

## 1-4: Factoring Review

Let's first review three types of factoring:

1. Greatest Common Factor (GCF)
2. Difference of Two Squares (DOTS)
3. Grouping (4 or more terms)

To factor a polynomial by Greatest Common Factor (GCF):

Step 1: Identify the GCF. Consider the coefficients and the variables.  
 Step 2: Divide the GCF out of each term of the polynomial.

Step 3: Re-write the expressions in factored form.

Examples: Factor each expression using GCF

$$\begin{array}{lll}
 1. \frac{3x^2 - 6x}{3x} & 2. \frac{x^2 - x}{x} & 3. \frac{2x^3 - 6x^2 + 10x}{2x} \\
 : 3x(x-2) & = x(x-1) & : 2x(x^2 - 3x + 5) \\
 4. \frac{6r^2s - 9rs^2 + 12r^2s^2}{3rs} & 5. \frac{y^6 + y^4}{y^4} & 6. y^{a+2} + y^a = \frac{y^a(y^2 + 1)}{y^a} \\
 : 3rs(2r - 3s + 4rs) & : y^4(y^2 + 1) & : y^a(y^2 + 1)
 \end{array}$$

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## To factor a polynomial by Difference Of Two Squares (DOTS):

Step 1: Take the square root of each term.  
 Step 2: The 1<sup>st</sup> square root is the 1<sup>st</sup> term of both parentheses.  
 Step 3: The 2<sup>nd</sup> square root is the 2<sup>nd</sup> term of both parentheses.  
 Step 4: Re-write the expressions in factored form.  
 \* Note: any even exponent is a perfect square.

Factor each binomial using DOTS.

$$\begin{array}{lll}
 1. a^2 - b^2 & 2. x^2 - 4 & 3. y^2 - 64 \\
 :(a+b)(a-b) & : (x+2)(x-2) & : (y+8)(y-8) \\
 4. 9a^2 - 16 & 5. x^2y^2 - 9 & 6. 25 - 64x^2 \\
 : (3a+4)(3a-4) & : (xy+3)(xy-3) & : (5+8x)(5-8x)
 \end{array}$$

Order matters

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## Factor by Grouping:

Example 1: Factor  $x^3 + 3x^2 - 4x - 12$ 

Step 1: Write the polynomial in standard form.

$$\underline{x^3 + 3x^2} - \underline{4x - 12}$$

Step 2: Group terms.

$$\underline{x^2(x+3)} - \underline{4(x+3)}$$

Step 3: Use GCF to factor common monomials from each group.

$$(x+3)(x^2 - 4)$$

Step 4: Factor out the common binomial.

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

Step 5: Factor using DOTS if possible.

2. Factor  $x^3 - 2x^2 - 9x + 18$ 

$$\begin{aligned}
 & \underline{x^2} - 9 \\
 & : \underline{x^3(x-2)} - \underline{9(x-2)} \\
 & : (x-2)(x^2 - 9) \\
 & : (x-2)(x+3)(x-3)
 \end{aligned}$$

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3. Factor  $2x^3 + x^2 + 8x + 4$ 

$$\begin{aligned}
 & : x^2(x+1) + 4(2x+1) \\
 & : (2x+1)(x^2+4)
 \end{aligned}$$

sum is done!

Factor Completely: Generally means more than 1 step to

$$\begin{aligned}
 1. \frac{36x^2 - 4y^2}{4 \quad 4} & \rightarrow (6x-2y)(6x+2y) & 2. \frac{12x^2 - 27}{3 \quad 3} \\
 & : 4(9x^2 - y^2) & = 3(4x^2 - 9) \\
 & : 4(3x+y)(3x-y) & = 3(2x+3)(2x-3) \\
 3. \frac{2y^4 + 2y^3 + 4y^2 + 4y}{2y \quad 2y \quad 2y \quad 2y} & \text{Aside} & 4. 81 - m^4 \text{ Double} \\
 & : 2y(y^3 + y^2 + 2y + 2) & = (9+m^2)(9-m^2) \\
 & = 2y(y+1)(y^2+2) & = (9+m^2)(3+m)(3-m)
 \end{aligned}$$

YouTube video on RSA encryption (about 10 minutes)

<http://www.youtube.com/watch?v=M7kEpw1tn50><https://www.youtube.com/watch?v=M7kEpw1tn50>

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## 1-3 HW Answer Key

$$\begin{array}{ll}
 1. x^4 + 3x^3 - 4x^2 - 9x + 3 & 12. 3x^3 - 5x^2 - x - 14 \\
 2. 4x^2 - 5x - 2 & 13. x^5 - 4x^4 + 4x^3 - 8x^2 + 32x - 32 \\
 3. x^2 + 2x + 4 & 14. x^2 - 4x + 3 \\
 4. x^3 + 2x^2 - 5x - 6 & 15. 2x^2 - 4x + 3 \\
 5. -x & 16. 7x^2 + 8x - 25 \\
 6. 2x^3 - x^2 - 3x + 14 & 17. 4x^2 - 6x + 12 \\
 7. x^2 + 7x - 2 & 18. x^3 + 2x^2 - 6x - 7 \\
 8. -x^2 - 2x & 19. 12x^5 + 24x^4 - 34x^3 - 8x^2 + 10x \\
 9. 2x^4 - 7x^3 + 9x^2 - 8x + 4 & 20. x^2 - 6x + 9 \\
 10. x^2 + 2x + 1 & \\
 11. x^4 - 2x^3 - 74x^2 + 115x - 12 & 
 \end{array}$$

$$\begin{aligned}
 & \frac{(x-3)^3}{x-3} \\
 & = (x-3)(x-3)(x-3) \\
 & = (x-3)^3
 \end{aligned}$$

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Re-write each polynomial in standard form by applying the operations in the appropriate order. You have some completed from the in class activity.

$$\begin{array}{ll}
 1) (x^2 - 3)(x^2 + 3x - 1) & 2) (5x^2 - 3x - 7) - (x^2 + 2x - 5) \\
 = x^4 + 3x^3 - x^2 - 3x - 2x + 3 & = 5x^2 - 3x - 7 - x^2 - 2x + 5 \\
 = x^4 + 3x^3 - x^2 - 9x + 3 & = 4x^2 - 5x - 2 \\
 \\ 
 3) (x^2 - 8) - (x-2) & 4) (x+1)(x-2)(x+3) \\
 = x^2 - 8 - x^2 + 2x - 2 & = x^3 - x^2 - 2x + 3x^2 - 3x - 6 \\
 = -8 + 2x & = x^3 + 2x^2 - 5x - 6 \\
 \\ 
 5) (x+1) - (x-2) - (x+3) & 6) (x+2)(2x^2 - 5x + 7) \\
 = x + 1 - x + 2 - x - 3 & = x(x^2 - 5x + 7) + 2(2x^2 - 5x + 7) \\
 = -x & = x^3 - 5x^2 + 7x + 4x^2 - 10x + 14 \\
 = -x & = 2x^3 - 3x^2 + 7x + 14 \\
 \\ 
 7) x^2 - 2x^2 - 65x + 18 & 8) (x^2 - 3x + 2) - (2 - x + 2x^2) \\
 = x^2 - 2x^2 - 65x + 18 & = x^2 - 3x + 2 - 2 + x - 2x^2 \\
 = -x^2 - 65x + 18 & = -x^2 - 2x \\
 = -x^2 - 65x + 18 & \\
 \\ 
 9) (x^2 - 3x + 2)(2 - x + 2x^2) & 10) \frac{x^2 - x^2 - 5x - 3}{x-3} \\
 = x^2(x - x^2 + 2x^2) - 2(x - x^2 + 2x^2) & = x^3 - x^2 - 5x - 3 \\
 = 2x^3 - 2x^2 + 2x^4 - 2x^3 + 4x^2 - 4x^4 - 4x^3 + 8x^2 & = x^3 + 2x^2 - 5x - 3 \\
 = 2x^4 - 7x^3 + 9x^2 + 4x^4 - 12x^3 - 12x^2 & = 2x^4 - 17x^3 + 16x^2 + 4x^4 - 12x^3 - 12x^2 \\
 = 2x^4 - 7x^3 + 9x^2 + 4x^4 - 12x^3 - 12x^2 & = 4x^4 - 19x^3 + 16x^2 + 4x^4 - 12x^3 - 12x^2 \\
 = 6x^4 - 19x^3 + 16x^2 & = 10x^4 - 31x^3 + 16x^2
 \end{array}$$

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$$\begin{aligned}
 12) & (2x^3 - 6x^2 - 7x - 2) + (x^3 + x^2 + 6x - 12) \\
 & = 3x^3 - 5x^2 - x - 14 \\
 & = x^3(x^2 - 4x + 4) \\
 & = x^3(x^2 - 4x + 4)(x^2 + 4x + 4) \\
 & = x^5 - 7x^4 + 14x^3 - 8x^2 + 32x - 32
 \end{aligned}$$
  

$$\begin{aligned}
 14) & (x^2 - 5x + 6) \div (x + 2) \\
 & \begin{array}{r} x-7 \\ x+2 \overline{x^2-5x+6} \\ \underline{-x^2-2x} \\ \hline -7x+6 \\ \underline{+7x+14} \\ \hline 0 \end{array}
 \end{aligned}$$
  

$$\begin{aligned}
 15) & (x^3 + 2x^2 - 3x - 1) \div (4 - x - x^2) \\
 & = 2x^3 - 4x + 3
 \end{aligned}$$
  

$$\begin{aligned}
 16) & (7x^2 + 5x - 10) \div (3x - 15) \\
 & = 7x^2 + 8x - 25
 \end{aligned}$$
  

$$\begin{aligned}
 18) & (x^2 - 4)(x + 3) - (x^2 + 2x - 5) \\
 & = (x^3 + 3x^2 - 4x - 12) - (x^2 + 2x - 5) \\
 & = x^3 + 3x^2 - 4x - 12 - x^2 - 2x + 5 \\
 & = x^3 + 2x^2 - 6x - 7
 \end{aligned}$$
  

$$\begin{aligned}
 19) & (6x^2 - 2x)(2x^2 + 4x - 5) \\
 & = 6x^3(2x^2 + 4x - 5) - 2x(2x^2 + 4x - 5) \\
 & = 12x^5 + 12x^4 - 30x^3 - 4x^3 - 8x^2 + 10x \\
 & = 12x^5 + 12x^4 - 34x^3 - 8x^2 + 10x
 \end{aligned}$$
  

$$\begin{aligned}
 20) & \frac{(x-3)^3}{x-3} \\
 & = \frac{(x-3)(x-3)(x-3)}{(x-3)} \\
 & = x^3 - 6x^2 + 9x - 6
 \end{aligned}$$
  

$$\begin{aligned}
 21) & (x^4 - 4x^2 - 17x + 30) \div (x - 6) \\
 & \begin{array}{r} x^3 + 2x^2 - 5 \\ x-6 \overline{x^4-4x^2-17x+30} \\ \underline{-x^4+6x^3} \\ \hline -2x^2-17x \\ \underline{-2x^2+12x} \\ \hline -5x+30 \\ \underline{-5x+30} \\ 0 \end{array}
 \end{aligned}$$

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# QUIZ

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