

Chapter 10 — Factoring

Teacher Guide

Teacher Chapter-at-a-Glance

Materials

Algebra tiles or area-model diagrams are optional but help make the GCF and difference-of-squares patterns visible.

Pacing

Spend the least time on GCF alone (mostly review) and the most time on the GCF-then-trinomial combination, since that is where the chapter's core trap lives.

Talk Prompt

"Did you check for a GCF before you started looking for a pattern?"

If Ready-to-Learn Reveals a Gap

If students cannot find a GCF or multiply two binomials, reteach the relevant part of Chapter 1 or Chapter 9 before continuing.

Mastery Decision Guide

What a missed Tripwire item actually means, and what to do about it before moving on.

Missed Tripwire #1 → Skipping the GCF (Mistake 1). *A factored answer's expansion is missing a constant multiple of the original polynomial.* Review before the next chapter.

Missed Tripwire #2 → Stopping After Partial Factoring (Mistake 2). *A factor left in the answer can still itself be factored further, most often a difference of squares hiding inside a remaining binomial.* Review before the next chapter.

Ready-to-Learn Check

Quick check before starting. A wrong answer below points to a specific gap worth closing first, not just a miss to shrug off.

1. Find the GCF of 12, 18, and 30.

Correct answer: 6

Likely wrong answer: 3

Misconception: Finds a common factor that works but stops before checking whether a larger one also divides all three numbers.

Next move: Review factors and GCF: list all factors of each number and find the largest one they share.

2. Expand $3x(x + 4)$.

Correct answer: $3x^2 + 12x$

Likely wrong answer: $3x + 12x$

Misconception: Multiplies the coefficient by the term but drops the variable that was already there, instead of multiplying the whole term.

Next move: Review the distributive property before starting factoring, since factoring is this multiplication in reverse.

3. Expand $(x + 2)(x + 5)$.

Correct answer: $x^2 + 7x + 10$

Likely wrong answer: $x^2 + 10$

Misconception: Multiplies only the first terms and the last terms, skipping the two middle products that combine into the middle term.

Next move: Review binomial multiplication (Chapter 9): all four products are needed, and this chapter reverses exactly that process.

Common Mistakes

TEACHING NOTE

Mistake 1 (skipping the GCF) drives both Tripwire items and is the single highest-value reteaching target in the whole chapter.

Students often run into the same kinds of trouble with this topic. Recognizing these patterns helps avoid them.

Mistake 1: Skipping the GCF

What students do: $2x^2 + 10x + 12$ is factored as $(x + 2)(x + 3)$.

Why this happens: The student sees the trinomial pattern inside but ignores that every term shares a factor of 2.

What to do instead: Always check whether every term shares a number, a variable, or both before using another pattern: $2x^2 + 10x + 12 = 2(x + 2)(x + 3)$.

Diagnostic trigger: A factored answer's expansion is missing a constant multiple of the original polynomial.

Mistake 2: Stopping After Partial Factoring

What students do: $4x^3 - 16x$ is factored as $4x(x^2 - 4)$ and left there.

Why this happens: The student factors out the GCF and assumes the work is done.

What to do instead: $x^2 - 4$ is a difference of squares, so the complete factorization is $4x(x + 2)(x - 2)$.

Diagnostic trigger: A factor left in the answer can still itself be factored further, most often a difference of squares hiding inside a remaining binomial.

Mistake 3: Swapping Signs in Trinomial Factoring

What students do: $x^2 - 4x - 12$ is factored as $(x + 6)(x - 2)$.

Why this happens: The student found the right numbers but put the signs on the wrong factors.

What to do instead: The product must be -12 and the sum must be -4 : $-6 + 2 = -4$, so $x^2 - 4x - 12 = (x - 6)(x + 2)$.

Diagnostic trigger: The two numbers used have the right magnitudes but the wrong individual signs, so the product is right but the sum is not (or vice versa).

Mistake 4: Trying to Factor a Sum of Squares

What students do: $x^2 + 25$ is factored as $(x + 5)(x - 5)$.

Why this happens: The student sees two perfect squares and ignores the plus sign between them.

What to do instead: $(x + 5)(x - 5) = x^2 - 25$, not $x^2 + 25$. A sum of squares does not factor over the integers or real numbers using this pattern.

***Diagnostic trigger:** Difference-of-squares factors are applied to an expression with a plus sign between two squared terms.*

Mistake 5: Skipping the Expansion Check

What students do: A factored form is written and the work ends there.

Why this happens: Students assume the factors are correct because they look familiar.

What to do instead: Expand the proposed factors. If the expansion does not match the original polynomial, the factoring is wrong.

***Diagnostic trigger:** No expansion check appears anywhere in the work before the final answer is given.*

Practice

Teacher solutions follow this practice set.

1. Factor $8x + 12$.
2. Factor $10x^2 - 15x$.
3. Factor $12x^3 + 18x^2 - 6x$.
4. Factor $x^2 + 8x + 15$.
5. Factor $x^2 - 9x + 20$.
6. Factor $x^2 + x - 20$.
7. Factor $x^2 - 3x - 18$.
8. Factor $x^2 + 16x + 64$.
9. Factor $x^2 - 49$.
10. Factor $9x^2 - 16$.
11. Factor completely $x^4 - 81$.
12. Factor completely $3x^3 - 27x$.

Practice Solutions

Use these concise solutions to check the method as well as the final answer.

1. Factor $8x + 12$.

Solution: The GCF is 4: $8x + 12 = 4(2x + 3)$.

2. Factor $10x^2 - 15x$.

Solution: The GCF is $5x$: $10x^2 - 15x = 5x(2x - 3)$.

3. Factor $12x^3 + 18x^2 - 6x$.

Solution: The GCF is $6x$: $12x^3 + 18x^2 - 6x = 6x(2x^2 + 3x - 1)$.

4. Factor $x^2 + 8x + 15$.

Solution: Find two numbers with product 15 and sum 8: 3 and 5. Thus $(x + 3)(x + 5)$.

5. Factor $x^2 - 9x + 20$.

Solution: Find two numbers with product 20 and sum -9: -4 and -5. Thus $(x - 4)(x - 5)$.

6. Factor $x^2 + x - 20$.

Solution: Find two numbers with product -20 and sum 1: 5 and -4. Thus $(x + 5)(x - 4)$.

7. Factor $x^2 - 3x - 18$.

Solution: Find two numbers with product -18 and sum -3: -6 and 3. Thus $(x - 6)(x + 3)$.

8. Factor $x^2 + 16x + 64$.

Solution: This is a perfect-square trinomial: $x^2 + 16x + 64 = (x + 8)^2$.

9. Factor $x^2 - 49$.

Solution: Use the difference of squares: $x^2 - 49 = (x - 7)(x + 7)$.

10. Factor $9x^2 - 16$.

Solution: Use the difference of squares: $9x^2 - 16 = (3x - 4)(3x + 4)$.

11. Factor completely $x^4 - 81$.

Solution: $x^4 - 81 = (x^2 - 9)(x^2 + 9) = (x - 3)(x + 3)(x^2 + 9)$.

12. Factor completely $3x^3 - 27x$.

Solution: First factor the GCF, then the difference of squares: $3x^3 - 27x = 3x(x^2 - 9) = 3x(x - 3)(x + 3)$.

Tripwire Check

These questions test whether the thinking is solid — not just whether the procedure was memorized. Each wrong answer below points to a specific misconception, not just "try again."

1. A student factors $4x^2 + 20x + 24$ as $(x + 2)(x + 3)$. Is the answer complete?

Correct answer: No. The complete factorization is $4(x + 2)(x + 3)$.

Likely wrong answer: $(x + 2)(x + 3)$

Misconception: The student factored the inside trinomial but omitted the GCF.

Next move: Expand the proposed answer and compare it with the original.

2. A student factors $4x^3 - 16x$ as $4x(x^2 - 4)$ and stops. Is the answer fully factored?

Correct answer: No. $4x(x - 2)(x + 2)$.

Likely wrong answer: $4x(x^2 - 4)$

Misconception: The student did not continue after removing the GCF.

Next move: Check whether the remaining expression matches another pattern.

Answer Key — Worksheets (Full Diagnostic)

Worksheet A: Guided Practice

1. Factor $12x + 18$.

1. $6(2x + 3)$ Likely wrong answer: $3(4x+6)$ (uses a common factor that isn't the greatest common factor). Misconception: A smaller common factor is used instead of checking for the largest one.

2. Factor $14x^2 - 21x$.

2. $7x(2x - 3)$ Likely wrong answer: $7(2x^2-3x)$ (leaves the variable factor inside instead of pulling it out too). Misconception: Only the numeric GCF is factored out; a common variable factor is left behind.

3. Factor $15x^3 + 10x^2 - 5x$.

3. $5x(3x^2 + 2x - 1)$ Likely wrong answer: $5(3x^3+2x^2-x)$ (leaves a variable factor inside instead of pulling it out too). Misconception: Only the numeric GCF is factored out; a common variable factor is left behind.

4. Factor $x^2 + 11x + 24$.

4. $(x + 3)(x + 8)$ Likely wrong answer: $(x+4)(x+6)$ (finds a pair that multiplies to 24 but doesn't check the sum). Misconception: Only the product condition is checked; the requirement that the pair also sums correctly is skipped.

5. Factor $x^2 - 11x + 24$.

5. $(x - 3)(x - 8)$ Likely wrong answer: $(x+3)(x+8)$ (uses positive factors despite the middle term being negative). Misconception: The sign pattern needed for a positive product and negative sum is not applied to both factors.

6. Factor $x^2 + 2x - 35$.

6. $(x + 7)(x - 5)$ Likely wrong answer: $(x+5)(x-7)$ (assigns the larger number the wrong sign). Misconception: The factor with the larger absolute value doesn't receive the sign that matches the middle term.

7. Factor $x^2 - 64$.

7. $(x - 8)(x + 8)$ Likely wrong answer: $(x-8)^2$ (treats a difference of squares as a perfect square trinomial). Misconception: A binomial with no middle term is factored as if it needed identical repeated factors.

8. Factor $x^2 - 5x - 24$.

8. $(x - 8)(x + 3)$ Likely wrong answer: $(x+8)(x-3)$ (assigns the wrong sign to the larger-magnitude factor). Misconception: The factor with the larger absolute value doesn't receive the sign that matches the middle term.

9. Factor $x^2 + 12x + 36$.

9. $(x + 6)^2$ Likely wrong answer: $(x+18)(x+2)$ (finds a pair that multiplies to 36 but doesn't check the sum). Misconception: Only the product condition is checked; the requirement that the pair also sums correctly is skipped.

10. Factor $16x^2 - 9$.

10. $(4x - 3)(4x + 3)$ Likely wrong answer: $(4x-9)(4x+1)$ (doesn't recognize 9 as a perfect square). Misconception: One of the two terms is not recognized as a perfect square before applying the pattern.

11. Factor $x^2 - 18x + 81$.

11. $(x - 9)^2$ Likely wrong answer: $(x-9)(x+9)$ (mistakes a perfect square trinomial for a difference of squares). Misconception: A trinomial with a middle term is factored as if it were a binomial with none.

12. Factor $9x^2 - 49$.

12. $(3x - 7)(3x + 7)$ Likely wrong answer: $(9x-49)(x+1)$ (doesn't recognize $9x^2$ as a perfect square). Misconception: One of the two terms is not recognized as a perfect square before applying the pattern.

13. Factor completely $4x^3 - 36x$.

13. $4x(x - 3)(x + 3)$ Likely wrong answer: $(2x-6)(2x+6)$ (skips factoring out the GCF of $4x$ first). Misconception: The GCF is not removed before attempting to apply a factoring pattern to the remaining terms.

14. Factor completely $2x^2 - 18$.

14. $2(x - 3)(x + 3)$ Likely wrong answer: $(x-3)(x+3)$ with the GCF of 2 left out entirely. Misconception: The GCF is factored out mentally but not written down as part of the final answer.

15. Does $x^2 + 49$ factor over the integers? Explain.

15. No; $x^2 + 49$ is a sum of squares. Likely wrong answer: says yes, $(x+7)(x-7)$. Misconception: A sum of two squares is factored as if it were a difference, ignoring that the pattern requires subtraction.

Worksheet B: Independent Practice

1. Factor completely $18x^3 - 12x^2$.

1. $6x^2(3x - 2)$ Likely wrong answer: $6x(3x^2-2x)$ (leaves a variable factor inside instead of pulling it out fully). Misconception: Only part of the common variable factor is factored out.

2. Factor completely $15x^3 + 10x^2 - 25x$.

2. $5x(3x^2 + 2x - 5)$ Likely wrong answer: $5(3x^3+2x^2-5x)$ (leaves a variable factor inside instead of pulling it out too). Misconception: Only the numeric GCF is factored out; a common variable factor is left behind.

3. Factor completely $12x^3 - 75x$.

3. $3x(2x - 5)(2x + 5)$ Likely wrong answer: $3x(4x^2-25)$ left unfactored further, missing the difference of squares inside. Misconception: The remaining binomial after removing the GCF is not checked for a further factoring pattern.

4. Factor $6x^2 + 7x - 20$.

4. $(3x - 4)(2x + 5)$ Likely wrong answer: $(6x-4)(x+5)$ (uses a factor pair that doesn't distribute back to the correct middle term). Misconception: A factor pair is chosen without verifying it reproduces the correct middle term when expanded.

5. Factor $2x^2 - 11x + 5$.

5. $(2x - 1)(x - 5)$ Likely wrong answer: $(2x-5)(x-1)$ (uses a factor pair that doesn't distribute back to the correct middle term). Misconception: A factor pair is chosen without verifying it reproduces the correct middle term when expanded.

6. Factor $3x^2 + x - 10$.

6. $(3x - 5)(x + 2)$ Likely wrong answer: $(3x+2)(x-5)$ (uses a factor pair that doesn't distribute back to the correct middle term). Misconception: A factor pair is chosen without verifying it reproduces the correct middle term when expanded.

7. Factor $x^2 - 13x + 40$.

7. $(x - 5)(x - 8)$ Likely wrong answer: $(x-4)(x-10)$ (finds a pair that multiplies to 40 but doesn't check the sum). Misconception: Only the product condition is checked; the requirement that the pair also sums correctly is skipped.

8. Factor $x^2 + 3x - 28$.

8. $(x + 7)(x - 4)$ Likely wrong answer: $(x-7)(x+4)$ (assigns the wrong sign to the larger-magnitude factor). Misconception: The factor with the larger absolute value doesn't receive the sign that matches the middle term.

9. Factor $x^2 - 16x + 64$.

9. $(x - 8)^2$ Likely wrong answer: $(x+8)(x-8)$ (mistakes a perfect square trinomial for a difference of squares). Misconception: A trinomial with a middle term is factored as if it were a binomial with none.

10. Factor $4x^2 + 20x + 25$.

10. $(2x + 5)^2$ Likely wrong answer: $(2x-5)(2x+5)$ (mistakes a perfect square trinomial for a difference of squares). Misconception: A trinomial with a middle term is factored as if it were a binomial with none.

11. Factor $25x^2 - 4$.

11. $(5x - 2)(5x + 2)$ Likely wrong answer: $(5x-4)(5x+1)$ (doesn't recognize 4 as a perfect square). Misconception: One of the two terms is not recognized as a perfect square before applying the pattern.

12. Factor completely $x^4 - 16$.

12. $(x - 2)(x + 2)(x^2 + 4)$ Likely wrong answer: $(x-4)(x+4)$ (stops after one difference-of-squares step, missing that x^2+4 doesn't factor further but the first pair should be reapplied correctly). Misconception: A repeated difference-of-squares pattern is not applied a second time to a binomial factor that is itself a difference of squares.

13. Factor completely $6x^2 - 54$.

13. $6(x - 3)(x + 3)$ Likely wrong answer: $(x-9)(x+9)$ with the GCF of 6 left out entirely. Misconception: The GCF is factored out mentally but not written down as part of the final answer.

14. Factor $x^2 - 5x - 36$.

14. $(x - 9)(x + 4)$ Likely wrong answer: $(x-4)(x+9)$ (assigns the wrong sign to the larger-magnitude factor). Misconception: The factor with the larger absolute value doesn't receive the sign that matches the middle term.

15. Factor completely $2x^3 - 8x^2 - 10x$.

15. $2x(x - 5)(x + 1)$ Likely wrong answer: $2x(x^2-4x-5)$ left unfactored further, missing the trinomial pattern inside. Misconception: The remaining trinomial after removing the GCF is not checked for a further factoring pattern.

16. A rectangle has area $x^2 + 11x + 28$. Find possible binomial dimensions.

16. $(x + 4)(x + 7)$ Likely wrong answer: $(x+2)(x+14)$ (finds a pair that multiplies to 28 but doesn't check the sum). Misconception: Only the product condition is checked; the requirement that the pair also sums correctly is skipped.

17. Solve by factoring: $x^2 - 7x - 18 = 0$.

17. $x = 9$ or $x = -2$. Likely wrong answer: $x=7$ or $x=-2$ (uses factors that multiply to -18 but don't add to -7). Misconception: A factor pair is chosen without checking that it sums to the correct middle coefficient.

18. Solve by factoring: $x^2 - 81 = 0$.

18. $x = 9$ or $x = -9$. Likely wrong answer: $x=81$ (forgets to take the square root, solving the unfactored equation directly). Misconception: The equation is not factored first; the constant is treated as the direct solution.

19. Explain why $x^2 + 36$ cannot be factored using difference of squares over the integers.

19. Sum of squares, not a difference of squares. Likely wrong answer: says it can be factored as $(x+6)(x+6)$. Misconception: A sum of two squares is mistaken for a perfect square trinomial, which requires a middle term.

20. A student factors $x^2 + 5x - 24$ as $(x + 8)(x - 3)$. Verify whether the student is correct.

20. Correct: $(x + 8)(x - 3)$. Likely wrong answer: says the student is incorrect without actually expanding to check. Misconception: A proposed factorization is judged without independently verifying it by expanding.

Worksheet C: Mixed Application

1. A student factors $2x^2 + 7x + 3$ as $(2x + 1)(x + 3)$. Verify by expanding. Is the student correct?

1. Correct: $(2x + 1)(x + 3) = 2x^2 + 7x + 3$. Likely wrong answer: says incorrect without actually expanding to check. Misconception: A proposed factorization is judged without independently verifying it by expanding.

2. A student factors $x^2 - 6x + 8$ as $(x - 2)(x - 4)$. Verify by expanding and explain how the factor pair was chosen.

2. Correct: $(x - 2)(x - 4) = x^2 - 6x + 8$. Likely wrong answer: $(x-1)(x-8)$ (finds a pair that multiplies to 8 but doesn't check the sum). Misconception: Only the product condition is checked; the requirement that the pair also sums correctly is skipped.

3. A student writes $x^2 + 25 = (x + 5)(x - 5)$. Identify the error.

3. $(x + 5)(x - 5) = x^2 - 25$, not $x^2 + 25$. Likely wrong answer: (already given) $x^2+25=(x+5)(x-5)$. Misconception: A sum of two squares is factored as if it were a difference, ignoring that the pattern requires subtraction.

4. A rectangle has area $x^2 - 2x - 35$. Find possible binomial dimensions.

4. $(x - 7)(x + 5)$ Likely wrong answer: $(x-5)(x+7)$ (assigns the wrong sign to the larger-magnitude factor). Misconception: The factor with the larger absolute value doesn't receive the sign that matches the middle term.

5. A rectangular garden has area $2x^2 - 5x - 12$. Find possible binomial dimensions.

5. $(2x + 3)(x - 4)$ Likely wrong answer: $(2x-4)(x-3)$ (uses a factor pair that doesn't distribute back to the correct middle term). Misconception: A factor pair is chosen without verifying it reproduces the correct middle term when expanded.

6. A square has area $x^2 - 10x + 25$. Write a possible side length.

6. $x - 5$ Likely wrong answer: $x+5$ (drops the negative sign from the repeated factor). Misconception: A perfect square trinomial's negative middle term is not carried into the sign of the repeated factor.

7. Factor $16x^2 - 81$ and explain why it is a difference of squares.

7. $(4x - 9)(4x + 9)$ Likely wrong answer: says it's a difference of squares but writes $(16x-81)(16x+81)$, not recognizing the perfect squares correctly. Misconception: The terms are not rewritten as their own perfect square roots before applying the pattern.

8. A student says $x^2 + 13x + 42$ has dimensions $x + 6$ and $x + 7$. Verify the claim.

8. Correct: $(x + 6)(x + 7)$. Likely wrong answer: says incorrect without actually expanding to check. Misconception: A proposed factorization is judged without independently verifying it by expanding.

9. Factor completely $4x^2 - 12x$.

9. $4x(x - 3)$ Likely wrong answer: $4(x^2-3x)$ (leaves a variable factor inside instead of pulling it out too). Misconception: Only the numeric GCF is factored out; a common variable factor is left behind.

10. Solve by factoring: $x^2 - 9x + 18 = 0$.

10. $x = 3$ or $x = 6$. Likely wrong answer: $x=-3$ or $x=-6$ (assigns the wrong signs to the factor pair). Misconception: The signs needed for a positive product and negative sum are not applied correctly to both factors.

11. Solve by factoring: $x^2 - 4x - 21 = 0$.

11. $x = 7$ or $x = -3$. Likely wrong answer: $x = -7$ or $x = 3$ (assigns the wrong sign to each solution). Misconception: The sign of each solution is not correctly matched to its corresponding factor.

12. Create a trinomial with factors $(x - 9)(x + 5)$. Expand to verify.

12. $x^2 - 4x - 45$ Likely wrong answer: $x^2 + 4x - 45$ (mishandles the sign when combining -9 and 5). Misconception: Unlike-signed values are combined by adding magnitudes instead of their signed values when expanding.

13. Create an expression that factors as $3x(x + 4)$. Expand to verify.

13. $3x^2 + 12x$ Likely wrong answer: $3x^2 + 4$ (distributes the monomial to only one term). Misconception: The monomial multiplier is applied to only one term inside the bracket.

14. Non-routine diagnostic: a student factors $6x^2 + 18x$ as $6x(x + 3)$. Is this factorization correct and complete? Explain and verify by expanding.

14. Correct and complete: $6x(x + 3)$. Likely wrong answer: (already given, explanatory item). Misconception: A factorization is accepted as complete without checking whether the remaining binomial factor could be broken down further.

15. Non-routine diagnostic: compare $x^2 - 36$ and $x^2 + 36$. Explain why only one factors over the integers using difference of squares.

15. $x^2 - 36 = (x - 6)(x + 6)$; $x^2 + 36$ is a sum of squares. Likely wrong answer: (already given, explanatory item). Misconception: A sum of two squares is assumed to factor the same way a difference of two squares does.

Answer Key — Exit Ticket

1. $5x(3x - 4)$
2. $(x - 6)(x + 4)$
3. $(5x - 6)(5x + 6)$

Worksheet 1: Guided Practice

1. $6(2x + 3)$
2. $7x(2x - 3)$
3. $5x(3x^2 + 2x - 1)$
4. $(x + 3)(x + 8)$
5. $(x - 3)(x - 8)$

6. $(x + 7)(x - 5)$
7. $(x - 8)(x + 8)$
8. $(x - 8)(x + 3)$
9. $(x + 6)^2$
10. $(4x - 3)(4x + 3)$
11. $(x - 9)^2$
12. $(3x - 7)(3x + 7)$
13. $4x(x - 3)(x + 3)$
14. $2(x - 3)(x + 3)$
15. No; $x^2 + 49$ is a sum of squares.

Worksheet 2: Independent Practice

1. $6x^2(3x - 2)$
2. $5x(3x^2 + 2x - 5)$
3. $3x(2x - 5)(2x + 5)$
4. $(3x - 4)(2x + 5)$
5. $(2x - 1)(x - 5)$
6. $(3x - 5)(x + 2)$
7. $(x - 5)(x - 8)$
8. $(x + 7)(x - 4)$
9. $(x - 8)^2$
10. $(2x + 5)^2$
11. $(5x - 2)(5x + 2)$
12. $(x - 2)(x + 2)(x^2 + 4)$
13. $6(x - 3)(x + 3)$
14. $(x - 9)(x + 4)$
15. $2x(x - 5)(x + 1)$
16. $(x + 4)(x + 7)$
17. $x = 9$ or $x = -2$.
18. $x = 9$ or $x = -9$.
19. Sum of squares, not a difference of squares.
20. Correct: $(x + 8)(x - 3)$.

Worksheet 3: Mixed Practice & Application

1. Correct: $(2x + 1)(x + 3) = 2x^2 + 7x + 3$.
2. Correct: $(x - 2)(x - 4) = x^2 - 6x + 8$.
3. $(x + 5)(x - 5) = x^2 - 25$, not $x^2 + 25$.
4. $(x - 7)(x + 5)$
5. $(2x + 3)(x - 4)$
6. $x - 5$
7. $(4x - 9)(4x + 9)$
8. Correct: $(x + 6)(x + 7)$.
9. $4x(x - 3)$
10. $x = 3$ or $x = 6$.
11. $x = 7$ or $x = -3$.
12. $x^2 - 4x - 45$
13. $3x^2 + 12x$
14. Correct and complete: $6x(x + 3)$.
15. $x^2 - 36 = (x - 6)(x + 6)$; $x^2 + 36$ is a sum of squares.