**K – Polynomials, Lesson 3, Factoring Polynomials (r. 2018)**

POLYNOMIALS

Factoring Polynomials

|  |  |
| --- | --- |
| **Common Core Standard** **A-SSE.2** Use the structure of an expression to identify ways to rewrite it. *For example, see  as, thus recognizing it as a difference of squares that can be factored as .* PARCC: Tasks limited to numerical and polynomial expressions in one variable. Recognize as a difference of squares and see an opportunity to rewrite it in the easier-to -evaluate form (53+47)(53-47). See an opportunity to rewrite  as (a+7)(a+2). NYSED: Does not include factoring by grouping and factoring the sum and difference of cubes.  | **Next Generation Standard****AI-A.SSE.2 Recognize** and use the structure of an expression to identify ways to rewrite it. (Shared standard with Algebra II) **e.g.,**  Note: Algebra I expressions are limited to numerical and polynomial expressions in one variable. **Use factoring techniques such as factoring out a greatest common factor, factoring the difference of two perfect squares, factoring trinomials of the form ax2+bx+c with a lead coefficient of 1, or a combination of methods to factor completely.** Factoring will not involve factoring by grouping and factoring the sum and difference of cubes.  |

**LEARNING OBJECTIVES**

Students will be able to:

1. factor monomials
2. factor binomials, and
3. factor trinomials

**Overview of Lesson**

|  |  |
| --- | --- |
| **Teacher Centered Introduction****Overview of Lesson****- activate students’ prior knowledge****- vocabulary****- learning objective(s)****- big ideas: direct instruction** **- modeling** | **Student Centered Activities****guided practice Teacher: anticipates, monitors, selects, sequences, and connects student work****- developing essential skills****- Regents exam questions****- formative assessment assignment (exit slip, explain the math, or journal entry)** |

**VOCABULARY**

binomial

factor completely

greatest common factor

monomial

perfect square

term

trinomial

**BIG IDEAS**

Factoring polynomials is one of four general methods taught in the Regents mathematics curriculum for finding the roots of a quadratic equation. The other three methods are the quadratic formula, completing the square and graphing.

 The roots of a quadratic equation can found using the **factoring** method when the discriminant’s value is equal to either zero or a perfect square.

**Factoring Monomials**:



**Factoring Binomials**: *NOTE: This is the inverse of the distributive property.*



**Factoring Trinomials**

Standard Approach

Given a trinomial in the form  whose discriminant equals zero or a perfect square, it may be factored as follows:



**Modeling:**

 

 



Box Method

|  |  |
| --- | --- |
|  | The Box MethodforFactoring a Trinomial |

|  |  |
| --- | --- |
| INSTRUCTIONS | EXAMPLE |
| STEP 1 Start with a factorable quadratic in standard form:  and a 2-row by 2-column table. | Solve by factoring:   |
| STEP 2 Copy the quadratic term into the upper left box and the constant term into the lower right box. |  |
| STEP 3 Multiply the quadratic term by the constant term and write the product to the right of the table. |    |
| STEP 4 Factor the product from STEP 3 until you obtain two factors that *sum* to the linear term (*bx*). |  |
| STEP 5 Write one of the two factors found in STEP 4 in the upper right box and the other in the lower left box. Order does not matter. |  |
| STEP 6 Find the greatest common factor of each row and each column and record these factors to the left of each row and above each column. Give each factor the same plus or minus value as the nearest term in a box.NOTE: If all four of the greatest common factors share a common factor, reduce each factor by the common factor and add the common factor as a third factor. Eg.   |  |
| STEP 7 Write the expressions above and beside the box as binomial factors of the original trinomial. |  |
| STEP 8 Check to see that the factored quadratic is the same as the original quadratic. |  |
| STEP 9 Convert the factors to zeros. |  |

**DEVELOPING ESSENTIAL SKILLS**

1. Factored completely, the expression  is equivalent to

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 2. Factored completely, the expression  is equivalent to

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 3. What are the factors of the expression ?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 4. Factored completely, the expression  is equivalent to

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 5. Factor completely: 

 6. The greatest common factor of  is?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 7. When factored completely, the expression  is equivalent to

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 8. Which is a factor of ?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 9. Which expression is a factor of ?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 10. Which expression is a factor of ?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 11. What are the factors of ?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 12. If one factor of  is , what is the other factor?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 13. If  is one factor of , what is the other factor?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 14. Factor completely: 

 15. Factored completely, the expression  is equivalent to

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 16. What are the factors of ?

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

 17. The greatest common factor of  and  is

|  |  |  |  |
| --- | --- | --- | --- |
| a. |  | c. |  |
| b. |  | d. |  |

**Answers**

 1. ANS: B

 2. ANS: B

 3. ANS: B

 4. ANS: D



 5. ANS:



 6. ANS: C

 7. ANS: D

 8. ANS: D

 9. ANS: A

 10. ANS: D

 11. ANS: C

 12. ANS: A

 13. ANS: C

 14. ANS:

. 

 15. ANS: A

 16. ANS: B

 17. ANS: A

**REGENTS EXAM QUESTIONS (through June 2016)**

A.SSE.A.2: Factoring Polynomials

 343) Which expression is equivalent to ?

|  |  |  |  |
| --- | --- | --- | --- |
| 1) |  | 3) |  |
| 2) |  | 4) |  |

 344) Four expressions are shown below.

 I 

 II 

 III 

 IV 

The expression  is equivalent to

|  |  |  |  |
| --- | --- | --- | --- |
| 1) | I and II, only | 3) | I, II, and IV |
| 2) | II and IV, only | 4) | II, III, and IV |

 345) When factored completely,  is

|  |  |  |  |
| --- | --- | --- | --- |
| 1) |  | 3) |  |
| 2) |  | 4) |  |

 346) Factor the expression  completely.

 347) The trinomial  can be expressed as

|  |  |  |  |
| --- | --- | --- | --- |
| 1) |  | 3) |  |
| 2) |  | 4) |  |

**SOLUTIONS**

 343) ANS: 1

Strategy 1. Factor 



Strategy 2. Work backwards using the distributive property to check each answer choice.

|  |  |
| --- | --- |
| a(correct) | c(wrong) |
| b(wrong) | d(wrong) |

PTS: 2 NAT: A.SSE.A.2 TOP: Factoring Polynomials

 344) ANS: 3

Strategy: Use the distributive property to expand each expression, then match the expanded expressions to the answer choices.

|  |  |
| --- | --- |
| I  | III |
| II  | IV  |

Answer choice *c* is correct.

PTS: 2 NAT: A.SSE.A.2 TOP: Factoring Polynomials

 345) ANS: 3



PTS: 2 NAT: A.SSE.A.2 TOP: Factoring Polynomials

 346) ANS:



Strategy: Factor the trinomial, then factor the perfect square.

STEP 1. Factor the trinomial .



STEP 2. Factor the perfect square.



PTS: 2 NAT: A.SSE.A.2 TOP: Factoring Polynomials

 347) ANS: 1

Strategy. Multiply binomials and eliminate wrong answers.

Choice 1: Correct

Choice 2: Wrong: middle term has wrong sign.

Choice 3: Wrong: no middle term and second term has wrong sign.

Choice 4: Wrong: middle term and third term have wrong coefficients.

PTS: 2 NAT: A.SSE.A.2 TOP: Factoring Polynomials

KEY: quadratic