**Writing Expressions and Equations**

**Write an algebraic expression for each verbal expression.**

1. the product of 6 and \( s \)
2. five less than \( t \)

3. \( g \) divided by 4
4. 13 increased by \( y \)

5. two more than the product of 7 and \( n \)
6. the quotient of \( c \) and nine decreased by 3

**Write a verbal expression for each algebraic expression.**

7. \( r + 4 \)
8. \( 8s \)

9. \( \frac{t}{5} \)
10. \( 3n - 2 \)

**Write an equation for each sentence.**

11. Thirteen decreased by \( n \) is equal to 9.

12. Three times \( g \) plus five equals 11.

13. Eight is the same as the quotient of 16 and \( x \).

14. Four less than the product of 6 and \( t \) is 20.

**Write a sentence for each equation.**

15. \( 8 - p = 1 \)

16. \( 6x + 3 = 21 \)

17. \( 18 \div c = 9 \)

18. \( \frac{2q}{4} = 3 \)
Simplify each expression.

19) \((8 + v^4) - (3 - 6v^4 + 5v^3)\)  
20) \((b - 3b^4) - (4b^3 - 2b^4 - b)\)

21) \((6x - 3x^2) + (2x^4 + 7x^2 + x)\)  
22) \((4 + n^4) - (4n^3 - 7 + 3n^4)\)

23) \((3r^3 + 3r^2 - 5) + (3r^2 + 7r^4 + 7r^3) - (2r^3 + 5r^4)\)

24) \((4 + a - 4a^3) + (8a - 5 - 8a^3) + (6a^3 - 6)\)

25) \((8 - 4x^4 + 8x^3) + (6x^2 + 2x^4 - 5) - (x^2 + 4x^3)\)

26) \((4v^2 + 6v^4 + 4v) - (8v - 3 - v^3) + (8 - 6v^4)\)

Find each product.

27) \(4(8n - 2)\)  
28) \(3(p + 1)\)

29) \(7m(7m + 6)\)  
30) \(2(2x + 3)\)

31) \((3r + 1)(6r + 5)\)  
32) \((6n + 8)(n + 5)\)

33) \((3x - 6)(3x - 7)\)  
34) \((3m - 5)(m + 5)\)

35) \((2n + 1)(4n^2 - 5n - 7)\)  
36) \((4v + 6)(7v^2 - 5v - 5)\)

37) \((2b + 1)(6b^2 - 5b - 6)\)  
38) \((5x - 2)(3x^2 + 4x + 8)\)
Simplify each expression.

39) \( \frac{a + 1}{2a^2 + 10a + 12} + \frac{3}{2a^2 + 10a + 12} \)  
40) \( \frac{x - 1}{9x^3 + 45x^2} - \frac{x + 6}{9x^3 + 45x^2} \)

41) \( \frac{2x - 4}{x^2 + 6x + 8} + \frac{x + 5}{x^2 + 6x + 8} \)  
42) \( \frac{6k + 4}{4k + 12} + \frac{5k + 5}{4k + 12} \)

43) \( \frac{3x - 4}{x - 1} + \frac{5x}{2} \)  
44) \( \frac{2}{p - 5} + \frac{4p}{p + 5} \)

45) \( \frac{6}{5m - 1} - \frac{2}{2m - 1} \)  
46) \( \frac{6}{2n - 2} - \frac{2}{5n} \)

47) \( \frac{1}{5r^2 + 30r} \cdot \frac{r^2 + 8r + 12}{r + 3} \)  
48) \( \frac{4n + 12}{n^2 + 11n + 24} \cdot \frac{10n^2}{4} \)

49) \( \frac{b^2 - 6b - 27}{5b + 15} \cdot \frac{5}{9b^2} \)  
50) \( \frac{6x^2 + 9x}{x + 1} \cdot \frac{8}{16x + 24} \)

51) \( \frac{7}{v - 7} \div \frac{1}{2v^2 - 14v} \)  
52) \( \frac{n - 4}{6n^2 + 6n} \div \frac{1}{n + 1} \)

53) \( \frac{6a^3 + 12a^2}{4} \div \frac{6a^3 + 12a^2}{a + 10} \)  
54) \( \frac{9x}{8 - x} \div \frac{1}{x^2 - 15x + 56} \)

Simplify. Your answer should contain only positive exponents.

55) \( 2xy^{-1} \cdot 2x^4 \cdot (2y^2)^2 \)  
56) \( (x^{-1}y^3 \cdot (y^2)^4)^2 \)

57) \( (2y \cdot x^4y^{-1})^{-1} \)  
58) \( (2u^4v^{-3})^3 \cdot (2u^{-4}v^{-3})^4 \)
59) \( \frac{y^3}{(x^{-1}y)^3 \cdot 2x^3 y^{-3}} \)

60) \( \frac{2u^3 v^4 \cdot u v^{-2} \cdot u^3}{(2u^{-3} v^4)^2} \)

61) \( \frac{(y x^2 \cdot xy^3)^{-2}}{2x^4 y^{-3}} \)

62) \( \frac{(a^2 b^2 \cdot 2b^2)^2}{2ab^{-3} \cdot 2a^4 b^3} \)

Simplify.

63) \( \sqrt{252m^2 n^3} \)

64) \( \sqrt{36xy^3} \)

65) \( \sqrt{16x^4 y^2} \)

66) \( \sqrt{200a^4 b^3} \)

67) \( 6\sqrt{252x^3 y^4 z^2} \)

68) \( 6\sqrt{27x^4 yz} \)

69) \( 6\sqrt{16p^2 q^4 r^4} \)

70) \(-6\sqrt{252mnp^4} \)

71) An aircraft carrier left Port 38 and traveled toward a navigational buoy at an average speed of 15 mph. A container ship left eight hours later and traveled in the opposite direction with an average speed of 15 mph. Find the number of hours the container ship needs to travel before the vessels are 300 mi. apart.

72) A passenger plane left Nairobi flying east five hours before a cargo plane. The cargo plane flew in the opposite direction going 20 mph slower then the passenger plane for six hours after which time the planes were 5065 mi. apart. How fast did the passenger plane fly?

73) Lisa made a trip to the recycling plant and back. On the trip there she drove 30 km/h and on the return trip she went 40 km/h. How long did the trip there take if the return trip took three hours?

74) A cattle train made a trip to the outer-most station and back. On the trip there it traveled 25 km/h and on the return trip it went 30 km/h. How long did the trip there take if the return trip took five hours?

75) Krystal left the White House and traveled toward the lake. DeShawn left one hour later traveling 10 km/h faster in an effort to catch up to her. After three hours DeShawn finally caught up. Find Krystal's average speed.

76) Beth left the hospital and drove toward her friend's house. Cody left two hours later driving 20 km/h faster in an effort to catch up to her. After three hours Cody finally caught up. What was Beth's average speed?
Solve each question. Round your answer to the nearest hundredth.

77) Alberto can paint a fence in ten hours. Daniel can paint the same fence in nine hours. Find how long it would take them if they worked together.

78) Working alone, it takes Arjun ten hours to pick forty bushels of apples. Kathryn can pick the same amount in 15 hours. Find how long it would take them if they worked together.

79) Working alone, Jaidee can tar a roof in 16 hours. One day her friend Jennifer helped her and it only took 7.17 hours. Find how long it would take Jennifer to do it alone.

80) Working together, Shanice and Darryl can dig a 10 ft by 10 ft hole in 4.44 hours. Had he done it alone it would have taken Darryl ten hours. How long would it take Shanice to do it alone?
Write an algebraic expression for each verbal expression.

1. the product of 6 and \( a \)
   \[ 6a \]
2. five less than \( t \)
   \[ t - 5 \]
3. \( g \) divided by 4
   \[ \frac{g}{4} \]
4. 13 increased by \( y \)
   \[ 13 + y \]
5. two more than the product of \( 7 \) and \( n \)
   \[ 7n + 2 \]
6. the quotient of \( c \) and nine decreased by 3
   \[ \frac{c}{9} - 3 \]

Write a verbal expression for each algebraic expression.

7. \( r + 4 \) the sum of \( r \) and \( 4 \)
8. \( 8s \) the product of 8 and \( s \)
9. \( \frac{t}{5} \) the quotient of \( t \) and \( 5 \)
10. \( 3n - 2 \) two less than the product of three and \( n \)

Write an equation for each sentence.

11. Thirteen decreased by \( n \) is equal to 9.
    \[ 13 - n = 9 \]
12. Three times \( g \) plus five equals 11.
    \[ 3g + 5 = 11 \]
13. Eight is the same as the quotient of 16 and \( x \).
    \[ 8 = \frac{16}{x} \]
14. Four less than the product of 6 and \( t \) is 20.
    \[ 6t - 4 = 20 \]

Write a sentence for each equation.

15. \( 8 - p - 1 \) \( p \) less than 8 is 1
16. \( 6x + 3 = 21 \) 3 more than 6 and a number is 21
17. \( 18 - c - 9 \) \( 9 \) is the quotient of 18 and \( c \)
18. \( \frac{2q}{4} = 8 \) the quotient of twice a number and 4 is 3

19. \( 7v^2 - 5v^3 + 5 \)
20. \( -b^3 - 4b^2 + 2b \)
21. \( 2x^4 + 4x^3 + 7x \)
22. \( -2n^4 - 4n^3 + 11 \)
23. \( 2r^4 + 8r^3 + 6r^2 - 5 \)
24. \( -6a^3 + 9a - 7 \)
25. \( -2x^4 + 4x^3 + 5x^2 + 3 \)
26. \( x^4 + 4x^2 - 4v + 11 \)
27. \( 32v - 8 \)
28. \( 3p^2 + 3 \)
29. \( 49m^2 + 42m \)
30. \( 4x + 6 \)
31. \( 18r^2 + 21r + 5 \)
32. \( 6r^2 + 38n + 40 \)
33. \( 9x^2 - 39x + 42 \)
34. \( 3m^2 + 10m - 5 \)
35. \( 8n^2 - 6n^2 - 19n - 7 \)
36. \( 28v^2 + 22v^2 - 50v - 30 \)
37. \( 12b^3 - 46b^2 - 17b - 6 \)
38. \( 15x^3 + 14x^2 + 32x - 16 \)
39. \( a + 4 \)
40. \( 2a^2 + 10a + 12 \)
41. \( \frac{7}{9a^3 + 45x^2} \)
42. \( \frac{3x + 1}{x^2 + 6x + 8} \)
43. \( \frac{11k + 9}{4k + 12} \)
44. \( \frac{-18p + 10 + 4p^2}{(p - 5)(p + 5)} \)
45. \( \frac{5 - 9}{9b^2} \)
46. \( \frac{13m + 2}{m - 1} \)
47. \( \frac{5p(n - 1)}{r + 3} \)
48. \( \frac{10b^2}{n + 8} \)
49. \( \frac{b - 9}{5m - 1} \)
50. \( \frac{3x}{x + 1} \)
51. \( \frac{\text{51}}{14v} \)
52. \( \frac{n - 4}{6n} \)
53. \( \frac{a + 10}{4} \)
54. \( \frac{-9x(x - 7)}{54} \)
55. \( \frac{16x^2y^3}{55} \)
56. \( \frac{\text{56}}{2x^2} \)
57. \( \frac{\text{57}}{2x^4} \)
58. \( \frac{128}{\sqrt{18}x^4} \)
59. \( \frac{\text{59}}{2x^3} \)
60. \( \frac{\text{60}}{2y^5} \)
61. \( \frac{1}{2y^5x^{10}} \)
62. \( \frac{b^9}{a} \)
63. \( \frac{6}{{6mm}^{\sqrt{7n}}} \)
64. \( \frac{\text{64}}{6x^2y} \)
65. \( \frac{\text{65}}{4x^2y^3} \)
66. \( \frac{10a^2b\sqrt{2b}}{66} \)
67. \( \frac{36y^2xz\sqrt{7x}}{67} \)
68. \( \frac{\text{68}}{18x^2\sqrt{3yz}} \)
69. \( \frac{\text{69}}{24y^7r^6p} \)
70. \( \frac{-36p^2\sqrt{7nn}}{70} \)
71. \( \frac{\text{71}}{6} \)
72. \( \frac{\text{72}}{305} \)
73. \( \frac{\text{73}}{4} \)
74. \( \frac{\text{74}}{6} \)
75. \( \frac{\text{75}}{30} \)
76. \( \frac{\text{76}}{30} \)
77. \( \frac{\text{77}}{4.74} \)
78. \( \frac{\text{78}}{6} \)
79. \( \frac{\text{79}}{12.99} \)
80. \( \frac{\text{80}}{7.99} \)
Patterns and Inductive Reasoning

Find the next three terms of each sequence.

1. 2, 4, 8, 16, ...  
2. 18, 9, 0, −9, ...

3. 6, 8, 12, 18, ...  
4. 3, −4, −11, −18, ...

5. −11, −6, −1, 4, ...  
6. 9, 10, 13, 18, ...

7. 1, 7, 19, 37, ...  
8. 14, 15, 17, 20, ...

Draw the next figure in each pattern.

9. △ □ ○ ○ △ □  
10. □ □ □ □ □

11. ○ ○ ○ ○  
12. △ △ △ △ △  

13. □ □ □ □  
14. ○ ○ ○ ○ ○

15. Find the next term in the sequence.

\[
\frac{1}{19}, \frac{3}{19}, \frac{5}{19}, \ldots
\]

16. What operation would you use to find the next term in the sequence 96, 48, 24, 12, ...?
Solve each equation.

17) \(-11 = n - 8\)  
18) \(36 = 6k\)

19) \(b + 10 = -5\)  
20) \(1 = v + 18\)

21) \(\frac{8}{7} + a = -\frac{397}{112}\)  
22) \(\frac{4875}{304} = \frac{25}{16}n\)

23) \(\frac{15p}{19} = \frac{143}{19}\)  
24) \(x + \frac{25}{16} = \frac{65}{144}\)

25) \(-12 = -2x + 4x\)  
26) \(2 = n - 1 + 5\)

27) \(-31 = -5(1 + x) - 1\)  
28) \(-4(-5x - 6) + 3x = -68\)

29) \(-3(n + 6) = -26 - 4n\)  
30) \(-6(-4r - 7) - 5 = 7r + 37\)

31) \(|x| = 8\)  
32) \(|r| = 9\)

33) \(|r - 9| = 19\)  
34) \(\left|\frac{x}{5}\right| = 4\)

35) \(\left|\frac{x}{5}\right| + 4 = 6\)  
36) \(-1 + \left|-10x\right| = 99\)
37) \(|9 - v| + 7 = 10\)

38) \(|10 + 2p| + 5 = 13\)

Solve each equation by factoring.

39) \(x^2 + 4x - 32 = 0\)

40) \(v^2 + v - 6 = 0\)

41) \(x^2 - 13x + 40 = 0\)

42) \(a^2 - 5a - 14 = 0\)

Solve each equation.

43) \(x^2 + 3x - 25 = 3\)

44) \(n^2 - 18 = 7\)

45) \(v^2 - 7v - 6 = 2\)

46) \(n^2 - 4n - 10 = -5\)

Solve each system by graphing.

47) \(3y - 12 = -x\)

\(-9 + 6x - 3y = 0\)

48) \(-x + 9 = -3y\)

\(-3y = -9 - x\)

49) \(-\frac{4}{5}y = x + \frac{12}{5}\)

\(12 = -x + 4y\)

50) \(-2 = -x - 2y\)

\(4 = -x + y\)
Sketch the solution to each system of inequalities.

51) \( y \geq \frac{2}{3}x + 3 \)
\( y \geq \frac{2}{3}x - 1 \)

52) \( y \geq x - 2 \)
\( y \geq 5x + 2 \)

53) \( y \geq 2x - 3 \)
\( y < \frac{1}{2}x + 2 \)

54) \( y < x + 1 \)
\( y > 4x - 2 \)

Solve each system by substitution.

55) \( 6x - 8y = -12 \)
\( -x + y = 2 \)

56) \( 7x + y = -6 \)
\( 3x - y = 6 \)

57) \( 3x - 7y = -7 \)
\( -3x + y = 1 \)

58) \( x - 4y = 9 \)
\( 6x - 2y = -12 \)
Solve each system by elimination.

59) \(-8x + 15y = -4\)  
   \[2x - 5y = -4\]

60) \(3x - 4y = -19\)  
   \[4x + 8y = 28\]

61) \(-3x + 6y = -18\)  
   \[4x - 3y = 24\]

62) \(-4x - 9y = 7\)  
   \[2x + y = 7\]

63) Ryan and Mark each improved their yards by planting rose bushes and shrubs. They bought their supplies from the same store. Ryan spent $92 on 6 rose bushes and 13 shrubs. Mark spent $84 on 6 rose bushes and 9 shrubs. Find the cost of one rose bush and the cost of one shrub.

64) Dan and John each improved their yards by planting grass sod and ivy. They bought their supplies from the same store. Dan spent $84 on 10 ft\(^2\) of grass sod and 2 pots of ivy. John spent $116 on 14 ft\(^2\) of grass sod and 2 pots of ivy. Find the cost of one ft\(^2\) of grass sod and the cost of one pot of ivy.

65) The school that Julia goes to is selling tickets to a play. On the first day of ticket sales the school sold 3 senior citizen tickets and 12 child tickets for a total of $108. The school took in $120 on the second day by selling 6 senior citizen tickets and 12 child tickets. What is the price each of one senior citizen ticket and one child ticket?

66) Krystal and Jennifer are selling cheesecakes for a school fundraiser. Customers can buy New York style cheesecakes and apple cheesecakes. Krystal sold 7 New York style cheesecakes and 1 apple cheesecake for a total of $67. Jennifer sold 13 New York style cheesecakes and 1 apple cheesecake for a total of $109. What is the cost each of one New York style cheesecake and one apple cheesecake?

67) Norachai and Anjali each improved their yards by planting daylilies and geraniums. They bought their supplies from the same store. Norachai spent $58 on 4 daylilies and 7 geraniums. Anjali spent $94 on 4 daylilies and 13 geraniums. Find the cost of one daylily and the cost of one geranium.

68) The water park is a popular field trip destination. This year the senior class at High School A and the senior class at High School B both planned trips there. The senior class at High School A rented and filled 12 vans and 2 buses with 288 students. High School B rented and filled 12 vans and 8 buses with 540 students. Each van and each bus carried the same number of students. How many students can a van carry? How many students can a bus carry?
Patterns and Inductive Reasoning

Find the next three terms of each sequence.

1. 2, 4, 8, 16, ... 32, 64, 128
2. 18, 9, 0, -9, ..., -18, -27, -36
3. 6, 8, 12, 18, ..., 26, 36, 48
4. 3, -4, -11, -18, ..., -25, -32, -39
5. -11, -6, -1, 4, ..., 9, 14, 19
6. 9, 10, 13, 18, ..., 25, 34, 45
7. 1, 7, 19, 37, ..., 61, 91, 127
8. 14, 15, 17, 20, ..., 24, 29, 35

Draw the next figure in each pattern.

9. △ □ ○ △ □ □
10. □ □ □ □ □ □
11. ○ △ △ ○ ○ ○
12. △ △ △ △ △ △
13. □ □ □ □ □ □
14. ○ ○ ○ ○ ○ ○

15. Find the next term in the sequence.
\[ \frac{1}{19}, \frac{2}{39}, ..., \frac{3}{119} \]

16. What operation would you use to find the next term in the sequence 96, 48, 24, 12, ...? \( \text{divide by 2} \)

17) \{-3\}
18) \{6\}
19) \{-15\}
20) \{-17\}
21) \{-\frac{75}{16}\}
22) \{-\frac{195}{19}\}
23) \{-\frac{143}{15}\}
24) \{-\frac{10}{9}\}
25) \{-6\}
26) \{-2\}
27) \{5\}
28) \{-4\}
29) \{-8\}
30) \{0\}
31) \{8, -8\}
32) \{9, -9\}
33) \{28, -10\}
34) \{20, -20\}
35) \{10, -10\}
36) \{-10, 10\}
37) \{6, 12\}
38) \{-1, -9\}
39) \{-8, 4\}
40) \{2, -2\}
41) \{8, 5\}
42) \{7, -2\}
43) \{-7, 4\}
44) \{5, -5\}
45) \{-1, 8\}
46) \{5, -1\}
47) \{3, 3\}
48) \{3, -3\}
49) \{-4, 2\}
50) \{-2, 2\}
51) \{-1, 1\}

52) 53) 54)

55) (-2, 0)
56) (0, -6)
57) (0, 1)
58) (-3, -3)
59) (8, 4)
60) (-1, 4)
61) (6, 0)
62) (5, -3)
63) rose bush: $11$, shrub: $2$
64) ft² of grass sod: $8$, pot of ivy: $2$
65) senior citizen ticket: $4$, child ticket: $8$
66) New York style cheesecake: $7$, apple cheesecake: $18$
67) daylily: $4$, geranium: $6$
68) Van: 17, Bus: 42