

MAT 142: Foundational Algebra Review

Dr. Gilbert

June 1, 2026

Reminders

At our last meeting, we discussed each of the following:

- Order of operations and combining like terms.
- Evaluating expressions by plugging in values for variables.
- Expanding products of variable expressions.
- Using rules for exponents.

Try the following warm-up problems.

Problem 1: Simplify

$$4x^2 - 3x + 7 - 2(x^2 + 5x - 1)$$

Problem 2: Evaluate

$$2x^3 - x + 4 \text{ for } x = -2$$

Problem 3: Expand and simplify

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

Problem 4: Simplify $\frac{(x^3y^2z^{-1})^2}{(x^2y^{-1})^{-3}}$

Problem 5: Expand and

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

Problem 6: Simplify

$$\frac{3x^4y^2 - 6x^2y^3}{3x^2y^2}$$

Objectives

Today, we'll focus on factoring, rational expressions, and simplification.

After today's class meeting, you should be able to:

- Identify the greatest common factor from a collection of terms.
- Factor the greatest common factor out of a collection of terms.
- Factor a quadratic expression.
- Factor a difference of squares.
- Use a common denominator to add or subtract two rational expressions.
- Simplify complex fractions.
- Use factoring to reduce complex fractions.

Factoring: Greatest Common Factor

Factoring will be a main strategy for us as we seek to find roots and solve equations. As with last class meeting, we'll do a few problems for review but, if you need a more comprehensive review, [check out this video](#).

Problem 1: Rewrite the expression $6x^4 + 8x^3 - 10x^2$ by factoring out the greatest common factor.

Solution.

$$6x^4 + 8x^3 - 10x^2$$

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Solution.

$$6x^4 + 8x^3 - 10x^2 = 2(3x^4 + 4x^3 - 5x^2)$$

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Solution.

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

Factoring: Greatest Common Factor

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Problem 1: Rewrite the expression $6x^4 + 8x^3 - 10x^2$ by factoring out the greatest common factor.

Solution.

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

Try It 1: Rewrite the expression $12x^3y^2 - 8x^2y^3 + 4xy$ by factoring out the greatest common factor.

Try It 2: Rewrite the expression $3x(x + 2) - 7(x + 2)$ by factoring out the greatest common factor.

Factoring: Quadratics I

Problem 2: Factor the quadratic $x^2 - 7x + 12$, if possible.

Solution.

- Start by looking at the leading/quadratic term (that's the one with x^2)
 - Since the leading term is just x^2 , your factors will take the form $(x ? \text{ ______}) (x ? \text{ ______})$
- Next, look at the sign in front of the constant term (that's the one with no variables in it)
 - If the sign is positive, then both constant terms in the factors will have the same sign
 - If the sign is negative, then the constant terms in the factors will have different signs
 - Here, they'll have the same sign!
- Now, the sign on the linear term (the one having x^1) will tell us what the sign on those constant terms will be
 - We'll have $(x - \text{ ______}) (x - \text{ ______})$
- To finish off, we'll need two factors that multiply together to give us 12, but add together to give us -7
 - This means $x^2 - 7x + 12 = \boxed{(x - 4)(x - 3)}$

Factoring: Quadratics II

Problem 3: Factor the quadratic $x^2 + 9x - 36$, if possible.

Solution.

- Start by looking at the leading/quadratic term (that's the one with x^2).
 - Since the leading term is just x^2 again, your factors will take the form $(x \text{ ? } \underline{\hspace{1cm}})(x \text{ ? } \underline{\hspace{1cm}})$.
- Next, look at the sign in front of the constant term (that's the one with no variables in it)
 - If the sign is positive, then both constant terms in the factors will have the same sign.
 - If the sign is negative, then the constant terms in the factors will have different signs.
 - Here, they'll have different signs!
 - We'll have $(x + \underline{\hspace{1cm}})(x - \underline{\hspace{1cm}})$
- Now the sign in front of the linear term (that's the one with x^1) will tell us what sign the dominant (bigger) number must have
 - Here, the bigger number will be positive
- To finish off, we'll need two factors that multiply together to give us -36 , but add together to give us 9
 - This means $x^2 + 9x - 36 = \boxed{(x + 12)(x - 3)}$

Factoring: Quadratics IV

The next scenario can be handled with the same strategy we used for the previous three examples.

It is a special case though, which warrants becoming familiar with.

Definition (Difference of Squares): An expression of the form $a^2 - b^2$ is known as a *difference of squares* and it factors nicely into $(a + b)(a - b)$.

Problem 5: Factor the difference of squares $x^2 - 16$, if possible.

Solution. $x^2 - 16 = \boxed{(x + 4)(x - 4)}$

Problem 6: Factor the difference of squares $9x^2 - 25$, if possible.

Solution. $9x^2 - 25 = \boxed{(3x + 5)(3x - 5)}$

Note: While the difference of squares factors nicely, a sum of squares will not.

Factoring: Quadratics Practice

Try each of the following practice problems.

Try It 3: Factor the quadratic $x^2 + 3x - 18$, if possible.

Try It 4: Factor the quadratic $x^2 - 5x - 24$, if possible.

Try It 5: Factor the quadratic $6x^2 + 18x - 24$, if possible.

Try It 6: Factor the quadratic $4x^2 - 9$, if possible.

Try It 7: Factor the quadratic $x^2 + 36$, if possible.

Try It 8: Factor the quadratic $2x^2 + 7x + 3$, if possible.

Try It 9: Factor the quadratic $4x^2 - 4x - 3$, if possible.

Rational Expressions I

Rational expressions are expressions of the form $\frac{\text{(First Expression)}}{\text{(Second Expression)}}$

You might think of these expressions as “fractions” which may contain variables.

As with previous review topics, we’ll work through a couple of examples. If you want a more comprehensive review, stop by office hours and check out [this video on adding and subtracting rational expressions](#) and [this one on simplification of complex rational expressions](#)

Problem 7: Add the two rational expressions $\frac{x}{6} + \frac{x}{15}$

Solution.

$$\frac{x}{6} + \frac{x}{15}$$

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Problem 7: Add the two rational expressions $\frac{x}{6} + \frac{x}{15}$

Solution.

$$\frac{x}{6} + \frac{x}{15} = \frac{x}{2(3)} + \frac{x}{5(3)}$$

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Solution.

$$\begin{aligned}\frac{x}{6} + \frac{x}{15} &= \frac{x}{2(3)} + \frac{x}{5(3)} \\ &= \frac{5x}{5(2)(3)} + \frac{2x}{2(5)(3)}\end{aligned}$$

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Solution.

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Solution.

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Problem 7: Add the two rational expressions $\frac{x}{6} + \frac{x}{15}$

Solution.

Rational Expressions II

Problem 8: Simplify the following rational expression $\frac{x+5}{x+1} - \frac{x-2}{x+3}$

Solution.

$$\frac{x+5}{x+1} - \frac{x-2}{x+3}$$

Rational Expressions II

Problem 8: Simplify the following rational expression $\frac{x+5}{x+1} - \frac{x-2}{x+3}$

Solution.

$$\frac{x+5}{x+1} - \frac{x-2}{x+3} = \frac{(x+3)(x+5)}{(x+3)(x+1)} - \frac{(x+1)(x-2)}{(x+1)(x+3)}$$

Rational Expressions II

Problem 8: Simplify the following rational expression $\frac{x+5}{x+1} - \frac{x-2}{x+3}$

Solution.

$$\begin{aligned}\frac{x+5}{x+1} - \frac{x-2}{x+3} &= \frac{(x+3)(x+5)}{(x+3)(x+1)} - \frac{(x+1)(x-2)}{(x+1)(x+3)} \\ &= \frac{x^2 + 8x + 15}{(x+3)(x+1)} - \frac{x^2 - x - 2}{(x+1)(x+3)}\end{aligned}$$

Rational Expressions II

Problem 8: Simplify the following rational expression $\frac{x+5}{x+1} - \frac{x-2}{x+3}$

Solution.

$$\begin{aligned}\frac{x+5}{x+1} - \frac{x-2}{x+3} &= \frac{(x+3)(x+5)}{(x+3)(x+1)} - \frac{(x+1)(x-2)}{(x+1)(x+3)} \\ &= \frac{x^2 + 8x + 15}{(x+3)(x+1)} - \frac{x^2 - x - 2}{(x+1)(x+3)} \\ &= \frac{(x^2 + 8x + 15) - (x^2 - x - 2)}{(x+3)(x+1)}\end{aligned}$$

Rational Expressions II

Problem 8: Simplify the following rational expression $\frac{x+5}{x+1} - \frac{x-2}{x+3}$

Solution.

$$\begin{aligned}\frac{x+5}{x+1} - \frac{x-2}{x+3} &= \frac{(x+3)(x+5)}{(x+3)(x+1)} - \frac{(x+1)(x-2)}{(x+1)(x+3)} \\ &= \frac{x^2 + 8x + 15}{(x+3)(x+1)} - \frac{x^2 - x - 2}{(x+1)(x+3)} \\ &= \frac{(x^2 + 8x + 15) - (x^2 - x - 2)}{(x+3)(x+1)} \\ &= \boxed{\frac{9x + 17}{(x+3)(x+1)}}\end{aligned}$$

Rational Expressions III

Problem 9: Simplify the following rational expression $\frac{\frac{1}{x+2} - \frac{1}{x}}{2}$

Solution.

$$\frac{\frac{1}{x+2} - \frac{1}{x}}{2}$$

Rational Expressions III

Problem 9: Simplify the following rational expression $\frac{\frac{1}{x+2} - \frac{1}{x}}{2}$

Solution.

$$\frac{\frac{1}{x+2} - \frac{1}{x}}{2} = \frac{\left(\frac{1}{x+2} - \frac{1}{x}\right)}{\left(\frac{2}{1}\right)}$$

Rational Expressions III

Problem 9: Simplify the following rational expression $\frac{\frac{1}{x+2} - \frac{1}{x}}{2}$

Solution.

$$\begin{aligned}\frac{\frac{1}{x+2} - \frac{1}{x}}{2} &= \frac{\left(\frac{1}{x+2} - \frac{1}{x}\right)}{\left(\frac{2}{1}\right)} \\ &= \left(\frac{1}{x+2} - \frac{1}{x}\right) \left(\frac{1}{2}\right)\end{aligned}$$

Rational Expressions III

Problem 9: Simplify the following rational expression $\frac{\frac{1}{x+2} - \frac{1}{x}}{2}$

Solution.

$$\begin{aligned}\frac{\frac{1}{x+2} - \frac{1}{x}}{2} &= \frac{\left(\frac{1}{x+2} - \frac{1}{x}\right)}{\left(\frac{2}{1}\right)} \\ &= \left(\frac{1}{x+2} - \frac{1}{x}\right) \left(\frac{1}{2}\right) \\ &= \frac{1}{2(x+2)} - \frac{1}{2x}\end{aligned}$$

Rational Expressions III

Problem 9: Simplify the following rational expression $\frac{\frac{1}{x+2} - \frac{1}{x}}{2}$

Solution.

$$\begin{aligned}\frac{\frac{1}{x+2} - \frac{1}{x}}{2} &= \frac{\left(\frac{1}{x+2} - \frac{1}{x}\right)}{\left(\frac{2}{1}\right)} \\&= \left(\frac{1}{x+2} - \frac{1}{x}\right) \left(\frac{1}{2}\right) \\&= \frac{1}{2(x+2)} - \frac{1}{2x} \\&= \frac{x}{2x(x+2)} - \frac{(x+2)}{2x(x+2)}\end{aligned}$$

Rational Expressions III

Problem 9: Simplify the following rational expression $\frac{\frac{1}{x+2} - \frac{1}{x}}{2}$

Solution.

$$\begin{aligned}\frac{\frac{1}{x+2} - \frac{1}{x}}{2} &= \frac{\left(\frac{1}{x+2} - \frac{1}{x}\right)}{\left(\frac{2}{1}\right)} \\&= \left(\frac{1}{x+2} - \frac{1}{x}\right) \left(\frac{1}{2}\right) \\&= \frac{1}{2(x+2)} - \frac{1}{2x} \\&= \frac{x}{2x(x+2)} - \frac{(x+2)}{2x(x+2)} \\&= \frac{x - (x+2)}{2x(x+2)}\end{aligned}$$

Rational Expressions III

Problem 9: Simplify the following rational expression $\frac{\frac{1}{x+2} - \frac{1}{x}}{2}$

Solution.

$$\begin{aligned}\frac{\frac{1}{x+2} - \frac{1}{x}}{2} &= \frac{\left(\frac{1}{x+2} - \frac{1}{x}\right)}{\left(\frac{2}{1}\right)} \\&= \left(\frac{1}{x+2} - \frac{1}{x}\right) \left(\frac{1}{2}\right) \\&= \frac{1}{2(x+2)} - \frac{1}{2x} \\&= \frac{x}{2x(x+2)} - \frac{(x+2)}{2x(x+2)} \\&= \frac{x - (x+2)}{2x(x+2)} \\&= \frac{-2}{2x(x+2)}\end{aligned}$$

Rational Expressions III

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Solution.

$$\begin{aligned}\frac{\frac{1}{x+2} - \frac{1}{x}}{2} &= \frac{\left(\frac{1}{x+2} - \frac{1}{x}\right)}{\left(\frac{2}{1}\right)} \\&= \left(\frac{1}{x+2} - \frac{1}{x}\right) \left(\frac{1}{2}\right) \\&= \frac{1}{2(x+2)} - \frac{1}{2x} \\&= \frac{x}{2x(x+2)} - \frac{(x+2)}{2x(x+2)} \\&= \frac{x - (x+2)}{2x(x+2)} \\&= \frac{-2}{2x(x+2)} \\&= \boxed{\frac{-1}{x(x+2)}}\end{aligned}$$

Rational Expressions Practice

Try each of the following practice problems.

Try It 10: Add the rational expressions $\frac{x}{4} + \frac{x}{6}$

Try It 11: Subtract the rational expressions $\frac{2x}{9} - \frac{x}{6}$

Try It 12: Simplify the rational expression $\frac{x-4}{x+2} - \frac{x+1}{x-3}$

Try It 13: Simplify the following rational expression $\frac{\frac{1}{x} + \frac{1}{x+3}}{2x}$

Try It 14: Simplify the following rational expression $\frac{\frac{1}{x+h} - \frac{1}{x}}{h}$

Factoring and Reducing Rational Expressions I

One of the reasons factoring is such a critical skill is because it allows us to simplify expressions significantly and gives great insight into the expressions.

Nearly every time we see an expression with exponents in it, we'll want to factor it because the factored form allows us to immediately see when that expression is 0.

Again, we'll look at a few examples, but for more comprehensive discussions please stop by office hours and check out [this video covering simplification of rational expressions](#).

Problem 10: Simplify the expression $\frac{8x}{2x^3 - 8x}$.

Solution.

$$\frac{8x}{2x^3 - 8x}$$

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Solution.

$$\frac{8x}{2x^3 - 8x} = \frac{8x}{2x(x^2 - 4)}$$

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Solution.

$$\begin{aligned}\frac{8x}{2x^3 - 8x} &= \frac{8x}{2x(x^2 - 4)} \\ &= \frac{4}{x^2 - 4}\end{aligned}$$

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Solution.

$$\begin{aligned}\frac{8x}{2x^3 - 8x} &= \frac{8x}{2x(x^2 - 4)} \\ &= \frac{4}{x^2 - 4} \\ &= \boxed{\frac{4}{(x + 2)(x - 2)}}\end{aligned}$$

Factoring and Reducing Rational Expressions II

Problem 11: Simplify the expression $\frac{x^2 - 9x + 14}{x^2 - 4x - 21}$.

Solution.

$$\frac{x^2 - 9x + 14}{x^2 - 4x - 21}$$

Factoring and Reducing Rational Expressions II

Problem 11: Simplify the expression $\frac{x^2 - 9x + 14}{x^2 - 4x - 21}$.

Solution.

$$\frac{x^2 - 9x + 14}{x^2 - 4x - 21} = \frac{(\underline{\hspace{1cm}} ? \underline{\hspace{1cm}})(\underline{\hspace{1cm}} ? \underline{\hspace{1cm}})}{(\underline{\hspace{1cm}} ? \underline{\hspace{1cm}})(\underline{\hspace{1cm}} ? \underline{\hspace{1cm}})}$$

Factoring and Reducing Rational Expressions II

Problem 11: Simplify the expression $\frac{x^2 - 9x + 14}{x^2 - 4x - 21}$.

Solution.

$$\frac{x^2 - 9x + 14}{x^2 - 4x - 21} = \frac{(x \text{ ? } \underline{\hspace{1cm}})(x \text{ ? } \underline{\hspace{1cm}})}{(\underline{\hspace{1cm}} \text{ ? } \underline{\hspace{1cm}})(\underline{\hspace{1cm}} \text{ ? } \underline{\hspace{1cm}})}$$

Factoring and Reducing Rational Expressions II

Problem 11: Simplify the expression $\frac{x^2 - 9x + 14}{x^2 - 4x - 21}$.

Solution.

$$\frac{x^2 - 9x + 14}{x^2 - 4x - 21} = \frac{(x - \underline{\quad})(x - \underline{\quad})}{(\underline{\quad} ? \underline{\quad})(\underline{\quad} ? \underline{\quad})}$$

Factoring and Reducing Rational Expressions II

Problem 11: Simplify the expression $\frac{x^2 - 9x + 14}{x^2 - 4x - 21}$.

Solution.

$$\frac{x^2 - 9x + 14}{x^2 - 4x - 21} = \frac{(x - 7)(x - 2)}{(___ ? ___)(___ ? ___)}$$

Factoring and Reducing Rational Expressions II

Problem 11: Simplify the expression $\frac{x^2 - 9x + 14}{x^2 - 4x - 21}$.

Solution.

$$\frac{x^2 - 9x + 14}{x^2 - 4x - 21} = \frac{(x - 7)(x - 2)}{(x - 7)(x + 3)}$$

Factoring and Reducing Rational Expressions II

Problem 11: Simplify the expression $\frac{x^2 - 9x + 14}{x^2 - 4x - 21}$.

Solution.

$$\frac{x^2 - 9x + 14}{x^2 - 4x - 21} = \frac{(x - 7)(x - 2)}{(x + \underline{\hspace{1cm}})(x - \underline{\hspace{1cm}})}$$

Factoring and Reducing Rational Expressions II

Problem 11: Simplify the expression $\frac{x^2 - 9x + 14}{x^2 - 4x - 21}$.

Solution.

$$\frac{x^2 - 9x + 14}{x^2 - 4x - 21} = \frac{(x - 7)(x - 2)}{(x + 3)(x - 7)}$$

Factoring and Reducing Rational Expressions II

Problem 11: Simplify the expression $\frac{x^2 - 9x + 14}{x^2 - 4x - 21}$.

Solution.

$$\begin{aligned}\frac{x^2 - 9x + 14}{x^2 - 4x - 21} &= \frac{(x - 7)(x - 2)}{(x + 3)(x - 7)} \\ &= \boxed{\frac{x - 2}{x + 3}}\end{aligned}$$

Factoring and Reducing Rational Expressions Practice

Try each of the following practice problems.

Try It 15: Simplify the expression $\frac{6x^2}{3x^3 - 12x^2}$.

Try It 16: Simplify the expression $\frac{4x + 8}{2x^2 + 8x + 8}$.

Try It 17: Simplify the expression $\frac{x^2 - 16}{3x^2 - 12x}$.

Try It 18: Simplify the expression $\frac{x^2 - x - 6}{x^2 + x - 12}$.

Try It 19: Simplify the expression $\frac{2x^2 + 5x - 3}{2x^2 - 7x + 3}$.

Exit Ticket Task

Navigate to [our MAT142 Exit Ticket Form](#), answer the questions, and complete the *task* below.

Note. Today's discussion is listed as [1. Algebra Foundations Review](#)



Task: What can I do to best help you (i) feel more comfortable with me. (ii) feel more comfortable in class, and (iii) ultimately find success in this course and beyond?

Summary and Next Time...

General Comments

- We covered a lot of ground today, and the topics we worked with are genuinely difficult.
- Factoring and working with rational expressions are two of the most common places mistakes are made.
- Please know that I want to work with you and I want you to be successful in this course.
- I'm looking forward to working with you in office hours.

Resources for Today's Content

- [Factoring strategies](#)
- [Rational expressions and common denominators](#)
- [Simplification of complex rational expressions](#)
- [Factoring and simplifying rational expression](#)

Next Time:

Describing Intervals of Real Numbers, Function Notation, and Function Evaluation

Homework:

Complete Homework 1 on MyOpenMath