Algebra

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Sec. 10.1 Adding & Subtracting Polynomials

Standard Form:
Terms are placed in descending order, from largest degree to smallest degree

Example: $2x^3 + 5x^2 - 4x + 7$

Degree of each term is the exponent of the variable.
Degree of a polynomial is the largest degree of its terms
Leading Coefficient is the coefficient of the first term when the polynomial is written in standard form.

Examples:

Rewrite the polynomial in standard form, then identify the coefficients.

1. $-4x^2 + x^3 + 3$
2. $4 - x + 2x^2$

Classifying Polynomials:

Number of terms	Name
One	monomial
Two	binomial
Three	trinomial

Examples

Polynomial	Degree	Classified by Degree	Classified by # of terms
6			
-2x			
$3x + 1$			
$-x^2 + 2x - 5$			
$4x^3 - 8x$			
$2x^4 - 7x^3 - 5x + 1$			

Adding & Subtracting Polynomials
To add or subtract polynomials, add or subtract like terms.

Examples:

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

2. $(2x^2 + x - 5) + (x + x^2 + 6)$

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

4. $(x^2 - 8) - (7x + 4x^2)$

5. $(3x^2 - 5x + 3) - (2x^2 - x - 4)$

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

10-1 Algebra

Identify the leading coefficient, classify by degree and by number of terms.

25) $-\frac{2}{3}x + 5x^4 - \frac{5}{6}$

Coeff. Degree #

27) $-9t^2 + 3t^3 - 4t^4 - 15$

Coeff. Degree #

Add or subtract the polynomials.

41) $(x^3 + x^2 + 1) - x^2$

45) $(6b^4 - 3b^3 - 7b^2 + 9b + 3) + (4b^4 - 6b^2 + 11b - 7)$

47) $(9x^3 + 12) + (16x^3 - 4x + 2)$

55) $(6t^2 - 19t) - (3 - 2t^2) - (8t^2 - 5)$

59) $(9x^4 - x^2 + 7x) + (x^3 - 6x^2 + 2x - 9) - (4x^3 + 3x + 8)$

61) $(-3.8y^3 + 6.9y^2 - y + 6.3) - (-3.1y^3 + 2.9y - 4.1)$

Use the distributive property to simplify the expression.

73) $-3(x+1)-2$ 75) $11x+3(8-x)$ 77) $-4(1-x)+7$

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Practice A

For use with pages 576–582

Write the polynomial in standard form.

1. $3x + 4x^2 - 5$

2. $5x^2 + 4 - 3x$

3. $x - 7x^3 + 2$

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

5. $5x^2 + 4x^3 - 2x$

6. $-4x + 7x^4 - 5x^3 + 1$

7. $3x - 7 + 2x^2$

8. $7x - 2$

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

Identify the leading coefficient, and classify the polynomial by degree and by number of terms.

10. 14

11. $2x + 3$

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

Leading Coefficient			
Degree			
Number of Terms			

13. $x^3 - 5$

14. $1 - x^4$

15. $x^2 + 4x - x^4 + 3x^3 - 8$

Leading Coefficient			
Degree			
Number of Terms			

Use a vertical format to add or subtract.

19. $(x^2 + 2x + 7) + (4x^2 + x - 3)$

20. $(5x^2 - 2x + 4) + (-2x^2 + 3x - 1)$

21. $(5n^2 + 2n + 3) - (n + 2)$

22. $(6n^2 + 4n + 6) - (5n^2 + n + 2)$

23. $(2a^3 - 4a^2 + 7) + (-2a^2 + a - 3)$

24. $(4n^2 - 6n + 5) - (8n^2 + n + 3)$

Use a horizontal format to add or subtract.

25. $(x^2 + 2x + 1) + (x - 3)$

26. $(3m^2 + 2m + 1) - (-2m^2 + 4m)$

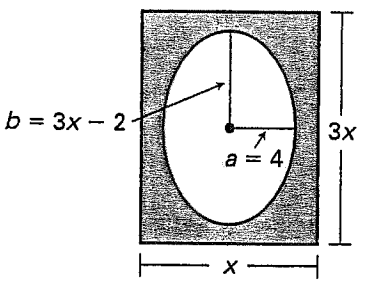
27. $(7x + 1) - (-x^2 + 3x - 5)$

28. $(5x^2 - 9) + (-3x^2 + 5x + 9)$

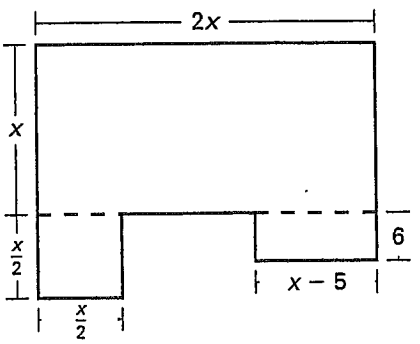
29. $(7x^3 - 8x^2 + 4) + (9x^2 + 5x + 2)$

30. $(n^2 - 2n) - (-5n^2 + 3n - 1)$

37. ***Photograph Mat*** A mat in a frame has an opening for a photograph (see figure). Find an expression for the area of the mat. (Area of opening: $A = \pi ab$).



38. ***Floor Plan*** The first floor of a home has the floor plan shown below. Find an expression in standard form for the area of the first floor.



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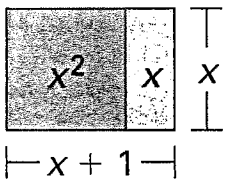
Sec. 10.2 Multiplying Polynomials

Match each area to the correct model. Then use the model to find the product.

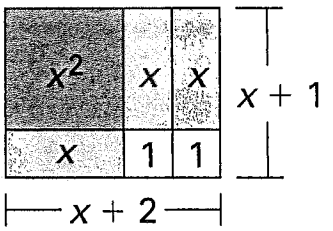
1. $x(x)$ **2.** $x(x + 1)$ **3.** $2x(x)$

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

A.



B.



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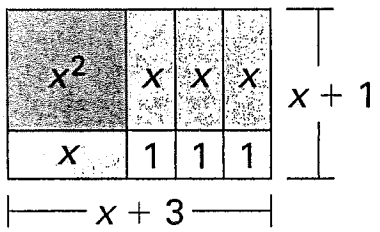
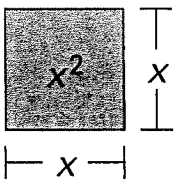
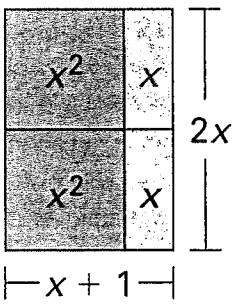


D.



E.



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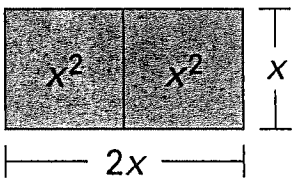

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Sec. 10.2 Multiplying Polynomials

Examples:
Multiply:

1. $5(2x^2 - 3x - 4)$

2. $-6(5 - 2x - x^3)$

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

FOIL
When multiplying two binomials, a method called FOIL can be used.
Multiply the **F**irst, **O**uter, **I**nner, and **L**ast terms

4. $(3x+4)(x+5)$

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

6. $(2x-3)(x-2)$

7. $(4x-7)(2x-5)$

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

9. $(x-4)(5x+9-2x^2)$

10. $(4x^2 - 3x - 1)(2x - 5)$

11. $(5x^2 - x - 3)(6x - 5)$

12. $(2x - 1)(3x^2 - x - 4)$

13. $(4x^3 - 2x + 5)(2x^2 - x + 1)$

14. $(4x - 1)(5 - 3x)$

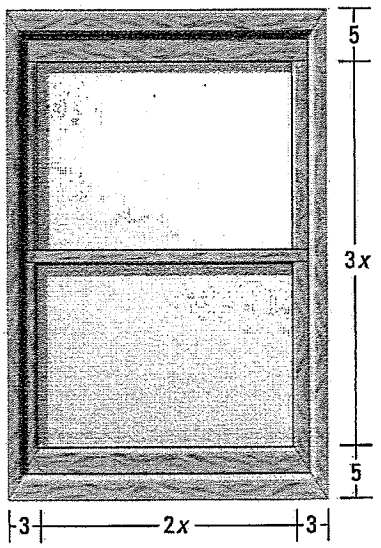
15. $(x + 6)(x - 6)$

16.

The diagram at the right shows the basic dimensions for a window. The glass portion of the window has a height-to-width ratio of 3 : 2. The framework adds 6 inches to the width and 10 inches to the height.

a. Write a polynomial expression that represents the total area of the window, including the framework.

b. Find the area when $x = 10$, 11, 12, 13, and 14.



X (in)	A (in²)
10	
11	
12	
13	
14	

SOLUTION

10-2 Algebra **Pages 587-589**

Find the product.

42) $(3x + 4)\left(\frac{2}{3}x + 1\right)$

47) $(-4s^2 + s - 1)(s + 4)$

Simplify.

63) $\left(\frac{1}{3}m\right)^2$

65) $(0.5w)^2$

67) $(4^2)^4$

69) $(4c^2)^4$

71) $(-w^4)^3$

73) $(8x^2y^8)^3$

LESSON 10.2

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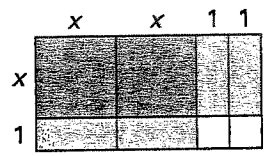
Practice A

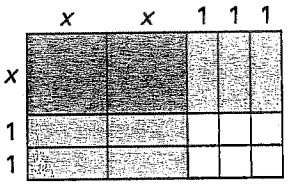
For use with pages 584–589

Write an equation that represents the product of two binomials as shown in the area model.

1.



2.



Find the product.

3. $2(3x + 1)$

4. $-4(3x - 5)$

5. $(2x)(5x - 1)$

6. $6n(4 - 5n)$

7. $x^2(3x - 7)$

8. $(8m^2 - 4m + 1)(3m^2)$

9. $(-5t)(t^2 + 2t - 4)$

10. $3x^2(2x^2 - 4x - 7)$

11. $(5a^2 + 3a - 7)(-2a^2)$

Use the distributive property to find the product.

12. $(t + 3)(t + 3)$

13. $(n + 5)(n + 1)$

14. $(2x + 5)(x - 4)$

15. $(4a + 5)(2a - 3)$ **16.** $(3x^2 + 2x + 1)(x + 3)$ **17.** $(4x^2 - 3x + 2)(2x + 5)$

Use the FOIL pattern to find the product.

18. $(w + 5)(w + 2)$ **19.** $(3z + 1)(z + 2)$ **20.** $(x - 2)(x - 3)$

21. $(4x + 7)(x + 5)$ **22.** $(2x - 2)(x + 8)$ **23.** $(5n + 3)(4n - 2)$

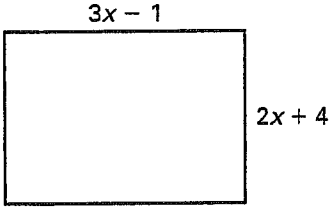
Find the product.

24. $(3b - 2)(2b - 3)$ **25.** $(5x + 4)(3x - 2)$ **26.** $(10n + 5)(3n - 2)$

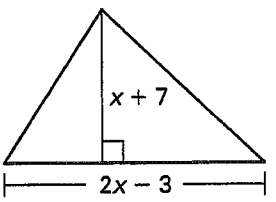
27. $(x - 7)(3x + 9)$ **28.** $(4t + 3)(4t + 3)$ **29.** $(x^2 + 3x + 1)(x - 2)$

Find an expression for the area of the figure. Give your answer as a quadratic polynomial. $A = lw$ $A = \frac{1}{2}bh$

30.



31.



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Sec. 10.3 Special Products of Polynomials

Use FOIL to find the patterns in each group

Group A

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

Group B

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

Group C

$(y-2)^2$ $(3p-7)^2$ $(x-y)^2$

SPECIAL PRODUCT PATTERNS

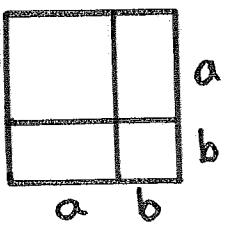
SUM AND DIFFERENCE PATTERN

$(a + b)(a - b) = a^2 - b^2$ **Example:** $(3x - 4)(3x + 4) = 9x^2 - 16$

SQUARE OF A BINOMIAL PATTERN

$(a + b)^2 = a^2 + 2ab + b^2$ **Example:** $(x + 4)^2 = x^2 + 8x + 16$

$(a - b)^2 = a^2 - 2ab + b^2$ **Example:** $(2x - 6)^2 = 4x^2 - 24x + 36$



Examples:

Find the products:

1. $(5t-2)(5t+2)$

2. $(7x-4)(7x+4)$

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

4. $(2x-7y)^2$

5. $(2p-5q)^2$

6. $(4x-10)(4x+10)$

7. $(3s-5t)(3s+5t)$

8. $(6x-5)^2$

10-3 Algebra **Pages 590-595**

Special Product Patterns

Sum and Difference Pattern

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

Example

$(3x - 4)(3x + 4) =$

Square of a Binomial Pattern

$(a + b)^2 =$

Example

$(x + 4)^2 =$

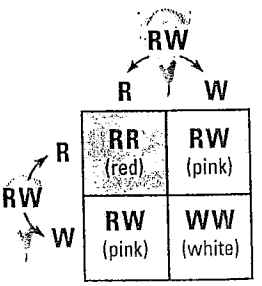
$(a - b)^2 =$

Example

$(2x - 6)^2 =$

Modeling a Punnett Square

The Punnett square at the right is an area model that shows the possible results of crossing two pink snapdragons, each with one red gene *R* and one white gene *W*. Each parent snapdragon passes along only one gene for color to its offspring. Show how the square of a binomial can be used to model the Punnett square.



Each parent snapdragon has half red genes and half white genes.

Simplify the expression. (no negative exponents)

63) $\left(\frac{x}{4}\right)^3$

65) $\left(\frac{4x}{y^3}\right)^3$

67) $\frac{3x^2y}{2x} \cdot \frac{6xy^2}{y^3}$

Solve the equation algebraically.

75) $x^2 - 10 = 6$

77) $\frac{1}{5}x^2 = 5$

79) $\frac{2}{3}x^2 = 6$

LESSON 10.3

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Practice A

For use with pages 590–596

Find the missing term.

1. $(x - y)^2 = x^2 - \_\_\_\_ + y^2$

2. $(a + b)^2 = a^2 + \_\_\_\_ + b^2$

Write the product of the sum and difference.

7. $(x + 2)(x - 2)$

8. $(t + 3)(t - 3)$

9. $(x + 9)(x - 9)$

10. $(5 + c)(5 - c)$

11. $(n + 5)(n - 5)$

12. $(2x + 7)(2x - 7)$

13. $(7 + d)(7 - d)$

14. $(3x + 1)(3x - 1)$

15. $(5x + 3)(5x - 3)$

Write the square of the binomial as a trinomial.

16. $(x + 4)^2$

17. $(x - 5)^2$

18. $(x + 8)^2$

19. $(2t + 3)^2$

20. $(3y - 5)^2$

21. $(4m - 3)^2$

22. $(2m + 4)^2$ **23.** $(2y + 9)^2$ **24.** $(2k - 3)^2$

Find the product.

25. $(w + 5)(w - 5)$ **26.** $(3z + 1)(3z - 1)$ **27.** $(x - 2)(x + 2)$

28. $(4x + 3)(4x - 3)$ **29.** $(2x - 9)(2x + 9)$ **30.** $(5n + 1)^2$

31. $(x - 5)^2$ **32.** $(3x - 2)^2$ **33.** $(7b + 3)^2$

Use mental math to find the product.

34. $18 \cdot 22$ **35.** $27 \cdot 33$ **36.** $54 \cdot 46$

37. ***Blue Eyes–Brown Eyes*** In humans, the brown eye gene B is dominant and the blue eye gene b is recessive. This means that humans whose eye genes are BB, Bb, or bB have brown eyes and those with bb have blue eyes. The Punnett square at the right shows the results of eye colors for children of parents who each have one B gene and one b gene. What percentage of children will have brown eyes? What percentage will have blue eyes? Use the model $(0.5B + 0.5b)^2 = 0.25BB + 0.5Bb + 0.25bb$ to answer the question.

	B	b
B	BB	Bb
b	bB	bb

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Review for Quiz 10-1, 2, 3 Hour _____

Use a vertical or horizontal format to add or subtract.

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

2) $(6n^2 + 4n + 6) - (5n^2 + n + 2)$

3) $(4n^2 - 6n + 5) - (8n^2 + n + 3)$

4) $(3m^2 + 2m + 1) - (-2m^2 + 4m)$

5) $(5x^2 - 9) + (-3x^2 + 5x + 9)$

6) $(n^2 - 2n) - (-5n^2 + 3n - 1)$

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

8) $(x^3 + x^2 + x + 1) + (-x^2 - x - 1)$

Find the product.

9) $(2x)(5x - 1)$

10) $(8m^2 - 4m + 1)(3m^2)$

11) $(5a^2 + 3a - 7)(-2a^2)$

Use FOIL to find the product.

12) $(3z + 1)(z + 2)$

13) $(2x - 2)(x + 8)$

14) $(x - 2)(x - 3)$

15) $(5n + 3)(4n - 2)$

16) $(5x + 4)(3x - 2)$

17) $(4t + 3)(4t + 3)$

18) $(10n + 5)(3n - 2)$

19) $(x^2 + 3x + 1)(x - 2)$

20) $(6 - x)(6 + x)$

21) $(2x + 7)(2x - 7)$

22) $(5x + 3)(5x - 3)$

Write the square of the binomial as a trinomial.

23) $(x + 8)^2$

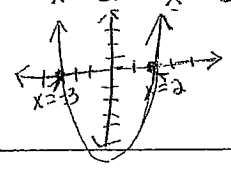
24) $(4m - 3)^2$

25) $(2k - 3)^2$

Algebra Chapte 10 Review

① Polynomial in Standard Form	Leading Coefficient, Degree, Constant term $2x^3+5x^2-4x+7$ Terms	Standard form means the terms are placed in order from largest degree to smallest degree.
② Types of Polynomials (classified by # of terms)	monomial → 1 term (3x) binomial → 2 terms (3x+2) trinomial → 3 terms ($4x^2+3x+2$)	Examples a) x^2+2x-5 is a quadratic trinomial b) $4x^3-8x$ is a cubic binomial c) 6 is a constant monomial. d) $2x^4-7x^3-5x+1$ is a quartic polynomial
③ Types of Polynomials (classified by degree)	Degree 0 → constant 1 → linear 2 → quadratic 3 → cubic 4 → quartic	
④ Adding and Subtracting Polynomials	To add or subtract two polynomials, add or subtract like terms.	*Adding a) $(2x^2+x-5)+(x+x^2+6)$ $(2x^2+x^2)+(x+1)+(-5+6)$ $3x^2+2x+1$
	* When you subtract, the second polynomial, don't forget to subtract each term.	*Subtracting b) $(x^2-8)-(7x+4x^2)$ $(x^2-4x^2)-8-7x$ $-3x^2-8-7x$ $-3x^2-7x-8$ ← standard form.

(5) Multiplying <u>two</u> Binomials using FOIL	FOIL First Outer Inner Last	ex. $(3x+4)(x+5)$ F, O, I, L $3x^2+15x+4x+20$ $3x^2+19x+20$
(6) multiplying Polynomials of any size.	Use the distributive property. <u>Remember each</u> term of one polynomial must be multiplied by <u>each</u> term of the other polynomial.	ex. $(3x-4)(5+3x-x^2)$ $15x+9x^2-3x^3-20-12x+4x^2$ After you distribute, combine like terms. $-3x^3+(9x^2+4x^2)+(15x-12x)-20$ $-3x^3+13x^2+3x-20$ ↑ Be sure the final answer is in standard form.
(7) <u>Special Product Patterns</u> Sum and difference pattern	sum, difference $(a+b)(a-b)=a^2-b^2$ The product of the sum and difference pattern has <u>no middle term</u>.	ex. sum, difference $(3x+5)(3x-5)$ $9x^2-25$
Squares of a binomial	When you square a binomial, write the binomial twice and use FOIL.	ex. $(5x+4)^2$ $(5x+4)(5x+4)$ $25x^2+20x+20x+16$ $25x^2+40x+16$

(8) Factored Form	A polynomial is in factored form if it is written as the product of two or more linear factors.	ex. Standard Form: $2x^2+7x-15=0$ * Factored Form: $(2x-3)(x+5)=0$
(9) Solving Polynomial Equations in factored form	Zero-Product Property: The product of two factors is zero only if one of the factors is zero.	ex. Solve $(x-2)(x+3)=0$ $x-2=0$ $\quad x+3=0$ $x=2$ $\quad x=-3$ Set each factor equal to zero and solve Solution $x=2,-3$
	Repeated factors: If an equation has a repeated factor, you only need to set the factor to zero one time because the answer would be the same.	ex. $(x+5)^2=0$ $x+5=0$ Solution $x=-5$ There is only one solution for this repeated factor.
	Solving a factored cubic equation: Set each factor equal to zero.	ex. $(2x+1)(x+3)(x-1)=0$ $2x+1=0$ $\quad x+3=0$ $\quad x-1=0$ $2x=-1$ $\quad x=-3$ $\quad x=1$ $x=-\frac{1}{2}$ Solutions $x=-\frac{1}{2},-3,1$
(10) Relating x-intercepts and factors.	When you solve a factor of a polynomial for zero, you are actually finding the x-intercepts of the equation.	ex. $(x-2)(x+3)=0$ $x=2$ $\quad x=-3$  Your solutions, 2, -3 are the x-intercepts!

Factoring $x^2 + bx + c$ $(x+p)(x+q)$

* Remember: $p+q=b$, $(p)(q)=c$

(11) Factoring when both b and c are positive.	x^2+3x+2 (b, c) $(x+1)(x+2)$	$b=3$, $c=2$ $p+q=3$ $(p)(q)=2$ Find factors of 2: $(1,2)$ ← pick $1+2=3$ ✓ $1\cdot 2=2$	Check by FOIL method. $(x+1)(x+2)$ $x^2+2x+1x+2$ x^2+3x+2 → Same as original trinomial, so factoring is correct!
(12) Factoring when b is negative and c is positive.	x^2-5x+6 (b, c) $(x-2)(x-3)$	$b=-5$ $c=6$ $p+q=-5$ $(p)(q)=6$ Find factors of 6: $(1,6)$, $(-1,-6)$, $(-2,-3)$ ← pick, $(2,3)$ $-2+-3=-5$ ✓ $-2\cdot -3=6$	Check by FOIL method $(x-2)(x-3)$ $x^2-3x-2x+6$ x^2-5x+6 → Same as original trinomial, so factoring is correct!
(13) Factoring when both b and c are negative.	x^2-2x-8 (b, c) $(x-4)(x+2)$	$b=-2$ $c=-8$ $p+q=-2$ $(p)(q)=-8$ Find factors of -8: $(-1,8)$, $(-8,1)$, $(8,-1)$, $(4,-2)$ ← pick $-4+2=-2$ ✓ $-4\cdot 2=-8$	Check by FOIL Method $(x-4)(x+2)$ $x^2+2x-4x-8$ x^2-2x-8 → Same as original trinomial, so factoring is correct.
(14) Discriminant b^2-4ac	The discriminant must be a perfect square in order to factor a quadratic trinomial ax^2+bx+c	① Can x^2+3x-4 be factored? $b^2-4ac=3^2-4(1)(-4)=9+16=25$ * Yes, because 25 is a perfect square. ② Can x^2+3x-6 be factored? $b^2-4ac=3^2-4(1)(-6)=9+24=33$ * No, because 33 is not a perfect square.	