

Complete the given problems.

$f(x) = 3x - 6$

$g(x) = 7x + 4$

$f(x) \div g(x)$
 $(f \div g) \downarrow$
 $\frac{3x-6}{7x+4}$

1. $f(x) - g(x) = (3x-6) - (7x+4)$

2. $g(x) - f(x) = \frac{4x+10}{-4x-10}$

$\frac{(7x+4) - (3x-6)}{7x+4}$
 $\frac{-3x+6}{7x+4}$
 $\frac{4x+10}{7x+4}$

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

4. $f(x) \cdot g(x) = 21x^2 - 30x - 24$

$(3x-6)(7x+4)$
 $21x^2 + 12x - 42x - 24$
 $21x^2 - 30x - 24$

5. $f(g(x)) = 3(7x+4) - 6$
 $21x + 12 - 6$

6. $g(f(x)) = 7(3x-6) + 4$
 $21x - 42 + 4$
 $21x - 38$

$7(3x-6) + 4$
 $21x - 42 + 4$
 $21x - 38$

Grouping

When to use it:

When there are 4 terms.

Steps:

1. Group the 1st and 2nd term, then group 3rd and 4th term.
2. Pull out the GCF from each group
3. Make sure the parenthesis are the same
4. Pull out the GCF again (it is the parenthesis)

Example 1: $16x^3 - 8x^2 - 14x + 7$

$$\frac{16x^3}{8x^2} \quad 8x^2(2x-1) - 7(2x-1)$$

$$(2x-1)(8x^2-7)$$

Example 2: $49x^3 + 35x^2 - 14x - 10$

$$\frac{49x^3}{7x^2} \quad 7x^2(7x+5) - 2(-7x+5)$$

$$\frac{35x^2}{7x^2} \quad (7x+5)(7x^2-2)$$

$-\frac{14x}{2}$
 $-\frac{10}{2}$

Quadratic Form

When to use it:

When there are 3 terms.

Steps:

1. Multiply a and c
2. Find two factors that multiply to ac and add to b
3. Rewrite the polynomial to have 4 terms.
4. Group.

$$9(-8) = -72$$

1	72
2	36
3	24
4	18
6	12
8	9

Example 3: $x^4 - 2x^2 - 48$

$$\begin{array}{r} x^4 + 6x^2 - 8x^2 - 48 \\ \hline x^2(x^2 + 6) - 8(x^2 + 6) \\ \hline (x^2 + 6)(x^2 - 8) \end{array}$$

1	48
2	24
3	16
4	12
6	8

Example 4: $9x^4 + 6x^2 - 8$

$$\begin{array}{r} 9x^4 - 6x^2 + 12x^2 - 8 \\ \hline 3x^2(3x^2 - 2) + 4(3x^2 - 2) \\ \hline (3x^2 - 2)(3x^2 + 4) \end{array}$$

Difference/Sum of Cubes

When to use it:

When there are 2 terms and the two terms are perfect cubes.

Steps:

1. Take the cube root of each term.
2. Fill in the pattern.
3. Fill in your signs according to SOAP

Pattern

$$a^3 \pm b^3 = (a \pm b)(a^2 \pm ab + b^2)$$

$$\sqrt[3]{x^3} = x$$

$$\sqrt[3]{64} = 4$$

Example 5: $x^3 + 64$

$$(x + 4)(x^2 - 4x + 16)$$

Same Opposite Always Positive

$$\sqrt[3]{x^3} = x$$

$$\sqrt[3]{27} = 3$$

Example 6: $x^3 - 27$

$$(x - 3)(x^2 + 3x + 9)$$

Difference of Squares

When to use it:

When there are 2 terms and the two terms are perfect squares and there is subtraction between.

Steps:

1. Take the square root of each term.
2. Fill in the pattern.
3. Check to repeat process.

Pattern

$$a^2 - b^2 = (a+b)(a-b)$$

Example 7: $16x^4 - 81$

$$\sqrt{16x^4} = 4x^2$$

$$\sqrt{81} = 9$$

$$\sqrt{4x^2} = 2x$$

$$\sqrt{9} = 3$$

$$(4x^2 - 9)(4x^2 + 9)$$

$$(2x+3)(2x-3)(4x^2+9)$$

Example 8: $9x^2 - 25$

$$(3x^2 - 5)(3x^2 + 5)$$

1-5 Grouping
6-10 GCF & Quad. form
11-15 Quad form
16-20 Diff of Squares
21-25 Diff/sum of Cubes

Answers to Factoring Higher Level Polynomials

- | | | | |
|---------------------------------|----------------------------------|-----------------------------|----------------------------|
| 1) $(7x^2 - 6)(2x - 3)$ | 2) $(b^2 - 2)(7b - 4)$ | 3) $(5v^2 - 2)(7v + 8)$ | 4) $(5n^2 - 3)(5n - 7)$ |
| 5) $(2k^2 - 1)(5k + 3)$ | 6) $4(m^2 + 6)(m - 1)(m + 1)$ | 7) $4(x^2 - 3)(x^2 - 5)$ | |
| 8) $5(m^2 + 1)(m^2 + 6)$ | 9) $6(x^2 + 2)(x^2 - 6)$ | 10) $2(x^2 + 9)(x^2 + 6)$ | 11) $(5x^2 + 8)(3x^2 + 7)$ |
| 12) $4(4x^2 - 5)(4x^2 - 7)$ | 13) $(4m^2 + 7)(5m^2 - 3)$ | 14) $(5x^2 + 8)(2x^2 + 3)$ | |
| 15) $(3x^2 + 5)(5x^2 - 6)$ | 16) $13(12 + 11x^2)(12 - 11x^2)$ | 17) $(8 + r^2)(8 - r^2)$ | |
| 18) $2(9r^2 + 5)(9r^2 - 5)$ | 19) $(14v^2 + 5)(14v^2 - 5)$ | 20) $6(7 + 9v^2)(7 - 9v^2)$ | |
| 21) $3(x - 5)(x^2 + 5x + 25)$ | 22) $(1 - 6x)(1 + 6x + 36x^2)$ | 23) $(2 + x)(4 - 2x + x^2)$ | |
| 24) $(3 + 5x)(9 - 15x + 25x^2)$ | 25) $(5x + 2)(25x^2 - 10x + 4)$ | | |