

Applications

1. An even number minus an even number will be even. Students may use examples, tiles, the idea of "groups of two," or the inverse relationship between addition and subtraction.
 - Using an example: $16 - 4$ is 12.
 - Using tiles: For example, if you take away one rectangle with a height of 2 from another rectangle with a height of 2, you will still have a rectangle with a height of 2.
 - Using groups of 2: If you have an even number of objects, you can bundle the number of objects into groups of 2. If you take away some bundles of 2 from a group of bundles of 2, you are still left with bundles of 2.
 - Using the inverse relationship between addition and subtraction: Students may know that if $a + b = c$, then $a = c - b$. In this way, the question is asking "If c and b are even, is a even or odd?" In the equation $a + b = c$, if the values of b and c are even, then the value of a must also be even, because even + even = even.
2. An odd number minus an odd number is even. If you have a rectangle with one extra square and you take away a rectangle with one extra square, you have taken away the extra square, and you are left with a rectangle with a height of 2.
3. An even number minus an odd number is odd. If you have a rectangle with a height of 2 and you subtract a rectangle with one extra square, you have broken up a pair of squares on the original rectangle and are left with another rectangle with an extra square.
4. An odd number minus an even number is odd. If you have a rectangle with one extra square and you subtract a rectangle with a height of 2, you are left with a rectangle with an extra square.
5. Evens have ones digits of 0, 2, 4, 6, or 8, and they are divisible by 2. Odds have ones digits of 1, 3, 5, 7, or 9, and they are not divisible by 2.
6. A sum is even if all of the addends are even, or if there is an even number of odd addends. Otherwise, the number is odd.
7. $4 \times (3 + 6)$ and $(4 \times 3) + (4 \times 6)$, total area 36
8. $(4 + 2) \times 7$ and $(4 \times 7) + (2 \times 7)$, total area 42
9. $5 \times (3 + 6 + 2)$ and $(5 \times 3) + (5 \times 6) + (5 \times 2)$, total area 55

For Exercises 10–12, the area of the largest rectangle is the sum of the areas of the two smaller rectangles. To find the dimensions of each rectangle, first find a common factor of each pair of numbers. Each Exercise has multiple possible dimensions.

10. (See Figure 1.)

Figure 1

Dimensions of 39 Square Unit Rectangles and Partitions

	Small	Medium	Large
Possible Rectangle 1	3×4	3×9	3×13
Possible Rectangle 2	1×12	1×27	1×39

11. (See Figure 2.)

12. (See Figure 3.)

13. $3 \times (4 + 6) = 3 \times 10$ or
 $(3 \times 4) + (3 \times 6) = 12 + 18$

14. $3 \times (5 + 1 + 3) = 3 \times 9$ or
 $(3 \times 5) + (3 \times 1) + (3 \times 3) = 15 + 3 + 9$
(See Figure 4.)

Figure 2

Dimensions of 49 Square Unit Rectangles and Partitions

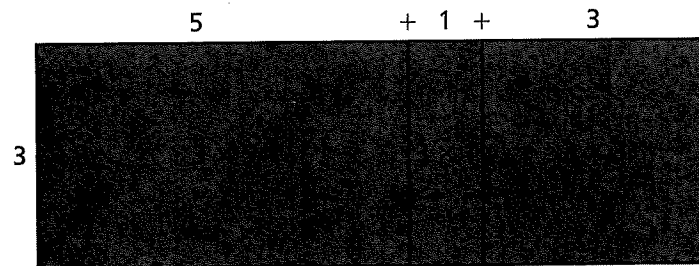
	Small	Medium	Large
Possible Rectangle 1	7×3	7×4	7×7
Possible Rectangle 2	1×21	1×28	1×49

Figure 3

Dimensions of 48 Square Unit Rectangles and Partitions

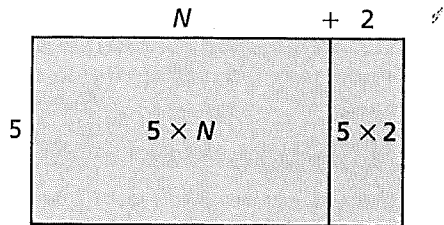
	Small	Medium	Large
Possible Rectangle 1	1×18	1×30	1×48
Possible Rectangle 2	2×9	2×15	2×24
Possible Rectangle 3	3×6	3×10	3×16
Possible Rectangle 4	6×3	6×5	6×8

Figure 4



15. $N \times (2 + 6) = 8N$ or
 $(N \times 2) + (N \times 6) = 2N + 6N$
 (See Figure 5.)

16. $5 \times (N + 2)$ or $(5 \times N) + (5 \times 2)$, $5N + 10$



17. $9 \times (30 + 4) = (9 \times 30) + (9 \times 4)$
 $= 270 + 36 = 306$
 (See Figure 6.)

Figure 5

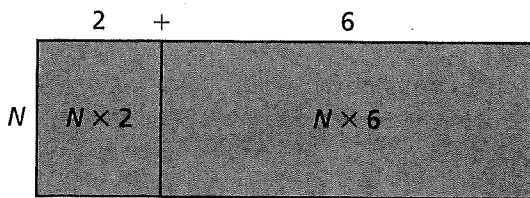
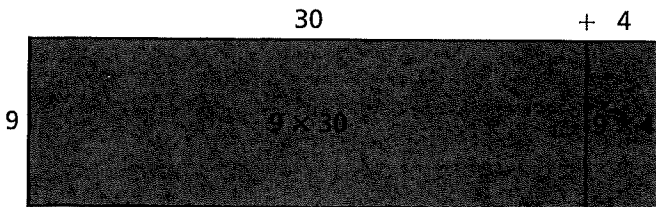
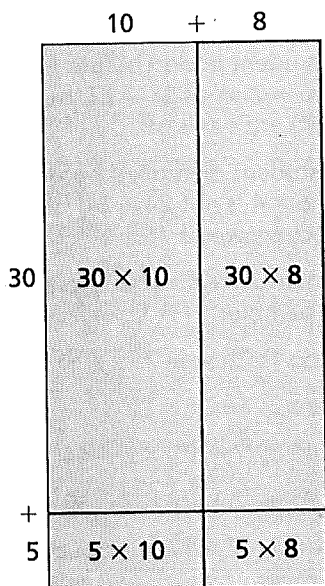


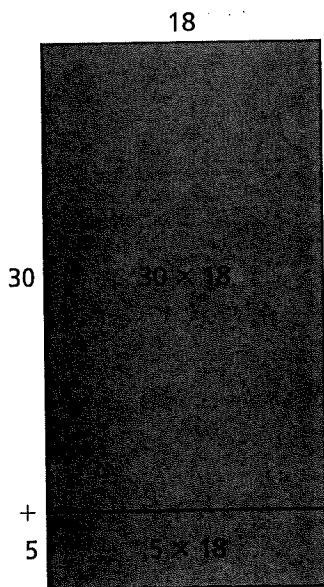
Figure 6



$$\begin{aligned}
 18. \quad 35 \times 18 &= (30 + 5) \times (10 + 8) \\
 &= (30 \times 10) + (5 \times 10) + \\
 &\quad (30 \times 8) + (5 \times 8) \\
 &= 300 + 50 + 240 + 40 \\
 &= 630
 \end{aligned}$$



$$\begin{aligned}
 (30 + 5) \times 18 &= (30 \times 18) + (5 \times 18) \\
 &= 540 + 90 \\
 &= 630
 \end{aligned}$$



Note: Some students may write $35 \times (20 - 2) = 700 - 70 = 630$, although this is not connected to the typical multiplication algorithm. The arithmetic may be easier with these numbers.

19. a. Answers will vary. Possible answer: $30 + 30$

b. Answers will vary. Possible answer: 6×10

c. Answers will vary. Possible answer: $6 \times 10 = 6 \times (5 + 5)$
 $= (5 \times 6) + (5 \times 6)$
 $= 30 + 30$

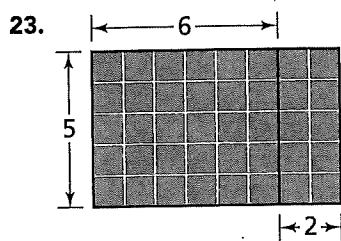
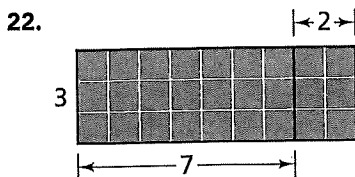
20. a. $90 = 20 + 70 = 10(2 + 7)$

b. $90 = 36 + 54 = 9(4 + 6)$

21. a. The black number in the lower-right-hand square is the sum of the red numbers in the right-most column and also the sum of the red numbers in the bottom row.

b. The same relationship will hold for any four numbers in the border squares. The black number is always the sum of the red numbers in the right-hand column and the red numbers in the bottom row.

c. Shalala is correct. The sum of the bottom row is $6(2 + 8) + 3(2 + 8)$. The sum of the last column is $2(6 + 3) + 8(6 + 3)$. From the first expression, you can factor $(2 + 8)$ to get $(2 + 8)(6 + 3)$. If you factor $(6 + 3)$ from the second expression, you get $(6 + 3)(2 + 8)$. By the Commutative Property of Multiplication, these two products are equal.



24. $m = 3$

25. $m = 10$

26. $m = 1$
27. $m = 6$
28. $(3 + 4) \times 2$
29. $12 \div 6 \times 2$
30. $11 \times 2 + 1$
31. $3^2 \cdot 3^2$
32. $2 + 5 \times 3 = 17$
33. $2 \times 5 + 3 = 13$
34. $2 \times 5 \times 3 = 30$
35. $2 \times 5 - 3 = 7$
36. Answers will vary. $3 + 2 + 4(1) = 9$ or $3 + (2 + 4)(1) = 9$ or $(3 + 2 + 4)(1) = 9$.
37. $3 + (2)(4 + 1) = 13$
38. $(3)(2 + 4 + 1) = 21$
39. $3 + (2)(4) + 1 = 12$
40. $3 + 2 + 4 + 1 = 10$
41. a. $4 + 3(6 + 1) = 25$, which is a multiple of 5.
- b. $4(3) + 6(1) = 18$, which is a factor of 36.
42. a. Answers will vary. Possible answer:
 $21 = 3 \times 7$
 $= 3 \times (5 + 2)$
 $= 3 \times 5 + 3 \times 2$
 $= 15 + 6$
- b. Answers will vary. Possible answer:
 $24 = 2 \times 12$
 $= 2 \times (10 + 2)$
 $= 2 \times 10 + 2 \times 2$
 $= 20 + 4$
- c. Answers will vary. Possible answer:
 $55 = 5 \times 11$
 $= 5 \times (10 + 1)$
 $= 5 \times 10 + 5 \times 1$
 $= 50 + 5$
- d. Answers will vary. Possible answer:
 $48 = 2 \times 24$
 $= 2 \times (20 + 4)$
 $= 2 \times 20 + 2 \times 4$
 $= 40 + 8$
43. The student interpreted exponents as multiplying the two numbers. 3^2 is not 6, and 3^3 is not 9. The correct answer is 9.
44. The student performed multiplication before exponentiation; 2×3^2 is not 6^2 , but 18. The correct answer is 26.
45. The student added before he subtracted; $18 - 6 + 6$ is not $18 - 12$, but $12 + 6$. The correct answer is 18.
46. The student multiplied before he divided; $24 \div 6 \times 4$ is not $24 \div 24$, but 4×4 . The correct answer is 16.
47. Any number will work. Explanations will vary. Sample:
 Step 1: Choose 7.
 Step 2: $7 + 15 = 22$
 Step 3: $(7 + 15) \times 2 = 44$
 Step 4: $(7 + 15) \times 2 - 30 = 14$
 $14 = 2 \times 7$, which is double the original number.
- Alternatively,
 $(n + 15) \times 2 - 30 = n \times 2 + 30 - 30$
 $= n \times 2$
 which is double the original number.
48. Choose N. Then,
 $((N \times 2 + 6) - 3) = (N \times 2 \div 2) + (6 \div 2) - 3$
 $= N + 3 - 3$
 $= N$

49. This can be solved algebraically. An area model works as well.

Let N = the area of a rectangle.

N	=	N
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Double it.

N	N	=	$2N$
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Add 6.
(See Figure 7.)

Divide by 2.
(See Figure 8.)

Subtract 3.

$\frac{1}{2}N$	$\frac{1}{2}N$	=	N
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50. 6

51. 2

In Exercises 52–57, each case could be explained by the Distributive Property and knowledge of place value.

52. True. $432 = 400 + 32$. So
 $50 \times 432 = 50(400 + 32)$ and
 $50(400 + 32) = 50 \times 400 + 50 \times 32$.

53. True. $50 \times 368 = 50(400 - 32)$
 $= 50 \times 400 - 50 \times 32$

54. False. If the equation involved subtraction instead of addition, then it would be true.
 $50 \times 800 = (50 \times 1,000) - (50 \times 200)$, since
 $800 = 1,000 - 200$.

55. False. $90 \times 70 = (90 \times 30) + (90 \times 40)$;
 $90 \times 30 > 70 \times 20$ and
 $90 \times 40 > 50 \times 20$, so
 $(90 \times 30) + (90 \times 40) > (70 \times 20) + (50 \times 20)$
 Alternatively,
 $90 \times 70 = 9 \times 7 \times 100 = 9 \times 7 \times 5 \times 20$.
 $9 \times 7 \times 5 \neq 70 + 50$, though, because
 $70 + 50$ is even and $9 \times 7 \times 5$ is odd.

56. False. 50 is not multiplied by the sum
 $(400 + 32)$. It is added to the product of
 400 and 32 .

57. True. $6 \times 17 = 6(20 - 3) = 6(20) - 6(3)$.
 Each expression is 102.

58. Yes; each expression has a value of 12.

59. a. Mrs. Lee is correct. Because you do
 multiplication before subtraction, Mrs.
 Lee's expression will calculate the area
 of the yard and swing set first, then
 take the difference of those areas to
 find the remaining area.

b. Mr. Lee is correct. Because you operate
 in parenthesis first, Mr. Lee's expression
 will calculate the difference in length
 first to find the length of the lawn, then
 multiply by the width to find the area.

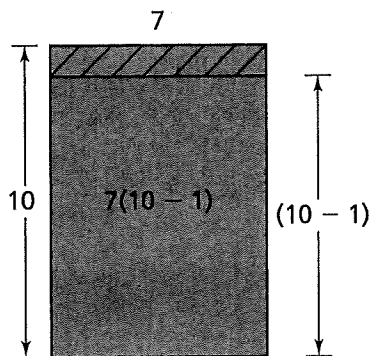
Figure 7

N	N	6	=	$2N + 6$
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Figure 8

			=	$N + 3$
$\frac{1}{2}N$	$\frac{1}{2}N$	3		

60.



The expression in expanded form is $7 \times 10 - 7 \times 1$.

If we simplify within parentheses first, we find the expression is equal to 63: $7(10 - 1) = 7 \times 9 = 63$.

If we distribute the 7, we find that the expression is still equal to 63: $7(10 - 1) = 7 \times 10 - 7 \times 1 = 70 - 7 = 63$.

61. There are $36 \cdot 12 = 432$ trading cards and $36 \cdot 2 = 72$ stickers.
62. $30(12 - 3) = 30 \cdot 9 = 270$, or \$270. Alternatively, students might find the cost for all students $30 \cdot 12 = 360$ and then subtract the total discount $30 \cdot 3 = 90$ for a total of 270, or \$270.

63. Tuesday's high temperature is 3 degrees colder than Sunday's high temperature. Students could use a variable, n , to represent Sunday's temperature. Then Tuesday's temperature can be represented by $n + 5 - 8$, which simplifies to $n - 3$, so Tuesday's high temperature is 3 degrees colder than n , Sunday's temperature.

Another method is to choose a few examples to see the relationship. Suppose Sunday's high temperature is 60 degrees. Then Monday's high temperature is 65 degrees, and Tuesday's high temperature is 57 degrees. For any starting amount (Sunday's high temperature), Tuesday's high temperature will be 3 degrees colder.

64. Elijah collected \$264, \$192 for the school and \$72 for his homeroom. Students might calculate the two parts first: $24 \cdot 8 = 192$ (school) and $24 \cdot 3 = 72$ (homeroom). Solving it this way uses the Distributive Property, because $24(11) = 24(8 + 3) = 24(8) + 24(3)$.
65. \$360. One way to solve this is to multiply $15(6)(4) = 360$. Another number sentence is $15(1 + 3 + 2)4 = 360$. In the second equation, students could distribute either the 15 or the 4 to each addend inside the parentheses.

Connections

66. A

67. 3,500

68. 1,750

69. 100

70. 6,000

71. 938

72. 3,200

73. 100

74. 900

75. $4 \times 5 = 4 \times (3 + 2)$
 $= (4 \times 3) + (4 \times 2)$

76. a. 32×12 is the area of a rectangle with dimensions 32 and 12. The sum of the areas of the bottom two rectangles in Jim's figure is $32 \times 2 = (30 + 2) \times 2 = 30 \times 2 + 2 \times 2 = 60 + 4 = 64$, the first partial product in the example. The sum of the areas of the upper two rectangles is $32 \times 10 = (30 + 2) \times 10 = 30 \times 10 + 2 \times 10 = 300 + 20 = 320$, the second partial product. By adding these areas together, we get the final product, 384

