

11. $(x - 3)(2x + 4)$ 12. $(y + 5)(3y - 2)$
 13. $(2x + 3)(x^3 - x + 2)$ 14. $(a + 2)(3a^2 - a + 5)$
 15. $\begin{array}{r} 3x - 2 \\ \times 5x + 1 \\ \hline \end{array}$ 16. $\begin{array}{r} 2z - 4 \\ \times 6z - 2 \\ \hline \end{array}$
 17. $\begin{array}{r} 3m^2 + 2m - 1 \\ \times 5m + 2 \\ \hline \end{array}$ 18. $\begin{array}{r} 2x^2 - 3x - 4 \\ \times 4x + 5 \\ \hline \end{array}$
 19. $-6a^2b^2(5a^2b^2 - 6a - 6b)$ 20. $7x^2y^3(-3ax - 4xy + z)$

Use special products to multiply. See Examples 5 and 6.

21. $(x - 3)(x + 4)$ 22. $(c - 3)(c + 1)$
 23. $(5x - 8y)(2x - y)$ 24. $(2n - 9m)(n - 7m)$
 25. $\left(4x + \frac{1}{3}\right)\left(4x - \frac{1}{2}\right)$ 26. $\left(4y - \frac{1}{3}\right)\left(3y - \frac{1}{8}\right)$
 27. $(5x^2 - 2y^2)(x^2 - 3y^2)$ 28. $(4x^2 - 5y^2)(x^2 - 2y^2)$

Use special products to multiply. See Examples 7 and 8.

29. $(x + 4)^2$ 30. $(x - 5)^2$
 31. $(6y - 1)(6y + 1)$ 32. $(7x - 9)(7x + 9)$
 33. $(3x - y)^2$ 34. $(4x + z)^2$
 35. $(7ab + 3c)(7ab - 3c)$ 36. $(3xy - 2b)(3xy + 2b)$
 37. $\left(3x + \frac{1}{2}\right)\left(3x - \frac{1}{2}\right)$ 38. $\left(2x - \frac{1}{3}\right)\left(2x + \frac{1}{3}\right)$

Use special products to multiply. See Examples 9 and 10.

39. $[3 + (4b + 1)]^2$ 40. $[5 - (3b - 3)]^2$
 41. $[(2s - 3) - 1][(2s - 3) + 1]$
 42. $[(2y + 5) + 6][(2y + 5) - 6]$
 43. $[(xy + 4) - 6]^2$ 44. $[(2a^2 + 4a) + 1]^2$

Multiply. See Example 11.

45. $(x + y)(x - y)(x^2 - y^2)$ 46. $(z - y)(z + y)(z^2 - y^2)$
 47. $(x - 2)^4$ 48. $(x - 1)^4$
 49. $(x - 5)(x + 5)(x^2 + 25)$ 50. $(x + 3)(x - 3)(x^2 + 9)$

MIXED PRACTICE

Multiply. See Examples 1 through 11.

51. $-8a^2b(3b^2 - 5b + 20)$ 52. $-9xy^2(3x^2 - 2x + 10)$
 53. $(6x + 1)^2$ 54. $(4x + 7)^2$
 55. $(5x^3 + 2y)(5x^3 - 2y)$ 56. $(3x^4 + 2y)(3x^4 - 2y)$

57. $(2x^3 + 5)(5x^2 + 4x + 1)$ 58. $(3y^3 - 1)(3y^3 - 6y + 1)$
 59. $(3x^2 + 2x - 1)^2$ 60. $(4x^2 + 4x - 4)^2$
 61. $(3x - 1)(x + 3)$ 62. $(5d - 3)(d + 6)$
 63. $(3x^4 + 1)(3x^2 + 5)$ 64. $(4x^3 - 5)(5x^2 + 6)$
 65. $(3x + 1)^2$ 66. $(4x + 6)^2$
 67. $(3b - 6y)(3b + 6y)$ 68. $(2x - 4y)(2x + 4y)$
 69. $(7x - 3)(7x + 3)$ 70. $(4x + 1)(4x - 1)$
 71. $\begin{array}{r} 3x^2 + 4x - 4 \\ \times 3x + 6 \\ \hline \end{array}$ 72. $\begin{array}{r} 6x^2 + 2x - 1 \\ \times 3x - 6 \\ \hline \end{array}$
 73. $(4x^2 - 2x + 5)(3x + 1)$ 74. $(5x^2 - x - 2)(2x - 1)$
 75. $[(xy + 4) - 6]^2$ 76. $[(2a^2 + 4) - 1]^2$
 77. $(11a^2 + 1)(2a + 1)$ 78. $(13x^2 + 1)(3x + 1)$
 79. $\left(\frac{2}{3}n - 2\right)\left(\frac{1}{2}n - 9\right)$ 80. $\left(\frac{3}{5}y - 6\right)\left(\frac{1}{3}y - 10\right)$
 81. $(3x + 1)(3x - 1)(2y + 5x)$
 82. $(2a + 1)(2a - 1)(6a + 7b)$

If $f(x) = x^2 - 3x$, find the following. See Example 12.

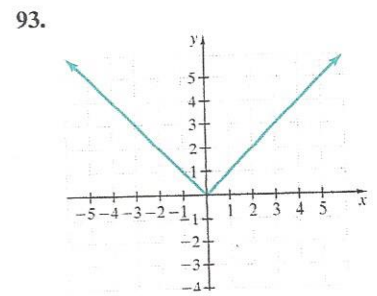
83. $f(a)$ 84. $f(c)$
 85. $f(a + h)$ 86. $f(a + 5)$
 87. $f(b - 2)$ 88. $f(a - b)$

REVIEW AND PREVIEW

Use the slope-intercept form of a line, $y = mx + b$, to find the slope of each line. See Section 3.4.

89. $y = -2x + 7$ 90. $y = \frac{3}{2}x - 1$
 91. $3x - 5y = 14$ 92. $x + 7y = 2$

Use the vertical line test to determine whether the following are graphs of functions. See Section 3.2.



6 Multiply.

a. $(3x - 5)(2x - 7)$

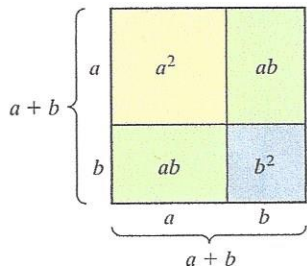
b. $(2x^2 - 3y)(4x^2 + y)$

OBJECTIVE

3 Squaring Binomials

The **square of a binomial** is a special case of the product of two binomials. By the FOIL order for multiplying two binomials, we have

$$\begin{aligned}
 (a + b)^2 &= (a + b)(a + b) \\
 &\quad \begin{array}{cccc} \text{F} & \text{O} & \text{I} & \text{L} \\ \downarrow & \downarrow & \downarrow & \downarrow \end{array} \\
 &= a^2 + ab + ba + b^2 \\
 &= a^2 + 2ab + b^2
 \end{aligned}$$



This product can be visualized geometrically by analyzing areas.

Area of larger square: $(a + b)^2$

Sum of areas of smaller rectangles: $a^2 + 2ab + b^2$

Thus, $(a + b)^2 = a^2 + 2ab + b^2$

The same pattern occurs for the square of a difference. In general,

Square of a Binomial

$$(a + b)^2 = a^2 + 2ab + b^2 \quad (a - b)^2 = a^2 - 2ab + b^2$$

In other words, a binomial squared is the sum of the first term squared, twice the product of both terms, and the second term squared.

Example for question #30

EXAMPLE 7 Multiply.

a. $(x + 5)^2$

b. $(x - 9)^2$

c. $(3x + 2z)^2$

d. $(4m^2 - 3n)^2$

Solution

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

$(x + 5)^2 = x^2 + 2 \cdot x \cdot 5 + 5^2 = x^2 + 10x + 25$

b. $(x - 9)^2 = x^2 - 2 \cdot x \cdot 9 + 9^2 = x^2 - 18x + 81$

c. $(3x + 2z)^2 = (3x)^2 + 2(3x)(2z) + (2z)^2 = 9x^2 + 12xz + 4z^2$

d. $(4m^2 - 3n)^2 = (4m^2)^2 - 2(4m^2)(3n) + (3n)^2 = 16m^4 - 24m^2n + 9n^2$ □

PRACTICE

7 Multiply.

a. $(x + 6)^2$

b. $(x - 2)^2$

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

d. $(3x^2 - 8b)^2$

Helpful Hint

Note that $(a + b)^2 = a^2 + 2ab + b^2$, **not** $a^2 + b^2$. Also,

$(a - b)^2 = a^2 - 2ab + b^2$, **not** $a^2 - b^2$.

Another special product applies to the sum and difference of the same two terms. Multiply $(a + b)(a - b)$ to see a pattern.

$$\begin{aligned}(a + b)(a - b) &= a^2 - ab + ba - b^2 \\ &= a^2 - b^2\end{aligned}$$

Product of the Sum and Difference of Two Terms

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

The product of the sum and difference of the same two terms is the difference of the first term squared and the second term squared.

Example for question #30

EXAMPLE 8 Multiply.

- a. $(x - 3)(x + 3)$ b. $(4y + 1)(4y - 1)$
 c. $(x^2 + 2y)(x^2 - 2y)$ d. $\left(3m^2 - \frac{1}{2}\right)\left(3m^2 + \frac{1}{2}\right)$

Solution

- a. $\begin{matrix} (a + b)(a - b) = a^2 - b^2 \\ \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \\ (x + 3)(x - 3) = x^2 - 3^2 = x^2 - 9 \end{matrix}$
 b. $(4y + 1)(4y - 1) = (4y)^2 - 1^2 = 16y^2 - 1$
 c. $(x^2 + 2y)(x^2 - 2y) = (x^2)^2 - (2y)^2 = x^4 - 4y^2$
 d. $\left(3m^2 - \frac{1}{2}\right)\left(3m^2 + \frac{1}{2}\right) = (3m^2)^2 - \left(\frac{1}{2}\right)^2 = 9m^4 - \frac{1}{4}$ □

PRACTICE

8 Multiply.

- a. $(x - 7)(x + 7)$ b. $(2a + 5)(2a - 5)$
 c. $\left(5x^2 + \frac{1}{4}\right)\left(5x^2 - \frac{1}{4}\right)$ d. $(a^3 - 4b^2)(a^3 + 4b^2)$

EXAMPLE 9 Multiply $[3 + (2a + b)]^2$.

Solution Think of 3 as the first term and $(2a + b)$ as the second term, and apply the method for squaring a binomial.

$$\begin{aligned}[a + b]^2 &= a^2 + 2(a) \cdot b + b^2 \\ [3 + (2a + b)]^2 &= 3^2 + 2(3)(2a + b) + (2a + b)^2 \\ &= 9 + 6(2a + b) + (2a + b)^2 \\ &= 9 + 12a + 6b + (2a)^2 + 2(2a)(b) + b^2 \quad \text{Square } (2a + b). \\ &= 9 + 12a + 6b + 4a^2 + 4ab + b^2\end{aligned}$$
 □

PRACTICE

9 Multiply $[2 + (3x - y)]^2$.