

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

$(x+2)(x-1)(x-5)$

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Divide f(x) by (x+3) What is missing?

$x+3=0$
$x=-3$

$f(x) = 2x^4 + 7x^3 + x - 12$

$$\begin{array}{c|ccccc} -3 & 2 & 7 & 0 & 1 & -12 \\ & & -6 & -3 & 9 & -30 \\ \hline & 2 & 1 & -3 & 10 & \boxed{-42} \end{array}$$ ← Remainder

$f(-3) = 2(-3)^4 + 7(-3)^3 + (-3) - 12 = -42$

What is the value of f(-3)?

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Remainder Theorem

If a polynomial, call it P(x), of degree 1 or higher is divided by (x – a), then the remainder is the value of P(a).

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Use Synthetic Division and the Remainder Theorem to determine P(a)

$P(x) = 9x^3 - 48x^2 + 13x + 3$; a = 5

If $f(x) = 9x^3 - 48x^2 + 13x + 3$ find f(5)

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ASSIGNMENT 6.3

p. 324 #13-33 odd,
49-55 odd, 61, 62, 64

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Example 3 (page 322) **Divide using synthetic division.**

13. $(x^3 + 3x^2 - x - 3) \div (x - 1)$
14. $(x^3 - 4x^2 + 6x - 4) \div (x - 2)$
15. $(x^3 - 7x^2 - 7x + 20) \div (x + 4)$
16. $(x^3 - 3x^2 - 5x - 25) \div (x - 5)$
17. $(x^3 - 2x^2 - 5x + 6) \div (x - 1)$
18. $(-2x^3 + 5x^2 - x + 2) \div (x + 2)$
19. $(x^2 + 3) \div (x - 1)$
20. $(3x^3 + 17x^2 + 21x - 9) \div (x + 3)$
21. $(x^3 + 27) \div (x + 3)$
22. $(6x^2 - 8x - 2) \div (x - 1)$

Example 4 (pages 322–323) **Use synthetic division and the given factor to completely factor each polynomial function.**

23. $y = x^3 + 2x^2 - 5x - 6; (x + 1)$
24. $y = x^3 - 4x^2 - 9x + 36; (x + 3)$

25. **Geometry** Refer to the diagram. The volume in cubic inches of the decorative box can be expressed as the product of the lengths of its sides as $V(x) = x^3 + x^2 - 6x$. Write linear expressions with integer coefficients for the locker's length and height.

Example 5 (page 323) **Use synthetic division and the Remainder Theorem to find $P(a)$.**

26. $P(x) = x^3 + 4x^2 - 8x - 6; a = -2$
27. $P(x) = x^3 + 4x^2 + 4x; a = -2$
28. $P(x) = x^3 - 7x^2 + 15x - 9; a = 3$
29. $P(x) = x^3 + 7x^2 + 4x; a = -2$
30. $P(x) = 6x^3 - x^2 + 4x + 3; a = 3$
31. $P(x) = 2x^3 - x^2 + 10x + 5; a = \frac{1}{2}$
32. $P(x) = 2x^3 + 4x^2 - 10x - 9; a = 3$
33. $P(x) = 2x^4 + 6x^3 + 5x^2 - 45; a = -3$

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Use synthetic division to determine whether each binomial is a factor of $3x^3 + 10x^2 - x - 12$.

48. $x + 3$
49. $x - 1$
50. $x + 2$
51. $x - 4$

Divide using synthetic division.

52. $(x^4 - 2x^3 + x^2 + x - 1) \div (x - 1)$
53. $(x^4 - 6x^2 - 27) \div (x + 2)$
54. $(x^4 - 5x^2 + 4x + 12) \div (x + 2)$
55. $\left(x^4 - \frac{9}{2}x^3 + 3x^2 - \frac{1}{2}x\right) \div \left(x - \frac{1}{2}\right)$

61. What is the remainder when $x^2 - 5x + 7$ is divided by $x + 1$?
A. -13 B. -1 C. 1 D. 13

62. Which binomial is NOT a factor of $x^3 - x^2 - 17x - 15$?
F. $x - 5$ G. $x + 1$ H. $x + 3$ J. $x + 5$

63. Which of the following, when multiplied by $x - 1$, results in a cubic polynomial whose standard form has three terms?
A. $(x - 1)^2$ B. $x^2 - x$ C. $x^2 - 1$ D. $x - 1$

64. One factor of $x^3 - 7x^2 - x + 7$ is $x - 1$. What are all the zeros of the related polynomial function? Show your work.

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