

Patterns, Functions, & Algebra

1. The first six terms of a sequence are shown below.

8 17 32 53 80 113

The sequence continues. Which expression represents the n^{th} term of the sequence?

- A. $2n + 1$
- B. $9n - 1$
- C. $3n^2 + 5$
- D. $2n^2 + 3n$

2. Use the table.

1	2	3	4
5	7	9	11

The pattern in the table continues. What is the next column in the table?

A.

5
10

B.

5
13

C.

10
5

D.

13
5

3. The first four terms of a sequence are shown below.

1 4 9 16

The sequence continues. What is the tenth term of the sequence?

- A. 10
- B. 20
- C. 100
- D. 200

4. Use the sequence below.

5 1 $\frac{1}{5}$ $\frac{1}{25}$ $\frac{1}{125}$

What is the n^{th} term in the sequence?

- A. 5^n
- B. 5^{2n-1}
- C. $\left(\frac{1}{5}\right)^{n-2}$
- D. $\left(\frac{1}{5}\right)^n$

5. The first five terms of a sequence are shown below.

1 3 5 7 9

What is the 11th term of the sequence?

- A. 10
- B. 11
- C. 20
- D. 21

6. The first four terms of a sequence are shown below.

-5 -2 1 4

The sequence continues. Which sentence describes each subsequent term of the sequence?

- A. The next term will be four times the previous term.
- B. The next term will be eight more than twice the previous term.
- C. The next term will be three less than the previous term.
- D. The next term will be three more than the previous term.

7. The first five terms of a sequence are given below.

1 3 9 27 81

The sequence continues. Which expression represents the n^{th} term of the sequence?

- A. 3^{n-1}
- B. $3n - 2$
- C. $3n$
- D. 3^n

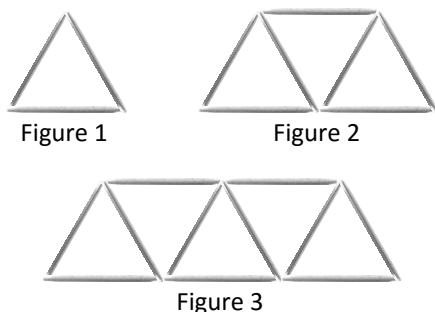
8. A sequence is defined as follows:

The n^{th} term is three more than twice the square of n .

What is the 7th term of the sequence?

- A. 5
- B. 7
- C. 101
- D. 199

9. The figures shown below are constructed from toothpicks.



Which expression represents the number of toothpicks in Figure n ?

- A. $3n$
- B. $n+6$
- C. $2n-1$
- D. $4n-1$

10. A pattern of numbers is shown below.

```

      1
     1 1
    1 2 1
   1 3 3 1
  ? ? ? ? ?
 1  5 10 10 5  1
    
```

Which list of numbers shows the missing line?

- A. 1 4 10 4 1
- B. 1 4 6 4 1
- C. 1 4 4 4 1
- D. 1 4 3 4 1

11. A function and its domain are shown below.

$$g(x) = 2x - 1$$

Domain: $\{1, 2, 3\}$

What is the range of the function?

- A. $\left\{0, \frac{1}{2}, 1\right\}$
- B. $\left\{\frac{1}{2}, 1\frac{1}{2}, 2\right\}$
- C. $\{1, 2, 3\}$
- D. $\{1, 3, 5\}$

12. A function and its range are shown below.

$$f(x) = 2x - 5$$

Range: $f(x) \in \{-7, -1, 1, 3\}$

What is the domain of the function?

- A. $x \in \{-1, 2, 3, 4\}$
- B. $x \in \{-7, -1, 1, 3\}$
- C. $x \in \{-19, -7, -3, 1\}$
- D. $x \in \{-24, -12, -8, -4\}$

13. Use the functions below.

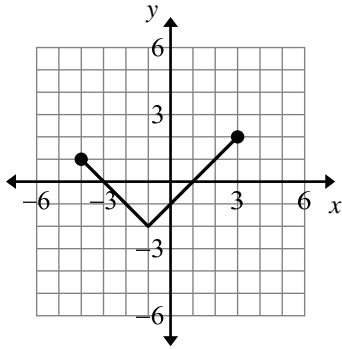
$$f(x) = -2x$$

$$g(x) = x^2$$

Which elements are in the range of f and also in the range of g ?

- A. All real numbers
- B. All positive real numbers
- C. All negative real numbers
- D. No real numbers

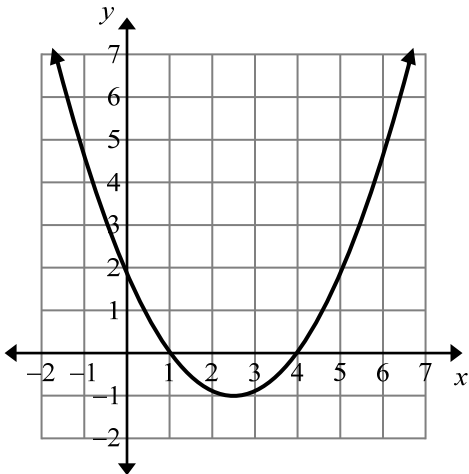
14. Use the graph of the absolute value function below.



What is the domain of this function?

- A. All real numbers
- B. $-4 \leq x \leq 3$
- C. $y \geq -2$
- D. $x \geq -2$

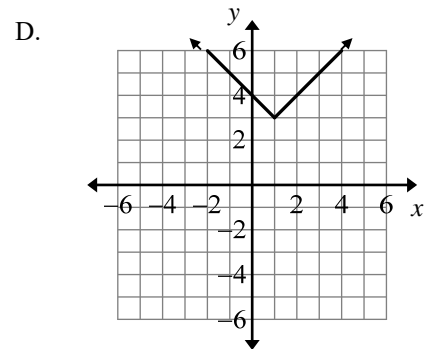
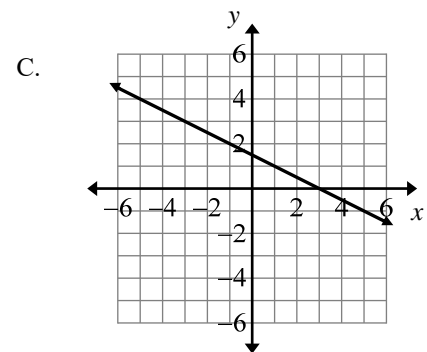
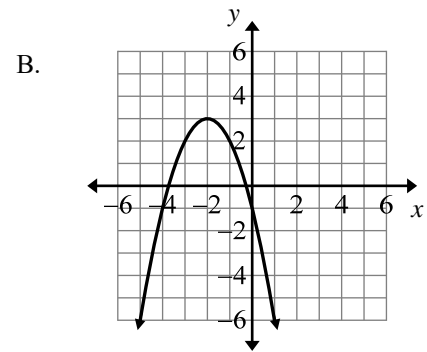
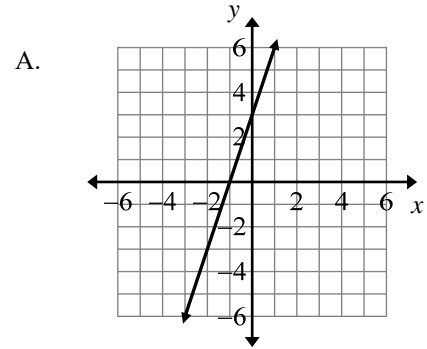
15. The graph of a function is shown below.



What is the domain of this function?

- A. $x = 1$ or $x = 4$
- B. x can be any real number
- C. $y \geq -1$
- D. $y = 2$

16. Which graph shows a function with range $y \leq 3$?



17. Which expression is equivalent to $\frac{9x^2 - 27x}{3x}$?

- A. $3(x-3)$
- B. $3(x-3x)$
- C. $3x(3x-9)$
- D. $3x(x-9)$

18. Simplify.

$$\frac{2x^2}{4x}, \text{ where } x \neq 0$$

- A. 1
- B. x
- C. $2x$
- D. $\frac{x}{2}$

19. An expression is given below.

$$\sqrt{2}(\sqrt{8} + y)$$

Which expression is equivalent to the one given?

- A. $\sqrt{10} + y$
- B. $\sqrt{10} + y\sqrt{2}$
- C. $4 + y$
- D. $4 + y\sqrt{2}$

20. Factor.

$$x^2 - 64$$

- A. $(x-1)(x+64)$
- B. $(x-4)(x+16)$
- C. $(x-8)(x+8)$
- D. $(x-8)^2$

21. Factor:

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

- A. $(3x-1)(x+4)$
- B. $(3x+2)(x-2)$
- C. $(3x+4)(x-1)$
- D. $(3x-4)(x+1)$

22. Factor.

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

- A. $(3x-1)(x+3)$
- B. $(3x+1)(x+3)$
- C. $3(x-1)(x+1)$
- D. $3(x-1)^2$

23. A polynomial is shown below.

$$x^2 - 12x + N$$

What value of N makes the polynomial a perfect trinomial square?

- A. -6
- B. -36
- C. 6
- D. 36

24. An equation is shown below.

$$x^2 + 6x - 72 = 0$$

What is the solution set of the equation?

- A. $\{-12, 6\}$
- B. $\{-9, 8\}$
- C. $\{-8, 9\}$
- D. $\{-6, 12\}$

25. Which equation has roots of -3 and 5 ?

- A. $x^2 - 2x - 15 = 0$
- B. $x^2 - 2x + 15 = 0$
- C. $x^2 + 2x - 15 = 0$
- D. $x^2 + 2x + 15 = 0$

26. An equation is shown below.

$$x^2 + 2x - 24 = 0$$

What is the solution set of the equation?

- A. $\{-4, 6\}$
- B. $\{-6, 4\}$
- C. $\{-12, 2\}$
- D. $\{-2, 12\}$

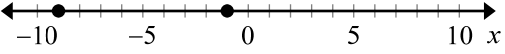
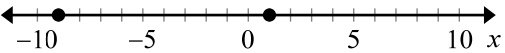
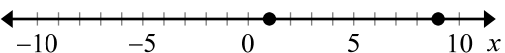
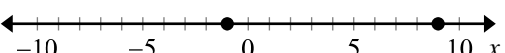
27. What must be added to $2n^2 + 4$ to get $5n^2 + 3n - 6$?

- A. $3n^2 + 3n - 10$
- B. $3n^2 + 3n - 2$
- C. $7n^2 + 3n - 2$
- D. $7n^2 + 3n - 10$

28. Look at the equation below.

$$|-x - 4| = 5$$

Which graph represents the solution set of the equation?

- A. 
- B. 
- C. 
- D. 

29. An inequality is shown below.

$$3x - 8 \geq 13$$

What is the solution of the inequality?

- A. $x \geq 18$
- B. $x \geq 15$
- C. $x \geq 7$
- D. $x \geq \frac{5}{3}$

30. An inequality is shown below.

$$\frac{p}{2} \geq \frac{10}{x}$$

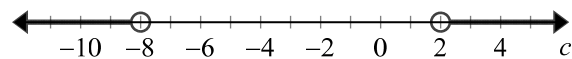
Which shows the inequality correctly solved for x , when $x > 0$?

- A. $x \geq \frac{20}{p}$
- B. $x \leq \frac{20}{p}$
- C. $x \geq 5p$
- D. $x \leq 5p$

31. Which inequality is equivalent to $|p + 5| \leq 8$?

- A. $-13 \leq p \leq 3$
- B. $-3 \leq p \leq 13$
- C. $p \leq -13$ or $p \geq 3$
- D. $p \leq -3$ or $p \geq 13$

32. The graph below represents the solution set of an inequality.



Which of these is the inequality?

- A. $|c - 3| > 5$
- B. $|c - 3| < 5$
- C. $|c + 3| > 5$
- D. $|c + 3| < 5$

33. Use the absolute value function below.

$$y = |x - 1| - 2$$

What is the range of the function?

- A. $y \geq 0$
- B. $y \geq 2$
- C. $y \geq -1$
- D. $y \geq -2$

34. Two linear equations are given below.

$$\text{Equation 1: } 2x - y = 3$$

$$\text{Equation 2: } 4x + 3y = 21$$

For which equation(s) is the point $(3, 3)$ a solution?

- A. Equation 1 only.
- B. Equation 2 only.
- C. Both equations 1 and 2.
- D. Neither equation 1 nor 2.

35. A system of equations is shown below.

$$\begin{cases} 5x + 3y = 7 \\ 2x - y = 6 \end{cases}$$

What is the x -value in the solution of the system of equations?

- A. $x = -\frac{40}{11}$
- B. $x = -\frac{16}{11}$
- C. $x = \frac{13}{11}$
- D. $x = \frac{25}{11}$

36. A system of equations is shown below.

$$\begin{cases} x + 5y = -13 \\ 2x - y = 7 \end{cases}$$

What is the value of y in the solution of the system of equations?

- A. $y = -\frac{11}{5}$
- B. $y = -\frac{7}{3}$
- C. $y = -2$
- D. $y = -3$

37. A system of linear equations is shown below.

$$\begin{cases} y = 2x + 1 \\ 2x - 3y = 5 \end{cases}$$

What is the y -coordinate of the point of intersection?

- A. -5
- B. -3
- C. -2
- D. 9

38. Use the system of equations below.

$$\begin{cases} y = 3x + 1 \\ 2y = px + q \end{cases}$$

For what values of p and q does the system have an infinite number of solutions?

- A. $p = 3, q = 1$
- B. $p = 3, q = 2$
- C. $p = 6, q = 1$
- D. $p = 6, q = 2$

39. Fred and Ethel are solving the system of linear equations shown below:

$$\begin{cases} 2x - 3y = 12 \\ -4x + 6y = -24 \end{cases}$$

Fred found the solution to be the point $(6, 0)$. Ethel found the solution to be the point $(0, -4)$. Which person has the correct solution to the system and why?

- A. Fred, because the point $(6, 0)$ lies on both lines.
- B. Ethel, because the point $(0, -4)$ lies on both lines.
- C. Neither, because any two lines may only have one point in common.
- D. Neither, because they have found only two of the infinitely many points that lie on both lines.

40. Two jobs offer different pay packages.

- Job A pays an annual salary of \$38,000 plus a commission of 3% of sales (s).
- Job B pays an annual salary of \$43,000 plus a commission of 1% of sales (s).

What system of equations would be used to find the amount of sales that makes the pay (P) for Job A equal to Job B?

- A. $P = 38000 + 0.01s$
 $P = 43000 + 0.03s$
- B. $P = 38000 + 0.03s$
 $P = 43000 + 0.01s$
- C. $s = 38000 + 0.01P$
 $s = 43000 + 0.03P$
- D. $P = 38000 + 43000$
 $s = 0.03 + 0.01$

41. Use the system of equations below.

$$\begin{cases} x = 4 \\ y = 2 \end{cases}$$

Which statement best describes the solution set of the system?

- A. The solution set is only the ordered pair $(4, 2)$.
- B. The solution set is all ordered pairs where $x = 4$; y can be any real number.
- C. The solution set is all ordered pairs where $y = 2$; x can be any real number.
- D. There is no solution to the system.

42. A box is in the shape of a rectangular prism. The height of the box is 4 inches. The length of the box is twice the width of the box. The volume of the box is 400 cubic inches. What is the width of the box in inches?

- A. $5\sqrt{2}$ in.
- B. 10 in.
- C. $10\sqrt{2}$ in.
- D. 100 in.

43. A secretary types 56 words in a minute. Which proportion shows the approximate number of words that she can type in $\frac{1}{2}$ hour?

- A. $\frac{56}{1} = \frac{x}{30}$
- B. $\frac{56}{30} = \frac{x}{1}$
- C. $\frac{56}{60} = \frac{x}{30}$
- D. $\frac{56}{60} = \frac{x}{1}$

44. You buy a lawn mower for \$280. You charge \$20 to mow a lawn. How many lawns will you have to mow to pay for the lawn mower plus show a profit of \$60?

- A. 3 lawns
- B. 11 lawns
- C. 14 lawns
- D. 17 lawns

45. Two companies build birdhouses. Company A pays their employees \$100 per day plus \$5 per birdhouse built. Company B pays their employees \$20 per day plus \$25 per birdhouse. How many birdhouses would have to be built in one day for an employee of either company to be paid the same amount?

- A. 3 birdhouses
- B. 4 birdhouses
- C. 5 birdhouses
- D. 6 birdhouses

46. An equation is shown below.

$$\frac{2g}{3h} - \frac{h-1}{6} = -\frac{2}{h}$$

Which is an equivalent equation solved for g ?

- A. $g = \frac{h-1}{2}$
- B. $g = \frac{h-3}{2}$
- C. $g = \frac{(h+4)(h-3)}{4}$
- D. $g = \frac{(h-4)(h+3)}{4}$

47. Use the inequality below where all variables are positive numbers.

$$Q \geq -\frac{MP}{R}$$

Which shows the inequality solved for M ?

- A. $M \geq -\frac{QP}{R}$
- B. $M \leq -\frac{QP}{R}$
- C. $M \geq -\frac{RQ}{P}$
- D. $M \leq -\frac{RQ}{P}$

48. The ratio of the length (L) to width (w) of a certain building is equal to the ratio of the height (h) to girth (g) of a man. Which equation represents the man's height?

- A. $h = g\left(\frac{L}{w}\right)$
- B. $h = g\left(\frac{w}{L}\right)$
- C. $h = \frac{1}{g}\left(\frac{L}{w}\right)$
- D. $h = \frac{1}{g}\left(\frac{w}{L}\right)$

49. An equation is shown below.

$$R = \frac{pL}{A}$$

Which is an equivalent equation solved for L ?

- A. $L = \frac{A}{pR}$
- B. $L = \frac{p}{AR}$
- C. $L = \frac{pR}{A}$
- D. $L = \frac{AR}{p}$

50. An equation is shown below.

$$PV = nRT$$

Which shows the equation correctly solved for R ?

- A. $R = \frac{PVT}{n}$
- B. $R = \frac{PVn}{T}$
- C. $R = \frac{PV}{nT}$
- D. $R = \frac{PT}{Vn}$

51. An equation is shown below.

$$P = k(T^2 - n^2)$$

Which is an equivalent equation solved for T ?

- A. $T = \pm \sqrt{\frac{P}{k}} + n$
- B. $T = \pm \sqrt{\frac{P}{k} + n^2}$
- C. $T = \pm \sqrt{\frac{P + n^2}{k}}$
- D. $T = \pm \sqrt{P + n^2 - k}$

52. Scientists say that temperature in degrees Fahrenheit can be determined by adding 41 to the number of chirps a cricket makes in 13 seconds (if the temperature is above 55°F). If n is the number of chirps counted in 13 seconds, which formula represents the temperature T in degrees Celsius?

- A. $T = \frac{5n + 45}{9}$
- B. $T = \frac{9n + 73}{5}$
- C. $T = \frac{5n + 493}{9}$
- D. $T = \frac{9n + 529}{5}$

53. The swing period (p) of a pendulum, in seconds, is related to its length (L), in centimeters, by the equation below.

$$L = 25p^2$$

A scientist wants to decrease the swing period of a 400-centimeter pendulum by one second. How should the scientist change the length of the pendulum?

- A. Decrease its length by 25 centimeters.
- B. Increase its length by 25 centimeters.
- C. Decrease its length by 175 centimeters.
- D. Increase its length by 225 centimeters.

54. Anthropologists examining remains can determine the approximate height of a person by measuring the femur (thigh bone). The table below shows the approximate heights of adult females based on the lengths of their femurs.

Femur Length (cm)	Approximate Height (cm)
30	136
34	146
40	161
42	166
46	176

The relationship between femur length and height continues. What is the approximate height of an adult female whose femur measures 55 centimeters?

- A. 184 cm
- B. 198 cm
- C. 210 cm
- D. 250 cm