**Algebra II 2016-2017**

**Chapter 5 - Polynomial Expressions and Equations**

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
<th>Friday</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nov. 7</strong></td>
<td>A Day</td>
<td>15 B Day</td>
<td>16 A Day</td>
<td>17 B Day</td>
</tr>
<tr>
<td>5.1 Analyzing Polynomial Functions</td>
<td>5.2 Polynomial Division</td>
<td>5.2 Polynomial Division (Day 2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Mon Nov. 14   | B Day   | 15 A Day | 16 B Day | 17 A Day | 18 B Day |
| 5.2 Polynomial Division (Day 2) | 5.3 The Factor Theorem & Remainder Theorem | 5.4 Factoring Higher Order Polynomials |

| 21          | 22      | 23       | 24       | 25       |

<table>
<thead>
<tr>
<th>Staff Development</th>
<th>Holiday</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Nov 28 A Day</strong></td>
<td><strong>29 B Day</strong></td>
</tr>
<tr>
<td>30 A Day</td>
<td>Dec 1 B Day</td>
</tr>
<tr>
<td>Chapter 5 Review</td>
<td>Chapter 5 Teacher Test</td>
</tr>
</tbody>
</table>

**Website:** [http://heritagealgebra2.weebly.com/](http://heritagealgebra2.weebly.com/)

**Tutoring**

<table>
<thead>
<tr>
<th>Monday</th>
<th>Tuesday</th>
<th>Wednesday</th>
<th>Thursday</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:20 AM – C107</td>
<td>Activity Period – C107</td>
<td>Activity Period – C107</td>
<td>8:20 AM – C107</td>
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<tr>
<td>4:20 PM – C107</td>
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</tr>
</tbody>
</table>

**Make-Up Tests (C110)**

- Tuesdays 7:45 AM – 8:45 AM
- Thursdays 4:20 PM – 5:20 PM
### Chapter Summary

Keep notes here with key points you want to study with for your test.

<table>
<thead>
<tr>
<th>Section</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.1 Analyzing Polynomial Functions</td>
<td></td>
</tr>
<tr>
<td>5.2 Polynomial Division</td>
<td></td>
</tr>
<tr>
<td>5.3 The Factor Theorem &amp; Remainder Theorem</td>
<td></td>
</tr>
<tr>
<td>5.4 Factoring Higher Order Polynomials</td>
<td></td>
</tr>
</tbody>
</table>
5.1 Analyzing Polynomial Functions

Write a definition for the term in your own words.

1. average rate of change --

Problem Set

The graph shows the number of vocabulary words a student is able to memorize based on the amount of time spent studying. Use the graph to answer the questions.

2. How many vocabulary words does the student know at the start of the study? Where is this information located on the graph?

3. Describe the relative minimum in terms of the problem situation.

4. What is the minimum amount of time the student studies before they begin to remember the vocabulary? Where is this information located on the graph?

5. How long did the student need to study in order to remember 22 vocabulary words? Where is this information located on the graph?

6. The graph has an $x$-intercept at (2, 0). Describe the activity of the student at this point in terms of the problem situation.

7. Does the graph accurately describe the problem situation? Explain your reasoning.
Determine the average rate of change for the given interval for each polynomial function.

8. (0, 1.5)

\[
\frac{f(b) - f(a)}{b - a} = \frac{f(1.5) - f(0)}{1.5 - 0}
\]

\[
= \frac{4.375 - 0}{1.5 - 0}
\]

\[
= \frac{4.375}{1.5}
\]

\[
\approx 2.92
\]

10. (–2, 0)

9. (1, 2)

11. (–3, –0.3)
Solve each equation using the information found in the graph.

14. The graph models the profit a group of students earns running a tutoring business. After how many weeks did it take the group to earn a profit? Where is this information located on the graph?

Answer: The group earns a profit after 5 weeks in business. The information is located at the x-intercept of (5, 0).

15. The graph models the amount of money a company makes producing floral displays. What is the maximum number of floral displays that the company can create and continue to increase their profit? Where is this information located on the graph?
16. The graph models the number of gallons of water that are filtered at a filtration plant hourly. How many gallons of water has the plant filtered after running for about 4.5 hours? Where is this information located on the graph?

18. The graph models the number of tricks that a dog can perform based on the number of hours it is trained. Estimate how long it takes the dog to learn 8 tricks. Where is this information located on the graph?

17. The graph models the amount of profit Emilio earns from his own lawn-care business. How much did Emilio initially invest to start his business? Where is this information located on the graph?

19. The graph models the number of electronic devices that are being used in a home during the hours of noon and 4:00 pm. Estimate the time when the greatest number of electronic devices are being used. Where is this information located on the graph?
5.2 Polynomial Division

Write an example for each term. Write the dividend as the product of the divisor and the quotient plus the remainder.

20. Polynomial long division

21. Synthetic division

Write the zero that corresponds to each factor.

22. $x + 5$
   ANS: $x = -5$

23. $x - 12$

24. $2x + 1$

25. $10x - 9$

26. $x - 13$

27. $3x + 4$

Write the factor that corresponds to each zero.

28. $x = 2$
   ANS: $x - 2$
   $x = \frac{2}{3}$

29. $x = -7$
   $x = -\frac{3}{8}$

30. $x = -75$
   $x = \frac{5}{4}$

31. $x = -\frac{3}{8}$

32. $x = \frac{5}{4}$
Determine if the given factor is a factor of each polynomial. Explain your reasoning.

34. Is $x - 1$ a factor of $x^4 - 3x^3 + 6x^2 - 12x + 8$?

ANS:

\[
x - 1 \bigg| \begin{array}{r}
  x^4 - 3x^3 + 6x^2 - 12x + 8 \\
  \hline
  x^3 - 2x^2 + 4x - 8 \\
  \hline
  x^4 - x^3 \\
  - 2x^3 + 6x^2 \\
  \hline
  - 4x^3 + 4x^2 \\
  4x^2 - 12x \\
  \hline
  - 8x + 8 \\
  \hline
  0
  \end{array}
\]

Yes, $x - 1$ is a factor of $x^4 - 3x^3 + 6x^2 - 12x + 8$ because it divides into the polynomial without a remainder.

35. Is $x - 1$ a factor of $x^4 + 6x^3 - 12x^2 - 38x - 21$?

36. Is $3x + 2$ a factor of $3x^5 + 20x^4 + 9x^3 - 92x^2 - 60x$?
37. Is \( x - 3 \) a factor of \( x^3 + 12x^2 + 17x - 30 \)?

38. Is \( x + 4 \) a factor of \( 2x^3 + 7x^2 - 10x - 24 \)?

39. Is \( x + 2 \) a factor of \( x^4 - 2x^3 - x^2 - 4x - 6 \)?

Determine each quotient using polynomial long division. Write the dividend as the product of the divisor and the quotient plus the remainder.

40. \( \frac{x - 4}{2x^3 - 7x^2 - 19x + 60} \)

ANS:

\[
\begin{array}{c|cccc}
2x^2 + x & 2x^3 & -7x^2 & -19x & +60 \\
x - 4 & 2x^3 & -7x^2 & -19x & +60 \\
\hline
2x^3 & -8x^2 & & & \\
x^2 & -19x & & & \\
x^2 & -4x & & & \\
& -15x & +60 & & \\
& -15x & +60 & & \\
& & & & 0
\end{array}
\]

\[
2x^3 - 7x^2 - 19x + 60 = (x - 4)(2x^2 + x - 15)
\]
41. \( x - 2 \overline{) 2x^3 - x^2 - 13x - 6} \)

42. \( x + 3 \overline{) x^3 + 8x^2 + 7x + 5} \)

43. \( x + 2 \overline{) 3x^3 + 5x^2 - 2x} \)

44. \( x + 1 \overline{) 4x^4 + 9x^3 - 82x^2 - 57x + 18} \)

45. \( x - 3 \overline{) x^4 + 5x^3 - 33x^2 + 27x} \)

46. \( x^2 - 3 \overline{) x^4 + 2x^3 - 4x^2 + 6x + 3} \)
47. \( \frac{x^2 - 1}{x^3 + 9x^2 + 5x - 6} \)

48. \( \frac{x^2 + 5}{x^3 + 2x^2 - 7x + 4} \)

50. \( \frac{x^2 - 2}{-12x^3 + 7x^2 - 25} \)

51. \( 3x^2 + 1 \) \( \frac{24x^4 - 6x^3 - 25x^2 - 2x - 11}{6x^4 - 4x^3 + 5x - 2} \)
Determine each quotient using synthetic division. Write the dividend as the product of the divisor and the quotient plus the remainder.

52. \((x^4 + 8x^3 - 3x^2 - 24x) + (x - 3)\)

ANS:

\[
\begin{array}{cccc}
3 & 1 & 8 & -3 & -24 & 0 \\
    & 3 & 33 & 90 & 198 & \\
\hline
    & 1 & 11 & 30 & 66 & 198
\end{array}
\]

\[x^4 + 8x^3 - 3x^2 - 24x = (x - 3)\left(x^3 + 11x^2 + 30x + 66 + \frac{198}{x - 3}\right)\]

53. \((x^4 - 3x^3 + 6x^2 - 12x + 8) + (x - 1)\)

55. \((x^4 + x^3 - 16x - 16) + (x + 2)\)

56. \((x^4 - 6x^3 - 19x^2 + 24x) + (x + 3)\)

54. \((2x^3 + 21x^2 + 22x - 45) + (2x + 5)\)

57. \((x^4 + 5x^3 - 33x^2 + 27x) + (x - 9)\)
5.3 The Factor Theorem and Remainder Theorem

| Remainder Theorem | Factor Theorem |

58. The ______________________ states that a linear polynomial \((x - r)\) is a factor of a polynomial \(p(x)\) if and only if \(p(r) = 0\) and \(\frac{p(x)}{x - r}\) has a remainder of zero.

59. The ______________________ states that when any polynomial equation or function is divided by a linear factor \((x - r)\), the remainder is the value of the equation or function when \(x = r\).

**Determine each function value using the Remainder Theorem. Explain your reasoning.**

60. Determine \(p(3)\) if \(p(x) = 2x^3 - 6x^2 - 36x - 36\).

When \(p(x)\) is divided by \(x - 3\),
the remainder is \(-144\).

So, by the Remainder Theorem \(p(3) = -144\).

61. Determine \(p(-2)\) if \(p(x) = x^4 - 10x^3 + 8x^2 + 106x - 105\).

62. Determine \(p(-3)\) if \(p(x) = 2x^4 + 5x^3 + 8x^2 + 15x + 6\).

64. Determine \(p(10)\) if \(p(x) = 6x^3 + 11x^2 - 3x - 2\).

65. Determine \(p\left(\frac{1}{3}\right)\) if \(p(x) = x^4 - x^3 + 7x^2 - 9x - 18\).
Use the Factor Theorem to determine whether the given expression is a factor of each polynomial. Explain your reasoning.

66. Is \(x - 2\) a factor of \(f(x) = x^3 + 8x^2 - 31x + 22\)?

ANS:
If \(x - 2\) is a factor of \(f(x)\), then by the Factor Theorem \(f(2) = 0\).

\[
f(2) = (2)^3 + 8(2)^2 - 31(2) + 22 \]
\[
f(2) = 8 + 32 - 62 + 22 \]
\[
f(2) = 0 \]

When \(f(x)\) is evaluated at 2, the result is 0. According to the Factor Theorem \(x - 2\) is a factor of \(f(x)\).

67. Is \(x - 3\) a factor of \(f(x) = 4x^4 - x^3 - 52x^2 - 35x + 12\)?

68. Is \(x - 12\) a factor of \(f(x) = x^4 - 12x^3 + x^2 - 12x\)?

69. Is \(x - 8\) a factor of \(f(x) = x^3 - 7x^2 - 14x + 48\)?

70. Is \(x - 5\) a factor of \(f(x) = x^3 + 5x^2 - x - 5\)?

71. Is \(3x + 4\) a factor of \(f(x) = 3x^3 + 13x^2 + 18x + 8\)?
Use the Factor Theorem to determine whether \( g(x) \) is the factored form of \( f(x) \). Explain your reasoning.

72. Is \( g(x) = (x + 8)(x - 1)(x + 2) \) the factored form of \( f(x) = x^3 - 7x^2 - 10x + 16 \)?

ANS:

\[
\begin{align*}
\vec{f}(-8) & = (-8)^3 - 7(-8)^2 - 10(-8) + 16 \\
\vec{f}(-2) & = (-2)^3 - 7(-2)^2 - 10(-2) + 16 \\
\vec{f}(-8) & = 512 - 448 + 80 + 16 \\
\vec{f}(-2) & = -8 - 28 + 20 + 16 \\
\vec{f}(1) & = 1 - 7 - 10 + 16 \\
\vec{f}(1) & = 0
\end{align*}
\]

No, the function \( g(x) \) is not the factored form of \( f(x) \). Since \( \vec{f}(-8) = 160 \), \( x + 8 \) is not a factor of \( f(x) \) by the Factor Theorem.

73. Is \( g(x) = (x - 3)(x + 5)(x + 2)(x - 1) \) the factored form of \( f(x) = x^4 + 3x^3 - 15x^2 - 19x + 30 \)?

74. Is \( g(x) = (x - 2)(x + 9)(x + 1) \) the factored form of \( f(x) = x^3 + 8x^2 + 11x - 18 \)?

75. Is \( g(x) = x(x - 4)(x - i\sqrt{7})(x + i\sqrt{7}) \) the factored form of \( f(x) = x^4 + 4x^3 + 7x^2 + 28x \)?

76. Is \( g(x) = (x + 1)(x + 2)(4x + 7) \) the factored form of \( f(x) = 4x^3 - 11x^2 - x + 14 \)?

77. Is \( g(x) = (x - 1)(x + 1)(x - 3i)(x + 3i) \) the factored form of \( f(x) = x^4 + 8x^2 - 9 \)?
Use the Factor Theorem to determine the unknown coefficient so that the given linear expression is a factor of the function.

78. Determine $a$ if $x + 3$ is a factor of $f(x) = x^3 + 9x^2 + ax + 15$.

ANS:
If $x + 3$ is a factor, then by the Factor Theorem $f(-3) = 0$.

$$f(-3) = (-3)^3 + 9(-3)^2 + a(-3) + 15$$
$$= -27 + 81 - 3a + 15$$
$$= 69 - 3a$$

By the Transitive Property, $69 - 3a = 0$.

$$69 - 3a = 0$$
$$69 = 3a$$
$$a = 23$$

79. Determine $a$ if $x - 4$ is a factor of $f(x) = x^3 + ax^2 - 20x - 48$.

80. Determine $a$ if $x - 1$ is a factor of $f(x) = ax^3 - 10x^2 - 13x + 20$.

81. Determine $a$ if $x - 7$ is a factor of $f(x) = x^4 - 4x^3 + ax^2 - 8x - 42$.

82. Determine $a$ if $x + 2$ is a factor of $f(x) = x^3 - x^2 + ax - 36$.

83. Determine $a$ if $x - 8$ is a factor of $f(x) = x^4 + ax^3 - 5x^2 - 21x - 24$. 
5.4 Factoring Higher Order Polynomials

Factor each expression completely.

84. \( x^2 + 12x - 13 \)

85. \( x^2 + 6x + 8 \)

86. \( x^2 - 12x - 28 \)

87. \( x^2 + 30x + 81 \)

88. \( x^2 - 5x - 14 \)

89. \( x^2 - 16x - 36 \)

90. \( 2x^3 - 8x^4 + 10x^3 \)

91. \( -9x^4 + 45x^3 - 9x^2 \)

92. \( 105x^3 - 147x \)

95. \( 8x^4 - 16x^3 + 56x^2 - 24x \)

Factor each expression completely using the chunking method.

96. \( 4x^2 + 8x + 3 \)

97. \( 25x^2 - 35x + 12 \)

98. \( 121x^2 - 44x - 12 \)

99. \( 49x^2 + 63x + 18 \)

100. \( 9x^2 + 30x - 11 \)

101. \( 169x^2 - 130x + 24 \)
Factor each expression completely using the factor by grouping method.

102. \(x^3 - 2x^2 + 3x - 6\)

103. \(x^3 + x^2 - 4x - 4\)

104. \(x^3 - 6x^2 - 9x + 54\)

Factor each quartic expression completely using the quadratic form method.

108. \(x^4 - 13x^2 + 36\)

109. \(x^4 - 50x^2 + 49\)

110. \(x^4 - 29x^2 + 100\)

111. \(x^4 - 25x^2 + 144\)

112. \(x^4 - 164x^2 + 6400\)

113. \(x^4 - 61x^2 + 900\)

Factor each binomial using the sum or difference of perfect cubes formula.

114. \(x^3 + 27\)

115. \(x^3 - 8y^3\)

116. \(8x^3 - 125\)

117. \(x^3 + 64y^3\)

119. \(216x^3 + 125y^3\)
Factor each binomial completely over the set of real numbers using the difference of squares method.

120. \( x^2 - 100 \)

121. \( x^4 - 36 \)

122. \( 49x^2 - 4y^2 \)

123. \( x^{10} - 81 \)

124. \( 9x^4 - 121y^2 \)

125. \( 4x^{14} - 9y^8 \)

Factor each perfect square trinomial.

126. \( 4x^2 + 12x + 9 \)

127. \( x^2 - 12xy + 36y^2 \)

128. \( 16x^2 + 104x + 169 \)

129. \( 25x^2 + 80x + 64 \)

130. \( 9x^4 + 42x^2y + 49y^2 \)

131. \( 64x^2 + 16xy^2 + y^4 \)
Use HAC to evaluate areas of weakness in the skills and academic categories. You will need to mention specific assignments and categories (for example a 50% for reading notes from the notes section). Once you have identified your weaknesses you will explain in detail what you will do to address your weakness.

### Self-Reflection:

<table>
<thead>
<tr>
<th>Preparedness</th>
<th>always</th>
<th>almost</th>
<th>with my teacher’s help</th>
<th>partially</th>
<th>never</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was __________ able to create an efficient system that allows me to manage materials and be prepared for learning. <em>Circle one.</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Participation</th>
<th>always</th>
<th>almost</th>
<th>with my teacher’s help</th>
<th>partially</th>
<th>never</th>
</tr>
</thead>
<tbody>
<tr>
<td>I was __________ able to engage in required classroom tasks such as group work, class discussion, or individual practice. <em>Circle one.</em></td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Punctuality</th>
<th>always</th>
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</tr>
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<tbody>
<tr>
<td>I was __________ able to follow a schedule and meet deadlines. <em>Circle one.</em></td>
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<tr>
<td>I was __________ able to recognize, record, and organize important information or apply skills from classroom lecture/outside readings. <em>Circle one.</em></td>
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### Strengths

*List topics, goals you met, areas, study skills you found as strengths during this unit.*

### Weaknesses

*List topics, goals you met, areas, study skills you found as weaknesses during this unit.*

### Plans to Address weaknesses

*Examples of plans include frequent HAC checks, change classroom seating, note-taking tutorials and checks, organization tutoring, academic tutorials, study groups, complete assignments*

Parent Signature: ___________________________        Student Signature: ___________________________