



# ELMALG: Rational Expressions and Quadratics

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## Learning Objectives

- Find the domain of a rational expression (excluded values)
- Solve quadratic equations by factoring
- Apply the quadratic formula to find roots
- Interpret the discriminant to describe the nature of roots

*Simplify each expression completely. Show all steps and circle your final answer.*

## Factoring trinomials

1. Factor completely:  $x^2 + 4x + 4$

$$x^2 + 4x + 4$$

Answer: \_\_\_\_\_

2. The area of a rectangular garden is  $x^2 + 11x + 24$  sq ft. Factor to find expressions for the length and width.

$$x^2 + 11x + 24$$

Answer: \_\_\_\_\_

3. Factor completely:  $x^2 + 9x + 14$

$$x^2 + 9x + 14$$

Answer: \_\_\_\_\_

4. The area of a rectangular garden is  $x^2 + 18x + 80$  sq ft. Factor to find expressions for the length and width.

$$x^2 + 18x + 80$$

Answer: \_\_\_\_\_

5. Factor completely:  $x^2 + 11x + 18$

$$x^2 + 11x + 18$$

Answer: \_\_\_\_\_

6. The area of a rectangular garden is  $x^2 + 12x + 27$  sq ft. Factor to find expressions for the length and width.

$$x^2 + 12x + 27$$

Answer: \_\_\_\_\_

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7. Factor completely:  $x^2 + 17x + 72$

$$x^2 + 17x + 72$$

Answer: \_\_\_\_\_

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8. The area of a rectangular garden is  $x^2 + 15x + 50$  sq ft. Factor to find expressions for the length and width.

$$x^2 + 15x + 50$$

Answer: \_\_\_\_\_

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9. Factor completely:  $x^2 + 8x + 12$

$$x^2 + 8x + 12$$

Answer: \_\_\_\_\_

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10. The area of a rectangular garden is  $x^2 + 20x + 96$  sq ft. Factor to find expressions for the length and width.

$$x^2 + 20x + 96$$

Answer: \_\_\_\_\_

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### Solving quadratic equations

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11. Solve by factoring:  $1x^2 + -6x + 8 = 0$ .

$$x^2 - 6x + 8 = 0$$

Answer: \_\_\_\_\_

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12. Find the x-intercepts of  $f(x) = 1x^2 + -1x + -12$  by solving the equation  $= 0$ .

$$x^2 - 1x - 12 = 0$$

Answer: \_\_\_\_\_

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13. Solve by factoring:  $x^2 + 2x + -24 = 0$

$$x^2 + 2x - 24 = 0$$

Answer: \_\_\_\_\_

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14. Solve by factoring:  $1x^2 + -3x + -4 = 0$ .

$$x^2 - 3x - 4 = 0$$

Answer: \_\_\_\_\_

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15. Find the x-intercepts of  $f(x) = 1x^2 + 2x + -3$  by solving the equation  $= 0$ .

$$x^2 + 2x - 3 = 0$$

Answer: \_\_\_\_\_

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16. Solve by factoring:  $x^2 + 0x + -4 = 0$

$$x^2 - 4 = 0$$

Answer: \_\_\_\_\_

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17. Solve by factoring:  $1x^2 + 2x + 1 = 0$ .

$$x^2 + 2x + 1 = 0$$

Answer: \_\_\_\_\_

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18. Find the x-intercepts of  $f(x) = 1x^2 + 3x + -4$  by solving the equation  $= 0$ .

$$x^2 + 3x - 4 = 0$$

Answer: \_\_\_\_\_

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19. Solve by factoring:  $x^2 + 1x + -12 = 0$

$$x^2 + 1x - 12 = 0$$

Answer: \_\_\_\_\_

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20. Solve by factoring:  $2x^2 + -4x + 0 = 0$ .

$$2x^2 - 4x = 0$$

Answer: \_\_\_\_\_

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21. Find the x-intercepts of  $f(x) = 1x^2 + 2x + -15$  by solving the equation  $= 0$ .

$$x^2 + 2x - 15 = 0$$

Answer: \_\_\_\_\_

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22. Solve by factoring:  $x^2 + 5x + -6 = 0$

$$x^2 + 5x - 6 = 0$$

Answer: \_\_\_\_\_

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## Domain of rational expressions

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23. Find the value of x that makes the expression undefined:  $f(x) = (3x + -4) / (4x + 6)$ .

$$f(x) = \frac{3x + -4}{4x + 6}$$

Answer: \_\_\_\_\_

---

24. Find the value of x that makes the expression undefined:  $f(x) = (2x + 2) / (3x + 7)$ .

$$f(x) = \frac{2x + 2}{3x + 7}$$

Answer: \_\_\_\_\_

---

25. Find the value of x that makes the expression undefined:  $f(x) = (4x + -3) / (2x + 2)$ .

$$f(x) = \frac{4x + -3}{2x + 2}$$

Answer: \_\_\_\_\_

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26. Find the value of x that makes the expression undefined:  $f(x) = (4x + 3) / (1x + -1)$ .

$$f(x) = \frac{4x + 3}{1x + -1}$$

Answer: \_\_\_\_\_

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### Simplifying rational expressions

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27. Simplify the rational expression:  $(4x + 8) / (4x + 24)$ . State any restrictions on x.

$$\frac{4x + 8}{4x + 24}$$

Answer: \_\_\_\_\_

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28. Simplify the rational expression:  $(2x + 4) / (2x + 6)$ . State any restrictions on x.

$$\frac{2x + 4}{2x + 6}$$

Answer: \_\_\_\_\_

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29. Simplify the rational expression:  $(3x + 3) / (3x + 24)$ . State any restrictions on x.

$$\frac{3x + 3}{3x + 24}$$

Answer: \_\_\_\_\_

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30. Simplify the rational expression:  $(2x + 2) / (2x + 16)$ . State any restrictions on  $x$ .

$$\frac{2x + 2}{2x + 16}$$

Answer: \_\_\_\_\_

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*Topics: Domain of rational expressions, Simplifying rational expressions, Factoring trinomials, Solving quadratic equations. All answers verified by independent computation.*

## Solutions

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## Factoring trinomials

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1. Factor completely:  $x^2 + 4x + 4$

$$x^2 + 4x + 4$$

→ Find two integers that multiply to 4 and add to 4: they are 2 and 2.

→ Factored form:  $(x + 2)(x + 2)$ .

**Answer:**  $(x + 2)(x + 2)$

---

2. The area of a rectangular garden is  $x^2 + 11x + 24$  sq ft. Factor to find expressions for the length and width.

$$x^2 + 11x + 24$$

→ Find two integers that multiply to 24 and add to 11: they are 3 and 8.

→ Length and width:  $(x + 3)(x + 8)$ .

**Answer:**  $(x + 3)(x + 8)$

---

3. Factor completely:  $x^2 + 9x + 14$

$$x^2 + 9x + 14$$

→ Find two integers that multiply to 14 and add to 9: they are 2 and 7.

→ Factored form:  $(x + 2)(x + 7)$ .

**Answer:**  $(x + 2)(x + 7)$

---

4. The area of a rectangular garden is  $x^2 + 18x + 80$  sq ft. Factor to find expressions for the length and width.

$$x^2 + 18x + 80$$

→ Find two integers that multiply to 80 and add to 18: they are 10 and 8.

→ Length and width:  $(x + 10)(x + 8)$ .

**Answer:**  $(x + 10)(x + 8)$

---

5. Factor completely:  $x^2 + 11x + 18$

$$x^2 + 11x + 18$$

→ Find two integers that multiply to 18 and add to 11: they are 9 and 2.

→ Factored form:  $(x + 9)(x + 2)$ .

**Answer:**  $(x + 9)(x + 2)$

---

6. The area of a rectangular garden is  $x^2 + 12x + 27$  sq ft. Factor to find expressions for the length and width.

$$x^2 + 12x + 27$$

→ Find two integers that multiply to 27 and add to 12: they are 3 and 9.

→ Length and width:  $(x + 3)(x + 9)$ .

**Answer:**  $(x + 3)(x + 9)$

---

7. Factor completely:  $x^2 + 17x + 72$

$$x^2 + 17x + 72$$

→ Find two integers that multiply to 72 and add to 17: they are 8 and 9.

→ Factored form:  $(x + 8)(x + 9)$ .

**Answer:**  $(x + 8)(x + 9)$

---

8. The area of a rectangular garden is  $x^2 + 15x + 50$  sq ft. Factor to find expressions for the length and width.

$$x^2 + 15x + 50$$

→ Find two integers that multiply to 50 and add to 15: they are 10 and 5.

→ Length and width:  $(x + 10)(x + 5)$ .

**Answer:**  $(x + 10)(x + 5)$

---

9. Factor completely:  $x^2 + 8x + 12$

$$x^2 + 8x + 12$$

→ Find two integers that multiply to 12 and add to 8: they are 2 and 6.

→ Factored form:  $(x + 2)(x + 6)$ .

**Answer:**  $(x + 2)(x + 6)$

---

10. The area of a rectangular garden is  $x^2 + 20x + 96$  sq ft. Factor to find expressions for the length and width.

$$x^2 + 20x + 96$$

→ Find two integers that multiply to 96 and add to 20: they are 8 and 12.

→ Length and width:  $(x + 8)(x + 12)$ .

**Answer:**  $(x + 8)(x + 12)$

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## Solving quadratic equations

---

11. Solve by factoring:  $1x^2 + -6x + 8 = 0$ .

$$x^2 - 6x + 8 = 0$$

→ Factor the quadratic. Set each factor = 0.

→ Solutions:  $x = 2$  and  $x = 4$ .

**Answer:**  $x = 2$  or  $x = 4$

---

12. Find the x-intercepts of  $f(x) = 1x^2 + -1x + -12$  by solving the equation = 0.

$$x^2 - 1x - 12 = 0$$

→ Set  $1x^2 + -1x + -12 = 0$ . Factor or use the quadratic formula.

→  $x = -3$  or  $x = 4$ .

**Answer:**  $x = -3$  or  $x = 4$

---

13. Solve by factoring:  $x^2 + 2x + -24 = 0$

$$x^2 + 2x - 24 = 0$$

→ Factor: find two numbers that multiply to -24 and add to 2.

→ Set each factor equal to zero.

→  $x = -6$  or  $x = 4$ .

**Answer:**  $x = -6$  or  $x = 4$

---

14. Solve by factoring:  $1x^2 + -3x + -4 = 0$ .

$$x^2 - 3x - 4 = 0$$

→ Factor the quadratic. Set each factor = 0.

→ Solutions:  $x = -1$  and  $x = 4$ .

**Answer:**  $x = -1$  or  $x = 4$

---

15. Find the x-intercepts of  $f(x) = 1x^2 + 2x + -3$  by solving the equation = 0.

$$x^2 + 2x - 3 = 0$$

→ Set  $1x^2 + 2x + -3 = 0$ . Factor or use the quadratic formula.

→  $x = -3$  or  $x = 1$ .

**Answer:**  $x = -3$  or  $x = 1$

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16. Solve by factoring:  $x^2 + 0x + -4 = 0$

$$x^2 - 4 = 0$$

→ Factor: find two numbers that multiply to -4 and add to 0.

→ Set each factor equal to zero.

→  $x = -2$  or  $x = 2$ .

**Answer:**  $x = -2$  or  $x = 2$

---

17. Solve by factoring:  $1x^2 + 2x + 1 = 0$ .

$$x^2 + 2x + 1 = 0$$

→ Factor the quadratic. Set each factor = 0.

→ Solutions:  $x = -1$  and  $x = -1$ .

**Answer:**  $x = -1$  or  $x = -1$

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18. Find the x-intercepts of  $f(x) = 1x^2 + 3x + -4$  by solving the equation = 0.

$$x^2 + 3x - 4 = 0$$

→ Set  $1x^2 + 3x + -4 = 0$ . Factor or use the quadratic formula.

→  $x = -4$  or  $x = 1$ .

**Answer:**  $x = -4$  or  $x = 1$

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19. Solve by factoring:  $x^2 + 1x + -12 = 0$

$$x^2 + 1x - 12 = 0$$

→ Factor: find two numbers that multiply to -12 and add to 1.

→ Set each factor equal to zero.

→  $x = -4$  or  $x = 3$ .

**Answer:**  $x = -4$  or  $x = 3$

---

20. Solve by factoring:  $2x^2 + -4x + 0 = 0$ .

$$2x^2 - 4x = 0$$

→ Factor the quadratic. Set each factor = 0.

→ Solutions:  $x = 0$  and  $x = 2$ .

**Answer:**  $x = 0$  or  $x = 2$

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21. Find the x-intercepts of  $f(x) = 1x^2 + 2x + -15$  by solving the equation = 0.

$$x^2 + 2x - 15 = 0$$

→ Set  $1x^2 + 2x + -15 = 0$ . Factor or use the quadratic formula.

→  $x = -5$  or  $x = 3$ .

**Answer:**  $x = -5$  or  $x = 3$

---

22. Solve by factoring:  $x^2 + 5x + -6 = 0$

$$x^2 + 5x - 6 = 0$$

→ Factor: find two numbers that multiply to -6 and add to 5.

→ Set each factor equal to zero.

→  $x = -6$  or  $x = 1$ .

**Answer:**  $x = -6$  or  $x = 1$

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## Domain of rational expressions

---

23. Find the value of  $x$  that makes the expression undefined:  $f(x) = (3x + -4) / (4x + 6)$ .

$$f(x) = \frac{3x + -4}{4x + 6}$$

→ Set denominator = 0:  $4x + 6 = 0$ .

→  $x = -3/2$  is excluded from the domain.

**Answer:**  $x \neq -3/2$

---

24. Find the value of  $x$  that makes the expression undefined:  $f(x) = (2x + 2) / (3x + 7)$ .

$$f(x) = \frac{2x + 2}{3x + 7}$$

→ Set denominator = 0:  $3x + 7 = 0$ .

→  $x = -7/3$  is excluded from the domain.

**Answer:**  $x \neq -7/3$

---

25. Find the value of  $x$  that makes the expression undefined:  $f(x) = (4x + -3) / (2x + 2)$ .

$$f(x) = \frac{4x + -3}{2x + 2}$$

→ Set denominator = 0:  $2x + 2 = 0$ .

→  $x = -1$  is excluded from the domain.

**Answer:**  $x \neq -1$

---

26. Find the value of  $x$  that makes the expression undefined:  $f(x) = (4x + 3) / (1x + -1)$ .

$$f(x) = \frac{4x + 3}{1x + -1}$$

→ Set denominator = 0:  $1x + -1 = 0$ .

→  $x = 1$  is excluded from the domain.

**Answer:**  $x \neq 1$

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## Simplifying rational expressions

---

27. Simplify the rational expression:  $(4x + 8) / (4x + 24)$ . State any restrictions on  $x$ .

$$\frac{4x + 8}{4x + 24}$$

→ Factor the numerator:  $4(x + 2)$ . Factor the denominator:  $4(x + 6)$ .

→ Cancel the common factor 4.

→ Simplified:  $(x + 2)/(x + 6)$ , where  $x$  is not equal to -6.

**Answer:**  $\frac{x + 2}{x + 6}, x \neq -6$

---

28. Simplify the rational expression:  $(2x + 4) / (2x + 6)$ . State any restrictions on  $x$ .

$$\frac{2x + 4}{2x + 6}$$

→ Factor the numerator:  $2(x + 2)$ . Factor the denominator:  $2(x + 3)$ .

→ Cancel the common factor 2.

→ Simplified:  $(x + 2)/(x + 3)$ , where  $x$  is not equal to -3.

**Answer:**  $\frac{x + 2}{x + 3}, x \neq -3$

---

29. Simplify the rational expression:  $(3x + 3) / (3x + 24)$ . State any restrictions on  $x$ .

$$\frac{3x + 3}{3x + 24}$$

→ Factor the numerator:  $3(x + 1)$ . Factor the denominator:  $3(x + 8)$ .

→ Cancel the common factor 3.

→ Simplified:  $(x + 1)/(x + 8)$ , where  $x$  is not equal to -8.

**Answer:**  $\frac{x + 1}{x + 8}, x \neq -8$

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30. Simplify the rational expression:  $(2x + 2) / (2x + 16)$ . State any restrictions on  $x$ .

$$\frac{2x + 2}{2x + 16}$$

→ Factor the numerator:  $2(x + 1)$ . Factor the denominator:  $2(x + 8)$ .

→ Cancel the common factor 2.

→ Simplified:  $(x + 1)/(x + 8)$ , where  $x$  is not equal to -8.

**Answer:**  $\frac{x + 1}{x + 8}, x \neq -8$

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