



SATASHKENT
College Prep Community

math 800 *book*



**Real Exam
Questions Collection**



** You will never walk alone...!**

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Introduction

Welcome to the MathBook by @satashkent.

Many real exam questions are officially and unofficially shared across the Internet, providing valuable practice materials for SAT students. However, these resources are often scattered, unstructured, and not categorized by topic, making it difficult for students to focus on specific areas of improvement.

Recognizing this challenge, our team created **MathBook**—a structured collection of **real exam questions from the past years, categorized by topic**. This book is designed for all **SAT learners** who want an efficient and organized approach to mastering Digital SAT Math. We have dedicated countless hours to compiling and structuring these questions to ensure you get the most relevant and targeted practice.

This book is divided into topics, covering all question types that appear on the DSAT. Each topic includes carefully selected real exam-level questions along with an answer sheet to help you track your progress, analyze mistakes, and strengthen weak areas. This structured approach will boost your confidence and help you recognize patterns in SAT Math problems.

Our **primary goal** is to **support students who are committed to excelling in SAT Math**.

Let's master SAT Math together!

How to Use This Book?

Step 1: **Open the book.** If you've made it, congrats!

Step 2: **Pick a question.** Go in order, choose a random one, or let ChatGPT choose.

Step 3: **Solve it.** Grab a pencil, solve, and try not to overthink. If you get stuck, stare at the "Patalok" for a while.

Step 4: **Check your answer.** If it's right, go next, no time for Celebrating. If it's wrong, try again.

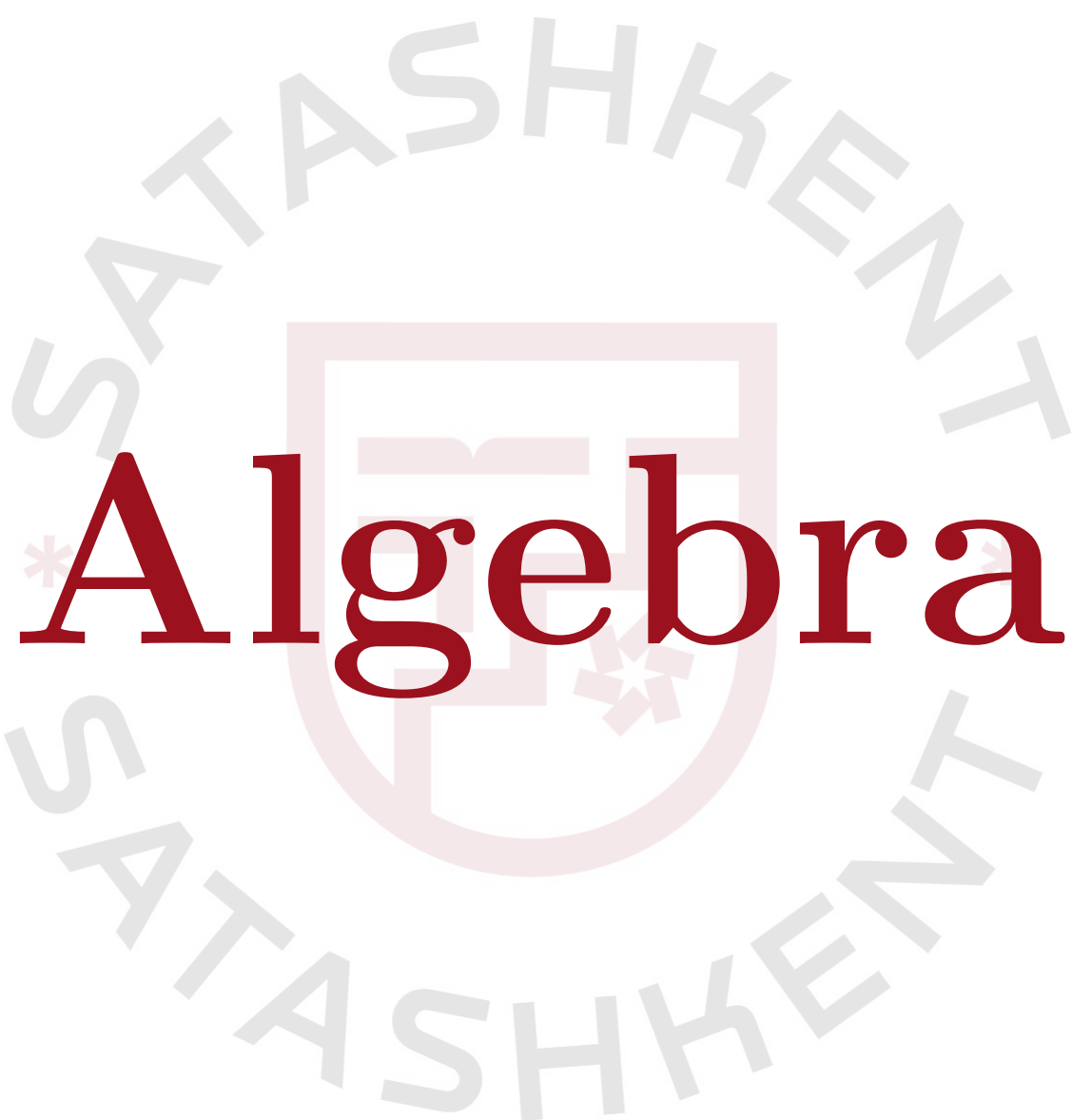
Step 5: **Repeat!** Math skills don't grow on trees (unfortunately).



References

All questions in this book are from College Board Real Exam Questions (2023–2024). This book is not affiliated with or endorsed by the College Board and is for educational use only.





Algebra

Expressions

1. [March US 2023]

The ratio of a person's weight on Earth to the person's weight on the Moon is constant. An astronaut who weighs 540 newtons on Earth weighs 90 newtons on the Moon. Another astronaut weighs w newtons on Earth. Which of the following expressions represents this astronaut's weight, in newtons, on the Moon?

- A) $6w$
B) $0.6w$
C) $\frac{6}{w}$
D) $\frac{w}{6}$

2. [March US 2023]

Which of the following expressions is equivalent to $(\frac{a}{4} + \frac{b}{3})^2$?

- A) $\frac{a^2}{4} + \frac{b^2}{3}$
B) $\frac{a^2}{16} + \frac{b^2}{9}$
C) $\frac{a^2}{4} + \frac{ab}{12} + \frac{b^2}{3}$
D) $\frac{a^2}{16} + \frac{ab}{6} + \frac{b^2}{9}$

3. [March US 2023]

Jaqueline spent \$150 for supplies and gas to start a lawn-mowing service. She charges \$25 for each lawn she mows. In the first week Jaqueline made \$50 after the cost of supplies and gas was deducted. Which equation represents this situation, where x is the number of lawns Jaqueline mowed during the first week?

- A) $25x - 150 = 50$
B) $50 - 25x = 150$
C) $150 - 25x = 50$
D) $25x + 50 = 150$

4. [June 2023]

Which expression is equivalent to $(3x^3 - x^2 + 4)(5x^2 + 8x)$?

- A) $15x^5 + 19x^4 - 8x^3 - 20x + 32$
B) $15x^5 + 19x^4 - 8x^3 - 20x^2 + 32$
C) $15x^5 + 19x^4 - 8x^3 - 20x^2 + 32x$
D) $15x^5 + 29x^4 - 8x^3 - 20x^2 + 32x$

5. [June 2023]

If $\frac{6}{7}p + 12 = 54$ what is the value of $7p$?

6. [June 2023]

$$b^2 + 5c = 9d$$

The given equation relates the real numbers b , c , and d , where $d > \frac{5}{9}c$. Which equation correctly expresses b in terms of c and d ?

- A) $b = \frac{9d + 5c}{2}$
B) $b = \frac{9d - 5c}{2}$
C) $b = \pm\sqrt{9d + 5c}$
D) $b = \pm\sqrt{9d - 5c}$

7. [August US 2023]

If $x^3 + y^3 = 12$ and $x^3 - y^3 = 6$, what is the value of $x^6 - y^6$?

8. [August US 2023]

Which expression is equivalent to $2(xy^2 + x^2y) - 8(xy^2 - 4x^2y)$?

- A) $-6xy^2 + 34x^2y$
B) $-6xy^2 + 33x^2y$
C) $-6xy^2 - 30x^2y$
D) $-6xy^2 - 31x^2y$

9. [November 2023]

If $2x + 3 = 9$, what is the value of $4x - 4$?

10. [November 2023]

Which expression is equivalent to $(131y)^{\frac{1}{2}}$, where $y > 1$?

- A) $131\sqrt{y}$ C) $\sqrt{131y}$
 B) $\sqrt{131}y$ D) $\sqrt{(131y)^2}$

11. [November 2023]

Which expression is equivalent to $(5a^2 - 3ab + 7b^2) - (4a^2 + ab - 2b^2)$

- A) $a^2 - 4ab + 9b^2$
 B) $a^2 - 2ab + 5b^2$
 C) $a^4 - 4a^2b^2 + 9b^4$
 D) $a^4 - 2a^2b^2 + 5b^4$

12. [November 2023]

$$7x + 16 = \frac{4}{y}$$

The given equation relates the distinct positive numbers x and y . Which equation correctly expresses y in terms of x ?

- A) $y = 7x + 12$
 B) $y = \frac{4}{7x + 16}$
 C) $y = \frac{7x + 16}{4}$
 D) $y = 4(7x + 16)$

13. [November 2023]

A total of 6 squares each have side length r . A total of 3 equilateral triangle each have side length t . None of these squares and triangles shares a side. The sum of the perimeters of all these squares and triangles is 75. Which equation represents this situation?

- A) $18r + 12t = 75$
 B) $24r + 9t = 75$
 C) $3r + 6t = 75$
 D) $6r + 3t = 75$

14. [December 2023]

$$v = -\frac{w}{130x}$$

The given equation relates the distinct positive numbers v , w , and x . Which equation correctly expresses w in terms of v and x ?

- A) $w = -130vx$
 B) $w = -\frac{130v}{x}$
 C) $w = -\frac{x}{130v}$
 D) $w = v + 130x$

15. [December 2023]

Which expression is equivalent to $15(x + 10)$?

- A) $15x + 10$ C) $15x + 25$
 B) $15x + 150$ D) $15x + 5$

16. [December 2023]

Which expression is equivalent to $60y + 90y$?

- A) $540y^2$ C) $150y^2$
 B) $540y$ D) $150y$

17. [December 2023]

If $9(x + 3) = 81$, what is the value of $x + 3$?

- A) 6 C) 69
 B) 9 D) 72

18. [March 2024]

Which expression is equivalent to

$$(9nr^2 + 3nr) + (6n^2r + 5nr)?$$

- A) $15n^2r^2 + 8nr$
 B) $15n^3r^3 + 8n^2r^2$
 C) $54n^3r^3 + 15n^2r^2$
 D) $9nr^2 + 6n^2r + 8nr$

19. [March 2024]

$$v = -\frac{w}{161x}$$

The given equation relates the distinct positive numbers v , w , and x . Which equation correctly expresses w in terms of v and x ?

- A) $w = -161vx$
- B) $w = -\frac{161v}{x}$
- C) $w = -\frac{x}{161v}$
- D) $w = v + 161x$

20. [March 2024]

Which expression is equivalent to $16(x + 5)$?

- A) $16x + 5$
- B) $16x + 80$
- C) $16x + 21$
- D) $16x + 11$

21. [March 2024]

$$x = 2a(b + 5)$$

The given equation relates the positive numbers a , b , and x . Which equation correctly expresses a in terms of b and x ?

- A) $a = \frac{x}{2} - (b + 5)$
- B) $a = \frac{x}{2(b + 5)}$
- C) $a = \frac{2(b + 5)}{x}$
- D) $a = 2x(b + 5)$

22. [March 2024]

Which expression is equivalent to

$$\frac{y + 2}{x - 9} + \frac{y(x - 9)}{x^2y - 9xy}?$$

- A) $\frac{xy + y - 7}{x^3y - 18x^2y + 81xy}$
- B) $\frac{xy + 10y + 2}{x^2y - 9xy + x - 9}$
- C) $\frac{xy^2 + 3xy - 9y}{x^2y - 9xy}$
- D) $\frac{xy^2 + 3xy - 9y}{x^3y - 18x^2y + 81xy}$

23. [March 2024]

If $\frac{x}{y} = 63$ and $\frac{cx}{3y} = 63$, what is the value of c ?

24. [March 2024]

$$x = 2a(b + 3)$$

The given equation relates positive numbers x , a , and b . Which equation correctly expresses a in terms of b and x ?

- A) $a = \frac{x}{2} - 4b + 3$
- B) $a = \frac{x}{2(b + 3)}$
- C) $a = \frac{2(b + 3)}{x}$
- D) $a = 2x(b + 3)$

25. [March 2024]

If $8 + \frac{9(6 - x)}{4} = \frac{7(6 - x)}{3}$, what is the value of $6 - x$?

26. [March 2024]

If $\frac{7}{8}p + 35 = 56$, what is the value of $8p$?

27. [March 2024]

The function f gives the product of a number, x , and a number that is 66 more than x . Which equation defines f ?

- A) $f(x) = x^2 + x + 66$
- B) $f(x) = x^2 + 66$
- C) $f(x) = x^2 + 66x$
- D) $f(x) = x^2 + 66x + 66$

28. [May 2024]

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

The given expression is equivalent to $bx^3 - 5$ where b is a constant. What is the value of b ?

29. [May US 2024]

Which expression is equivalent to

$$(4x^2 + 6) - (3x^2)?$$

- A) 7
B) $7x^2 + 6$
C) $x^2 - 6$
D) $x^2 + 6$

30. [June 2024]

Which expression is equivalent

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

- A) $x^3 + 4x^2 - 8x + 32$
B) $x^3 + 14x^2 - 8x + 32$
C) $x^3 + 8x^2 - 8x + 32$
D) $x^3 + 6x^2 - 8x + 32$

31. [June 2024]

The product of a positive number x and the number that is 1 less than x is equal to 342. What is the value of x ?

- A) 0.5
B) 19
C) 341
D) 343

32. [March 2024]

Which expression is equivalent to

$$\frac{y+4}{x-7} + \frac{y(x-7)}{x^2y-7xy}?$$

- A) $\frac{xy+y-3}{x^3y-14x^2y+49xy}$
B) $\frac{xy+8y+4}{x^2y-7x^2y+x-7}$
C) $\frac{xy^2+5xy-7y}{x^2y-7xy}$
D) $\frac{xy^2+5xy-7y}{x^3y-14x^2y+49xy}$

33. [June 2024]

If $\frac{x}{y} = 3$ and $\frac{5x}{ty} = 135$, what is the value of t ?

- A) $\frac{1}{9}$
B) $\frac{3}{5}$
C) $\frac{5}{3}$
D) 9

34. [June 2024]

A piece of string with a length of 35 inches is cut into two parts. One part has a length of x inches, and the other part has a length of y inches. The value of x is 5 more than 2 times the value of y . What is the value of x ?

35. [June 2024]

Which expression is equivalent to

$$(x^3 + 4x^2 - 3x) + 5(x^2 + 8)?$$

- A) $x^3 + 9x^2 - 3x + 40$
B) $x^3 + 4x^2 - 3x + 40$
C) $x^3 + 8x^2 - 3x + 40$
D) $x^3 + 5x^2 - 3x + 40$

36. [June 2024]

$$\frac{2}{c} - \frac{7}{d} = 5$$

The given equation relates the variables c and d , where c and d are greater than 1. Which equation correctly expresses d in terms of c ?

- A) $d = \frac{c}{7(2-5c)}$
B) $d = \frac{7c}{2-5c}$
C) $d = \frac{7(2-5c)}{c}$
D) $d = \frac{2-5c}{7c}$

37. [August 2024]

$$(9y + 9) - (5y + 7)$$

The given expression is equivalent to $by + c$, where b and c are constants. What is the value of b ?

38. [June 2024]

$$ak = \frac{b}{12}(7 + m)$$

The given equation relates the positive variables a, b, k , and m . Which equation correctly expresses m in terms of a, b , and k ?

- A) $m = \frac{12(ak - 7)}{b}$
- B) $m = ak - 7 - \frac{b}{12}$
- C) $m = ak - \frac{7b}{12}$
- D) $m = \frac{12ak}{b} - 7$

39. [August 2024]

If

$$a = 3k + 4r \text{ and } b = 9k - 12r + 6,$$

which expression is equivalent to $a - b$?

- A) $-6k + 16r - 6$
- B) $-6k + 16r + 6$
- C) $-6k - 8r + 6$
- D) $-6k - 8r - 6$

40. [August 2024]

The product of a positive number x and the number that is 5 more than x is 104. What is the value of x ?

- A) 4
- B) 8
- C) 13
- D) 26

41. [August 2024]

Which expression is equivalent to

$$15(x + 10)?$$

- A) $15x + 10$
- B) $15x + 150$
- C) $15x + 25$
- D) $15x + 5$

42. [August 2024]

$$\frac{20}{p} = \frac{20}{q} - \frac{20}{r} - \frac{20}{s}$$

The given equation relates the positive variables p, q, r , and s . Which of the following is equivalent to q ?

- A) $p + r + s$
- B) $20(p + r + s)$
- C) $\frac{prs}{pr + rs + ps}$
- D) $\frac{prs}{20p + 20r + 20s}$

43. [August US 2024]

Which expression is equivalent to

$$\frac{20\pi^2}{\pi^2 - x^2} - \frac{20\pi}{x + \pi}?$$

- A) $\frac{20\pi}{\pi - x}$
- B) $\frac{20\pi x}{\pi^2 - x^2}$
- C) $\frac{20\pi^2 - 20\pi}{\pi^2 - x^2}$
- D) $\frac{20\pi - 10}{(\pi - x^2)(x + 1)}$

44. [October 2024]

Which expression is equivalent to $4(x^2 + 6)$?

- A) $4x^2 + 24$
- B) $4x^2 + 10$
- C) $4x^2 + 6$
- D) $4x^2 - 2$

45. [August US 2024]

On average, a certain tree grows 51 centimeters every m months. At this rate, which expression represents the number of centimeters, on average, the tree grows every k years?

- A) $\frac{17m}{4k}$
- B) $\frac{17k}{4m}$
- C) $\frac{612m}{k}$
- D) $\frac{612k}{m}$

46. [August US 2024]

Which expression is equivalent to

$$(6t^4 - 3t^2 + 3t - 6) - (2t^4 - 4t^3 + 6t^2 - 6)?$$

- A) $4t^4 + 4t^3 - 9t^2 - 3t - 12$
- B) $4t^4 + 4t^3 - 9t^2 - 3t$
- C) $4t^4 + t^3 - 9t - 12$
- D) $4t^4 + t^3 + 3t$

47. [August US 2024]

$$b - 22 = \frac{x}{y}$$

The given equation relates positive numbers b , x , and y . Which equation correctly expresses x in terms of b and y ?

- A) $x = \frac{by - 22}{y}$
- B) $x = by - 22$
- C) $x = by - 22y$
- D) $x = \frac{b - 22}{y}$

48. [October 2024]

The expression $72y^5 - 48y^4$ is equivalent to $ry^4(12y - 8)$, where r is a constant. What is the value of r ?

49. [October US 2024]

Which expression is equivalent to

$$11(x^2 - 100y^2)?$$

- A) $11(x - 2y)(x - 50y)$
- B) $11(x - 2y)(x + 50y)$
- C) $11(x - 10y)(x - 10y)$
- D) $11(x - 10y)(x + 10y)$

50. [October US 2024]

Which expression is equivalent to

$$(9c + 8) - (4c^3 - 6)?$$

- A) $4c^3 + 9c + 2$
- B) $4c^3 + 9c + 14$
- C) $-4c^3 + 9c + 2$
- D) $-4c^3 + 9c + 14$

51. [October US 2024]

The kinetic energy K , in joules, of an object is given by the formula $K = \frac{1}{2}mv^2$, where m is the mass of the object, in kilograms, and v is the velocity of the object, in meters per second. If the kinetic energy of a certain object can be found by using the formula $K = 32v^2$, what is the mass of the object, in kilograms?

- A) 1,024
- B) 64
- C) 32
- D) 16

52. [October US 2024]

In a set of four consecutive odd integers, where the integers are ordered from least to greatest, the first integer is represented by x . The product of 28 and the third odd integer in the set is at most the value of 50 less than the sum of the first and fourth odd integers in the set. What is the greatest possible value of x ?

53. [October 2024]

The total mass, in kilograms, of r identical objects is t . Which expression represents the total mass, in kilograms, of $146r$ of these objects?

- A) $146 - t$ C) $\frac{t}{146}$
 B) $146 + t$ D) $146t$

54. [October US 2024]

Which expression is equivalent to

$$11x^3 + 2x^2 + 7x?$$

- A) $20(x^3 + x^2 + x)$
 B) $x(11x^2 + 2x + 7)$
 C) $7x(11x^3 + 2x^2 + 1)$
 D) $20(x^3 + x^2 + x)$

55. [October US 2024]

$$\frac{49}{p} = \frac{49}{q} - \frac{49}{r} - \frac{49}{s}$$

The given equation relates the positive variables p , q , r and s . Which of the following is equivalent to q ?

- A) $p + r + s$
 B) $(49p + r + s)$
 C) $\frac{prs}{pr + ps + rs}$
 D) $\frac{prs}{49p + 49r + 49s}$

56. [October US 2024]

If

$$\frac{j}{k} = 62 \text{ and } \frac{96j}{12xk} = 62,$$

what is the value of x ?

- A) $\frac{1}{8}$ C) 8
 B) $\frac{6}{31}$ D) 96

57. [October 2024]

If $\frac{42}{x} = 7x$, what is the value of $7x^2$?

- A) 6 C) 42
 B) 7 D) 294

58. [October 2024]

$$b - 72 = \frac{x}{y}$$

The given equation relates the positive numbers b , x , and y . Which equation correctly expresses x in terms of b and y ?

- A) $x = \frac{b - 72}{y}$
 B) $x = by - 72$
 C) $x = \frac{by - 72}{y}$
 D) $x = by - 72y$

59. [October US 2024]

Which expression is equivalent to $63x^2$?

- A) $63(1 + x^2)$ C) $(7x^2)(9x^2)$
 B) $(7x)(9x)$ D) $(63x^2)(x)$

60. [October US 2024]

Which expression is equivalent to

$$(3nr^2 + 4nr) + (8n^2r + 2nr)?$$

- A) $11n^2r^2 + 6nr$
 B) $11n^3r^3 + 6n^2r^2$
 C) $24n^3r^3 + 8n^2r^2$
 D) $3nr^2 + 8n^2r + 6nr$

61. [November 2024]

$$v = -\frac{w}{188x}$$

The given equation relates the distinct positive numbers v , w and x . Which equation correctly expresses w in terms of v and x ?

A) $w = -188vx$

B) $w = -\frac{188v}{x}$

C) $w = -\frac{x}{188v}$

D) $w = v + 188x$

62. [November 2024]

One gallon of sealant costs \$23 and will cover 250 square feet of a surface. A deck has a total surface area of d square feet. Which of the following represents the cost c , in dollars, of the sealant needed to cover the deck twice?

A) $c = \frac{250d}{23}$

B) $c = \frac{500d}{23}$

C) $c = 23\left(\frac{d}{125}\right)$

D) $c = 23\left(\frac{d}{250}\right)$

63. [December 2024]

Which expression is equivalent to

$$158t^3 - 24t^2u?$$

A) $2t(79t^2 - 12u)$

B) $2t^2(79t - 12u)$

C) $2tu(79t^2 - 12)$

D) $2t^2u(79t - 12)$

64. [December 2024]

$$PC = N(44 - C)$$

The given equation relates the variables P , N , and C . Which expression represents the value of C for distinct positive values of P and N ?

A) $\frac{C(N + P)}{N}$

B) $\frac{PC}{44 - C}$

C) $\frac{44N}{N + P}$

D) $\frac{44N}{P + 1}$

65. [December 2024]

$$49 = \frac{2K}{x^2}$$

For an object with a mass of 49 kilograms, the given equation relates the kinetic energy K , in joules, of the object to the object's speed v , in meters per second, where K and v are positive. Which equation correctly expresses this object's speed, in meters per second, in terms of the object's kinetic energy, in joules?

A) $v = \sqrt{\frac{2K}{49}}$

B) $v = \sqrt{\frac{49}{2K}}$

C) $v = \frac{49^2}{2K}$

D) $v = \frac{2K}{49^2}$

66. [December 2024]

On average, a certain tree grows 87 centimeters every m months. At this rate, which expression represents the number of centimeters, on average, the tree grows every k years?

A) $\frac{29m}{4k}$

B) $\frac{29k}{4m}$

C) $\frac{1,044m}{k}$

D) $\frac{1,044k}{m}$

Answers: Expressions

Number	Answer	Number	Answer
1	D	21	B
2	D	22	C
3	A	23	3
4	C	24	B
5	343	25	-48
6	D	26	192
7	72	27	C
8	A	28	11
9	8	29	D
10	C	30	B
11	A	31	B
12	B	32	C
13	B	33	A
14	A	34	25
15	B	35	A
16	D	36	B
17	B	37	14
18	D	38	D
19	A	39	A
20	B	40	B

Number	Answer	Number	Answer
41	B	54	B
42	C	55	C
43	B	56	C
44	A	57	D
45	D	58	D
46	B	59	A
47	C	60	D
48	16	61	A
49	D	62	C
50	D	63	B
51	B	64	C
52	-7	65	A
53	D	66	D

Linear Equations

1. [March US 2023]

If $(x + 9) - 5 = 25$, what is the value of $x + 9$?

- A) 30
B) 21
C) 20
D) 11

2. [March US 2023]

Which equation has no solution?

- A) $x = x + 1$
B) $x = 2x + 2$
C) $x + 1 = x + 1$
D) $x + 1 = 2x + 2$

3. [March US 2023]

$$|15 - x| - 9 = 0$$

What are all positive solutions to the given equation?

- A) -6 and -24
B) -6 and 24
C) 6 and -24
D) 6 and 24

4. [March US 2023]

$$ax - y = bxy$$

The given equation relates the positive numbers a, b, x , and y . Which equation correctly expresses a in terms of b, x , and y ?

- A) $a = \frac{bxy + y}{x}$
B) $a = \frac{bxy - y}{x}$
C) $a = \frac{x}{bxy + y}$
D) $a = \frac{x}{bxy - y}$

5. [March US 2023]

What value of x is the solution to the equation $x + 10 = 3$

- A) -13
B) -7
C) 7
D) 13

6. [June 2023]

If $5(x + 1) = 25$, what is the value of $x + 1$?

- A) 4
B) 5
C) 19
D) 20

7. [August US 2023]

$$|3x - 12| = 18$$

What is the sum of the solutions to the given equation?

- A) -2
B) 8
C) 10
D) 12

8. [August US 2023]

$$\frac{1}{3}(6y - 9) = 13$$

What value of y satisfies the given equation?

9. [August US 2023]

The cost to rent a bus from Company X is \$950 for the first 3 hours and an additional \$50 per hour for each hour after the first 3 hours. If the total cost to rent the bus from Company X for t hours is 1,250, which equation represents this situation?

- A) $950 + 50(t - 3) = 1,250$
B) $950 + 50(3t) = 1,250$
C) $950(t - 3) + 50t = 1,250$
D) $950(3t) + 50t = 1,250$

10. [August US 2023]

$$6(x - 9) = 11(x - 9)$$

what value of x is the solution to the given equation?

11. [August US 2023]

How many solutions does the equation $10x = 10$ have?

- A) Zero
- B) Exactly one
- C) Exactly two
- D) Infinitely many

12. [November 2023]

$$|6x - 3| = |5x|$$

What is the smallest solution to the given equation?

13. [November 2023]

$$* \quad 9x + x = 2x + x + 5$$

Which of the following equations lies the same solution as the given equation?

- A) $7x = 5$
- B) $7x = -5$
- C) $11x = 5$
- D) $11x = -5$

14. [December 2023]

$$12x = 65 - x$$

What value of x is the solution to the given equation?

15. [December 2023]

Gentoo penguins are the fastest swimming-underwater birds. A gentoo penguin was recorded swimming at a rate of 6 meters per second for 110 meters. For approximately how many seconds was the penguin recorded swimming at this rate?

- A) 18
- B) 50
- C) 55
- D) 66

16. [November 2023]

If $2x + 3 = 9$, what is the value of $4x - 4$?

17. [March 2024]

If $2x + 3 = 9$, what is the value of $4x - 4$?

18. [March 2024]

If $-9(15 - 3x) + 5 = -10(15 - 3x) + 21$, what is the value of $15 - 3x$?

19. [December 2023]

$$-5x + 15rx = 135$$

In the given equation, r is a constant. The equation has no solution. What is the value of r ?

- A) $\frac{1}{9}$
- B) $\frac{1}{3}$
- C) 3
- D) 9

20. [March 2024]

A veterinarian recommends that each day a certain cat should eat 24 calories per pound of the cat's weight, plus an additional 14 calories. Which equation represents this situation, where c is the total number of calories the veterinarian recommends the cat should eat each day if the cat's weight is x pounds?

- A) $c = 24x$
- B) $c = 38x$
- C) $c = 14x + 24$
- D) $c = 24x + 14$

21. [March 2024]

How many solutions does the equation $9x + 6 = 5x + 4x + 12$ have?

- A) Exactly one
- B) Exactly two
- C) Infinitely many
- D) Zero

22. [March 2024]

Raheem bought 3 shirts that were each the same price. He used a coupon for \$30 off the entire purchase. The cost for the entire purchase after using the coupon was \$15. What was the original price, in dollars, for 1 shirt?

23. [March 2024]

If $4 + \frac{5(3-x)}{2} = \frac{8(3-x)}{3}$, what is the value of $3 - x$?

24. [May 2024]

$$13x = 42 - x$$

What value of x is the solution to the given equation?

25. [May 2024]

The product of a positive number x and the number that is 7 less than x is equal to 228. What is the value of x ?

26. [May 2024]

If $\frac{x-18}{30} = \frac{x-18}{6}$,

what is the value of $x + 18$?

- A) 0 C) 18
B) 5 D) 36

27. [May 2024]

$$-5x + 15rx = 135$$

In the given equation, r is a constant. The equation has no solution. What is the value of r ?

- A) $\frac{1}{9}$ C) 3
B) $\frac{1}{3}$ D) 9

28. [May 2024]

If $2x = 10$, what is the value of $4x$?

- A) 7 C) 12
B) 10 D) 20

29. [May 2024]

$$k + 21 = 63$$

What is the solution to the given equation?

- A) 3 C) 84
B) 42 D) 1,323

30. [May 2024]

If $\frac{x-4}{5} = \frac{x-4}{7}$, the value of $x - 4$ is between which of the following pairs of values?

- A) -7 and -5
B) -3 and 3
C) 3.5 and 4.5
D) 4.75 and 7.25

31. [May US 2024]

If $12 + \frac{7(3-x)}{6} = \frac{5(3-x)}{3}$, which equation must also be true?

- A) $3 - x = 207$
B) $3 - x = -24$
C) $x - 3 = 207$
D) $x - 3 = -24$

32. [May US 2024]

What value of x is the solution to the equation $20x + 72 = 32x$?

- A) -5 C) $\frac{6}{13}$
B) $\frac{1}{6}$ D) 6

33. [May US 2024]

$$|x - 9| + 81 = 99$$

What is the sum of the solutions to the given equation?

34. [May US 2024]

The cost to rent a bus from Company X is \$950 for the first 2 hours and an additional \$50 per hour for each hour after the first 2 hours. If the total cost to rent the bus from Company X for t hours, where $t > 2$ is \$1,250, which equation represents this situation?

- A) $950(t - 2) + 50t = 1,250$
- B) $950(2t) + 50t = 1,250$
- C) $950 + 50(t - 2) = 1,250$
- D) $950 + 50(2t) = 1,250$

35. [June 2024]

If $4x = 6$, what is the value of $12x$?

- A) 9
- B) 3
- C) 18
- D) 27

36. [June 2024]

Which equation has no solution?

- A) $-19x - \frac{1}{7} = -19x - \frac{1}{7}$
- B) $-19x - \frac{1}{7} = -19x + \frac{1}{7}$
- C) $-19x - \frac{1}{7} = 19x - \frac{1}{7}$
- D) $-19x - \frac{1}{7} = 19x + \frac{1}{7}$

37. [June 2024]

$$F(x) = \frac{9}{5}(x - 273.15) + 32$$

The function F gives the temperature, in degrees Fahrenheit, that corresponds to a temperature of x kelvins. If a temperature increased by 8.80 kelvins, by how much did the temperature increase, in degrees Fahrenheit?

- A) 15.84
- B) 47.84
- C) 475.83
- D) 507.83

38. [June 2024]

The function g is defined by $g(x) = \frac{x}{2}$. For what value of x does $g(x) = 624$?

39. [June 2024]

If $5x = 4$, what is the value of $40x$?

- A) 4
- B) 12
- C) 28
- D) 32

40. [June 2024]

Raheem bought 9 shirts that were each the same price. He used a coupon for \$54 off the entire purchase. The cost for the entire purchase after using the coupon was \$108. What was the original price, in dollars, for 1 shirt?

41. [June 2024]

$$\frac{8(cx + 3)}{5} = 4x - 3$$

In the given equation, c is a constant. If the equation has no solution, what is the value of c ?

- A) $-\frac{5}{2}$
- B) $-\frac{2}{5}$
- C) $\frac{2}{5}$
- D) $\frac{5}{2}$

42. [June 2024]

The equation $4|x - 3| = k$, where k is a constant, has exactly one solution. Which of the following could be the value of $\frac{k}{4}$?

- A) -3 only
- B) -3 or 3
- C) 0 only
- D) 3 only

43. [August 2024]

$$\sqrt{2x + 19} = 5$$

What is the solution to the equation shown?

- A) 22
- B) 12
- C) 3
- D) -7

44. [August US 2024]

$$\frac{1}{6}(x+2) - \frac{1}{5}(x+2) = -5$$

What value of x is the solution to the given equation?

- A) -7
B) -2
C) 148
D) 270

45. [August 2024]

How many solutions does the equation $6x + 4 = 6x + 8$ have?

- A) Infinitely many
B) Exactly two
C) Exactly one
D) Zero

46. [August 2024]

A batch of smoothies consist of 4 cups of milk and 2 bananas and has 1,228 milligrams (mg) of calcium. There is 304 mg of calcium in 1 cup of milk. How much calcium, in mg, is in 1 banana?

- A) 6
B) 12
C) 462
D) 1,216

47. [August 2024]

If

$$\frac{x-5}{4} = \frac{x-5}{11},$$

the value of $x - 5$ is between which of the following pairs of values?

- A) -11 and -7
B) -6 and -3
C) -3 and 2
D) 4 and 6

48. [August 2024]

$$7x - 6x + 130 = 260$$

What value of x is the solution to the given equation?

49. [August US 2024]

$$|x - 6| = 13$$

What is the sum of the solutions to the given equation?

- A) 0
B) 12
C) 19
D) 26

50. [August 2024]

$$5(y - 15) + 10 = 4(y - 15) + 10$$

What value of y is the solution to the given equation?

- A) 0
B) 1
C) 10
D) 15

51. [August US 2024]

A teacher is creating an assignment worth 28 points. The assignments will consist of questions worth 1 point and questions worth 2 points. Which equation represents this situation, where x represents the number of 1-point questions and y represents the number of 2 points questions?

- A) $3xy = 28$
B) $3(x + y) = 28$
C) $2x + y = 28$
D) $x + 2y = 28$

52. [August 2024]

$$-3x + 6rx = 42$$

In the given equation, r is a constant. The equation has no solution. What is the value of r ?

- A) $\frac{1}{7}$
B) $\frac{1}{2}$
C) 2
D) 7

53. [August 2024]

The result of increasing the quantity x by 600% is 126. What is the value of x ?

- A) 18 C) 474
B) 21 D) 756

54. [August US 2024]

Raheem bought 9 shirts that were each the same price. He used a coupon for \$54 off the entire purchase. The cost for the entire purchase after using the coupon was \$108. What was the original price, in dollars, for 1 shirt?

55. [August US 2024]

If $8(x+3) = 64$, what is the value of $(x+3)$?

- A) 5
B) 8
C) 53
D) 56

56. [August US 2024]

An object's average acceleration, in meters per second squared, is the change in the object's speed, in meters per seconds. A certain object's changes by 22 meters per second in 8 seconds. What is this object's average acceleration, in meters per second squared, during this time period?

- A) 0.36 C) 14
B) 2.75 D) 30

57. [August US 2024]

How many solutions does the equation $5x + 3 = 5x + 7$ have?

- A) Zero
B) Exactly one
C) Exactly two
D) Infinitely many

58. [August US 2024]

If $6(8 - 2x) + 3 = 5(8 - 2x) + 19$, what is the value of $8 - 2x$?

- A) -16 C) 4
B) -4 D) 16

59. [October US 2024]

$$13x + 50 = 180$$

Which equation has the same solution as the given equation?

- A) $13x = 50$ C) $13x = 130$
B) $13x = 80$ D) $13x = 180$

60. [October US 2024]

Which equation has no solution?

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

61. [October 2024]

If $46 = 16 + 2(x - 8)$, what is the value of $2(x - 8)$?

- A) 16 C) 30
B) 23 D) 38

62. [October US 2024]

Sophia bought confetti and balloons for \$56. Each package of confetti costs \$3, and each balloon costs \$1. If Sophia bought 10 packages of confetti, how many balloons did she buy?

63. [October US 2024]

If $\frac{1}{6}x + 5 = 8$, what is the value of $6x$?

- A) 108 C) 318
B) 258 D) 468

64. [October 2024]

In 2010, a skating team had a total of 35 skaters, each classified as either advanced or intermediate. From 2010 to 2020, the number of advanced skaters on the team increased by approximately 53%, and the number of intermediate skaters on the team increased by approximately 44%. The total number of skaters on the team increased by approximately 49%. Which equation best represents this situation, where a represents the number of advanced skaters on the team in 2010 and b represents the number of intermediate skaters on the team in 2010?

- A) $1.53a + 1.49b = 35(1.44)$
- B) $1.49a + 0.53b = 35(1.44)$
- C) $1.53a + 1.44b = 35(1.49)$
- D) $1.44a + 1.53b = 35(1.49)$

65. [October 2024]

$$\frac{12x + 28}{4} - \frac{s}{13} = r(x - 8)$$

In the given equation, s and r are constants, and $s > 0$. If the equation has infinitely many solutions, what is the value of s ?

66. [October US 2024]

The equation $d = 33w + 100$ gives the total amount of money d , in dollars, that James plans to save w weeks after he starts to save. What is the total amount of money, in dollars, he plans to save in 10 weeks?

- A) 380
- B) 430
- C) 480
- D) 530

67. [October US 2024]

Which of the following equations has exactly one solution?

- A) $\frac{1}{44} + x = x$
- B) $\frac{1}{44} - x = -x - \frac{1}{44}$
- C) $\frac{1}{44} - x = \frac{1}{44} - x$
- D) $\frac{1}{44} - x = -x$

68. [October US 2024]

$$0.10x + 0.20y = 0.19(x + y)$$

The equation gives a volume x , in gallons, of a 10% salt water solution that could be mixed with a volume y , in gallons of a 20% saltwater solution to produce a 19% saltwater solution. According to this equation, what volume, in gallons, of the 20% saltwater solution could be mixed with 50.0 gallons of 10% saltwater solution to produce a 19% saltwater solution? (Assume that the volume of the mixture is the sum of the volumes of the two solutions before they were mixed.)

69. [October US 2024]

$$-3x + 6rx = 54$$

In the given equation, r is a constant. The equation has no solution. What is the value of r ?

- A) $\frac{1}{9}$
- B) $\frac{1}{2}$
- C) 2
- D) 9

70. [October US 2024]

$$4(x - 3) = 13 + 2(x - 3)$$

If x is the solution to the given equation, what is the value of $x - 3$?

71. [October US 2024]

A park rents beach umbrellas to visitors. The park earns revenue of \$16 for each beach umbrella they rent for the day. On Wednesday, the park earned \$400 in profit from renting beach umbrellas after paying daily expenses of \$144. How many beach umbrellas did the park rent on Wednesday? (profit = total revenue - total expenses)

- (A) 16
- (B) 25
- (C) 32
- (D) 34

72. [October US 2024]

To purchase a used car at a total price of 14,000 dollars, a one-time down payment is required, and then fixed monthly payments are made for the remaining amount owed for the car. The equation $14,000 = 2,800 + 200t$ represents this situation, where t is the number of fixed monthly payments that are made. Which of the following is the best interpretation of 200 in this context?

- (A) The amount, in dollars, of the down payment.
- (B) The amount, in dollars, of each fixed monthly payment.
- (C) The total amount, in dollars, paid for the car after t fixed monthly payments.
- (D) The total number of fixed monthly payments.

73. [October US 2024]

How many solutions does the equation $5x + 3 = 5x$ have?

- A) Zero
- B) Exactly one
- C) Exactly two
- D) Infinitely many

74. [November 2024]

If $8x + 7 = 79$, what's the value of $80x + 70$?

- A) 790
- B) 150
- C) 90
- D) 9

75. [November 2024]

If $8(x + 7) = 7(x + 7) + 68$. What is the value of $x + 7$?

- A) -7
- B) 61
- C) 68
- D) 75

76. [November 2024]

Casey is raising h horses and g goats. Each horse requires 2 acres of land, and each goat requires 1 acre of land. The h horses and g goats require 21 acres of land. Which equation represents this situation?

- A) $2g + h = 21$
- B) $g + 2h = 21$
- C) $g + \frac{h}{2} = 21$
- D) $\frac{g}{2} + h = 21$

77. [November 2024]

A gallery had x artifacts in a collection. When more artifacts were added to the collection, number of artifacts increased by 149%. What is the number of artifacts in the collection in terms of x ?

- A) $5.10x$
- B) $0.51x$
- C) 1.49
- D) $2.49x$

78. [November US 2024]

A piece of string with a length of 96 inches is cut into two parts. One part has a length of x inches, and the other part has a length of y inches. The value of x is 6 more than 4 times the value of y . What is the value of x ?

- A) 23
- B) 26
- C) 51
- D) 78

79. [November US 2024]

How many solutions does the equation $17(x - 16) = -16(x + 17)$ have?

- A) Exactly one
- B) Exactly two
- C) Infinitely many
- D) Zero

80. [November US 2024]

If $44 = 6 + 2(x - 3)$, what is the value of $2(x - 3)$?

- A) 6
B) 22
C) 38
D) 41

81. [November US 2024]

A machine makes 9-inch, 8-inch, and 3-inch parts. During a certain day, the number of 9-inch parts that the machine makes is 4 times the number n of 8-inch parts, and the number of 3-inch parts is 15. During this day, the machine makes 100 parts total. Which equation represents this situation?

- A) $9(4n) + 8n + 3(15) = 100$
B) $9n + 8n + 3n = 100$
C) $4n + 15 = 100$
D) $5n + 15 = 100$

82. [December US 2024]

$$2.5c + 5d = 60$$

The given equation describes the relationship between the number of cats, c , and the number of dogs, d , that can be cared for at a pet care business during a week. If the business cares 12 dogs during a week, how many cats can it care for during this week?

- A) 0
B) 5
C) 30
D) 60

83. [December US 2024]

How many solutions does the equation $7x - 19 = 19 - 7x$ have?

- A) Zero
B) Exactly one
C) Exactly two
D) Infinitely many

84. [December US 2024]

$$6(x - 4) = (x - 4) + 6$$

If x is the solution to the given equation, what is the value of $x - 4$?

85. [December 2024]

Raheem bought 9 shirts that were each the same price. He used a coupon for \$54 off the entire purchase. The cost for the entire purchase after using the coupon was \$108. What was the original price, in dollars, for 1 shirt?

86. [December 2024]

If $9 - 4(4 - 9x) = 2 - 5(4 - 9x)$, what is the value of $4 - 9x$?

87. [December 2024]

$$a(7x - 14) + 5a = 7(ax - 2a) - 35$$

In the given equation, a is a constant. The equation has infinitely many solutions. What are all possible values of a ?

- A) 0 only
B) -7 only
C) Any real number
D) No real number

88. [December 2024]

$$d = 15t$$

The given equation relates the distance d , in inches, of an object from its starting position to the time t , in seconds, since the object started moving. What is the rate of change of the object's distance from its starting position over time?

- A) $15t$ inches per second
B) 15 inches per second
C) $\frac{1}{15}$ inches per second
D) $\frac{1}{15t}$ inches per second

89. [December 2024]

A certain pigeon species can fly at an average speed of 16 meters per second when in continuous flight. At this rate, how many meters would this pigeon species fly in 4 seconds?

- A) 64
B) 20
C) 16
D) 12

90. [December 2024]

The rectangular region of land is divided into 40 square lots of equal area R , in square units. The length of the region is 1.6 times the width of the region. If the width of the region is $x\sqrt{R}$ units, what is the value of x ?

91. [December 2024]

A company that manufactures staplers calculates its monthly profit, in dollars, by subtracting its fixed monthly costs, in dollars, from its monthly sales revenue, in dollars. The equation

$$11,000 = 2.00x - 6,500$$

represents this situation for a month where x staplers are manufactured and sold. Which statement is the best interpretation of $2.00x$ in this context?

- A) The monthly sales revenue, in dollars, from selling x staplers
B) The monthly sales revenues, in dollars, from each stapler sold.
C) The monthly cost, in dollars, of manufacturing each stapler.
D) The monthly cost, in dollars, of manufacturing x staplers.

92. [December 2024]

$$-\frac{3}{19}rx + \frac{s}{8} = 10 - \frac{5}{57}x$$

In the given equation, r and s are constants. The equation has no solution. What is the value of r ?

93. [December 2024]

If

$$\frac{x - 16}{27} = \frac{x - 16}{9},$$

what is the value of $x + 16$?

- A) 0
B) 3
C) 16
D) 32

94. [December 2024]

$$8|7 - x| + 1 = 81$$

What is the sum of the solutions to the given equation?

- A) -14
B) -3
C) 10
D) 14

Answers: Linear Equations

Number	Answer	Number	Answer
1	A	21	D
2	A	22	15
3	D	23	24
4	A	24	3
5	C	25	19
6	B	26	D
7	B	27	B
8	8	28	D
9	A	29	B
10	9	30	B
11	B	31	D
12	3/11	32	D
13	A	33	18
14	5	34	C
15	A	35	C
16	8	36	B
17	8	37	A
18	16	38	1248
19	B	39	D
20	D	40	18

Number	Answer	Number	Answer
41	D	61	C
42	C	62	26
43	C	63	A
44	C	64	C
45	D	65	403
46	A	66	B
47	C	67	C
48	130	68	450
49	B	69	B
50	D	70	6.5
51	D	71	D
52	B	72	B
53	A	73	A
54	18	74	A
55	B	75	C
56	B	76	B
57	A	77	D
58	D	78	D
59	C	79	A
60	B	80	C

Number	Answer
81	D
82	A
83	B
84	$\frac{6}{5}$
85	18
86	-7
87	B
88	B
89	A
90	5
91	A
92	$\frac{5}{9}$
93	D
94	D

Linear System of Equations

1. [March US 2023]

$$5x + 4y = 44$$

$$3x - 7y = 17$$

The solution to the given system of equations is (x, y) . What is the value of $8x - 3y$?

2. [March US 2023]

$$2x - 2y = 2$$

One of the two linear equation in a system is given. The system has exactly one solution. Which equation could be the second equation in this system?

- A) $-8x + 8y = 3$
- B) $3x - 3y = 8$
- C) $-10x + 8y = 5$
- D) $-x + y = -1$

3. [March US 2023]

$$y = 18x + 25$$

$$y = -14x - 7$$

What is the solution (x, y) to the given system of equations?

- A) $(-7, 25)$
- B) $(-1, 7)$
- C) $(7, -1)$
- D) $(25, -7)$

4. [June 2023]

$$3x + 5y = 8$$

$$9x + 15y = 24$$

For each real number, r which of the following points lies on the graph of each equation in the xy -plane for the given system?

- A) $(r, -\frac{5r}{3} + \frac{8}{3})$
- B) $(r, \frac{3r}{5} + \frac{8}{5})$
- C) $(-\frac{5r}{3} + \frac{8}{3}, r)$
- D) $(\frac{r}{3} + 8, -\frac{r}{3} + 24)$

5. [June 2023]

$$mx + ky = -83$$

$$2x + ky = 22$$

In the given system of equations, m and k are constants. The graph of these equations in the xy -plane intersect at the point $(5, y)$. What is the value of m ?

6. [August US 2023]

$$2x + y = 8$$

$$ax + 3y = 24$$

In the given system of equations, a is a constant. The system has infinitely many solutions. What is the value of a ?

7. [August US 2023]

$$2x = -4$$

$$2x + y = -2$$

The solution to the given system of equations is (x, y) . What is the value of $4x + y$?

- A) -6
- B) -2
- C) 2
- D) 8

8. [August US 2023]

A small business budgeted \$1,000 to spend on printers and toner cartridges. The small business paid \$300 for each printer and \$50 for each toner cartridge. The entire budget was spent to purchase 2 printers and several toner cartridges. How many toner cartridges were purchased?

- A) 3
- B) 8
- C) 12
- D) 20

9. [August US 2023]

$$3x + y = 12$$

$$x - 3y = 0$$

The solution to the given system is (x, y) .
What is the value of x ?

10. [November 2023]

$$4x - 16y = 8$$

One of the two equations in a system of linear equations is given. The system has no solution. Which equation could be the second equation in this system?

- A) $x - 8y = 0$
- B) $\frac{1}{2}x - 2y = 1$
- C) $\frac{1}{2}x - 2y = 0$
- D) $x - 4y = 2$

11. [November 2023]

$$y = -\frac{1}{9}x$$

$$y = \frac{1}{7}x$$

The solution to the given system of equations is (x, y) . What is the value of x ?

- A) -9
- B) -2
- C) 0
- D) 7

12. [March 2024]

$$3x - 4y = 5$$

$$x = 7$$

What is the solution (x, y) to the given system of equations?

- A) $(7, 4)$
- B) $(7, 12)$
- C) $(7, -12)$
- D) $(7, -4)$

13. [November 2023]

$$4x - 16y = 8$$

One of the two equations in the system of linear equations is given. The system has no solution. Which of the following be the second equation in this system?

- A) $x - 8y = 0$
- B) $\frac{1}{2}x - 2y = 1$
- C) $\frac{1}{2}x - 2y = 0$
- D) $x - 4y = 2$

14. [March 2024]

Which system of linear equations has no solution?

- A) $-2x + 8y = -5$
 $2x - 8y = 5$
- B) $2x - 8y = 5$
 $3x + 9y = 6$
- C) $2x - 8y = 5$
 $-6x + 24y = -15$
- D) $-2x + 8y = 5$
 $4x - 16y = 10$

15. [March 2024]

$$8x + 7y = 58$$

$$8x + 21y = 142$$

The solution to the system is (x, y) . What is the value of $14y$?

- A) 2
- B) 6
- C) 84
- D) 200

16. [March 2024]

$$5x = 50y - 125$$

One of the two equations in a system of linear equations is given. The system has no solution. Which equation could be the second equation in this system?

- A) $x = 2y$
- B) $\frac{1}{5}x = 2y$
- C) $x = 10y - 25$
- D) $\frac{x}{5} = 10y - 25$

17. [March 2024]

$$x + 4y = -16$$

$$5x + 20y = 0$$

$$3x + 12y = 34$$

The given equations are graphed in the xy -plane. How many solutions (x, y) does the system of three equations have?

- A) Zero
- B) Exactly one
- C) Exactly two
- D) Infinitely many

18. [March 2024]

$$x + 5y = -18$$

$$6x + 30y = 0$$

$$4x + 20y = 28$$

The given equations are graphed in the xy -plane. How many solutions (x, y) does the system of equations have?

- A) Zero
- B) Exactly one
- C) Exactly two
- D) Infinitely many

19. [March 2024]

$$y = 6x^2 - 36x + 56$$

$$y + 3 = 0$$

How many solutions are there to the given system of equations?

- A) There is exactly 1 solution.
- B) There are exactly 2 solutions.
- C) There are exactly 3 solutions.
- D) There are no solutions.

20. [March 2024]

$$2(9x) + 5(8y) = 284$$

$$2(9x) - 5(8y) = -356$$

The solution to the given system of equations is (x, y) . What is the value of $9x + 8y$?

- A) -82
- B) -18
- C) 46
- D) 64

21. [March 2024]

Two customers bought the same kind of cheese and milk at a store. The first customer paid 12.45 dollars for 1 pound of cheese and 2 gallons of milk. The second customer paid 19.70 dollars for 3 pounds of cheese and 1 gallon of milk. What is the cost, in dollars, of 1 gallon of milk?

- A) 3.53
- B) 4.15
- C) 4.93
- D) 5.39

22. [May US 2024]

Which system of linear equations has no solution?

- A) $-5x + 9y = -8$
 $5x - 9y = 8$
- B) $5x - 9y = 8$
 $6x + 10y = 9$
- C) $5x + 9y = 8$
 $-15x + 27y = -24$
- D) $-5x + 9y = 8$
 $10x - 18y = 16$

23. [May 2024]

$$9x + 5y = 19$$

$$-9x - 3y = 7$$

The solution to the given system of equations is (x, y) . What is the value of $2y$?

24. [May 2024]

$$31(x - n) = 31y + 31n$$

One of the equations in a system of two linear equations is given, where n is a positive constant. The system has no solution. Which equation could be the second equation in this system?

- A) $3x - 3y = 6n$
- B) $3x + 3y = 3n$
- C) $3x + 3y = 6n$
- D) $3x - 3y = 3n$

25. [May 2024]

At what point (x, y) do the graphs of the equations $y = 2x + 4$ and $y = 3x - 6$ intersect in the xy -plane?

- A) (2,3)
- B) (3,2)
- C) (10,24)
- D) (24,10)

26. [May 2024]

$$2x + 5y = 3$$

$$8x + 20y = 12$$

For each real number r , which of the following points lies on the graph of each equation in the xy -plane for the given system?

- A) $(r, -\frac{5r}{2} + \frac{3}{2})$
- B) $(r, \frac{2r}{5} + \frac{3}{5})$
- C) $(\frac{r}{4} + 3, -\frac{r}{4} + 12)$
- D) $(-\frac{5r}{2} + \frac{3}{2}, r)$

27. [May US 2024]

$$3x - 2y = 5$$

$$x = 7$$

What is the solution (x, y) to the given system of equations?

- A) (7,8)
- B) (7,14)
- C) (7,-8)
- D) (7,-14)

28. [June 2024]

$$y = -\frac{1}{3}x$$

$$y = \frac{1}{5}x$$

The solution to the given system of equations is (x, y) . What is the value of x ?

- A) -3
- B) 0
- C) 2
- D) 5

29. [June 2024]

$$y = -\frac{1}{7}x$$

$$y = \frac{1}{11}x$$

The solution to the given system of equations is (x, y) . What is the value of x ?

- (A) -7
- (B) 0
- (C) 4
- (D) 11

30. [August 2024]

$$x = 2 + 8y$$

$$x = 4 - 8y$$

The solution to the given system of equations is (x, y) . What is the value of $2x$?

31. [August US 2024]

$$3x + 5y = 21$$

$$y = 3$$

What is the solution (x, y) to the given system of equations?

- A) (3,7)
- B) $(3, \frac{7}{5})$
- C) $(\frac{8}{5}, 3)$
- D) (2,3)

32. [August 2024]

A scientist makes batches of bricks using different sand-to-cement ratios to test how the sand-to-cement ratio affects the strength of the brick. For one batch of bricks, the scientist uses 4,880 cubic centimeters (cm^3) of sand and cement, where the ratio of the volume of sand to the volume of cement is 7 to 3. If s represents the volume, in cm^3 , of sand and c represents the volume, in cm^3 , of cement that the scientist uses for this batch of bricks, which system of equations represents this situation?

- A) $s = c$
 $7s + 3c = 4,880$
- B) $s = c$
 $3s + 7c = 4,880$
- C) $7s = 3c$
 $s + c = 4,880$
- D) $3s = 7c$
 $s + c = 4,880$

33. [August 2024]

$$\frac{x-18}{6} + \frac{y+25}{3} = -5$$

$$\frac{x-18}{3} - \frac{y+25}{6} = 5$$

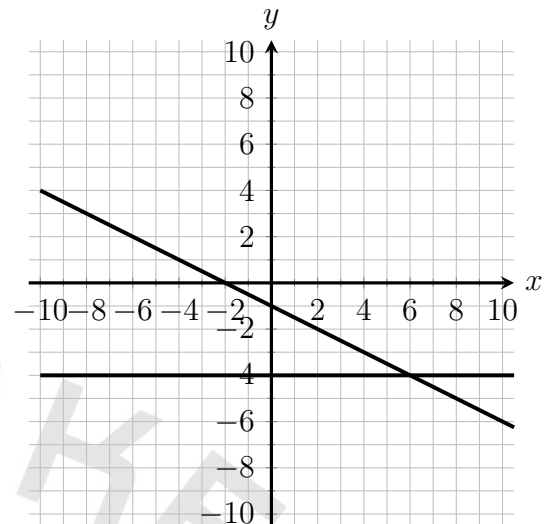
The solution to the given system of equations is (x, y) . What is the value of $x - y$?

34. [August US 2024]

Which system of linear equations has infinitely many solutions?

- A) $4x + 2y = 12$
 $4x + 8y = 48$
- B) $x + 2y = 12$
 $x + 8y = 48$
- C) $x + 2y = 12$
 $4x + 8y = 48$
- D) $4x + 2y = 12$
 $xx + 8y = 48$

35. [August 2024]



The graph of a system of two linear equations is shown. If a third equation, $x + 2y = -8$, is added to this system, how many solutions will the resulting system of three equations have?

- A) Zero
- B) Exactly one
- C) Exactly two
- D) Infinitely many

36. [August US 2024]

$$3.5x + 1.2y = 8$$

$$17.5x + 6y = 40$$

How many solutions does the given system of equations have

- A) Exactly one
- B) Exactly two
- C) Infinitely many
- D) Zero

37. [August US 2024]

$$(x - 2) - 8(y + 3) = 123$$

$$(x - 2) + 8(y + 3) = 432$$

The solution to the given system of equations is (x, y) . What is the value of $10(x - 2)$?

38. [August US 2024]

$$5x + 7y = 8$$

$$30x + 42y = 48$$

For each real number r , which of the following points lies on the graph of each equation in the xy -plane for the given system?

- A) $(r, -\frac{5r}{7} + \frac{8}{7})$
- B) $(-\frac{5r}{7} + \frac{8}{7}, r)$
- C) $(-\frac{5r}{7} + 8, \frac{5r}{7} + 48)$
- D) $(\frac{r}{6} + 8, -\frac{r}{6} + 48)$

39. [October US 2024]

At how many points do the graphs of the equations $y = x + 24$ and $y = 7x$ intersect in the xy -plane?

- A) 0
- B) 1
- C) 2
- D) 7

40. [October US 2024]

$$y = 5x + 7$$

$$y = -4x - 11$$

The solution to the given system of equations is (x, y) . What is the value of y ?

- A) -18
- B) -4
- C) -3
- D) -2

41. [October 2024]

$$y = 6x + 16$$

$$-7x - y = 36$$

What is the solution (x, y) to the given system of equations?

- A) $(-4, -8)$
- B) $(-\frac{20}{13}, -\frac{80}{13})$
- C) $(4, 40)$
- D) $(20, 136)$

42. [October 2024]

$$7x + 4y = 3$$

$$35x + 20y = 15$$

For each real number r , which of the following points lies on the graph of each equation in the xy -plane for the given system?

- A) $(\frac{r}{5} + 3, -\frac{r}{5} + 15)$
- B) $(-\frac{4r}{7} + \frac{3}{7}, r)$
- C) $(r, \frac{7r}{4} + \frac{3}{4})$
- D) $(r, -\frac{4r}{7} + \frac{3}{7})$

43. [October US 2024]

$$2x = 20y - 8$$

One of the two equations in a system of linear equations is given. The system has no solution. Which equation could be the second equation in this system?

- A) $x = 5y$
- B) $\frac{1}{2}x = 5y$
- C) $x = 10y - 4$
- D) $\frac{1}{2}x = 10y - 4$

44. [October US 2024]

$$3y = 8x + 18$$

$$-3y = 7x - 26$$

The solution to the given systems of equations is (x, y) . What is the value of $30x$?

- A) -16
- B) -8
- C) 8
- D) 16

45. [October US 2024]

$$5(8x) + 4(6y) = 12$$

$$-5(8x) + 4(6y) = 12$$

The solution to the given system of equations is (x, y) . What is the value of $8x + 6y$?

- A) 0.5
- B) 0.6
- C) 3
- D) 1.2

46. [October US 2024]

$$6x + 3y = 5$$

The given equation is one equation in a system of two linear equations. If the system of equations has at least one solution, which of the following equations could be the other equation in the system?

- I. $9x + 4.5y = 7.5$
- II. $9x - 4.5y = 7.5$
- A) I only
- A) II only
- A) I and II
- A) Neither I and II

47. [November 2024]

$$y = -\frac{1}{7}x$$

$$y = \frac{1}{5}x$$

The solution to the given system of equations is (x, y) . What is the value of x ?

- A) -7
- B) -2
- C) 0
- D) 5

48. [November 2024]

$$45x + 33y - 200 = -359$$

$$2wx + 11y = -53$$

In the given system of equations, W is a constant. The system has infinitely many solutions. What is the value of w ?

49. [November US 2024]

$$22x - 21y = 43$$

$$5x + 14y = 59$$

The solution to the given system of equations is $(x, y) = (\frac{p}{50}, \frac{w}{826})$, where p and w are integers. What is the value of p ?

50. [December US 2024]

The solution to the given system of equations is (x, y) .

$$\frac{5}{4}x + 2y = 17$$

$$\frac{3}{4}x + 2y = 15$$

What is the value of $\frac{11}{4}x + 6y$?

- A) 4
- B) 6
- C) 32
- D) 47

51. [December US 2024]

$$5x + 8y = 9$$

$$15x + 24y = 27$$

For each real number r , which of the following points on the graph of each equation on the xy -plane for the given system?

- A) $(r, -\frac{5r}{8} + \frac{9}{8})$
- B) $(-\frac{5r}{8} + \frac{9}{8}, r)$
- C) $(-\frac{5r}{8} + 9, \frac{5r}{8} + 27)$
- D) $(\frac{r}{3} + 9, -\frac{r}{3} + 27)$

52. [December US 2024]

A carnival receives \$10 for each adult admission ticket sold and \$5 for each child admission sold. On a particular day, the carnival received a total of \$4,100 from selling adult and child admission tickets. If 220 adult admission tickets were sold on that day, how many child tickets were sold?

53. [December US 2024]

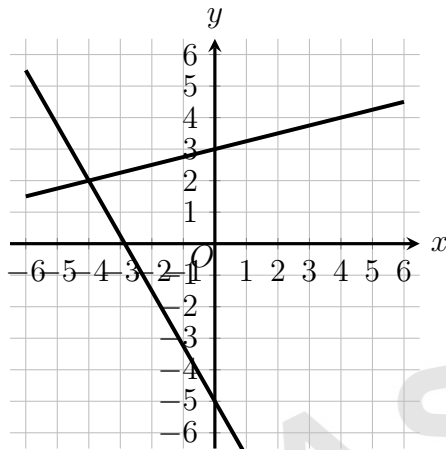
$$y - x = 32$$

$$y = x^2 - 30x$$

The graphs of the equations in the given system intersect at the point (x, y) in the xy -plane. What is a possible value of y ?

- A) 32
- B) 33
- C) 63
- D) 64

54. [December 2024]



The graph of a system of two linear equations is shown. The solution to the system is (x, y) . What is the value of y ?

- A) -5 C) 2
B) -4 D) 3

55. [December 2024]

$$\frac{x}{7} + 5(y - 14) = 29$$

$$\frac{x}{3} - 5(y - 14) = 41$$

The solution to the given system of equations is (x, y) . What is the value of $10x$?

56. [December 2024]

If $x + 4y = 41$ and $7x - 20y = -97$, what is the value of y ?

57. [December 2024]

$$13(x - n) = 13y + 13n$$

One of the equations in a system of two linear equations is given, where n is a positive constant. The system has no solution. Which equation could be the second equation in this system?

- A) $2x - 2y = 4n$ C) $2x + 2y = 4n$
B) $2x + 2y = 2n$ D) $2x - 2y = 2n$

58. [June 2023]

$$(x - 3) - 8(y + 9) = 129$$

$$(x - 3) + 8(y + 9) = 432$$

The solution to the given equation is (x, y) . What is the value of $8(x - 3)$?

59. [June 2023]

$$y = 5(x - 2)^2$$

$$y = 10(x - 2)$$

A solution to the given system of equations is (x, y) . What is the one possible value of $x + y$?

- A) -20 C) 20
B) 4 D) 24

60. [December 2023]

$$\frac{7}{3}x + 4y = 27$$

$$\frac{5}{3}x + 4y = 25$$

The solution to the given system of equations is (x, y) .

What is the value of $\frac{17}{3}x + 12y$?

- A) 3 C) 52
B) 5 D) 77

61. [March 2024]

At a constant temperature, a scuba diver combines two different concentrations of nitrox mix (oxygen-nitrogen gas mixture) to fill a tank to a total pressure of 130 atmospheres (atm), of which 34% is contributed by oxygen. Nitrox mix A contributes x atm of pressure to the tank, of which 22% is contributed by oxygen. Nitrox mix B contributes y atm of pressure to the tank, of which 48% is contributed by oxygen. Which system of equations represents this situation?

- A) $x + y = 130$
 $0.48x + 0.22y = 0.34(130)$
B) $x + y = 130$
 $0.22x + 0.48y = 0.34(130)$
C) $x + y = 0.34(130)$
 $0.48x + 0.22y = 130$
D) $x + y = 0.34(130)$
 $0.22x + 0.48y = 130$

Answers: Linear System of Equations

Number	Answer	Number	Answer
1	61	21	A
2	C	22	D
3	B	23	26
4	C	24	D
5	-19	25	C
6	6	26	D
7	A	27	A
8	B	28	B
9	3.6	29	B
10	C	30	6
11	C	31	D
12	A	32	D
13	C	33	17
14	D	34	C
15	C	35	A
16	B	36	C
17	A	37	2775
18	A	38	A
19	B	39	B
20	C	40	C

Number	Answer	Number	Answer
41	B	51	B
42	B	52	380
43	B	53	D
44	D	54	C
45	C	55	1470
46	B	56	8
47	C	57	D
48	7.5	58	2244
49	263	59	D
50	D	60	D
		61	B

Linear Functions

1. [March US 2023]

Line k passes through the points $(1,1)$ and $(2,6)$ in the xy -plane. If the equation for the line k is written in the form $y = mx + b$, where m and b are constants, what is the value of m ?

2. [March US 2023]

In the linear functions g , $g(-2) = \frac{3}{4}$ and $g(3) = \frac{9}{2}$. Which equation defines g ?

- A) $g(x) = \frac{3}{4}x + \frac{9}{4}$
- B) $g(x) = \frac{3}{4}x + \frac{9}{2}$
- C) $g(x) = \frac{15}{4}x - \frac{27}{4}$
- D) $g(x) = \frac{15}{4}x + \frac{33}{4}$

3. [March US 2023]

Line k in the xy -plane has slope $-\frac{2p}{5}$ and y -intercept $(0,p)$, where p is a positive constant. What is the x -coordinate of the x -intercept of line k ?

4. [March US 2023]

The function f is defined by

$$f(x) = \frac{1}{5}x + \frac{9}{10}.$$

For what value of x does $f(x) = 1$?

5. [March US 2023]

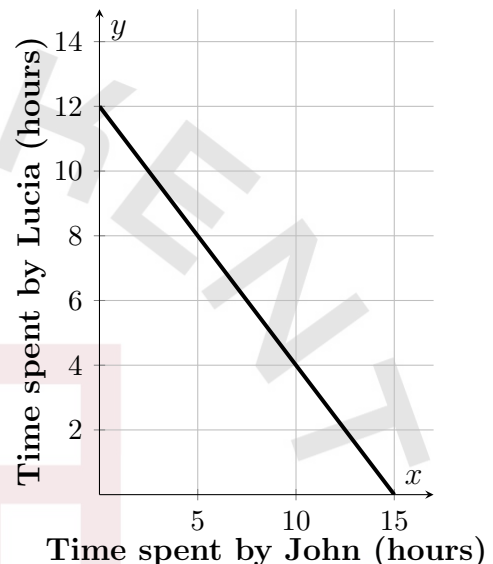
The function m is defined by

$$m(x) = 30x + 120.$$

What is the slope of the graph of $y = m(x)$ in the xy -plane?

6. [March US 2023]

Lucia and John will work together to make 60 paper flowers for a school party. The line shown represents the possible combinations of time, in hours, spent by Lucia and John to fulfill this task.



According to the graph, on average, how many paper flowers will Lucia make per hour.

- A) 4
- B) 5
- C) 12
- D) 15

7. [June 2023]

A business consultant charges \$408 for the first hour and \$204 for each additional hour of work. Which of the following functions gives the charge $C(h)$, in dollars, for h hours of work, where h is a positive integer?

- A) $C(h) = 204h + 204$
- B) $C(h) = 204h + 408$
- C) $C(h) = 408h + 204$
- D) $C(h) = 408h + 612$

8. [June 2023]

To make a bookcase, a worker charged a onetime *fee* plus \$17 per hour worked. The equation $17h + 45 = 164$ represents this situation, where h is the number of hours worked. Which of the following is the best interpretation of 164 in this context?

- A) The one time fee, in dollars
- B) The number of hours worked
- C) The charge per hour, in dollars
- D) The total charge, in dollars

9. [June 2023]

x	y
0	n
4	$n + 19$
8	$n + 38$

There is a linear relationship between x and y . The table shows three values of x and their corresponding values of y in terms of a constant n . What is the slope of the line that represents this relationship in the xy -plane?

10. [June 2023]

What is the y -intercept of the graph of $3x + 2y = 96$ in the xy -plane?

- A) (0,5)
- B) (0,6)
- C) (0,32)
- D) (0,48)

11. [June 2023]

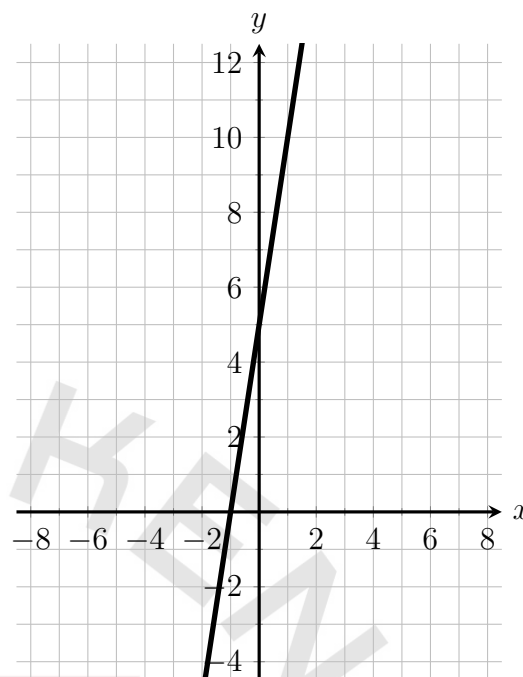
For the linear function f , the graph of $y = f(x)$ in the xy -plane passes through the points (0,2) and (3,3). What is the slope of $y = f(x)$?

12. [December 2024]

The function f is defined by $f(x) = \frac{x+11}{3}$, and $f(a) = 16$, where a is a constant. What is the value of a ?

- A) 9
- B) 16
- C) 59
- D) 37

13. [June 2023]



Line n is shown in the xy -plane. Line k (not shown) is perpendicular to line n . What is slope of line k ?

- A) $-\frac{1}{5}$
- B) $-\frac{1}{6}$
- C) 5
- D) 6

14. [August US 2023]

A line in the xy -plane passes through the points (0,12) and (1,14). The equation of the line is $y = mx + b$, where m and b are constants. What is the value of b ?

15. [August US 2023]

$$p = 873 - 88t$$

The given equation models the approximate pressure p , in pounds per square inch, in an astronaut's oxygen tank during a spacewalk that lasts for t hours, where $t \leq 9$. What would be the tank pressure, in pounds per square inch, at the end of a spacewalk that lasted 1 hour?

- A) 829
- B) 785
- C) 741
- D) 697

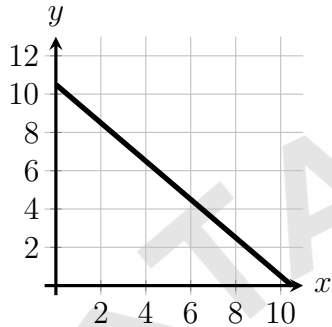
16. [August US 2023]

The function p is defined by

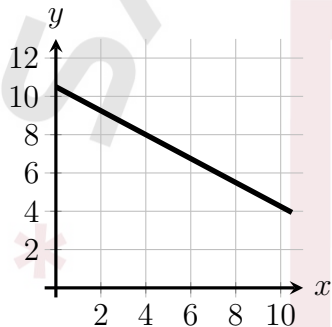
$$p(x) = -\frac{5}{8}x + \frac{21}{2}.$$

What is the graph of $y = p(x)$?

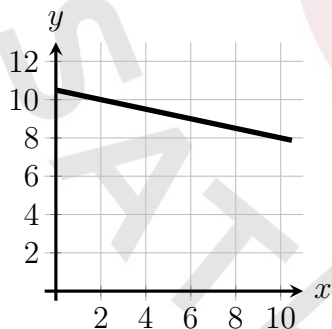
A)



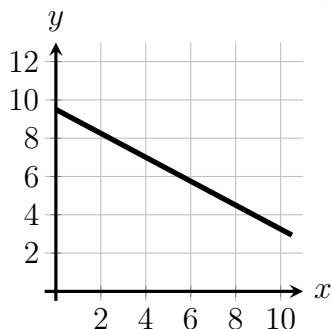
B)



C)



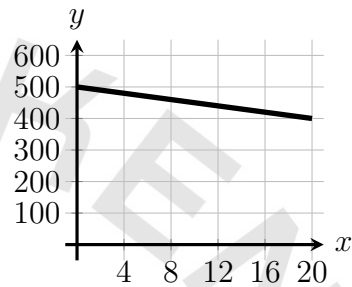
D)



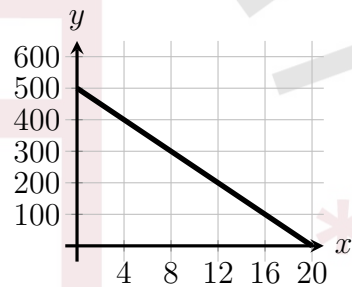
17. [August US 2023]

The average price, in dollar, when adjusted for inflation, of a US domestic airline ticket each quarter of a year can be modeled by the equation $y = -5x + 500$, where x is the number of quarters after the last quarter of 1999, and $x \leq 20$. Which graph represents this model?

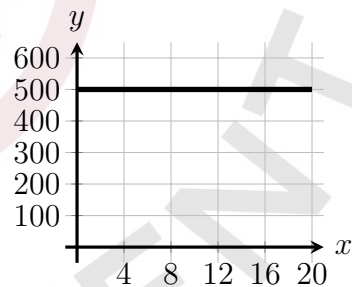
A)



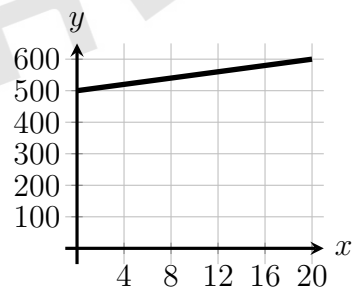
B)



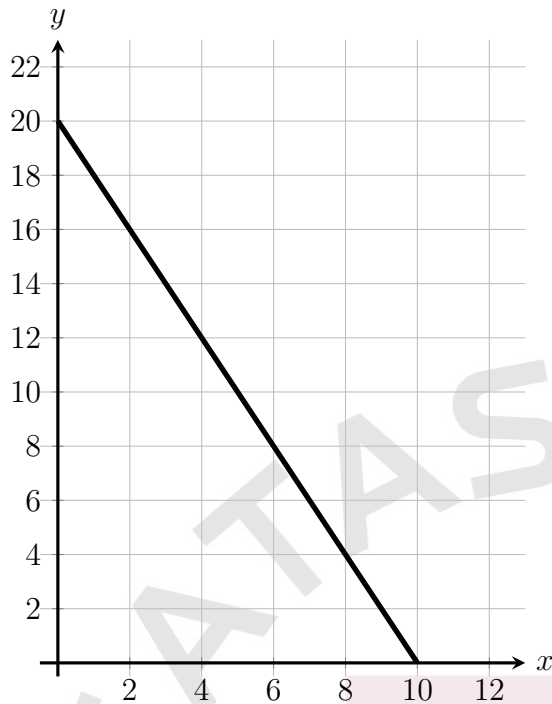
C)



D)



18. [August US 2023]

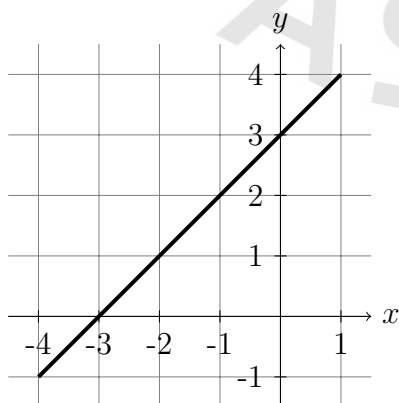


A publishing company is preparing boxes of workbooks and textbooks for shipping. Each box of workbooks and textbooks will weigh a total of 40 pounds. The graph shown models the relationship between the number of textbooks x and the number of workbooks y that can be shipped in 1 box. Based on the graph, what is the weight, in pounds, of 1 textbook?

- A) -26 C) 4
B) 10 D) 2

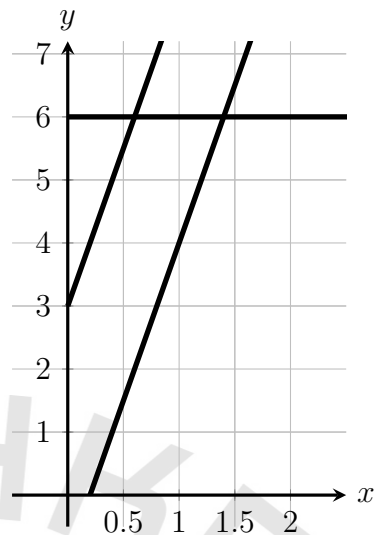
19. [August US 2023]

Which is an equation of the graph shown?



- A) $y = x + 1$ C) $y = x + 3$
B) $y = x - 1$ D) $y = x - 3$

20. [August US 2023]



How many solutions (x, y) does the systems of three linear equations represented in the graph have?

- A) 0 C) 2
B) 1 D) 3

21. [August US 2023]

Demarcus has 200 Japanese yen (JPY). He needs to exchange Hong Kong dollars (HKD) for more JPY. The exchange rate is 14 JPY for every HKD. Which function f gives the total amount, in JPY, Demarcus will have after exchanging x HKD?

- A) $f(x) = 14 - 200x$
B) $f(x) = 14 + 200x$
C) $f(x) = 200 - 14x$
D) $f(x) = 200 + 14x$

22. [August US 2023]

In the xy -plane, the graph of the linear function f contains the points $(5, 7)$ and $(3, 11)$. Which equation defines f , where $y = f(x)$?

- A) $f(x) = \frac{1}{2}x + \frac{9}{2}$
B) $f(x) = -\frac{1}{2}x + \frac{19}{2}$
C) $f(x) = 2x - 3$
D) $f(x) = -2x + 17$

23. [August US 2023]

$$w(t) = 3.1t - 1.7$$

The function w models the weight, in pounds, of a certain pig t months after it was born, where $1 \leq t \leq 36$. Which statement is the best interpretation of $w(7) = 20$ in this context?

- A) The pig weighed 20 pounds 7 months after it was born.
- B) The pig weighed 7 pounds 20 months after it was born.
- C) The pig's weight increased by 20 pounds during the 7th month after it was born.
- D) The pig's weight increased by 7 pounds during the 20th month after it was born.

24. [November 2023]

The total amount of food y in pounds that a zookeeper feeds a giraffe over x days is represented by the equation $y = 30x$. What is the total amount of food, in pounds, that the zookeeper feeds the giraffe over 3 days?

- A) 30
- B) 33
- C) 90
- D) 93

25. [November 2023]

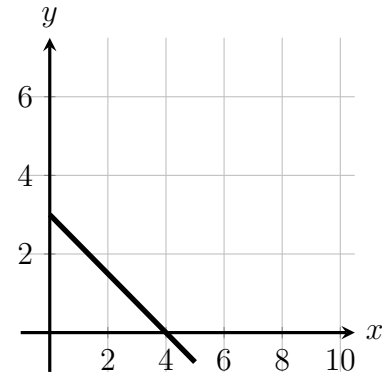
For the linear function f , the graph of $y = f(x)$ in the xy -plane passes through the points $(0,5)$ and $(7,7)$. What is the slope of $y = f(x)$?

26. [November 2023]

The function f is defined by the equation $f(x) = 100x + 2$. What is the value of $f(x)$ when $x = 8$?

- A) 110
- B) 116
- C) 800
- D) 802

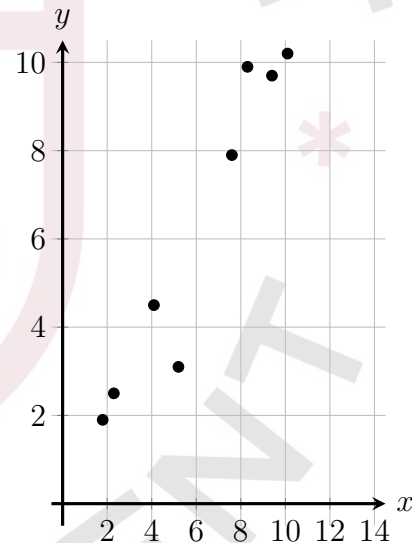
27. [November 2023]



The graph of the linear equation $15x + By = 60$ is shown, where B is a constant. What is the value of B ?

- A) $\frac{3}{4}$
- B) 3
- C) 4
- D) 20

28. [November 2023]



Which of the following equations is the most appropriate linear model for the data shown?

- A) $y = -2x$
- B) $y = -x$
- C) $y = x$
- D) $y = 2x$

29. [November 2023]

An equation of the line in the xy -plane that contains the points $(0,2)$ and $(8,0)$ is $ax + by = 1$, where a and b are constants. What is the value of a ?

30. [November 2023]

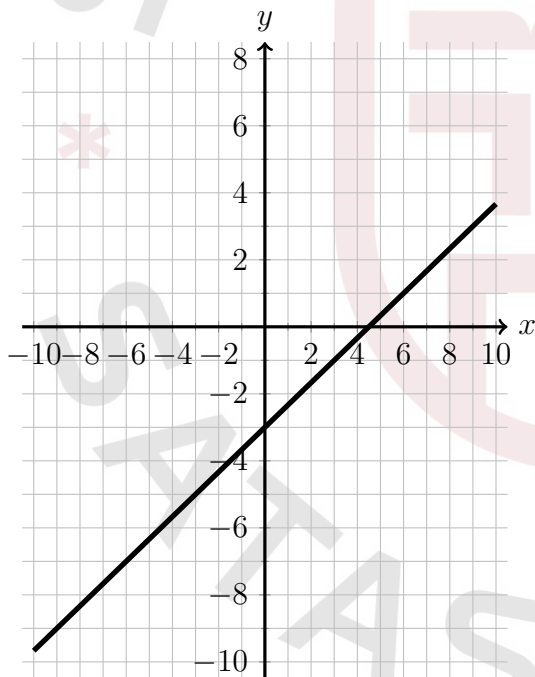
A business consultant charges \$444 for the first hour and \$222 for each additional hour of work. Which of the following functions gives the charges $C(h)$, in dollars, for h hours of work, where h is a positive integer?

- A) $C(h) = 222h + 222$
- B) $C(h) = 222h + 444$
- C) $C(h) = 444h + 222$
- D) $C(h) = 444h + 666$

31. [December 2023]

The function g is defined by $g(x) = \frac{4}{5}x - 32$. What is the x coordinate of x intercept of the graph of $y = g(x)$ in the xy -plane?

32. [December 2023]



Line k is shown in the xy -plane. Line n (not shown) is perpendicular to line k and passes through the point $(2, 9)$. Which equation defines line n ?

- A) $y = -\frac{3}{2}x + 6$
- B) $y = -\frac{3}{2}x + 12$
- C) $y = \frac{3}{2}x + 6$
- D) $y = \frac{3}{2}x + 12$

33. [December 2023]

A linear model estimates the population of a city from 1991 to 2015. The model estimates the population was 59 thousands in 1991, 222 thousand in 2011, and x thousand in 2015. To the nearest whole number, what is the value of x ?

34. [December 2023]

What is the slope of the graph of

$$8x - 4y = -12$$

in the xy -plane?

- A) -2
- B) $-\frac{2}{3}$
- C) $\frac{2}{3}$
- D) 2

35. [December 2023]

When the linear function h is graphed in the xy -plane, where $y = h(x)$, its slope is -2 . If $h(5) = 3$, which equation defines h ?

- A) $h(x) = -2x + 5$
- B) $h(x) = -2x + 13$
- C) $h(x) = -2x + 3$
- D) $h(x) = -2x - 7$

36. [December 2023]

The cost of renting a piece of constructing equipment for up to 5 days is \$350 for the first day and \$175 for each additional day. Which of the following equations gives the cost y , in dollars, of renting the equipment for x days, where x is a positive integer and $x \leq 5$?

- A) $y = 175x + 175$
- B) $y = 350x - 175$
- C) $y = 175x + 350$
- D) $y = 350x + 175$

37. [December 2023]

Harper deposited a fixed amount into her bank account each month. The function $f(t) = 50 + 55t$ gives the amount, in dollars, in Harper's bank account t monthly deposits. What is the best interpretation of 55 in this context?

- A) With each monthly deposit, the amount in Harper's bank account increased by \$55
- B) Harper made a total of 55 monthly deposits
- C) Before Harper made any monthly deposits, the amount in her bank account was \$55
- D) After 1 monthly deposit, the amount in Harper's bank account was \$55

38. [March 2024]

The function f is defined by $f(x) = \frac{x}{10} + 74$. What is the value of $f(20)$?

39. [March 2024]

x	y
-11	-25
9	55

The table shows two values of x and their corresponding values of y . The graph of the linear equation representing this relationship passes through the point $(\frac{1}{3}, a)$. What is the value of a ?

40. [March 2024]

$$g(m) = -0.05m + 14.1$$

The given function g models the number of gallons of gasoline that remains from a full gas tank in a car after driving m miles. According to the model, about how many gallons of gasoline are used to drive each mile?

- A) 0.05
- B) 14.1
- C) 20
- D) 282.0

41. [March 2024]

Line r is defined by the equation

$$4x - 5y = 8.$$

Line s is parallel to line r in the xy -plane. What is the slope of line s ?

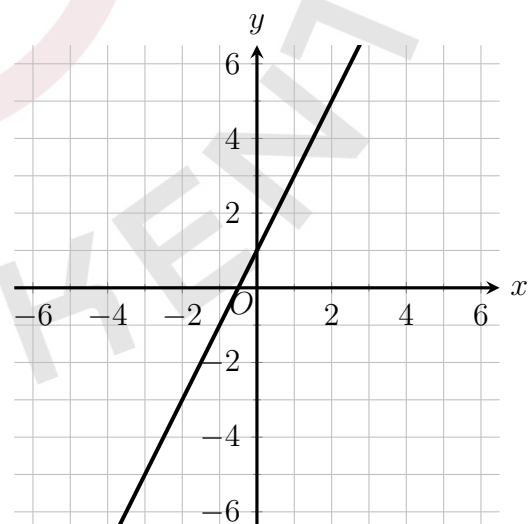
- A) $\frac{5}{4}$
- B) $\frac{4}{5}$
- C) -4
- D) -5

42. [March 2024]

The cost to rent a bus from Company X is \$750 for the first 2 hours and an additional \$50 per hour for each hour after the first 2 hours. If the total cost to rent the bus from Company X for t hours, where $t > 2$, is \$1,050, which equation represents this situation?

- A) $750(t - 2) + 50t = 1,050$
- B) $750(2t) + 50t = 1,050$
- C) $750 + 50(t - 2) = 1,050$
- D) $750 + 50(2t) = 1,050$

43. [March 2024]



The graph of $y = f(x)$ is shown. What is the y -intercept of the graph of $y = f(x) + 13$?

- A) $(0, -12)$
- B) $(0, 14)$
- C) $(1, 13)$
- D) $(0, 13)$

44. [March 2024]

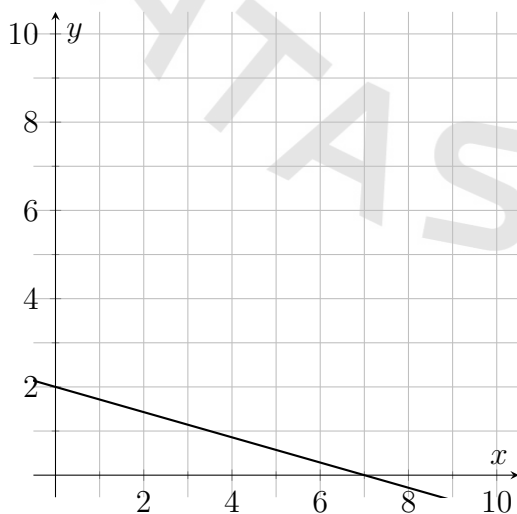
Alex engages in up to 3 types of exercise each week for a total of 9 hours while training for a triathlon. Alex swims for the same number of minutes each week. The equation $y = 540 - x - 200$ represents the situation where Alex bikes for x minutes during a week and runs for any remaining training time, y , in minutes. If this equation is graphed in the xy -plane, which statement is the best interpretation of the x -intercept of the graph?

- A) During a week when Alex swims for 340 minutes, he bikes for 200 minutes.
- B) Each week, Alex bikes and runs for a total of 340 minutes.
- C) During a week when Alex doesn't bike, he runs for 340 minutes.
- D) During a week when Alex doesn't run, he bikes for 340 minutes.

45. [March 2024]

During hibernation, American black bears do not eat or replenish calories. A certain black bear weighed 389 pounds when entering hibernation and lost weight at a rate of 0.9 pound per day. At this rate, how many days after entering hibernation did the black bear weigh 380 pounds?

46. [March 2024]



The graph of the linear equation $8x + By = 56$ is shown, where B is a constant. What is the value of B ?

47. [March 2024]

The function f is defined by

$$f(x) = \frac{1}{2}(x + 8).$$

What is the value of $f(10)$?

- A) 36
- B) 18
- C) 16
- D) 9

48. [March 2024]

$$19.5x + 29.75y = 394$$

Odalys ordered mulch and river rock, which cost a total of \$394, for her home. The given equation represents the relationship between the number of cubic yards of mulch, x , and the number of tons of river rock, y , Odalys ordered. How much more, in dollars, did a ton of river rock cost Odalys than a cubic yard of mulch?

49. [March 2024]

In the xy -plane, line ℓ passes through the point $(0, 0)$ and is parallel to the line represented by the equation $y = 6x + 3$. If line ℓ also passes through the point $(3, d)$, what is the value of d ?

50. [March 2024]

A family has money in an account for renting movies online. Each time the family rents a movie, the cost of the rental is withdrawn from the account, and each rental costs the same amount of money. The function $f(m) = 30 - 6m$ gives the amount of money, in dollars, in the account after the family has rented m movies. Which of the following represents the amount of money, in dollars, withdrawn from the account each time the family rents a movie?

- A) $6m$
- B) 6
- C) 30
- D) $30 - 6m$

51. [March 2024]

$$f(x) = 5x - 9$$

Function f is defined by the given equation. The function g is defined by $g(x) = f(x)(3x - 2)$. What is the x -coordinate of the x -intercept of the graph of $y = g(x)$ in the xy -plane?

- A) $\frac{11}{8}$ C) $\frac{7}{2}$
 B) $\frac{9}{5}$ D) $\frac{11}{2}$

52. [March 2024]

$y = -2x + 70$ Which table gives the values of x and the corresponding values of y for the given equation?

A)

x	y
0	0
1	2
2	4

B)

x	y
0	0
1	72
2	74

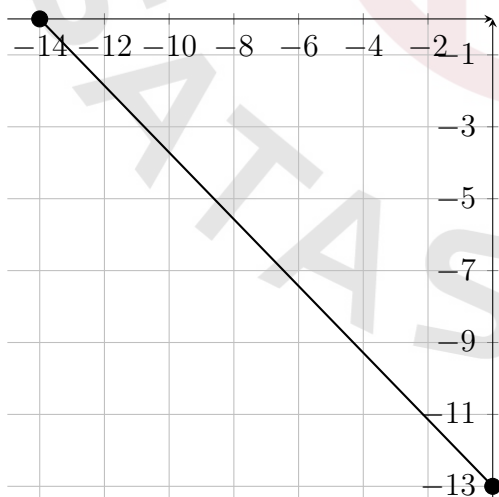
C)

x	y
0	0
1	72
2	144

D)

x	y
0	70
1	68
2	66

53. [March 2024]



The point $(v, -7)$ lies on the line shown. What is the value of v ?

- A) $-\frac{84}{13}$ C) $\frac{83}{14}$
 B) $\frac{13}{14}$ D) $\frac{280}{13}$

54. [March 2024]

x	$g(x)$
-25	4
-9	0
15	6

The table shows three values of x and their corresponding values of $g(x)$, where $g(x) = \frac{f(x)}{x + 5}$ and f is a linear function. What is the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane?

55. [March 2024]

For the linear function f , the graph of $y = f(x)$ in the xy -plane has a slope of $\frac{4}{5}$ and passes through the point $(20, 19)$. Which equation defines f ?

- A) $f(x) = \frac{4}{5}x + \frac{19}{20}$
 B) $f(x) = \frac{4}{5}x + \frac{24}{5}$
 C) $f(x) = \frac{4}{5}x + 19$
 D) $f(x) = \frac{4}{5}x + 3$

56. [March 2024]

A linear function f give company's profit, in dollars, for selling x items. The company's profit is \$320 when it sells 6 items, and its profit is \$640 when it sells 10 items. Which equation defines f ?

- A) $f(x) = 180x - 640$
 B) $f(x) = 64x$
 C) $f(x) = 80x - 10$
 D) $f(x) = 80x - 160$

57. [March 2024]

$$F(x) = \frac{9}{5}(-273.15) + 32x$$

The function F gives the temperature, in degrees Fahrenheit, that corresponds to x kelvins. If a temperature is increased by 11.70 kelvins, by how much did the temperature increase in degrees Fahrenheit?

58. [March 2024]

For the linear function f , the graph $y = f(x)$ in the xy -plane has a slope of $\frac{2}{3}$ and passes through the point $(6, 5)$. Which equation defines f ?

- A) $f(x) = \frac{2}{3}x + \frac{5}{6}$
- B) $f(x) = \frac{2}{3}x + \frac{8}{3}$
- C) $f(x) = \frac{2}{3}x + 5$
- D) $f(x) = \frac{2}{3}x + 1$

59. [March 2024]

The function f is defined by $f(x) = 10x + 8$. What is the value of $f(x)$ when $x = 7$.

- A) 25
- B) 66
- C) 78
- D) 87

60. [March 2024]

The function f is defined by

$$f = -12x + 28.$$

What is the y -coordinate of the y intercept of the graph $y = f(x)$ in the xy -plane?

61. [May 2024]

Scientists collected fallen acorns that each housed a colony of the ant species *P. ohioensis* and analyzed each colony's structure. For any of these colonies, if the colony has x worker ants, the equation $y = 0.67x + 2.6$, where $20 \leq x \leq 110$ gives the predicted number of larvae y in the colony. If one of these colonies has 46 worker ants, which of the following is closest to the predicted number of larvae in the colony?

- A) 33
- B) 49
- C) 65
- D) 150

62. [May 2024]

Javier deposits \$45 in a savings account at the end of each week. At the beginning of the 1st week of a year there was \$700 in that savings account. How much money, in dollars, will be in the account at the end of the 6th week of the year?

- A) 430
- B) 745
- C) 751
- D) 970

63. [May US 2024]

$$g(x) = 3(16x - 17)$$

What is the y -coordinate of the y -intercept of the graph of $y = g(x) - 5$ in the xy -plane?

- A) -56
- B) -51
- C) -22
- D) -17

64. [May 2024]

$$f(x) = 5x + b$$

For the linear function f , b is a constant and $f(7) = 35$. What is the value of b ?

- A) 0
- B) 1
- C) 5
- D) 7

65. [May 2024]

The cost of renting a piece of equipment is $\$64n$ for the first day and $\$32n$ for each additional day, where n is a positive integer. Which of the following functions gives the cost $C(x)$ in dollars, of renting this equipment for x days, where x is a positive integer?

- A) $C(x) = 32nx + 32n$
- B) $C(x) = 32nx + 64n$
- C) $C(x) = 64nx + 32n$
- D) $C(x) = 64nx - 32n$

66. [May 2024]

At a depth of h meters below the surface, the estimated total pressure P_1 , in kilopascals (kPa), a diver experienced is given by $P_1 = 10h + 101$, which is a combination of estimated water pressure and estimated atmospheric pressure. After maintaining a certain depth, the diver descended d additional meters. The estimated total pressure P_2 , in kPa, that the diver experienced after descending these d additional meters is given by $P_2 = 10d + 311$. Which of the following is the best interpretation of 311 in this context?

- A) The estimated total pressure, in kPa, the diver experienced at a depth of d meters.
- B) The estimated increase in the total pressure, in kPa, the diver experienced for each increase in the depth by 1 meters.
- C) The estimated increase in the total pressure, in kPa, the diver experienced for each increase in the depth by d meters.
- D) The estimated total pressure, in kPa, the diver experienced when the diver began to descend d additional meters.

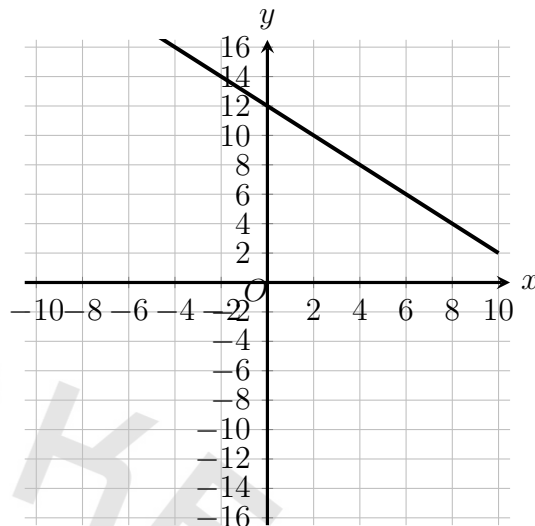
67. [May US 2024]

Number of cars	Maximum number of passengers and crew
4	164
6	242
8	320

The table shows the linear relationship between the number of cars, c , on a commuter train and the maximum number of passengers and crew, p , that the train can carry. Which equation represents the linear relationship between c and p ?

- A) $39c - p = -8$
- B) $39c - p = 8$
- C) $39p - c = -8$
- D) $39p - c = 8$

68. [May 2024]



What is an equation of the graph shown?

- A) $y = x + 12$
- B) $y = -x + 12$
- C) $y = 2x + 12$
- D) $y = -2x + 12$

69. [May 2024]

Line k is defined by $y = 6x + \frac{1}{9}$. Line j is perpendicular to line k in the xy -plane. What is the slope of line j ?

- A) -9
- B) $-\frac{1}{6}$
- C) $\frac{1}{9}$
- D) 6

70. [May US 2024]

$$17.5x + 28.75y = 530$$

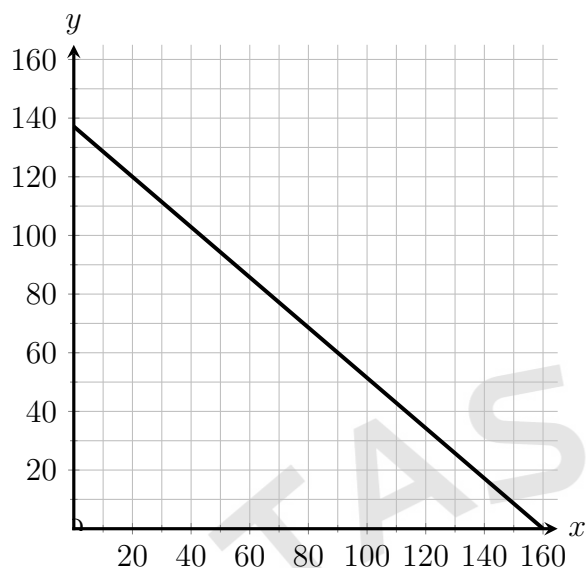
Odalys ordered mulch and river rock, which cost a total of \$530, for her home. The given equation represents the relationship between the number of cubic yards of mulch, x , and the number of tons of river rock, y , Odalys ordered. How much more, in dollars, did a ton of river rock cost Odalys than a cubic yard of mulch?

71. [May 2024]

$$n(x) = 2(x + 8) + (x - 8)$$

The function n is defined as shown. For what value of x is $n(x) = 35$?

72. [May 2024]



A certain open star cluster contains M -type stars and K -type stars. The estimated total mass of all M -type and K -type stars in this open star cluster is 132.77 quettagrams. The graph shown models the possible combinations of the number of M -type stars, x , and K -type stars, y , that could be in this open star cluster if all the M -type stars have the same estimated mass and all the K -type stars have the same estimated mass. Based on the graph, which of the following is closest to the estimated mass, in quettagrams, of each star in this cluster?

- A) 828 C) 52,992
B) 973 D) 79,786

73. [May US 2024]

The function f is defined by

$$f(x) = \frac{7}{10}x + 61$$

What is the value of $f(20)$?

74. [May 2024]

Lines h and k are graphed in the xy -plane. The graph of line h has a slope of $\frac{5}{3}$ and an x -intercept at $(17, 0)$. Line k is the result of translating the graph of line h down 4 units. What is the y -coordinate of the y -intercept of the graph of line k ?

75. [May 2024]

During a specific 2-hour period of the day, the mean photosynthetic rate, $P(x)$, of a plant species increases at a constant rate in terms of the photochemical energy available, x . During this period, $P(300) = 9.8$, and the mean photosynthetic rate increases by 0.43 micromoles per meter squared per second ($\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$) when the photochemical energy available increases by 5 $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$. Which equation gives the mean photosynthetic rate, in $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$, in terms of the photochemical energy available, in $\mu\text{mol} \cdot \text{m}^{-2} \cdot \text{s}^{-1}$, during this period?

- A) $P(x) = 0.026x + 9.8$
B) $P(x) = 0.026x + 2$
C) $P(x) = 9.8x + 0.026$
D) $P(x) = 9.8x - 2,930.2$

76. [May US 2024]

x	y
-11	-33
6	52

The table shows two values of x and their corresponding values of y . The graph of the linear equation representing this relationship passes through the point $(\frac{1}{4}, a)$. What is the value of a ?

77. [May 2024]

Distance (miles)	Average time (minutes)
0.06	3
0.28	14
0.34	17

The table gives the average time t in minutes, it takes Adriana to travel a certain distance d in miles. Which equation could represent this linear relationship?

- A) $t = \frac{1}{50}d$ C) $t = 2d$
B) $t = \frac{1}{2}d$ D) $t = 50d$

78. [May 2024]

$$T(x) = 61 - 8x$$

The function T estimates the temperature, in degrees Fahrenheit ($^{\circ}\text{F}$), in a certain city one day in January, where x is the number of hours after 10 a.m. and $1 \leq x \leq 7$. What is the best interpretation of $T(5) = 21$ in this context?

- A) 5 hours after 10 a.m., the function estimates that the temperature is 21°F .
- B) 5 hours before 10 a.m., the function estimates that the temperature decreased 21°F .
- C) 5 hours after 10 a.m., the function estimates that the temperature decreased 21°F .
- D) 5 hours before 10 a.m., the function estimates that the temperature is 21°F .

79. [May 2024]

x	y
$-2s$	20
$-s$	16
s	8

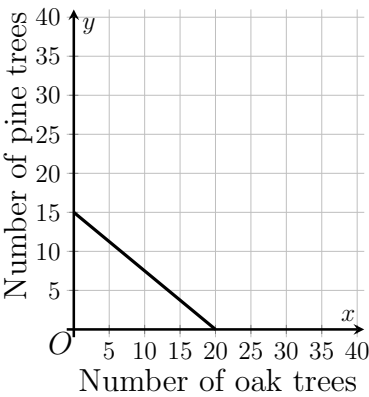
The table shows three values of x and their corresponding values of y , where s is a constant. There is a linear relationship between x and y . Which of the following equations represents this relationship?

- A) $sx + 4y = 12s$
- B) $4x + sy = 12s$
- C) $4x + sy = 12$
- D) $sx + 4y = 12$

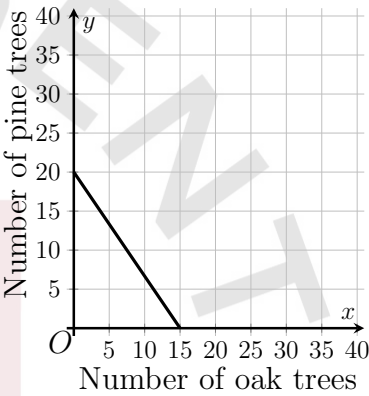
80. [May 2024]

A botanist wants to plant certain types of oak trees and pine trees in a 600-foot-long row. Each of these oak trees requires 40 feet of space to grow, and each of these pine trees requires 30 feet of space to grow. The equation $40x + 30y = 600$ models the possible number of oak trees, x , and pine trees, y , that the botanist can plant. Which graph represents this relationship?

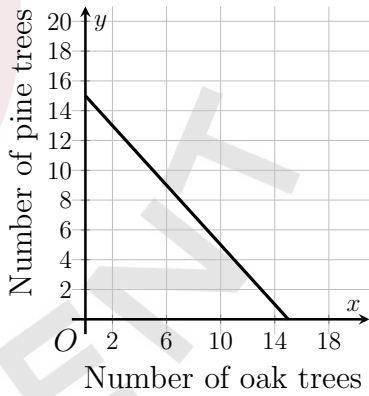
A)



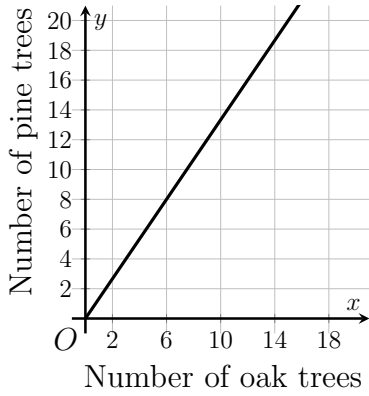
B)



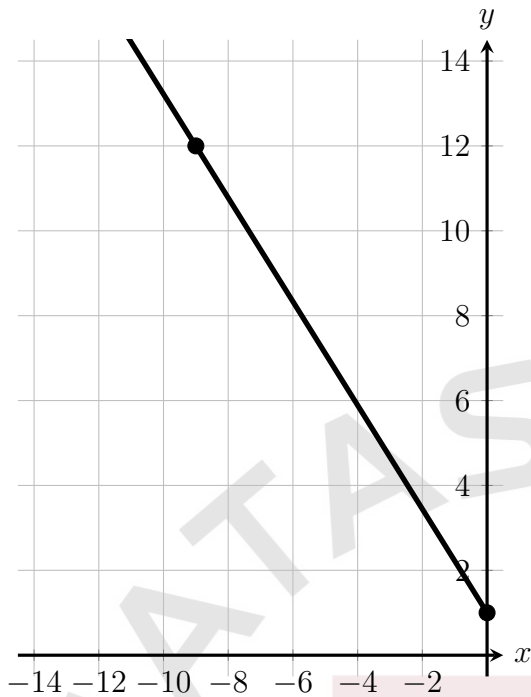
C)



D)



81. [May US 2024]



The graph of line g is shown in the xy -plane. Line k is defined by $165x + py = w$, where p and w are constants. If line k is graphed in this xy plane, resulting in the graph of a system of two linear equations, the system of two linear equations will have infinitely many solutions. What is the value of $p + w$?

82. [May US 2024]

$$g(m) = -0.04m + 16.6$$

The given function g models the number of gallons of gasoline that remains from a full gas tank in a car after driving m miles. According to the model, about how many gallons of gasoline are used to drive each mile?

- A) 0.04 C) 25
B) 16.6 D) 415.0

83. [May US 2024]

$$w(t) = 600 - 8t$$

The function w models the volume of water, in milliliters, in a container t seconds after it begins draining from a hole at the bottom. According to the model, what is the predicted volume, in milliliters, draining from the container each second?

- A) 8 C) 592
B) 75 D) 600

84. [May 2024]

A computer repair specialist charges \$160 for the first two hours of repair plus an hourly fee for each additional hour. The total cost for 4 hours of repair is \$240. Which function f gives the total cost, in dollars, for x hours of repair, where $x \geq 2$?

- A) $f(x) = 40x + 80$
B) $f(x) = 40x + 160$
C) $f(x) = 60x$
D) $f(x) = 60x + 160$

85. [May US 2024]

Line r is defined by the equation

$$4x - 7y = 3.$$

Line s is parallel to line r in the xy -plane. What is the slope of line s ?

- A) $\frac{7}{4}$ C) -4
B) $\frac{4}{7}$ D) -7

86. [June 2024]

Eli used wax to make candles. The function $f(x) = -15x + 60$ approximates the weight, in ounces, of wax Eli had remaining after making x candles. Which statement is the best interpretation of the y -intercept of the graph of $y = f(x)$ in the xy -plane in this context?

- A) Eli had approximately 15 ounces of wax when he began to make the candles.
B) Eli used approximately 15 ounces of wax for each candle.
C) Eli had approximately 60 ounces of wax when he began to make the candles.
D) Eli used approximately 60 ounces of wax for each candle.

87. [June 2024]

$$5x - 4y = -20$$

For the given equation, which table gives three values of x and their corresponding values of y ?

- A)

x	0	4	8
y	5	10	15
- B)

x	0	4	8
y	15	10	5
- C)

x	5	10	15
y	0	4	8
- D)

x	5	10	15
y	8	4	0

88. [June 2024]

$$y = \frac{3}{8}x + 7$$

One of two equations in a system of linear equations is given. The system has infinitely many solutions. What is the slope of the graph of the second equation?

- A) $-\frac{8}{3}$ C) $\frac{3}{8}$
 B) $-\frac{3}{8}$ D) $\frac{8}{3}$

89. [June 2024]

A carpenter charges a flat rate of \$234 for the first 3 hours of work and \$65 for each additional hours of work. Which equation gives the total amount y , in dollars, that the carpenter charges for x hours of work, where $x > 3$?

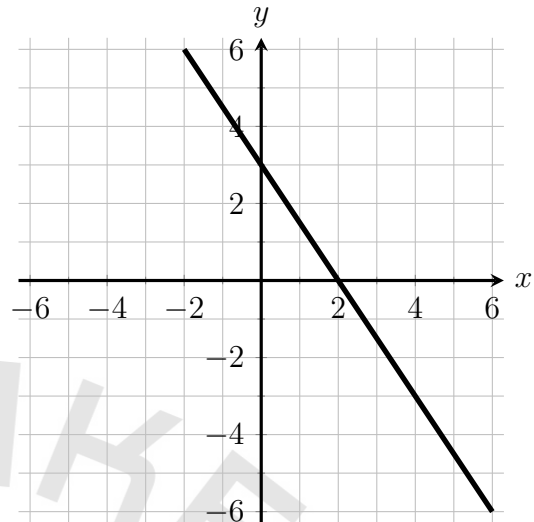
- A) $y = 65x + 39$
 B) $y = 234x + 65$
 C) $y = 65x + 234$
 D) $y = 234x + 429$

90. [June 2024]

$$f(x) = 8x + b$$

For the linear function f , b is a constant and $f(0) = 11$. What is the value of b ?

91. [June 2024]



Line k is shown in the xy -plane. Line j (not shown) is perpendicular to line k and passes through the point $(-12, -19)$. Which equation defines line j ?

- A) $y = \frac{2}{3}x - 11$
 B) $y = \frac{2}{3}x - 27$
 C) $y = \frac{3}{2}x - 11$
 D) $y = \frac{3}{2}x - 27$

92. [June 2024]

Line k is defined by $y = 6x + 5$. Line j is parallel to line k in the xy -plane and passes through the point $(0, 11)$. Which equation defines line j ?

- A) $y = 6x + 11$
 B) $y = 11x + 5$
 C) $y = -6x + 11$
 D) $y = -11x + 5$

93. [June 2024]

$$y = \frac{5}{7}x + 9$$

One of two equations in a system of linear equations is given. The system has infinitely many solutions. What is the slope of the graph of the second equation?

- (A) $-\frac{7}{5}$ (C) $\frac{5}{7}$
 (B) $-\frac{5}{7}$ (D) $\frac{7}{5}$

94. [June 2024]

$$7x - 5y = -70$$

For the given equation, which table gives three values of x and their corresponding values of y ?

A)

x	0	5	10
y	14	21	28

B)

x	0	5	10
y	28	21	14

C)

x	14	21	28
y	0	5	10

D)

x	14	21	28
y	10	5	0

95. [June 2024]

$$T(x) = 62 - 8x$$

The function T estimates the temperature, in **degrees Fahrenheit** ($^{\circ}F$), in a certain city one day in January, where x is the number of hours after 10 a.m. and $1 \leq x \leq 5$. According to the function, what the estimated decrease in temperature each hour, in $^{\circ}F$, in this city during this time period?

- A) 4 C) 54
B) 8 D) 62

96. [June 2024]

The function $f(x)$ is defined as 17 more than 3 times a number x . If $y = f(x)$ is graphed in the xy -plane, what is the best interpretation of the x -intercept?

- A) When $f(x) = 0$, the number is $-\frac{17}{3}$.
B) When the number is 0, $f(x) = 17$.
C) For each increase of 1 in the value of the number, $f(x)$ increases by 3.
D) The value of $f(x)$ increases by 1 for each increase of 3 in the value of the number.

97. [June 2024]

The cost of renting a piece of construction equipment for up to 5 days is \$230 for the first day and \$115 for each additional day. Which of the following equations gives the cost y , in dollars, of renting the equipment for x days, where x is a positive integer and $x \leq 5$?

- A) $y = 230x + 115$
B) $y = 230x - 115$
C) $y = 115x + 230$
D) $y = 115x + 115$

98. [August 2024]

If 380% of n is 38, what is the value of n ?

- A) 14,440 C) 1,000
B) 1,444 D) 10

99. [August 2024]

The function $f(x) = 180(x - 2)$ gives the sum of the interior angles, in degrees, for a polygon with x sides. What is the sum of the interior angles, in degrees, for a polygon with 14 sides?

100. [August 2024]

For a particular car, the linear function f gives the predicted power, in brake horsepower (bhp), for engine speeds between 1,000 revolutions per minute (rpm) and 6,000 rpm. According to this function, the car's predicted power is 228 bhp at an engine speed of 1,896 rpm and 600 bhp at an engine speed of 4,500 rpm. The equation

$$f(x) = \frac{1}{7}(x - a) + 228$$

defines f , where x is the engine speed, in rpm, and a is a constant. What is the value of a ?

101. [August 2024]

$$p(x) = 146 - 5x$$

The function p shown gives the number of blank sheets of paper, $p(x)$, remaining in a printer x days after the printer had been loaded with paper. Which statement is the best interpretation of $p(8) = 106$?

- A) The number of blank sheets of paper remaining in the printer decreased by a total of 8 sheets after 106 days.
- B) There were 8 blank sheets of paper remaining in the printer 106 days after the printer had been loaded with paper.
- C) There were 106 blank sheets of paper remaining in the printer 8 days after the printer had been loaded with paper.
- D) The number of blank sheets of paper remaining in the printer decreased by a total of 106 sheets after 8 days.

102. [August 2024]

For the linear function p , $p(c) = -6$, where c is a constant, $p(3) = 26$, and the slope of the graph of $y = p(x)$ in the xy -plane is 8. For the linear function t , $t(c) = -7$ and $t(4) = 38$. What is the slope of the graph of $y = t(x)$ in the xy -plane?

- A) -1
- B) 2
- C) 8
- D) 9

103. [August 2024]

Line k is defined by $y = 4x + 1$. Line j is parallel to line k in the xy -plane and passes through the point $(0, 5)$. Which equation defines line j ?

- A) $y = -5x + 1$
- B) $y = 5x + 1$
- C) $y = -4x + 5$
- D) $y = 4x + 5$

104. [August 2024]

In the xy -plane, line l has a slope of 4 and an x -intercept of $(\frac{4}{3}, 0)$. What is the y -intercept of line l ?

- A) $(\frac{4}{3}, 0)$
- B) $(-\frac{16}{3}, 0)$
- C) $(0, \frac{4}{3})$
- D) $(0, -\frac{16}{3})$

105. [August 2024]

In March, an account manager completed 15 more than 3 times the number of sales the account manager completed in April. In March and April, the account manager completed 327 sales. How many sales did the account manager complete in April?

106. [August 2024]

$$f(x) = 12x + 6$$

The function gives the total number of people on a school trip with x teachers. What is the total number of people on a school trip with 12 teachers?

107. [August Int 2024]

A total of 271 toothpicks of equal length were used to construct two types of figures: triangles and squares. The triangles and squares were constructed so that no two figures had a common side. The equation $3x + 4y = 271$ represents this situation, where x is the number of triangles constructed and y is the number of squares constructed. What is the best interpretation of $(x, y) = (13, 58)$ in this context?

- A) If 13 triangles were constructed, then 58 squares were constructed.
- B) If 13 triangles were constructed, then 58 toothpicks were used.
- C) If 58 triangles were constructed, then 13 toothpicks were used.
- D) If 58 triangles were constructed, then 13 squares were constructed.

108. [August 2024]

$$y = \frac{2}{5}x + 7$$

One of the two equations in a system of linear equations is given. The system has infinitely many solutions. If the second equation in the system is $y = mx + b$, where m and b are constants, what is the value of b ?

- A) -7 C) $\frac{1}{7}$
B) $-\frac{1}{7}$ D) 7

109. [August 2024]

If $f(x) = x + 3$ and $g(x) = 3x$, what is the value of $5f(2) - g(2)$?

110. [August 2024]

In 6 days, a polar bear ate 25.8 pounds of fat. Which equation describes the amount of fat, y , in pounds, the polar bear ate in these 6 days?

- A) $y = 25.8 + 6$
B) $y = 25.8$
C) $y = \frac{25.8}{6}$
D) $y = 6$

111. [August 2024]

As part of a science experiment on evaporation, Ella measured the height of water in a glass over a period of time. The function $f(x) = 36 - 0.16x$ gives the estimated height, in centimeters (cm), of water in the glass x days after the start of the experiment. What is the best interpretation of 0.16 in this context?

- A) The estimated height, in cm, of the water at the start of the experiment
B) The estimated height, in cm, of the water at the end of the experiment
C) The estimated change in height, in cm, of the water each day
D) The estimated number of days for all the water in the glass to evaporate

112. [August US 2024]

A large square has an area of 36 square centimeters (cm^2). Small squares of area $4cm^2$ are cut out of the large square one by one. Which function f gives the area of the resulting figure, in cm^2 , after x small squares are cut out?

- A) $f(x) = 36 - 4x$
B) $f(x) = 36x - 2$
C) $f(x) = 40x$
D) $f(x) = 34x$

113. [August 2024]

$$y = \frac{4}{7}x + 5$$

One of the two equations in a system of linear equations is given. The system has infinitely many solutions. If the second equation in the system is $y = mx + b$, where m and b are constants, what is the value of b ?

- A) -5 C) $\frac{1}{5}$
B) $-\frac{1}{5}$ D) 5

114. [August 2024]

What is the slope of the graph of

$$y = \frac{1}{2}(11x + 16) + 4x$$

in the xy -plane?

- A) $\frac{11}{2}$ C) 11
B) $\frac{19}{2}$ D) 15

115. [August US 2024]

The function g is defined by

$$g(x) = \frac{3}{4}x - 18$$

What is the x -coordinate of the x -intercept of the graph of $y = g(x)$ in the xy -plane?

116. [August 2024]

In the xy -plane, line s passes through the point $(0,0)$ and is parallel to the line represented by the equation $y = 25x + 5$. If line s also passes through the point $(2, d)$, what is the value of d ?

- A) 5
- B) 25
- C) 50
- D) 55

117. [August US 2024]

The cost renting a power washer is \$92 for the first day and \$46 for each additional day. Which of the following functions gives the cost $C(d)$, in dollars, of renting the power washer for d days, where d is a positive integer?

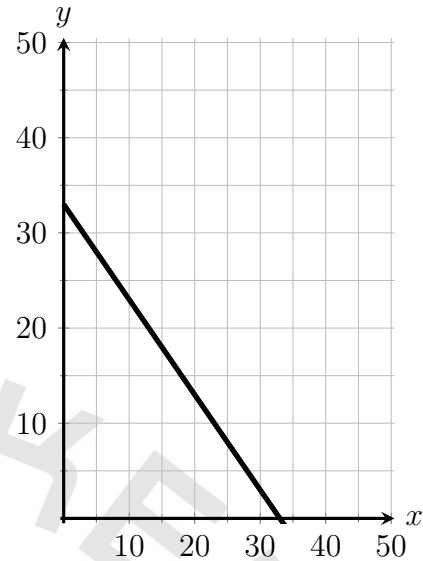
- A) $C(d) = 46d + 46$
- B) $C(d) = 46d + 92$
- C) $C(d) = 92d - 46$
- D) $C(d) = 92d + 138$

118. [August US 2024]

The Mars Perseverance Rover is a robot designed to collect samples of rock and soil. During an experiment, the rover moves at a constant speed in a straight line toward a designated target. The equation $y = 390 - 142x$ gives the rover's remaining distance y , in meters, x hours after the start of the experiment. What is the best interpretation of 390 in this context?

- A) The number of hours it takes for the rover to reach its target
- B) The rover's speed, in meters per hour, during the experiment
- C) The rover's distance, in meters, from the target at the start of the experiment.
- D) The total distance, in meters, that rover travels in 1 hour

119. [August US 2024]



Two students are playing a game. In the first round, Player 1 answers 33 questions. If an answer is correct, Player 1 earns 1 point. If an answer is incorrect, Player 2 will earn 1 point instead. The graph shows $y = f(x)$, where y is the number of points Player 2 will earn when x is the number of points Player 1 earns. Which of the following is the best interpretation of the point $(33,0)$ in this context?

- A) When Player 1 earns 33 points, Player 2 will earn 33 points.
- B) When Player 1 earns 33 points, Player 2 will earn 0 points.
- C) When Player 1 earns 0 points, Player 2 will earn 33 points.
- D) When Player 1 earns 0 points, Player 2 will earn 0 points.

120. [August US 2024]

$h(x) = x + b$ For the linear function h , b is a constant and $h(0) = 21$. What is the value of b ?

121. [August US 2024]

The function f is defined by

$$f(x) = 135x - 20.$$

What is the value of $f(x)$ when $x = 4$?

122. [August US 2024]

x	y
-12	94
-6	70
6	22
12	-2

The table shows four values of x and their corresponding values of y . There is a linear relationship between x and y . Which of the following equations represents this relationship?

- A) $24x + 6y = 46$
- B) $24x + 6y = 276$
- C) $6x + 24y = 46$
- D) $6x + 24y = 276$

123. [August US 2024]

$$f(x) = 50x + 8$$

The given function f estimates the distance a train has traveled, in kilometers, from a station in a certain city x hours after crossing the city border. What is the best interpretation of 8 in this context?

- A) Between the station and the city border, the train traveled an estimated total distance of 8 kilometers.
- B) Between the station and the city border, the train traveled at an estimated speed of 8 kilometers per hour.
- C) After crossing the city border, the train traveled at an estimated speed of 8 kilometers per hour.
- D) After crossing the city border, the train traveled an estimated total distance of 8 kilometers.

124. [August US 2024]

Line r on the xy -plane has a slope of 2 and passes through a point $(0, 12)$. Which of the following defines r ?

- A) $y = -12x + 2$
- B) $y = 12x + 2$

C) $y = 2x - 12$

D) $y = 2x + 12$

125. [August US 2024]

A linear model estimates the population of a city from 1995 to 2019. The model estimates the population was 59 thousand in 1995, 217 thousand in 2015, and x thousand in 2019. To the nearest whole number, what is the value of x ?

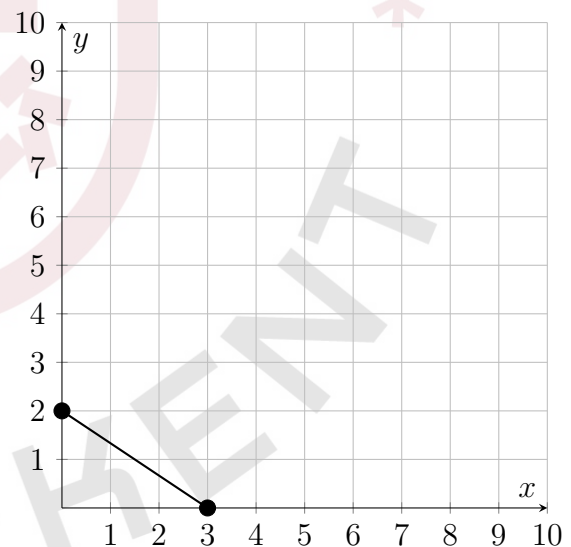
126. [August US 2024]

Line p in the xy -plane is defined by

$$y = x + \frac{5}{9}$$

and passes through the points $(a, 0)$ and $(0, b)$, where a and b are constants. What is the value of a ?

127. [August US 2024]



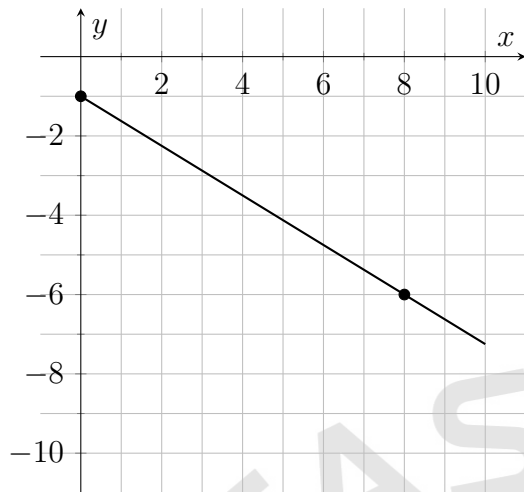
The graph of the linear equation

$$4x + BY = 12$$

is shown, Where B is a constant. What is the value of B ?

- A) $\frac{2}{3}$
- B) 3
- C) 2
- D) 6

128. [August US 2024]



The graph of a linear function f is shown in the graph, where $y = f(x)$. Which equation defines f ?

- A) $f(x) = \frac{5}{8}x - 1$
- B) $f(x) = \frac{8}{5}x - 1$
- C) $f(x) = -\frac{5}{8}x - 1$
- D) $f(x) = -\frac{5}{8}x - 1$

129. [August US 2024]

The function g is defined by

$$g(x) = 2x - 148.$$

For what values of x does $g(x) = 76$?

130. [October US 2024]

A student council group is selling car stickers for a fundraiser. They use the function $p(x) = 5x - 240$ to determine their profit $p(x)$, in dollars, for selling x car stickers. In order to earn a profit of 700, how many car stickers must they sell?

131. [October US 2024]

A line in the xy -plane has a slope of 7 and passes through the point $(0, -5)$. Which equation represents this line?

- A) $y = -5x + 7$
- B) $y = -5x - 7$
- C) $y = 7x + 5$
- D) $y = 7x - 5$

132. [October US 2024]

Line r is defined by equation $4x - 3y = 8$. Line s is parallel to line r in the xy -plane. What is the slope of line s ?

- A) -4
- B) -3
- C) $\frac{3}{4}$
- D) $\frac{4}{3}$

133. [October US 2024]

x	y
0	12
1	19
2	26

The table shows three values of x and their corresponding values of y . There is a linear relationship between x and y . What is the y -coordinate of the y -intercept of the line in the xy -plane that represents this relationship?

134. [October US 2024]

The cost to rent a bus from Company X is 850 for the first 2 hours and an additional 30 per hour for each hour after the first 2 hours. If the total cost to rent the bus from Company X for t hours, where $t > 2$, is 1,030, which equation represents this situation?

- A) $850(t - 2) + 30t = 1,030$
- B) $850(2t) + 30t = 1,030$
- C) $850 + 30(t - 2) = 1,030$
- D) $850 + 30(2t) = 1,030$

135. [October US 2024]

If $f(x) = x + 2$ and $g(x) = 2x$, what is the value of $6f(3) - g(3)$?

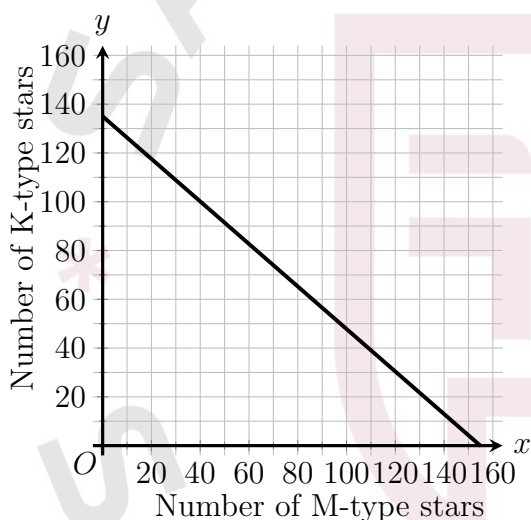
- A) -1
- B) 12
- C) 14
- D) 24

136. [October US 2024]

A plumbing company charges its customers \$112 for the first hour of a plumbing service call and \$40 for each additional hour, plus the cost of plumbing parts. Which equation represents the total cost y , in dollars, for an x -hour plumbing service call where the cost of parts was z and $x \geq 1$?

- A) $y = 40x + z$
- B) $y = 40x + z + 72$
- C) $y = 112x + z$
- D) $y = 112x + 40z + 72$

137. [October US 2024]



A certain open star cluster contains M-type stars and K-type stars. The estimated total mass of M-type and K-type stars in this open star cluster is 129,492 quettagrams. The graph shown models the possible combinations of the number of M-type stars, x , and K-type stars, y , that could be in this open star cluster if all the M-type stars have the same estimated mass and all the K-type stars have the same estimated mass. Based on the graph, which of the following is closest to the estimated mass, in quettagrams, of each M-type star in this cluster?

- A) 830
- B) 959
- C) 55,622
- D) 73,870

138. [October 2024]

For the linear function f , the graph of $y = f(x)$ in the xy -plane has a slope of $\frac{1}{4}$ and passes through the point $(0, 5)$. Which equation defines f ?

- A) $f(x) = \frac{1}{4}x + 5$
- B) $f(x) = \frac{1}{4}x + \frac{1}{5}$
- C) $f(x) = \frac{1}{4}x - \frac{5}{4}$
- D) $f(x) = \frac{1}{4}x - 5$

139. [October 2024]

For the given equation, $7x - 4y = -84$, which table gives three values of x and their corresponding values of y ?

- A)

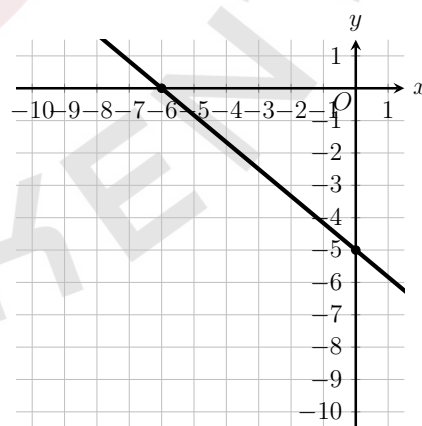
x	0	4	8
y	21	28	35
- B)

x	0	4	8
y	35	28	21
- C)

x	21	28	35
y	0	4	8
- D)

x	21	28	35
y	8	4	0

140. [October 2024]



Line k is shown in the xy -plane. Line j (not shown) is perpendicular to line k . What is the slope of line j ?

- A) $-\frac{6}{5}$
- B) $\frac{6}{5}$
- C) 6
- D) -5

141. [October 2024]

The function f is defined by $f(x) = 9x + 9$. What is the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane?

142. [October 2024]

The equation $h = \frac{9(v - 273.15)}{5} + 32$ gives the corresponding temperature h , in degrees Fahrenheit, of any substance that has temperature of v kelvins, where $v \geq 0$. If a substance has a temperature of 467.33 degrees Fahrenheit, what is the corresponding temperature, in kelvins, of this substance?

143. [October 2024]

As part of a science experiment on evaporation, Ella measured the height of water in a glass over a period of time. The function $f(x) = 39 - 0.18x$ gives the estimated height, in centimeters (cm), of the water in the glass x days after the start of the experiment. Which of the following is the best interpretation of 39 in this context?

- A) The estimated height, in cm, of the water at the start of the experiment
- B) The estimated height, in cm, of the water at the end of the experiment
- C) The estimated change in the height, in cm, of the water each day
- D) The estimated number of days for all the water to evaporate

144. [October 2024]

$$y = \frac{2}{7}x + 3$$

One of the two equations in a system of linear equations is given. The system has infinitely many solutions. If the second equation in the system is $y = mx + b$, where m and b are constants, what is the value of b ?

- A) -3
- B) $-\frac{1}{3}$
- C) $\frac{1}{3}$
- D) 3

145. [October 2024]

Area (square feet)	Water (gallons)
2,520	4,536
3,780	6,804
5,040	9,072

The roofs on the buildings of a public garden are designed to allow water to drain into the garden. The table shows the relationship between the area x , in square feet, of a roof and the amount of water $f(x)$, in gallons, drained from the roof into the garden over a certain period of time. Which equation could define f ?

- A) $f(x) = 0.6x$
- B) $f(x) = 1.8x$
- C) $f(x) = 2,268.0x$
- D) $f(x) = \frac{x}{6}$

146. [October 2024]

The cost of renting a piece of construction equipment for up to 5 days is 270 for the first day and 135 for each additional day. Which of the following equations gives the cost y , in dollars, of renting the equipment for x days, where x is a positive integer and $x \leq 5$?

- A) $y = 135x + 135$
- B) $y = 270x - 135$
- C) $y = 270x + 135$
- D) $y = 135x + 270$

147. [October US 2024]

For the linear function f , the graph of $y = f(x)$ in the xy -plane has a slope of -2 and passes through the point $(0, -19)$. Which equation defines f ?

- A) $f(x) = -19x$
- B) $f(x) = -2x$
- C) $f(x) = -2x - 19$
- D) $f(x) = 2x + 19$

148. [October US 2024]

Line p is defined by $y = 6x - 8$. Line s is parallel to line p in the xy -plane. What is the slope of line s ?

149. [October US 2024]

The y -intercept of the graph of

$$5x + 2y = -18$$

is $(0, y)$. What is the value of y ?

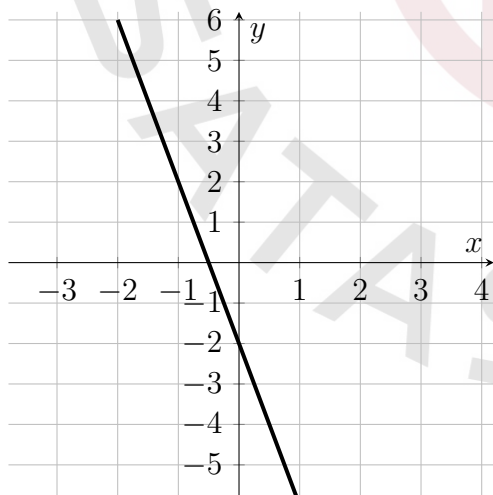
150. [October US 2024]

For groups of 25 or more people, a museum charges \$22 per person for the first 25 people and \$14 for each additional person. Which function f gives the total charge, in dollars, for a tour group with n people, where $n \geq 25$?

- A) $f(n) = 14n + 200$
- B) $f(n) = 14n + 22$
- C) $f(n) = 14n + 550$
- D) $f(n) = 36n - 350$

151. [October US 2024]

The graph of $y = f(x) - 11$ is shown.



Which equation defines the linear function f ?

- A) $f(x) = -15x - 11$
- B) $f(x) = -4x + 9$
- C) $f(x) = -15x + 9$
- D) $f(x) = -4x - 11$

152. [October US 2024]

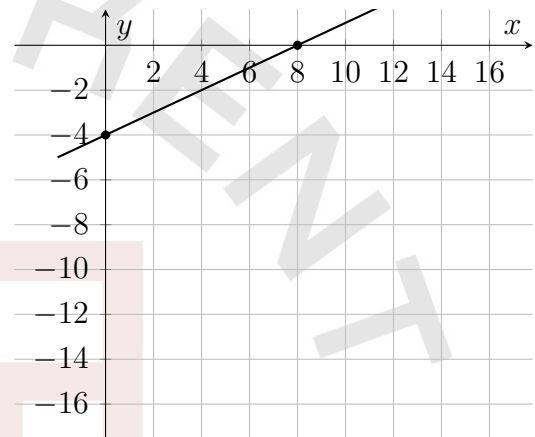
The function f is defined by

$$f(x) = -4x + 50.$$

What is the value of $f(x)$ when $x = -7$?

- A) 39
- B) 43
- C) 46
- D) 78

153. [October US 2024]



What is the slope of the line shown?

154. [October US 2024]

Line t in the xy -plane has a slope of $\frac{1}{3}$ and passes through the point $(15, -6)$. Which equation defines line t ?

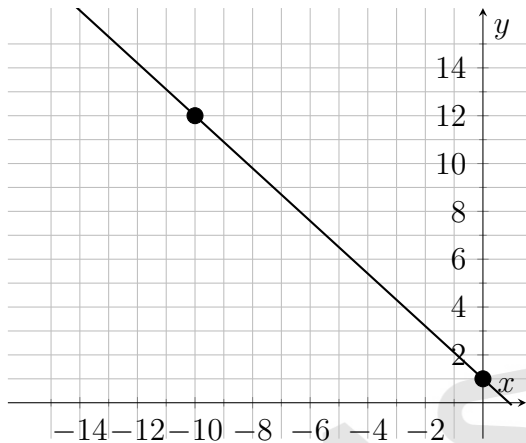
- A) $y = -11x + \frac{1}{3}$
- B) $y = \frac{x}{3} - 11$
- C) $y = \frac{x}{3} - 6$
- D) $y = 15x - 6$

155. [October US 2024]

The value of y is 49 more than twice the value of x . Which equation represents y in terms of x ?

- A) $y = 2x + 49$
- B) $y = 49x + 2$
- C) $y = 51x - 2$
- D) $y = 51x + 49$

156. [October US 2024]



The graph of line g is shown in the xy -plane. Line k is defined by the equation $165x + py = w$, where p and w are constants. If line k is graphed in this xy -plane, resulting in the graph of a system of two linear equations, the system will have infinitely many solutions. What is the value of $p + w$?

157. [November 2024]

Two numbers have a product y such that one number is x and the other number is 99 less than x . Which of the following equations represents the relationship between y and x ?

- A) $y = x(x) + 99$
- B) $y = x(x) - 99$
- C) $y = x(x + 99)$
- D) $y = x(x - 99)$

158. [October US 2024]

The function f is defined by $f(x) = 30x$. For what value of x is $f(x) = 180$?

159. [November 2024]

The function h is defined by

$$h(x) = 5x - 9.$$

What is the value of $h(-3)$?

- A) -24
- B) -14
- C) 14
- D) 24

160. [October US 2024]

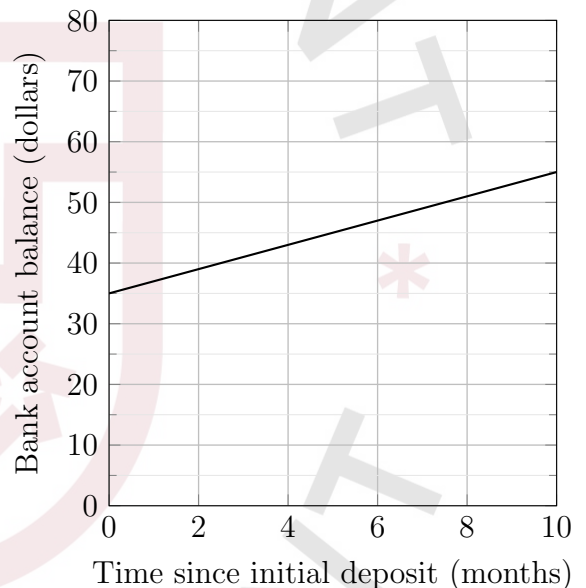
The linear function g is defined by

$$g(x) = 15x - b$$

where b is a constant. If $g(c + 7) = c$, where c is a constant, which of the following expressions represents the value of b ?

- (A) $\frac{15c}{4}$
- (B) $\frac{19c}{4} + 7$
- (C) $\frac{61c}{4} + 105$
- (D) $14c + 105$

161. [November 2024]



A bank account was opened with an initial deposit. Over the next several months, regular deposits were made into this account and there were no withdrawals made during this time. The graph of the function $y = f(x)$ estimates the account balance, in dollars, in this bank account x months since the initial deposit. To the nearest whole dollar, what is the amount of the initial deposit estimated by the graph?

162. [November 2024]

In the xy -plane, line p has a slope of $\frac{3}{4}$ and an x -intercept of $(19, 0)$. What is the y -coordinate of the y -intercept of line p ?

163. [November 2024]

A line on the xy -plane has a slope of $-\frac{1}{4}$ and passes through the point $(0, 19)$. Which equation represents this line?

- A) $y = -\frac{1}{4}x - 19$
- B) $y = -\frac{1}{4}x + 19$
- C) $y = \frac{1}{4}x - 19$
- D) $y = \frac{1}{4}x + 19$

164. [November 2024]

The function $F(m) = 7m$ models the force, in newtons, acting on each object in a certain field as a function of the object's mass m , in kilograms. Which statement is the best interpretation of $F(4) = 28$ in this context?

- A) The estimated force acting on an object with a mass of 4 kilograms is 28 newtons.
- B) The estimated force acting on an object with a mass of 28 kilograms is 4 newtons.
- C) The estimated force acting on an object with a mass of 7 kilograms is 4 newtons.
- D) The estimated force acting on an object with a mass of 7 kilograms is 28 newtons.

165. [November 2024]

The function f and g are defined as

$$f(x) = \frac{1}{5}x - 9 \text{ and } g(x) = \frac{4}{5}x + 27.$$

If the function h is defined as $h(x) = f(x) + g(x)$, what is the x -intercept of the graph of the $y = h(x)$ in the xy -plane?

- A) $(-\frac{135}{4}, 0)$
- A) $(\frac{45}{4}, 0)$
- A) $(-18, 0)$
- A) $(18, 0)$

166. [November 2024]

The function $f(x) = -40x + 280$ gives the predicted height above the ground $f(x)$, in feet, of a model airplane x minutes after it begins to descend. What is the predicted height above the ground, in feet, of the model airplane 4 minutes after it begins to descend.

- A) 120
- B) 160
- C) 240
- D) 440

167. [November 2024]

The function g is defined by $g(x) = 3x$. For what value of x is $g(x) = 12$?

168. [November US 2024]

The function f is defined by

$$f(x) = -3x + 40.$$

What is the value of $f(x)$ when $x = -6$?

- A) 58
- B) 37
- C) 34
- D) 31

169. [November US 2024]

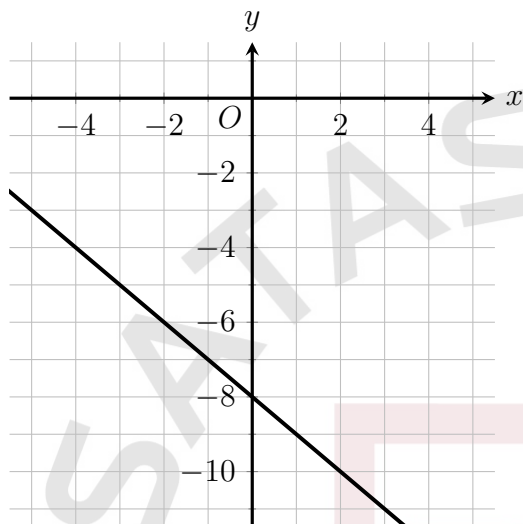
A school swim team sold shirts to raise money. The team raised \$13 from each short-sleeved shirt sold and raised \$14 from each long-sleeved shirt sold. The team raised a total of \$423 from the sale of these shirts. The equation $13x + 14y = 423$ represents this situation. Which of the following is the best interpretation of y in this context?

- A) The number of long-sleeved shirts sold
- B) The number of short-sleeved shirts sold
- C) The price, in dollars, of each long-sleeved shirt
- D) The price, in dollars, of each short-sleeved shirt

170. [November US 2024]

Line p in the xy -plane is defined by $y = x + \frac{1}{3}$ and passes through the points $(a, 0)$ and $(0, b)$, where a and b are constants. What is the value of a ?

171. [November US 2024]



The graph of the linear function $y = f(x) - 19$ is shown. If c and d are positive constants, which equation could define f ?

- A) $f(x) = d - cx$
- B) $f(x) = -d + cx$
- C) $f(x) = d + cx$
- D) $f(x) = -d - cx$

172. [November US 2024]

Number of cars	Maximum number of passengers and crew
3	99
5	161
10	316

The table shows the linear relationship between the number of cars, c , on a commuter train and the maximum number of passengers and crew, p , that the train can carry. Which equation represents the linear relationship between c and p ?

- A) $31c - p = -6$
- B) $31c - p = 6$
- C) $31p - c = -6$
- D) $31p - c = 6$

173. [November US 2024]

The function h is defined by $h(x) = 2(9x - 10)$. What is the value of $h(10)$?

- A) 10
- B) 20
- C) 90
- D) 160

174. [November US 2024]

The graph of the polynomial function f in the xy -plane, where $y = f(x)$, passes through the point $(9, 7)$. What is the value of $f(9)$?

- A) 7
- B) 9
- C) 16
- D) 63

175. [November US 2024]

x	y
2	$-\frac{183}{10}$
4	$-\frac{171}{10}$
7	$-\frac{153}{10}$

The table shows three values of x and their corresponding values of y . There is a linear relationship between x and y . What is the x -coordinate of the x -intercept of the graph that represents this linear relationship in the xy -plane?

176. [December US 2024]

The function g is defined by

$$g(x) = -18 - 9x.$$

For what values of x does $g(x) = -216$?

- A) -26
- B) 22
- C) 26
- D) 1926

177. [December US 2024]

The graph of a line in the xy -plane passes through the point $(1, 8)$ and crosses the x -axis at the point $(7, 0)$. The line crosses the y -axis at the point $(0, b)$. What is the value of b ?

178. [December US 2024]

x	y
-2	19
0	31
2	43

The table shows three values of x and their corresponding values of y . The linear relationship between x and y can be represented by an equation written to the form $Ax + By = C$, where A , B , and C are constants. What is the value of $\frac{A}{B}$?

179. [December US 2024]

For the linear function h , $h(0) = 0$ and $h(11) = 5$. Which equation defines h ?

- A) $h(x) = \frac{5}{11}x$
- B) $h(x) = \frac{5}{11} + 5$
- C) $h(x) = \frac{11}{5}x$
- D) $h(x) = \frac{11}{5}x + 11$

180. [December US 2024]

Hassan put up wire fencing along each edge of a rectangular garden with a length of x feet and a width of y feet. Hassan put up a total of 44 feet of wire fencing. Which equation represents this situation?

- A) $2x + 2y = 44$
- B) $x + y = 44$
- C) $2xy = 44$
- D) $xy = 44$

181. [December US 2024]

The linear function f gives a company's profit, in dollars, for selling x items. The company's profit is \$190 when it sells 4 items, and its profit is \$670 when it sells 10 items. Which equation defines f ?

- A) $f(x) = 180x - 670$
- B) $f(x) = 67x$
- C) $f(x) = 80x - 10x$
- D) $f(x) = 80x - 130$

182. [December 2024]

In the xy -plane, the graph of $y = f(x)$ is a line that passes through $(0, 21)$ and has a slope of 4. Which equation defines f ?

- A) $f(x) = 21x$
- B) $f(x) = 21x + 4$
- C) $f(x) = 4x$
- D) $f(x) = 4x + 21$

183. [December 2024]

The function f is defined by

$$f(x) = 1.5x + 10.$$

What is the value of $f(x)$ when $x = 2$?

- A) 27
- B) 30
- C) 40
- D) 50

184. [December 2024]

$$y = \frac{2}{5}x + 2$$

One of the two equations in a system of linear equations is given. The system has infinitely many solutions. If the second equation in the system is $y = mx + b$, where m and b are constants, what is the value of b ?

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

185. [December 2024]

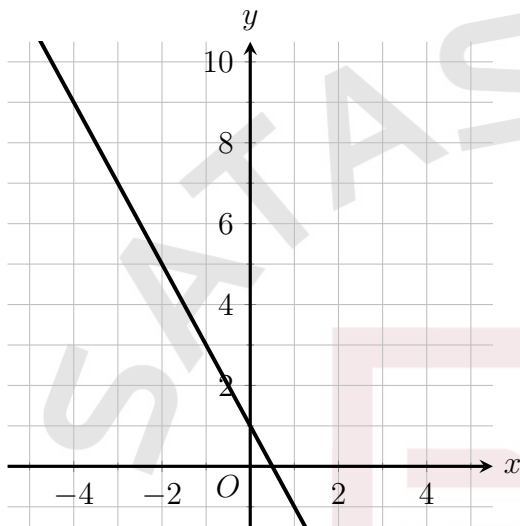
Line t in the xy -plane has a slope of $-\frac{1}{3}$ and passes through the point $(9, 4)$. Which equation defines line t ?

- A) $y = 7x - \frac{1}{3}$
- B) $y = 9x + 4$
- C) $y = -\frac{x}{3} + 7$
- D) $y = -\frac{x}{3} + 7$

186. [December 2024]

A linear model estimates the population of a city from 1995 to 2019. The model estimates the population was 55 thousand in 1995, 217 thousand in 2015, and x thousand in 2019. To the nearest whole number, what is the value of x ?

187. [December 2024]



The graph of the linear function $y = f(x) + 11$ is shown. If c and d are positive constants, which equation could define f ?

- A) $f(x) = -d - cx$
- B) $f(x) = d + cx$
- C) $f(x) = d - cx$
- D) $f(x) = -d + cx$

188. [December 2024]

A family has money in an account for renting movies online. Each time the family rents a movie, the cost of the rental is withdrawn from the account, and each rental costs the same amount of money. The function $f(m) = 21 - 3m$ gives the amount of money, in dollars, in the account after the family has rented m movies. Which of the following represents the amount of money, in dollars, withdrawn from the account each time the family rents a movie?

- A) $3m$
- B) 3
- C) 21
- D) $21 - 3m$

189. [December 2024]

x	y
0	22
1	23
2	24

The table shows three values of x and their corresponding values of y . There is a linear relationship between x and y . Which of the following equations represents this relationship?

- A) $y = x + 22$
- B) $y = 24x$
- C) $y = 24x + 2$
- D) $y = 22x$

190. [December 2024]

A book-of-the-month club charges \$13 for the first book purchased during the month and an additional \$11 for each book after the first. Which equation describes this situation, where y is the total cost, in dollars, for books purchased during a month, x is the number of books purchased during the month, and $x > 0$?

- A) $y = x + 13$
- B) $y = 11x + 13$
- C) $y = 11(x - 1) + 13$
- D) $y = (x - 1) + 13$

191. [December 2024]

The function f is defined by

$$f(x) = 12x + 18.$$

What is the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane?

192. [December 2024]

Line k is defined by $y = 7x + 2$. Line j is parallel to line k in the xy -plane and passes through the point $(0, 3)$. Which equation defines line j ?

- A) $y = 7x + 3$
- B) $y = -3x + 3$
- C) $y = -7x + 3$
- D) $y = 3x + 3$

193. [December 2024]

For the linear function f , the graph of $y = f(x)$ in the xy -plane has a slope of 28 and passes through the point $(0,0)$. The function f is defined by $f(x) = ax$, where a is a constant. What is the value of a ?

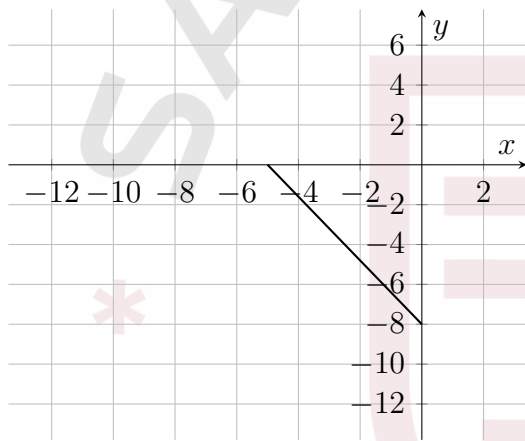
194. [December 2024]

What is the slope of the graph of

$$y = \frac{1}{2}(15x + 12) + 3x$$

in the xy -plane?

195. [December 2024]



The graph of line h is shown in the xy -plane. Line k (not shown) is defined by $sx + 40y = t$, where s and t are constants. If line k is graphed in this xy -plane, the result is a graph of two linear equations. This system of two linear equations has no solution. Which of the following is NOT a possible value of t ?

- A) 200
- B) 64
- C) -8
- D) -320

196. [December 2024]

A partially filled container containing 24 milliliters of water is placed under a leaky faucet that produces one 0.03 milliliter drop of water every 3 seconds. Until the container is full, which of the following can be used to represent the volume v , in milliliters, of water in the container t seconds after it is placed under the faucet, where t is a multiple of 3?

- A) $v = 0.01t + 24$
- B) $v = 0.03t + 24$
- C) $v = 0.09t + 24$
- D) $v = 3t$

Answers: Linear Functions

Number	Answer	Number	Answer
1	5	21	D
2	A	22	D
3	$5/2$	23	A
4	$1/2$	24	C
5	30	25	$2/7$
6	B	26	D
7	A	27	D
8	D	28	C
9	$19/4$	29	$1/8$
10	D	30	A
11	$1/3$	31	40
12	D	32	B
13	A	33	255
14	12	34	D
15	B	35	B
16	B	36	A
17	A	37	A
18	C	38	76
19	C	39	$61/3$
20	A	40	A

Number	Answer	Number	Answer
41	B	61	A
42	C	62	D
43	B	63	A
44	D	64	A
45	10	65	A
46	28	66	D
47	D	67	A
48	10.25	68	B
49	18	69	B
50	A	70	11.25
51	B	71	9
52	D	72	A
53	A	73	75
54	45	74	97/3
55	D	75	B
56	D	76	23.25
57	374.4	77	D
58	D	78	A
59	C	79	B
60	28	80	B

Number	Answer	Number	Answer
81	270	101	C
82	A	102	D
83	A	103	D
84	A	104	D
85	B	105	78
86	B	106	150
87	A	107	A
88	C	108	D
89	A	109	19
90	11	110	B
91	A	111	C
92	A	112	A
93	C	113	D
94	A	114	B
95	B	115	24
96	A	116	C
97	D	117	A
98	D	118	C
99	2160	119	B
100	1896	120	21

Number	Answer	Number	Answer
121	520	141	9
122	B	142	515
123	A	143	A
124	D	144	D
125	249	145	B
126	46	146	A
127	D	147	C
128	C	148	-1/6
129	112	149	-9
130	118	150	A
131	D	151	B
132	D	152	D
133	12	153	1/2
134	C	154	B
135	D	155	A
136	B	156	300
137	A	157	D
138	A	158	6
139	A	159	A
140	B	160	D

Number	Answer	Number	Answer
161	35	179	A
162	$-57/4$	180	A
163	B	181	D
164	A	182	D
165	A	183	C
166	A	184	D
167	4	185	C
168	A	186	249
169	A	187	A
170	$-1/3$	188	B
171	A	189	A
172	A	190	C
173	D	191	18
174	A	192	A
175	32.5	193	28
176	B	194	10.5
177	$28/3$	195	D
178	-6	196	A

Linear Inequalities

1. [June 2023]

$$y = 5x$$

$$y = 2x + 2$$

How many solutions does the given system of equations have?

- A) Exactly one
- B) Exactly two
- C) Infinitely many
- D) Zero

2. [June 2023]

In the xy -plane, which of the following does NOT contain any points (x, y) that are solutions to $7x + 4y > 12$?

- A) The region where $x > 0$ and $y > 0$
- B) The region where $x < 0$ and $y > 0$
- C) The region where $x < 0$ and $y < 0$
- D) The region where $x > 0$ and $y < 0$

3. [June 2023]

In December 2017, the lowest temperature recorded in a certain city was 40 degrees Fahrenheit (F°) and the highest temperature recorded was $90^\circ F$. Which inequality is true for all values of t , where t represents any temperature in F° , recorded in the city in December?

- A) $40 \leq t \leq 90$
- B) $t \leq 40$
- C) $t \leq 50$
- D) $t \geq 90$

4. [August US 2023]

$$y \leq \frac{2}{3}x + 5$$

For which of the following tables are all the values of x and their corresponding values of y solutions to the given inequality?

A)

x	y
-1.5	6
1.5	5
3	-4

B)

x	y
-1.5	5
1.5	7
3	8

C)

x	y
-1.5	6
1.5	5
3	6

D)

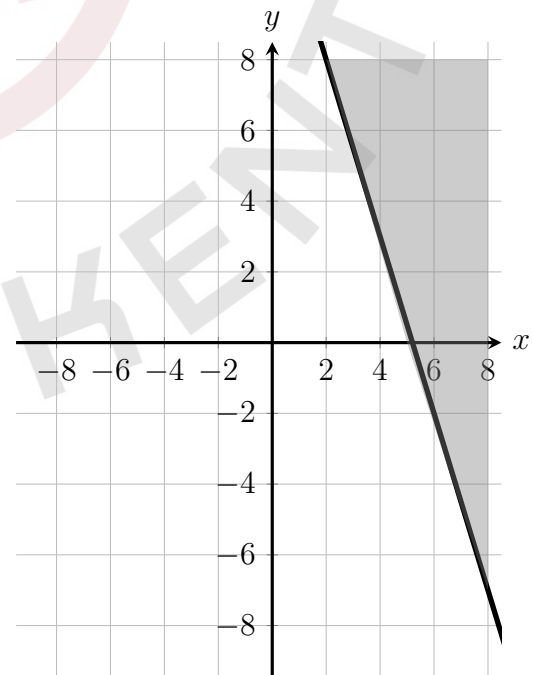
x	y
-1.5	3
1.5	5
3	6

5. [December 2023]

A model estimates that a gray whale travels 73 to 78 miles each day during its migration. Based on this model, which inequality represents the estimated total number of miles, x , a gray whale could travel in 31 days of its migration?

- A) $(73)(31) \leq x \leq (78)(31)$
- B) $73 + 31 \leq x \leq 78 + 31$
- C) $73 \leq 31x \leq 78$
- D) $73 \leq 31 + x \leq 78$

6. [December 2023]



The shaded region shown represents solutions to inequality. Which ordered pair (x, y) is a solution to this inequality?

- A) $(-7,0)$ C) $(0,7)$
 B) $(0,-7)$ D) $(7,0)$

7. [March 2024]

The minimum value of x is 11 less than 8 times another number n . Which inequality shows the possible values of x ?

- A) $x \leq 8n - 11$
 B) $x \geq 8n - 11$
 C) $x \leq 11 - 8n$
 D) $x \geq 11 - 8n$

8. [November 2023]

$$y \leq x + 9$$

$$y \geq -2x - 9$$

Which point (x, y) is a solution to the given system of inequalities in the xy -plane?

- A) $(0,-10)$ C) $(-7,0)$
 B) $(0,10)$ D) $(7,0)$

9. [November 2023]

The function $f(x) = \frac{1}{7}(x - 5)^2 + 6$ gives the toy car's height above the ground $f(x)$, in inches, x seconds after it started moving on an elevated track, where $0 < x \leq 10$.

Which of the following is the best interpretation of the vertex of the graph of $y = f(x)$ in the xy -plane?

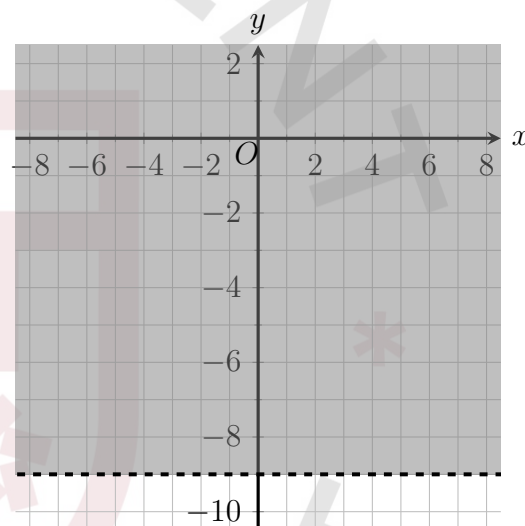
- A) The toy car's minimum height was 6 inches above the ground.
 B) The toy car's minimum height was 5 inches above the ground
 C) The toy car's height was 6 inches above the ground when it started moving
 D) The toy car's height was 5 inches above the ground when it started moving

10. [May 2024]

An arborist measured and recorded the heights of red maple trees in a certain area. Of the red maple tree heights recorded in this area, the minimum was 42 feet and the maximum was 57 feet. Which inequality is true for all possible values of t , where t represents the recorded height, in feet, of a red maple tree in this area?

- A) $t \leq 42$ C) $t \geq 99$
 B) $t \geq 57$ D) $42 \leq t \leq 57$

11. [March 2024]



The shaded region shown represents the solutions to the inequality $-18y < c$, where c is a constant. What is the value of c ?

- A) 162 C) -9
 B) 9 D) -162

12. [March 2024]

$$y \leq x + 2$$

$$y \geq -3x - 4$$

Which point (x, y) is a solution to the given system of inequalities in the xy -plane?

- A) $(0, -8)$ C) $(-8, 0)$
 B) $(0, 8)$ D) $(8, 0)$

13. [March 2024]

A certain truck can tow a trailer if the combined weight of the trailer and the packages it contains is no more than 4600 pounds. What is the maximum number of objects this truck can tow in a trailer with a weight of 600 pounds if each package weighs 120 pounds?

- A) 33 C) 38
B) 34 D) 39

14. [March 2024]

A certain truck can tow a trailer if the combined weight of the trailer and the packages it contains is no more than 4,200 pounds. What is the maximum number of packages the truck can tow in a trailer with a weight of 600 pounds if each package weighs 110 pounds?

- A) 32 C) 38
B) 33 D) 39

15. [March 2024]

$$y \leq x + 2$$

$$y \geq -4x - 6$$

Which point (x, y) is a solution to the given system of inequalities in the xy -plane?

- A) $(0, -12)$
B) $(0, 12)$
C) $(-12, 0)$
D) $(12, 0)$

16. [May US 2024]

In a set of four consecutive odd integers, where the integers are ordered from least to greatest, the first integer is represented by x . The product of 18 and the fourth odd integer is at most 22 less than the sum of the first and third odd integers. Which inequality represents this situation?

- A) $18(x + 6) \leq x + (x + 4) - 22$
B) $18(x + 6) \geq 22 - (x + (x + 4))$
C) $18(x + 4) \leq x + (x + 3) - 22$
D) $18(x + 4) \geq 22 - (x + (x + 3))$

17. [June 2024]

During a portion of a flight, a small airplane's cruising speed varied between 180 miles per hour and 190 miles per hour. Which inequality best represents this situation, where s is the cruising speed, in miles per hour, during this portion of the flight?

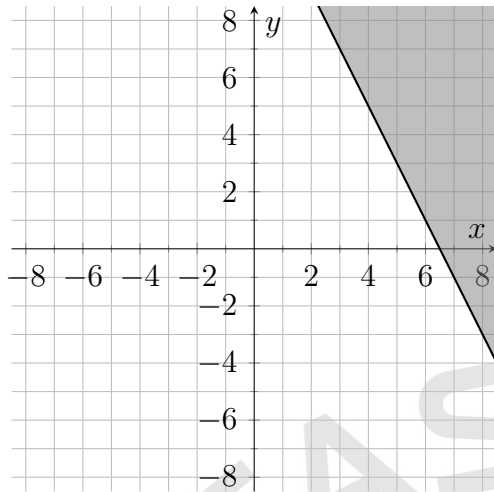
- A) $s \leq 10$
B) $s \leq 180$
C) $s \leq 190$
D) $180 \leq s \leq 190$

18. [June 2024]

During a portion of a flight, a small airplane's cruising speed varied between 125 miles per hour and 135 miles per hour. Which inequality best represents this situation, where s is the cruising speed, in miles per hour, during this portion of the flight?

- A) $s \leq 10$
B) $s \leq 125$
C) $s \leq 135$
D) $125 \leq s \leq 135$

19. [June 2024]



The shaded region shown represents solutions to an inequality. Which ordered pair (x, y) is a solution to this inequality?

A) $(-8, 0)$

B) $(0, 8)$

C) $(0, -8)$

D) $(8, 0)$

20. [August 2024]

A newspaper stand sells magazines for \$5 each and newspapers for \$2 each. The stand needs to sell m magazines and n newspapers for a combined total value of at least \$150 each day to cover operation costs. Which inequality represents this situation?

A) $5m + 2n \leq 150$

B) $5m + 2n \geq 150$

C) $7mn \leq 150$

D) $7mn \geq 150$

21. [August 2024]

The water depth in a certain river is 78.7 feet (ft). During a 30-day period, the water depth in this river is predicted to increase by a minimum of 1 ft and a maximum of 3 ft. What is the predicted maximum water depth, in feet, during this time?

A) 75.7

B) 77.7

C) 79.7

D) 81.7

22. [August 2024]

$$y < -6x - 22$$

$$y > -4x - 7$$

For what of the following tables are all the values of x and their corresponding values of y solutions to the given system of inequalities?

A)

x	-9	-10	-12
y	27	51	-4

B)

x	-9	-10	-12
y	32	36	-4

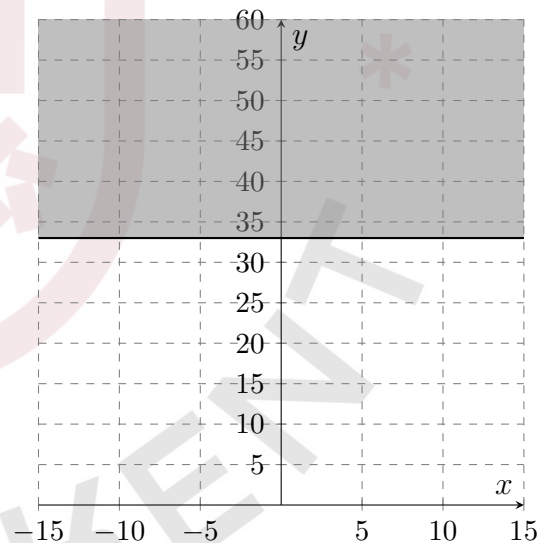
C)

x	-9	-10	-12
y	28	36	48

D)

x	-9	-10	-12
y	30	37	48

23. [August US 2024]



The shaded region shown in the graph represents all the solutions to which inequality?

A) $x < 33$

B) $x \geq 33$

C) $y \leq 33$

D) $y \geq 33$

24. [August 2024]

A model estimates that a gray whale travels 72 to 77 miles each day during its migration. Based on this model, which inequality represents the estimated total number of miles, x , a gray whale could travel in 14 days of its migration?

- A) $(72)(14) \leq x \leq (77)(14)$
- B) $72 + 14 \leq x \leq 77 + 14$
- C) $72 \leq 14x \leq 77$
- D) $72 \leq 14 + x \leq 77$

25. [October US 2024]

A plant nursery classifies a perennial species as tall if its typical height when fully grown is more than 100 centimeters. Each of the following inequalities represent the possible heights h , in centimeters, for a specific perennial species when fully grown. Which inequality represents the possible heights h , in centimeters, of a tall perennial flower species?

- A) $107 < h < 158$
- B) $76 < h < 100$
- C) $41 < h < 95$
- D) $16 < h < 91$

26. [October US 2024]

A shopper goes to a pet store to buy dog food and treats. The shopper has \$20. Each can of food costs \$1.87, and each bag of treats costs \$2.37. Which inequality represents the relationship between the number of cans of food, c , and the number of bags of treats, t , the shopper can buy?

- A) $1.87c + 2.37t \leq 20$
- B) $1.87c + 2.37t \geq 20$
- C) $2.37c + 1.87t \leq 20$
- D) $2.37c + 1.87t \geq 20$

27. [October US 2024]

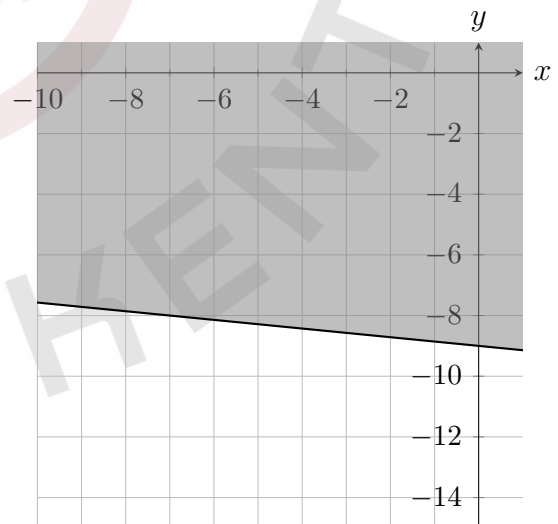
For a particular tree species, it is recommended to plant a maximum of 102 trees per acre. Based on this recommendation, what is the maximum number of trees of this species that can be planted on 3 acres?

- A) 408
- B) 306
- C) 105
- D) 99

28. [October 2024]

A geologist estimates that the volume of a boulder is greater than 12.7 cubic feet but less than 15.7 cubic feet. The geologist also estimates that the boulder weighs 160 pounds per cubic foot of volume. Which inequality represents this situation, where x represents the estimated total weight, in pounds, of the boulder?

- A) $160 - 15.7 < x < 160 - 12.7$
- B) $160 + 12.7 < x < 160 + 15.7$
- C) $160(12.7) < x < 160(15.7)$
- D) $\frac{160}{15.7} < x < \frac{160}{12.7}$

29. [October US 2024]

The shaded region shown represents solution to $rx + ty \geq -77$, where r and t are constants. What is the value of $r + t$?

- A) 8
- B) 6
- C) -6
- D) -7

30. [October US 2024]

A botanist estimates the number of oak trees in a forest to be at least 2600 and no more than 3200. Which inequality best represents the number oak trees, x , in the forest?

- A) $x \leq 600$
- B) $x \leq 2600$
- C) $2600 \leq x \leq 3200$
- D) $x \leq 2600$ or $x \geq 3200$

31. [October US 2024]

If $x \geq -6$ represent all solutions to the inequality $ax - 27 \leq 15$, where a is a constant, what is the greatest possible value of a ?

32. [November 2024]

Cristina was elected to the city council. Each city council person is required to attend at least 21 of the 27 scheduled meetings in a year to keep their position. Which inequality represents the number of city council meetings, x , Cristina must attend in a year to keep her position on the city council?

- A) $x \leq 21$
- B) $x \geq 48$
- C) $21 \leq x \leq 27$
- D) $27 \leq x \leq 48$

33. [November 2024]

To cut a lawn, Antwan charges a fee of \$10.00 for his equipment and \$8.50 per hour spent cutting lawn. Taylor charges a fee of \$7.00 for his equipment and \$9.50 per hour spent cutting a lawn. If x represents the number of hours spent cutting a lawn, what are the value of x for which Taylor's total charge is greater than Antwan's total charge?

- A) $2 \leq x \leq 3$
- B) $3 \leq x \leq 4$
- A) $x < 2$
- B) $x > 3$

34. [November US 2024]

An employee earns \$30 per hour for the first 40 hours worked in a week. For each hour worked over 40 hours, the employee earns \$45 per hour. What is the least number of whole hours that the employee must work in a week to earn at least \$1,610?

- A) 50
- B) 49
- C) 10
- D) 9

35. [November US 2024]

$$y > 5x - 6$$

For which of the following tables are all the values of x and their corresponding values of y solutions to the given inequality?

A)

x	y
3	3
5	13
8	28

B)

x	y
3	9
5	19
8	34

C)

x	y
3	11
5	21
8	39

D)

x	y
3	-9
5	-19
8	-34

36. [December US 2024]

$$y > 17$$

$$4x + y < 21$$

The point $(x, 54)$ is a solution to the given system of inequalities in the xy -plane. Which of the following could be the value of x ?

- A) 9
- B) 5
- C) -5
- D) -9

37. [December US 2024]

A soccer team's goal is to earn at least \$1,320 by selling coupon books. The team earns \$12 from selling each coupon book. Which of the following inequalities describes the possible values for the number of coupon books, n , the team can sell to meet the goal?

- A) $n + 12 \leq 1320$
- B) $n + 12 \geq 1320$
- C) $12n \leq 1320$
- D) $12n \geq 1320$

38. [December 2024]

When several resistors are connected in series in a circuit, the total resistance of the circuit is the sum of the resistances of these resistors. A certain circuit consists of 8 resistors connected in series, where the resistance of each resistor is positive. This circuit has a total resistance of 130 ohms. The total resistance of 3 resistors in this circuit is 90 ohms. Which inequality best represents all possible values of the resistance x , in ohms, of one of the other 5 resistors in this circuit?

- A) $0 < x < 8$
- B) $0 < x < 40$
- C) $40 < x < 90$
- D) $40 < x < 130$

39. [December 2024]

Sabrina has a goal to save at least 240 USD. Sabrina has already saved 180 USD. If x represents the additional amount of money, in dollars, Sabrina needs to save to meet her goal, which inequality represents this situation?

- A) $\frac{x}{180} \geq 240$
- B) $180x \geq 240$
- C) $180 + x \geq 240$
- D) $180 - x \geq 240$

40. [December 2024]

$$y < 42 - 7x$$

$$\frac{y}{7} > 10$$

Which inequality represents the x values for all solutions (x, y) that satisfy the given system of inequalities in the xy -plane?

- | | |
|------------|-------------|
| A) $x > 6$ | C) $x > -4$ |
| B) $x < 6$ | D) $x < -4$ |

Answers: Linear Equations

Number	Answer	Number	Answer
1	A	21	D
2	C	22	D
3	A	23	D
4	D	24	A
5	A	25	A
6	D	26	A
7	B	27	B
8	D	28	C
9	A	29	A
10	D	30	C
11	A	31	-7
12	D	32	C
13	B	33	A
14	A	34	C
15	D	35	C
16	A	36	D
17	D	37	D
18	D	38	B
19	D	39	C
20	B	40	D

Advanced math

Polynomials

1. [August US 2023]

Which expression is equivalent to

$$x^2 - 5x - 24?$$

- A) $(x + 6)(x - 4)$
- B) $(x + 4)(x - 6)$
- C) $(x + 3)(x - 8)$
- D) $(x + 8)(x - 3)$

2. [November 2023]

Time(years)	Total amount (dollars)
0	604.00
1	607.62
2	611.27

Sam opened a savings account at a bank. The table shows the exponential relationship between the time, t , in years, since Sam opened the account and the total amount, n , in dollars, in the account. If Sam made no additional deposits or withdrawals, which of the following equations best represents the relationship between t and n ?

- A) $n = 0.006(1 + 604)^t$
- B) $n = 604(1 + 0.006)^t$
- C) $n = (1 + 0.006)^t$
- D) $n = (1 + 604)^t$

3. [June 2024]

The function f is defined by

$$f(x) = (x - 5)(x - 8)(x + k),$$

where k is a constant. In the xy -plane, the graph of $y = f(x)$ passes through the point $(-2, 0)$. What is the value of $f(0)$?

- A) -140
- B) -2
- C) 11
- D) 80

4. [May 2024]

$$7x^2(4x - 13)(4x - u) = 0$$

In the given equation, u is a positive constant. The sum of the solutions to the equations is 9. What is the value of u ?

5. [December 2023]

The graph of the polynomial function f in the xy -plane, where $y = f(x)$, has x -intercepts of $(-7, 0)$ and $(9, 0)$. Which of the following must be true?

- A) $f(0) = -7$
- B) $f(9) = -7$
- C) $f(-7) = 0$
- D) $f(-7) = 9$

6. [March 2024]

$$\frac{4}{7}(4x + 7)(x + \sqrt{4k + 7})(x - \sqrt{4k + 7}) = 0$$

In the given equation, k is a positive constant. The product of the solutions to the equation is 77. What is the value of k ?

7. [May 2024]

Which of the following expressions has a factor of $x + 2b$, where b is a positive integer constant?

- A) $3x^2 + 9x + 18b$
- B) $3x^2 + 24x + 18b$
- C) $3x^2 + 30x + 18b$
- D) $3x^2 + 39x + 18b$

8. [May 2024]

The graph of the function f in the xy -plane, where $y = f(x)$, has x -intercepts of $(-5, 0)$, $(3, 0)$, and $(6, 0)$. Which of the following must be true?

- A) $f(0) = -5$
- B) $f(0) = 3$
- C) $f(5) = 0$
- D) $f(6) = 0$

9. [May 2024]

$$34z^{14} + bz^7 + 70$$

In the given expression b is a positive integer. If $qz^7 + r$ is a factor of the expression, where q and r are positive integers, what is the greatest possible value of b ?

10. [August 2024]

Which expression is a factor of

$$2x^2 + 30x + 8?$$

- A) 2
B) $4x$
C) $30x$
D) $2x^2$

11. [August 2024]

The function p is defined by

$$p(x) = ((x+6)^2 - b)((x+6)^2 - c),$$

where a, b , and c are constants. In the xy -plane, the graph of $y = p(x)$ passes through the points $(-7, 24)$ and $(0, 899)$. What is the value of $p(-12) + p(-5)$?

12. [August 2024]

$$f(x) = 3(x-a)(x-b)(x-c)$$

The function f is defined by the given equation, where a, b , and c are distinct constants. When $a < x < b$, the value of $f(x)$ is positive. The graph of $y = f(x)$ in the xy -plane contains the point (r, s) , where r and s are constants. If $s = 8$, which of the following could be true?

- I. $r < a$
II. $b < r < c$
III. $r > c$
A) I only
B) III only
C) I and III only
D) II and III only

13. [August US 2024]

The graph of a polynomial function $y = f(x)$ in the xy -plane passes through the point $(8, 9)$. What is the value of $f(8)$?

- A) 8
B) 9
C) 17
D) 72

14. [October US 2024]

The function f is defined by

$$f(x) = (x-8)(x-5)(x-3).$$

In the xy -plane, the graph of $y = g(x)$ is the result of translating the graph of $y = f(x)$ up 3 units. What is the value of $g(0)$?

15. [October US 2024]

The given equation is:

$$0 = (x-k)(7x+t) - (x-k)$$

In the given equation, k and t are positive constants. A solution to the equation is $x = -\frac{22}{7}$. What is the value of t ?

16. [October US 2024]

The function h is defined by

$$h(x) = (x+p)(x-2)(2x-12),$$

where p is a constant. In the xy -plane the graph of $y = h(x)$ passes through the point $(-3, 0)$. What is the value of $h(0)$?

- A) -36
B) -3
C) 5
D) 72

17. [December US 2024]

The graph of the polynomial function f in the xy -plane, where $y = f(x)$, has x -intercepts of $(-5, 0)$ and $(6, 0)$. Which of the followings must be true?

- A) $f(0) = -5$
B) $f(6) = -5$
C) $f(-5) = 0$
D) $f(-5) = 6$

18. [December US 2024]

$$(x - 16)(x - 10)(x + 7)(x + 17) = 0$$

What is the positive solution to the given equation?

19. [December 2024]

$$(x - 16)(x - 12)(x + 7)(x + 13) = 0$$

What is the positive solution to the given equation?

20. [December 2024]

The graph of the polynomial function f in the xy -plane, where $y = f(x)$, passes through the point $(5, 3)$. What is the value of $f(5)$?

A) 3

B) 5

C) 8

D) 15

21. [December 2024]

The function p is defined by

$$p(x) = a((x + 5)^2 - b)((x + 5)^2 - c),$$

where a , b , and c are constants. In the xy -plane, the graph of $y = p(x)$ passes through the points $(-6, 30)$ and $(0, 342)$. What is the value of $p(-10) + p(-4)$?

Answers: Polynomials

Number	Answer	Number	Answer
1	C	11	923
2	B	12	B
3	D	13	B
4	23	14	-117
5	C	15	155
6	$37/4$	16	D
7	D	17	C
8	D	18	16 or 10
9	2381	19	16 or 12
10	A	20	A
21	372		

Exponents&Radicals

1. [March US 2023]

$$\sqrt{a^2b^6}$$

If a and b are positive numbers, which of the following is equivalent to the expression above?

A) ab^4

B) ab^3

C) $ab\sqrt{ab^4}$

D) $ab\sqrt{b^3}$

2. [March US 2023]

Which expression is equivalent to $\sqrt[5]{32a^3b^4}$, where $a > 0$ and $b > 0$?

A) $2a^{\frac{3}{5}}b^{\frac{4}{5}}$

B) $2a^{\frac{5}{3}}b^{\frac{5}{4}}$

C) $32a^{\frac{3}{5}}b^{\frac{4}{5}}$

D) $32a^{\frac{5}{3}}b^{\frac{5}{4}}$

3. [June 2023]

The expression

$$\frac{x^{20}(x-4)}{5x^2} + \frac{4x^{20}}{5x^2}$$

is equivalent to $\frac{1}{5}x^c$, where c is a constant and $x > 0$. What is the value of c ?

A) 4

B) 5

C) 19

D) 21

4. [August US 2023]

$$W = \frac{R^2}{R^2 + S^2}$$

The given equation relates the variables R , S , and W , where R , S , and W represent positive numbers. Which equation correctly expresses S in terms of R and W ?

A) $S = \sqrt{\frac{R^2 - WR^2}{W}}$

B) $S = \frac{R^2}{R^2 + W^2}$

C) $S = \sqrt{R^2 - WR^2}$

D) $S = \sqrt{\frac{R^2}{W}} - R^2$

5. [March 2024]

$$f(x) = 9x - 7$$

Function f is defined by the given equation. The function g is defined by

$$g(x) = f(x) - (7x - 2).$$

What is the x -coordinate of the x -intercept of the graph of $y = g(x)$ in the xy -plane?

A) $\frac{9}{16}$

B) $\frac{7}{9}$

C) $\frac{5}{2}$

D) $\frac{9}{2}$

6. [May US 2024]

If n and k are numbers greater than 1 and $\sqrt[3]{n^4}$ is equivalent to $\sqrt[5]{k^2}$, for what value of a is n^{2a+1} equal to k ?

7. [June 2024]

$$\sqrt[5]{119n} \left(\sqrt[6]{119n} \right)^2$$

For what value of x is the given expression equivalent to $(119n)^{30x}$, where $n > 1$?

8. [June 2024]

$$\sqrt[5]{p^2} = t^{\frac{3}{4}}$$

In the given equation, $p > 1$ and $t > 1$. If $t = p^{2n-1}$ where n is a constant, what is the value of n ?

9. [August 2024]

Which expression is equivalent to $(\sqrt[12]{x^5y^5})$, where x and y are positive?

A) $(xy)^{\frac{12}{5}}$

B) $(xy)^{\frac{5}{12}}$

C) $(xy)^{17}$

D) $(xy)^{60}$

10. [August US 2024]

The expression $(6x^2)(3x^7)$ is equivalent to bx^9 , where b is a constant. What is the value of b ?

11. [October US 2024]

$$r = \sqrt{5w - 3}$$

The given equation relates the real number r and w , where $w > \frac{3}{5}$. Which equation correctly expresses w in terms of r ?

A) $w = \sqrt{-3r + 5}$

B) $w = \sqrt{5r - 3}$

C) $w = \frac{r^2}{5} + \frac{3}{5}$

D) $w = \frac{r^2}{5} + 3$

12. [December US 2024]

If n and k are numbers greater than 1 and $\sqrt[4]{n^5}$ is equivalent to $\sqrt[3]{k^2}$, for what value of a is n^{2a+1} equal to k ?

13. [December 2024]

$$\sqrt[5]{x^m}$$

In the given expression, m is a constant and $x > 1$. The expression can be rewritten as $\sqrt[7]{x}$. What is the value of m ?

Answers: Exponents&Radicals

Number	Answer	Number	Answer
1	B	8	$23/30$
2	A	9	B
3	C	10	18
4	A	11	C
5	C	12	$7/16$
6	$7/6$	13	$5/7$
7	$4/225$		

Functions&Function Notation

1. [June 2023]

The graph of the quadratic function $y = f(x)$ in the xy -plane intersects the x -axis when $x=39$ and when $x = p$, where p is a constant. The maximum value of $y = f(x)$ occurs at the point $(14,m)$, where m is a constant. What is the value of p ?

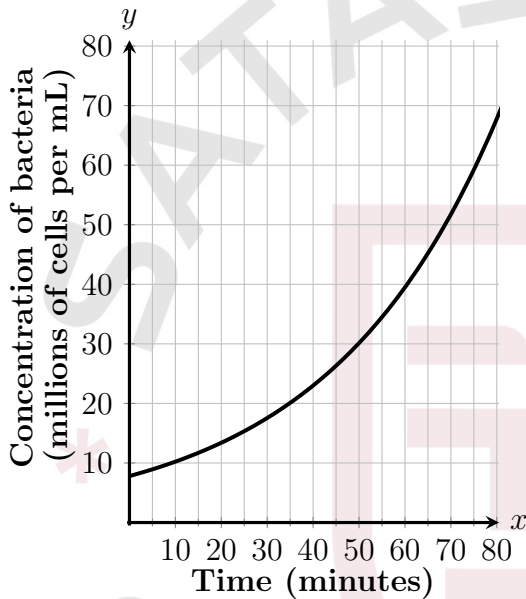
A) -37

C) -20

B) -34

D) -17

2. [June 2023]



The graph shows the estimated concentration of a certain strain of bacteria, in millions of cells per mL, of nutrient medium, over time x , in minutes since the initial measurement. According to the graph, which of the following is closest to the number of minutes it took for estimated concentration of the bacteria to increase from 20 million cells per mL of nutrient to 30 million cells per mL of nutrient medium?

A) 15

C) 30

B) 20

D) 35

3. [June 2023]

$$g(x) = 2(16x - 17)$$

What is the y -intercept of the graph of $y = g(x) - 3$ in the xy -plane?

4. [June 2023]

$$f(x) = |71 - 2x|$$

The function f is defined by the given equation. For which of the following values of k does $f(k) = 3k$?

A) $\frac{71}{5}$

C) $\frac{213}{5}$

B) $\frac{71}{2}$

D) 71

5. [June 2023]

The function f is defined by

$$f(x) = 6(2x + 4).$$

For what value of x does $f(x) = 48$?

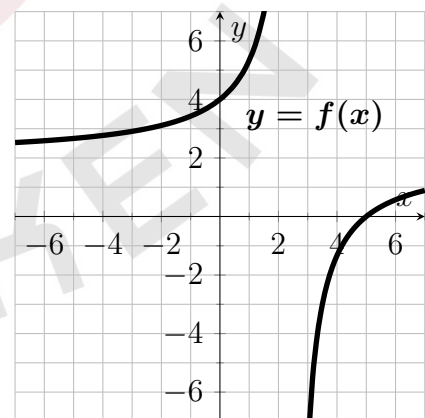
A) 2

C) 8

B) 6

D) 22

6. [August US 2023]



The graph of $y = f(x)$ is shown. What is the value of $f(0)$?

A) -5

C) 4

B) -4

D) 5

7. [August US 2023]

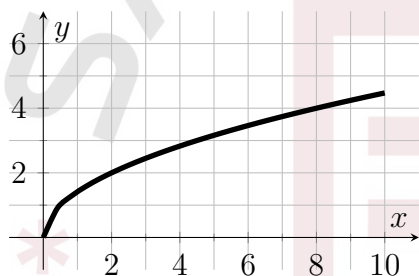
x	y
0	0
2	2
8	4
18	6

Which graph best models the relationship between x and y in the given table?

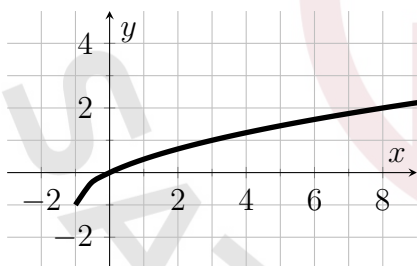
A)



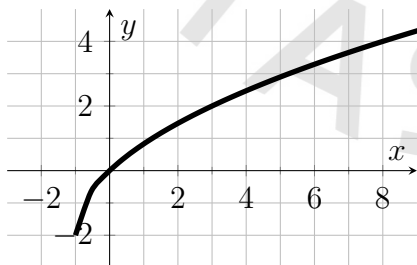
B)



C)



D)



8. [November 2023]

x	y
20	-20
24	12
28	-20

The table shows three values of x and their corresponding values of y , where $y = f(x) + 6$ and f is a quadratic function. What is the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane?

9. [November 2023]

The y -intercept of the graph of

$$y = 6x^2 + 77$$

is $(0, y)$. What is the value of y ?

10. [November 2023]

Exactly how many x -intercepts does the graph of $f(x) = x(x - 8)^2(x - 13)^3$ have in the xy -plane, where $y = f(x)$?

A) 0

C) 2

B) 1

D) 3

11. [November 2023]

$$p(v) = 15v$$

The function p gives the relationship between the instantaneous power $p(v)$, in watts, and the potential difference v , in volts, for a current of 150 amperes. Which statement is the best interpretation of $p(3) = 450$ in this context?

A) For a potential difference of 3 volts, the instantaneous power is 450 watts.

B) For a current of 3 amperes, the instantaneous power is 450 watts.

C) For an instantaneous power of 3 watts, the potential difference is 450 volts.

D) For a current of 150 amperes, the potential difference is 450 volts.

12. [November 2023]

$$y = -0.5$$

$$y = x^2 + 10x + a$$

In the given system of equations, a is a positive integer constant. The system has no real solutions. What is the least possible value of a ?

13. [November 2023]

The function

$$f(x) = 70,000(2)^{\frac{t}{820}}$$

gives the number of bacteria in a population t minutes after an initial observation. How much time, in minutes, does it take for the number of bacteria in the population to double?

- A) 2 C) 1,640
B) 820 D) 70,000

14. [December 2023]

The cost of renting a piece of constructing equipment for up to 5 days is \$350 for the first day and \$175 for each additional day. Which of the following equations gives the cost y , in dollars, of renting the equipment for x days, where x is a positive integer and $x \leq 5$?

- A) $y = 175x + 175$
B) $y = 350x - 175$
C) $y = 175x + 350$
D) $y = 350x + 175$

15. [December 2023]

The function g is defined by

$$g(x) = \sqrt{6x + 7}.$$

What is the value of $g(3)$?

- A) $\frac{5}{6}$ C) 5
B) $\frac{25}{6}$ D) 25

16. [December 2023]

The function g is defined by

$$g(x) = \sqrt{6x + 7}.$$

What is the value of $g(3)$?

- A) $\frac{5}{6}$ C) 5
B) $\frac{25}{6}$ D) 25

17. [December 2023]

The function f is defined by

$$f(x) = 25x + 80.$$

What is the value of $f(x)$ when $x = 2$?

- A) 50 C) 130
B) 107 D) 210

18. [December 2023]

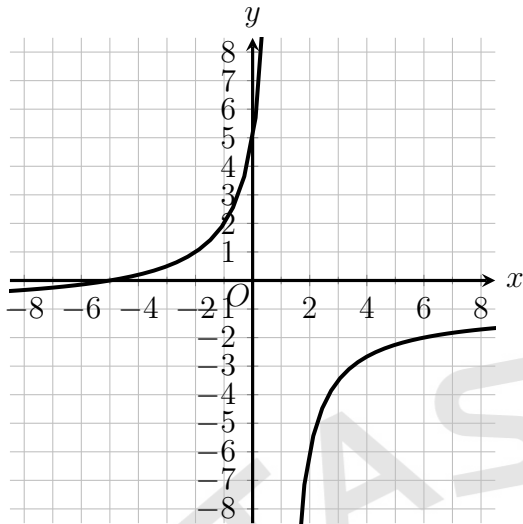
A proposal for a construction project was included on a city election ballot. A TV news report stated that 4 times as many people voted of the proposal as people who voted against it. An internet article reported that 10,500 more people voted in favor of the proposal than voted against it. Based on these data, how many people voted against the proposal?

19. [March 2024]

The function f is defined by $f(x) = 8 + \sqrt{x}$. What is the value of $f(36)$?

- A) 0 C) 17
B) 14 D) 26

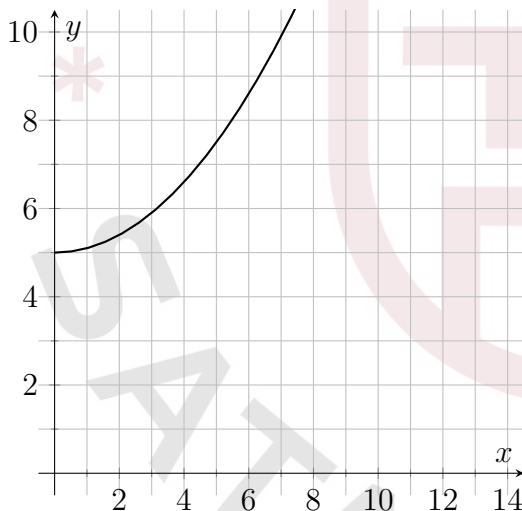
20. [March 2024]



The graph of $y = f(x)$ is shown in the xy plane. What is the value of $f(0)$?

- A) 5
- B) -6
- C) -2
- D) 4

21. [March 2024]



The graph models the population, in thousands, of a town x years since 2004, where $0 \leq x \leq 15$. Which statement is the best interpretation of the point $(1, 5.30)$?

- A) In 2019, the estimated population of the town was 5,300.
- B) In 2018, the estimated population of the town was 5,300.
- C) In 2005, the estimated population of the town was 5,300.
- D) In 2004, the estimated population of the town was 5,300.

22. [March 2024]

The function f is defined by $f(x) = |x - 6x|$. What value of a satisfies $f(7) - f(a) = -15$?

- A) -22
- B) 3
- C) 10
- D) 75

23. [March 2024]

The function f is defined by $f(x) = 4x^2$. What is the value of $f(11)$?

- A) 44
- B) 52
- C) 88
- D) 484

24. [March 2024]

The function g is defined by

$$g(x) = \sqrt{5x + 1}.$$

What is the value of $g(7)$?

- A) $\frac{6}{5}$
- B) $\frac{36}{5}$
- C) 6
- D) 36

25. [March 2024]

For $x > 0$, the function f is defined as follows:

$$f(x) \text{ equals } 111\% \text{ of } x$$

Which of the following could describe this function?

- A) Decreasing exponential
- B) Decreasing linear
- C) Increasing exponential
- D) Increasing linear

26. [May 2024]

The function h is defined by $h(x) = 5|x|$. What is the value of $h(-3)$?

- A) -15
- B) 2
- C) 8
- D) 15

27. [May 2024]

Liam has \$150 in an account. Each year he expects to have 2.8% more money in the account than he had the previous year. Which of the following models best describes how Liam expects the money in his account to change over time?

- A) Decreasing exponential
- B) Decreasing linear
- C) Increasing exponential
- D) Increasing linear

28. [May 2024]

$$7|x - 7| = 42$$

What is the sum of the solutions to the given equation?

- A) -6
- B) 0
- C) 14
- D) 49

29. [May 2024]

The function f is defined by

$$f(x) = (x - 9)(x - 6)(x - 5).$$

In the xy -plane, the graph of $y = g(x)$ is the result of translating the graph of $y = f(x)$ up 4 units. What is the value of $g(0)$?

30. [May 2024]

The function f is defined by $f(x) = a\sqrt{b - x}$, where a and b are constants. In the xy -plane, the graph of $y = f(x)$ passes through the point $(22, 0)$, and $f(-22) < 0$. Which of the following must be true?

- A) $a < 0$
- B) $b < 0$
- C) $f(0) = -22$
- D) $f(0) = 22$

31. [May US 2024]

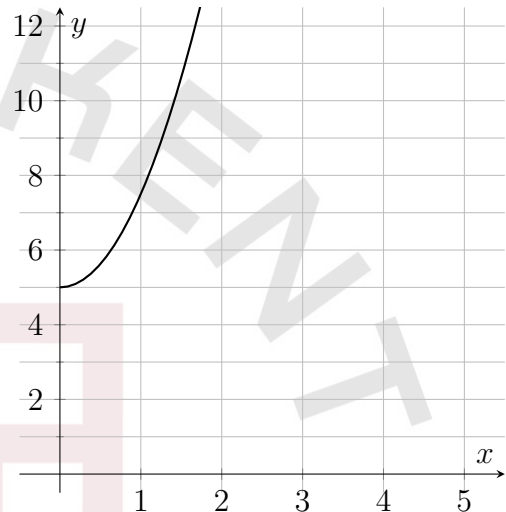
The function f is defined by $f(x) = 5 + \sqrt{x}$. What is the value of $f(64)$?

- A) 0
- B) 13
- C) 21
- D) 37

32. [May 2024]

If $f(x) = x + 2$ and $g(x) = 2x$, what is the value of $3f(-5) - g(-5)$?

- A) -19
- B) -3
- C) 1
- D) 7

33. [June 2024]

The graph gives the estimated population y , in thousands, of a town x years since 2007, where $0 \leq x \leq 5$. Which of the following best describes the increase in the estimated population from $x = 0$ to $x = 1$?

- A) The estimated population at $x = 1$ is 3.5 times the estimated population at $x = 0$.
- B) The estimated population at $x = 1$ is 2.5 times the estimated population at $x = 0$.
- C) The estimated population at $x = 1$ is 1.5 times the estimated population at $x = 0$.
- D) The estimated population at $x = 1$ is 0.5 times the estimated population at $x = 0$.

34. [June 2024]

The function f is defined by $f(x) = x^3 + 17$. What is the value of $f(2)$?

35. [June 2024]

The function g is defined by $g(x) = \frac{x}{2}$. For what value of x does $g(x) = 244$?

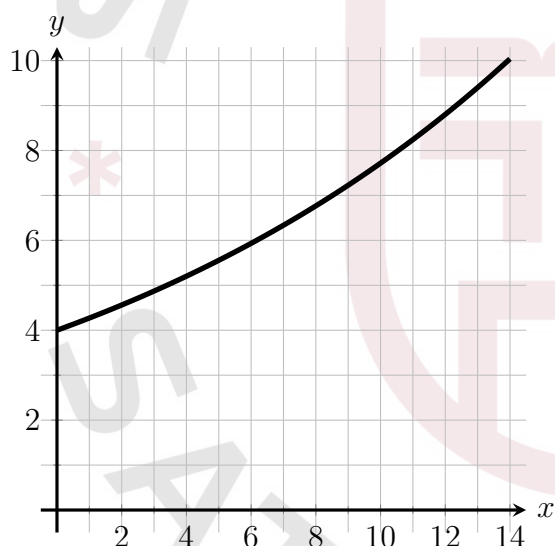
36. [June 2024]

x	-20	-8	10
$g(x)$	4	0	6

The table shows three values of x and their corresponding values of $g(x)$, where $g(x) = \frac{f(x)}{x+5}$ and f is a linear function. What is the y -intercept of the graph of $y = f(x)$ in the xy -plane?

- A) (0,-8) C) (0,8)
B) (0,5) D) (0,40)

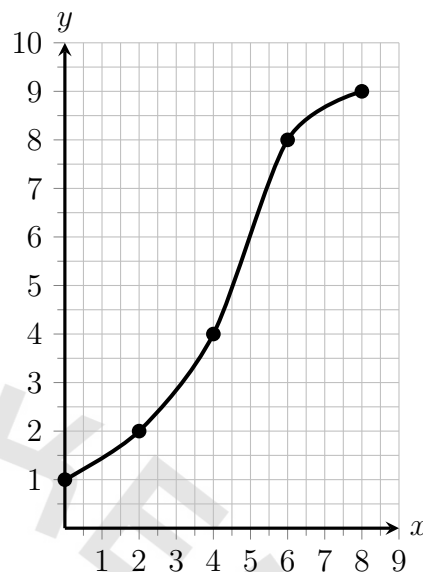
37. [August 2024]



The graph models the population, in thousands, of a town x years since 2003, where $0 \leq x \leq 15$. Which statement is the best interpretation of the point (1, 4.24)?

- A) In 2003, the estimated population of the town was 4,240.
B) In 2004, the estimated population of the town was 4,240.
C) In 2017, the estimated population of the town was 4,240.
D) In 2018, the estimated population of the town was 4,240.

38. [August US 2024]



The graph shows the momentum y , in newton-seconds, of an object x seconds after object started moving, for $0 \leq x \leq 8$. What is the average rate of change, in newton-seconds per second, in the momentum of the object from $x = 2$ to $x = 6$?

39. [June 2024]

The function f is defined by $f(x) = x^3 + 14$. What is the value of $f(2)$?

40. [August 2024]

For $x > 0$, the function f is defined as follows:

$$f(x) \text{ equals } 300\% \text{ of } x$$

Which of the following could describe this function?

- A) Decreasing exponential
B) Decreasing linear
C) Increasing exponential
D) Increasing linear

41. [August 2024]

The function k is defined by

$$k(x) = x^3 + 700.$$

What is the value of $k(x)$ when $x = 2$?

A) 700

C) 706

B) 705

D) 708

42. [August 2024]

For the function h , $h(0) = 0$ and $h(7) = 4$. Which equation defines h ?

A) $h(x) = \frac{7}{4}x$

B) $h(x) = \frac{7}{4}x + 7$

C) $h(x) = \frac{4}{7}x$

D) $h(x) = \frac{4}{7}x + 4$

43. [August 2024]

The function g is defined as

$$g(x) = \frac{2x - 4}{(x + 11)(x - 6)}$$

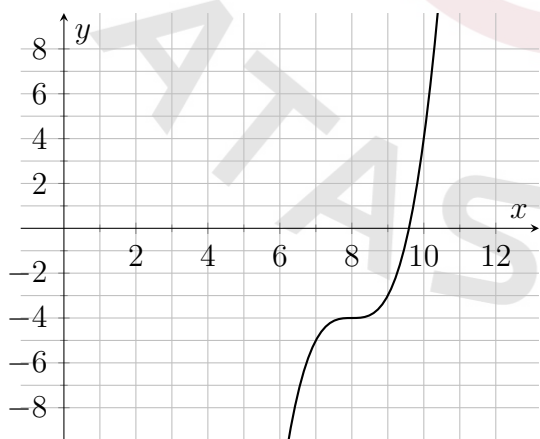
If $g(a + 5) = 0$, where a is a constant, what is the value of a ?

44. [August 2024]

$$|x - 8| = -|x - 8| + 20$$

What is the sum of the solutions to the given equation?

45. [August US 2024]



The complete graph of $y = f(x)$ is shown. For how many values of x does $f(x) = 0$?

A) *Zero*C) *Two*B) *One*D) *Three*

46. [October 2024]

The function f is defined by $f(x) = 5 + \sqrt{x}$. What is the value of $f(144)$?

47. [October US 2024]

$$g(x) = \frac{2}{7}x + \frac{8}{5}$$

$$h(x) = 5x - 7$$

The functions g and h are defined by the equations shown. Which expression is equivalent to $g(x) \cdot h(x)$?

A) $\frac{10x^2}{7} - \frac{56}{5}$

B) $\frac{10x^2}{7} + \frac{13x}{6} - \frac{56}{5}$

C) $\frac{10x^2}{7} - 6x - \frac{56}{5}$

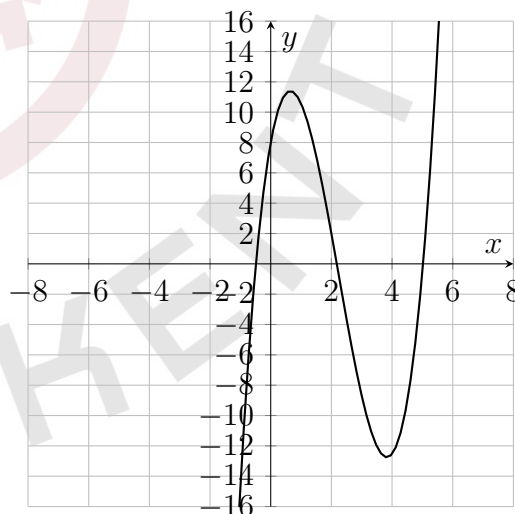
D) $\frac{10x^2}{7} + 6x - \frac{56}{5}$

48. [October US 2024]

$$f(x) = -(x - 6)^2 + 4$$

The function f is defined by the given equation. For what value of x does $f(x)$ reach its maximum?

49. [October US 2024]



The graph of $y = f(x) - k$ is shown in the xy -plane. If k , a , and b are positive constants, which equation could define f ?

A) $f(x) = (x - a)^2(x + b)$

B) $f(x) = (x + a)^2(x - b)$

C) $f(x) = (x - a)^2(x + b)^2$

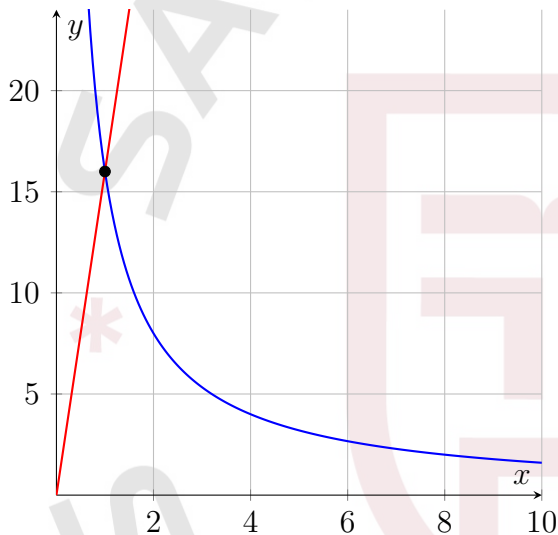
D) $f(x) = (x + a)^2(x - b)^2$

50. [October US 2024]

For the function f , for every increase of 2 in the value of x , the value of $f(x)$ increase by a factor of c , where c is a constant. Which of the following equivalent forms of function f displays the value of c as the base of the coefficient?

- A) $f(x) = 26(2)^6x$
- B) $f(x) = 26(8)^2x$
- C) $f(x) = 26(64)^x$
- D) $f(x) = 26(4096)^{\frac{x}{2}}$

51. [November 2024]



The system of two equations, $y = \frac{16}{x}$ and $y = 16x$, is graphed in the xy -plane as shown. Which ordered pair is a solution to this system?

- A) (0, 0)
- B) (0, 16)
- C) (1, 16)
- D) (16, 16)

52. [November 2024]

The graph of a polynomial function $y = f(x)$ in the xyp -plane passes through the point (5, 7). What is the value of $f(5)$

- A) 5
- B) 7
- C) 12
- D) 35

53. [November 2024]

The functions g and h are defined by the given equations.

$$g(x) = \sqrt{(x - 11)^2 + 45}$$

$$h(x) = \sqrt[3]{64} + \frac{x^2}{2}$$

If the value of $g(8) = t$, where t is a constant, what is the value of $h(t)$?

- A) $3\sqrt{6}$
- B) 22
- C) 31
- D) 51

54. [November 2024]

For $x > 0$, the function f is defined as follows:

$$f(x) \text{ equals } 111\% \text{ of } x$$

Which of the following could describe this function?

- A) Decreasing exponential
- B) Decreasing linear
- C) Increasing exponential
- D) Increasing linear

55. [November US 2024]

The function f is defined by $f(x) = x^3 + 27$. What is the value of $f(2)$?

56. [November US 2024]

The table shows selected values from the function f .

x	$f(x)$
-1	$\frac{1}{69}$
0	1
1	69
2	4,761

Which of the following is the best description of function f ?

- A) Increasing linear
- B) Decreasing linear
- C) Increasing exponential
- D) Decreasing exponential

57. [December US 2024]

The function k is defined by $k(s) = \sqrt{s + 110}$. If $k(53p) = p$, where p is a constant, what is the value of p ?

58. [March 2024]

x	$g(x)$
-23	2
-9	0
19	4

The table shows three values of x and corresponding values of $g(x)$, where

$$g(x) = \frac{f(x)}{x + 2}$$

and f is a linear function. What is the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane?

59. [December 2024]

The function h is defined by $h(x) = 7|x|$. What is the value of $h(-2)$?

- A) -14
B) 5
C) 9
D) 14

60. [December 2024]

x	$f(x)$
-37	4
-9	0
33	6

The table shows three values of x and their corresponding values of $f(x)$, where $f(x) = \frac{kx + 45}{x + 2}$ and k is a constant. What is the value of k ?

61. [November 2023]

For certain air temperatures, the table gives wind chill temperatures for two different wind speeds.

Air temperature (°F)	Wind chill temperature at wind speed 20 mph	Wind chill temperature at wind speed 60 mph
33°F	21°F	15°F
34°F	23°F	16°F
35°F	24°F	17°F

According to the table what is the wind chill temperature, in degrees Fahrenheit (°F), when the air temperature is 33 °F and the wind speed is 20 miles per hour (mph)? (Disregard the degree symbol when entering your answer)

62. [December US 2024]

For certain air temperature, table gives wind chill temperatures for two different wind speeds.

Air temperature	Wind chill temperature at wind speed 15 mph	Wind chill temperature at wind speed 45 mph
26°F	14°F	7°F
30°F	19°F	12°F
34°F	24°F	18°F

According to the table, what is the wind chill temperature, in degrees Fahrenheit (°F), when the air temperature is 26°F and the wind speed is 15 miles per hour (mph)? (Disregard the degree symbol when entering your answer.)

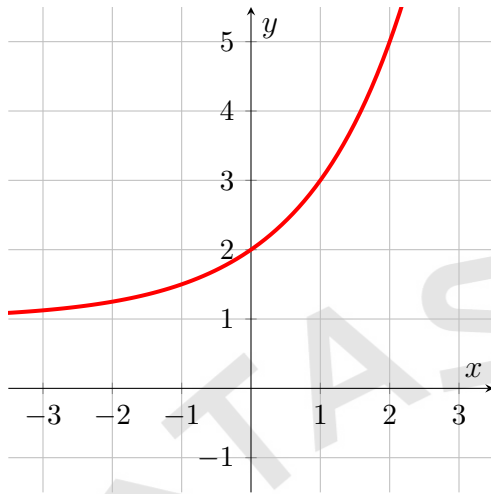
Answers: Functions&Function Notation

Number	Answer	Number	Answer
1	-11	21	C
2	A	22	C
3	A	23	D
4	A	24	C
5	A	25	D
6	C	26	D
7	B	27	C
8	-1146	28	C
9	77	29	-176
10	D	30	A
11	A	31	B
12	25	32	C
13	B	33	C
14	A	34	25
15	C	35	488
16	C	36	A
17	C	37	B
18	3500	38	1.5
19	B	39	22
20	A	40	D

Number	Answer	Number	Answer
41	D	52	B
42	C	53	C
43	-3	54	D
44	16	55	35
45	B	56	A
46	17	57	55
47	D	58	D
48	6	59	5
49	A	60	21
50	D	61	14
51	C		

Exponential Functions

1. [March US 2023]



The graph of $y = f(x) - 1$ is shown. Which equation could define function f ?

- A) $f(x) = 2^x$
- B) $f(x) = 2^x - 1$
- C) $f(x) = 2^x + 1$
- D) $f(x) = 2^x + 2$

2. [June 2023]

An acceptable noise criterion rating for the background noise in a laundry room is 50. For a noise criterion rating of 50, the equation $y = 22(0.997)^{x-60} + 47$ gives the estimated sound pressure level, y , in decibels, as a function of the octave band center frequency, x , in hertz, where $x \geq 60$. Which of the following is the best interpretation of 47 in this context?

- A) 47 is 22 less than the estimated sound pressure level, in decibels, at an octave band center frequency of 60 hertz.
- B) 47 is 22 less than the estimated sound pressure level, in decibels, at an octave band center frequency of 0 hertz.
- C) 47 is the estimated sound pressure level, in decibels, at an octave band center frequency of 60 hertz.
- D) 47 is the estimated sound pressure level, in decibels, at an octave band center frequency of 0 hertz.

3. [March US 2023]

By examining pollen in the soil, scientists estimated that the number of *Ulmus* trees in an ancient population doubled every 664 years. There were n trees in the earliest known sample, where n is a constant. Which expression gives the estimated number of *Ulmus* trees x years after the year of the earliest known sample?

- A) $n(2)^{664x}$
- B) $n(2)^{\frac{664}{x}}$
- C) $n(2)^{\frac{x}{664}}$
- D) $n(2)^{(664+x)}$

4. [March US 2023]

$$f(x) = 5^x + 3$$

If the given function f is graphed in the xy -plane, where $y = f(x)$, what is the y -intercept of the graph?

- A) (0, 3)
- B) (0, 4)
- C) (0, 5)
- D) (0, 8)

5. [March US 2023]

Which table could represent values of x and their corresponding values of $f(x)$ for a decreasing exponential function f ?

A)

x	1	2	3	4
$f(x)$	1	2	3	4

B)

x	1	2	3	4
$f(x)$	8	4	2	1

C)

x	1	2	4	8
$f(x)$	1	9	17	25

D)

x	1	2	4	8
$f(x)$	25	17	9	1

6. [June 2023]

A certain neighborhood had a population of 1,340 in 2009. Each year for the next 5 years, the population of the neighborhood increased by approximately 3% of the population the previous year. Which of the following equations represents the population, N , of the neighborhood t years after 2009, where $t \leq 5$?

- A) $N = 0.03(1,340)^t$
- B) $N = 1,340(0.03)^t$
- C) $N = 1,340(1.03)^t$
- D) $N = 1.03(1,340)^t$

7. [August US 2023]

The function f is defined by $f(x) = a^x - b$, where a and b are constants. The graph of $y = f(x)$ in the xy -plane passes through the points $(0, -5)$ and $(1, 2)$. What is the value of a ?

- A) 8
- B) 7
- C) 6
- D) 5

8. [August US 2023]

$$f(x) = 6.4(0.5)^{3x}$$

A sample of carbon-11 radioactively decays. The function f models the mass, in grams(g), of carbon-11 in the sample x hours after it is initially measured. Which statement is the best interpretation of $f(2) = 0.1$?

- A) After 0.1 hour, the mass of carbon-11 in the sample is 2g.
- B) After 2 hour, the mass of carbon-11 in the sample is 0.1g.
- C) After 0.1 hour, the mass of carbon-11 in the sample has decreased by exactly 2g.
- D) After 2 hour, the mass of carbon-11 in the sample has decreased by exactly 0.1g.

9. [August US 2023]

Which table shows 3 values of x and their corresponding values of $f(x)$ for an increasing exponential function f ?

A)

x	$f(x)$
0	25
1	15
2	5

B)

x	$f(x)$
0	5
1	15
2	25

C)

x	$f(x)$
0	5
1	15
2	45

D)

x	$f(x)$
0	45
1	15
2	5

10. [August US 2023]

According to a model, the population of Canada's Yukon Territory was 33 thousand in 2008 and increased by 2% of the previous year's population for each of the next 4 years. Which function represents this model, where $f(x)$ is the population, in thousands, predicted by the model x years after 2008 and $0 \leq x \leq 4$?

- A) $f(x) = 33(x)^{1.02}$
- B) $f(x) = 33^{1.02x}$
- C) $f(x) = 33(0.02)^x$
- D) $f(x) = 33(1.02)^x$

11. [August US 2023]

$$f(x) = 7.3(0.98)^x$$

The function shown models the annual soil erosion rate, in tons per acre year, on US cropland x years since 1982. According to the model, which is the best interpretation of $7.3(0.98)^{10}$ in this context?

- A) The number of acres of US cropland in 1982
- B) The number of acres of US cropland in 1992
- C) The annual soil erosion rate, in tons per acre per year, in 1982
- D) The annual soil erosion rate, in tons per acre per year, in 1992

12. [December 2023]

The predicted number, $B(t)$, of a certain type of bacterial cell in a growth medium is given by the function $B(t) = 40(3)^t$, where t is the time, in days, since the number of bacterial cells was first measured. Which of the following is the best interpretation of $B(5) = 9,720$ in this context?

- A) 5 days after the number of bacterial cells was first measured, the predicted number of bacterial cells was 9,720
- B) 243 days after the number of bacterial cells was first measured, the predicted number of bacterial cells was 9,720
- C) 9,720 days after the number of bacterial cells was first measured, the predicted number of bacterial cells was 5
- D) 9,720 days after the number of bacterial cells was first measured, the predicted number of bacterial cells was 243

13. [November 2023]

A model estimates that the initial number of photos in a beam is 800 when the beam reaches the surface of a certain material. The model also estimates that when the beam passes through this material the number of photos in the beam decreases by 50% for each 13 millimeters of the material the beam passes through. Which equation represents this model, where I is the estimated number of photos in the beam when the beam reaches a point x millimeters from the surface?

- A) $I = 800(0.5)^{\frac{x}{13}}$
- B) $I = 800(0.5)^x$
- C) $I = 800(2)^{\frac{x}{13}}$
- D) $I = 800(13)^{\frac{x}{2}}$

14. [December 2023]

The function f is defined by $f(x) = a^x + b$, where a and b are constants. In the xy -plane, the graph of $y = f(x)$ has an x -intercept at $(2,0)$ and y -intercept at $(0,-255)$. What is the value of b ?

15. [December 2023]

$$f(t) = 7,000(0.67)^t$$

The given function f models the number of catalogs a company sent to their customers at the end of each year, where t represents the number of years since the end of 1995, and $0 \leq t \leq 5$. If $y = f(x)$ is graphed in the ty -plane, which of the following is the best interpretation of the y -intercept of the graph in this context?

- A) The minimum estimated number of catalogs the company sent to their customers during 5 year is 1,411
- B) The minimum estimated number of catalogs the company sent to their customers during the 5 years was 7,000
- C) The estimated number of catalogs the company sent to their customers at the end of 1995 was 1,411
- D) The estimated number of catalogs the company sent to their customers at the end of 1995 was 7,000

16. [November 2023]

A savings account is opened with an initial deposit of \$6,000. The amount of money in the account t years after the initial deposit is given by the function $f(t) = 6,000(1.01)^{2t}$. Which of the following is the best interpretation of the statement " $f(5)$ is approximately equal to 6,627.73" in this context?

- A) 5 years after the initial deposit, the amount of money, in dollars, in the account is 6,627.73
- B) Every 5 years, the amount of money, in dollars, in the account increases by 6,627.73
- C) 5 years after the initial deposit, the amount of money, in dollars, in the account has increased by 6,627.73
- D) Every 5 years, the amount of money, in dollars, in the account decreases by 6,627.73

17. [December 2023]

A certain neighborhood had a population of 1,130 in 2006. Each year for the next 5 years the population of the neighborhood increased by approximately 4% of the population of the previous year. Which of the following equations represents the population N , of the neighborhood t years after 2006, where $t \leq 5$?

- A) $N = 0.04(1,130)^t$
- B) $N = 1,130(0.04)^t$
- C) $N = 1,130(1.04)^t$
- D) $N = 1.04(1,130)^t$

18. [March 2024]

$$f(x) = 6,000(0.70)^x$$

A conservation scientist implemented a program to reduce a certain invasive insect population in an area. The given function estimates this insect species' population x years after 2008, where $x \leq 8$. Which of the following is the best interpretation of 6,000 in this context?

- A) The estimated percent decrease in the insect population for this species and area every 8 years after 2008
- B) The estimated percent decrease in the insect population for this species and area each year after 2008
- C) The estimated insect population for this species and area 8 years after 2008
- D) The estimated initial insect population for this species and area in 2008

19. [March 2024]

The function f is defined by $f(x) = 42(0.24)^x$. For any positive integer n , the value of $f(n)$ is $p\%$ less than the value of $f(n-1)$. What is the value of p ?

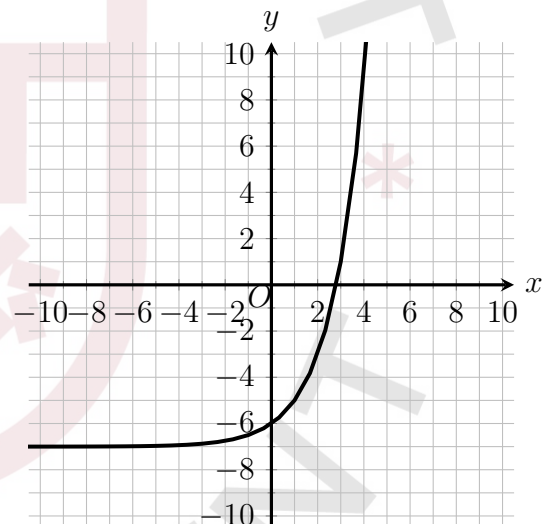
- A) 76
- B) 58
- C) 42
- D) 24

20. [March 2024]

In a certain state, the population of pheasants, a type of bird, is estimated each year by counting the number of pheasants observed along certain roads in the state. On average, each year from 2005 to 2015 the number of pheasants counted per mile of road decreased by 3.5% of the number of pheasants per mile of road the previous year. Based on this average, if there were 6.97 pheasants per mile of road in this state in 2005, which of the following best approximates the number of pheasants per mile of road in 2015?

- A) $0.965(6.97)^{10}$
- B) $1.035(6.97)^{10}$
- C) $6.97(0.035)^{10}$
- D) $6.97(0.965)^{10}$

21. [March 2024]



The graph of the equation $y = 2^x + k$ is shown, where k is a constant. What is the value of k ?

- A) -7
- B) -6
- A) 7
- B) 6

22. [May US 2024]

What is the y -intercept of $y = -(7)^x - 22$ in the xy -plane?

- A) (0,-23)
- B) (0,-29)
- C) (0,-22)
- D) (0,-21)

23. [March 2024]

At the time of posting a video, a social media channel had 95 subscribers. Each day for five days after the video was posted, the number of subscribers doubled from the previous day. Which equation gives the total number of subscribers, n , to the channel d days after the video was posted?

- A) $n = (95)^d$ C) $n = 95 \left(\frac{1}{2}\right)^d$
 B) $n = 95(2)^d$ D) $n = (95)^2 + d$

24. [March 2024]

$$q(x) = 44(4^x)$$

Which table gives three values of x and their corresponding values of $q(x)$ for function q ?

A)

x	-1	0	1
$q(x)$	176	0	176

B)

x	-1	0	1
$q(x)$	$\frac{1}{11}$	4	176

C)

x	-1	0	1
$q(x)$	$\frac{1}{11}$	44	176

D)

x	-1	0	1
$q(x)$	11	44	176

25. [March 2024]

At the time of posting a video, a social media channel has 88 subscribers. Each day after the video was posted, the number of subscribers doubled from the number of subscribers on the previous day. Which equation gives the total number of subscribers, n , to the channel d days after the video was posted?

- A) $n = (88)^d$
 B) $n = 88(2)^d$
 C) $n = 88\left(\frac{1}{2}\right)^d$
 D) $n = 88^2 + d$

26. [March 2024]

The estimated number of a certain bacteria $B(t)$ in a petri dish is given by the equation $B(t) = 6700(2)^t$, where t is the time, in hours, after the bacteria were added to the petri dish. Which statement is the best interpretation of $B(4) = 107200$ in this context?

- A) 0 hours after the bacteria were added to the petri dish, the estimated number of bacteria in the petri dish is 4.
 B) 0 hours after the bacteria were added to the petri dish, the estimated number of bacteria in the petri dish is 107200.
 C) 4 hours after the bacteria were added to the petri dish, the estimated number of bacteria in the petri dish is 4.
 D) 4 hours after the bacteria were added to the petri dish, the estimated number of bacteria in the petri dish is 107200.

27. [March 2024]

$$q(x) = 12(3)^x$$

Which table gives three values of x and their corresponding values of $q(x)$ for function q ?

A)

x	-1	0	1
$q(x)$	4	12	36

B)

x	-1	0	1
$q(x)$	$\frac{1}{4}$	12	36

C)

x	-1	0	1
$q(x)$	$\frac{1}{4}$	3	36

D)

x	-1	0	1
$q(x)$	-36	0	36

28. [May 2024]

The function h is defined by $h(x) = a^x + b$, where a and b are positive constants. The graph of $y = h(x)$ in the xy -plane passes through the points $(0, 8)$ and $(2, 32)$. What is the value of ab ?

- A) 32 C) 40
 B) 35 D) 64

29. [May 2024]

$$f(x) = k(1.84)^x$$

The function f is defined by the given equation, where k is a constant. The value of $f(x)$ increases by $p\%$ for every increase of x in 1. For which of the following functions, where k is a constant, does the value of $g(x)$ increase by $p\%$ for every increase of x in 4?

- A) $g(x) = k(1.84^x)^{\frac{1}{4}}$
- B) $g(x) = k(1.84^x)^4$
- C) $g(x) = k(1.84)^{x-4}$
- D) $g(x) = k(1.84)^{x+4}$

30. [May 2024]

For a certain isotope, at the end of every 29-year period, the mass of a sample of the isotope has decreased to half its mass at the beginning of the 29-year period. The function $s(t) = 216(0.5)^{\frac{t}{29}}$ gives the approximate mass of this isotope, in grams, remaining t years after a 216-gram sample starts to decay. Which statement is the best interpretation of $s(3 \cdot 29) = 27$ in this context?

- A) The mass of the sample is approximately 27 grams 3 years after the sample starts to decay.
- B) The mass of the sample is approximately 27 grams 3 29-year periods after the sample starts to decay.
- C) The mass of the sample is approximately 3 grams 27 29-year periods after the sample starts to decay.
- D) The mass of the sample is approximately 3 grams 27 years before the sample starts to decay.

31. [May US 2024]

In a certain state, the population of pheasants, a type of bird, is estimated each year by counting the number of pheasants observed along certain roads in the state. On average, each year from 2005 to 2015 the number of pheasants counter per mile of road decreased by 3.5% of the number of

pheasants per mile of road the previous year. Based on this average, if there were 6.93 pheasants per mile of road in this state in 2005, which of the following best approximates the number of pheasants per mile of road i 2015?

- A) $6.93(0.965)^{10}$
- B) $6.93(0.035)^{10}$
- C) $1.035(6.93)^{10}$
- D) $0.965(6.93)^{10}$

32. [May US 2024]

At the start of an experiment, the pressure inside a container was 19 pounds per square inch (psi). The pressure inside the container doubled every 28 minutes after the start of the experiment. Which equation represents this situation, where y is the pressure, in psi, inside the container x minutes after the start of the experiment?

- A) $y = 19(2)^{\frac{x}{28}}$
- B) $y = 19(28)^{2x}$
- C) $y = 19(x + 28)^2$
- D) $y = 19x^2 + 28$

33. [May US 2024]

x	$h(x)$
0	1.46
2	2.32
4	3.68

The table shows exponential relationship between the number of years, x , since Isela started training in pole vault, and the estimated height $h(x)$, in meters, of her best pole vault for that year. Which of the following functions best represents this relationship, where $x \leq 4$?

- A) $h(x) = 1.26(0.46)^x$
- B) $h(x) = 1.26(1.46)^x$
- C) $h(x) = 1.46(0.26)^x$
- D) $h(x) = 1.46(1.26)^x$

34. [May 2024]

x	$h(x)$
0	1.25
2	1.80
4	2.59

The table shows the exponential relationship between the number of years, x , since Hana started training in pole vault, and the estimated height $h(x)$, in meters, of her best pole vault for that year. Which of the following functions best represents this relationship, where $x \leq 4$?

- A) $h(x) = 1.20(0.25)^x$
- B) $h(x) = 1.20(1.25)^x$
- C) $h(x) = 1.25(0.20)^x$
- D) $h(x) = 1.25(1.20)^x$

35. [May US 2024]

$$f(x) = 2,000(0.85)^x$$

A conservation scientist implemented a program to reduce a certain invasive insect population in an area. The given function estimates this insect species' population x years after 2008, where $x \leq 8$. Which of the following is the best interpretation of 2,000 in this context?

- A) The estimated percent decrease in the insect population for this species and area every 8 years after 2008
- B) The estimated percent decrease in the insect population for this species and area each year after 2008
- C) The estimated insect population for this species and area 8 years after 2008
- D) The estimated initial insect population for this species and area in 2008

36. [June 2024]

The function $f(t) = 10,000(2)^{\frac{t}{330}}$ gives the number of bacteria in a population t minutes after an initial observation. How much time, in minutes, does it take for the number of bacteria in the population to double?

37. [May 2024]

The function $P(x) = 533(1.011)^x$ models the population of a certain town each year from 1951 through 1966, where x is the number of years after 1951. Which of the following is the best interpretation of " $P(5)$ is approximately equal to 563" in this context?

- A) The population of the town is estimated to be approximately 5 greater in 1956 than in 1951.
- B) The population of the town is estimated to be approximately 563 in 1956.
- C) The population of the town is estimated to be approximately 5 times greater in 1956 than in 1951.
- D) The population of the town is estimated to increase by approximately 563 every 5 years between 1951 and 1956.

38. [May 2024]

$$P(t) = 260(1.03)^{\left(\frac{6}{n}\right)t}$$

The function P models the population, in thousands, of a certain city t years after 2006. According to the model, the population is predicted to increase by 3% every n months. What is the value of n ?

- A) 8
- B) 12
- C) 18
- D) 72

39. [May 2024]

The number of bacteria in a liquid medium doubles every day. There are 72,000 bacteria in the liquid medium at the start of an observation. Which of the following represents the number of bacteria, y , in the liquid medium t days after the start of the observation?

- A) $y = \frac{1}{2}(72,000)^t$
- B) $y = 2(72,000)^t$
- C) $y = 72,000\left(\frac{1}{2}\right)^t$
- D) $y = 72,000(2)^t$

40. [June 2024]

A company has a customer loyalty program. In January 2018, there were 900 customers enrolled in the loyalty program. For the next 24 months after January 2018, the total number of customers enrolled in the loyalty program each month was 2% greater than the total number enrolled the previous month. Which equation gives the total number of customers, c , enrolled in the company's loyalty program m month after January 2018, where $m \leq 24$?

- A) $c = 900(0.02)^m$
- B) $c = 900(1.02)^m$
- C) $c = 900(1.2)^m$
- D) $c = 900(2)^m$

41. [June 2024]

A company has a customer loyalty program. In January 2018, there were 1,600 customers enrolled in the loyalty program. For the next 24 months after January 2018, the total number of customers enrolled in the loyalty program each month was 5% greater than the total number enrolled the previous month. Which equation gives the total number of customers, c , enrolled in the company's loyalty program m months after January 2018, where $m \leq 24$?

- (A) $c = 1,600(0.05)^m$
- (B) $c = 1,600(1.05)^m$
- (C) $c = 1,600(1.5)^m$
- (D) $c = 1,600(5)^m$

42. [June 2024]

$$f(x) = 24(1.30)^{\frac{x}{3}}$$

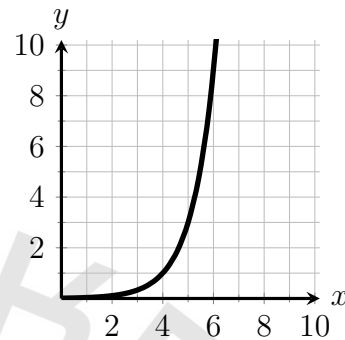
For the given function f , the value of $f(x)$ increases by $p\%$ for every increase of x by 6. What is the value of p ?

- A) 30
- B) 41
- C) 60
- D) 69

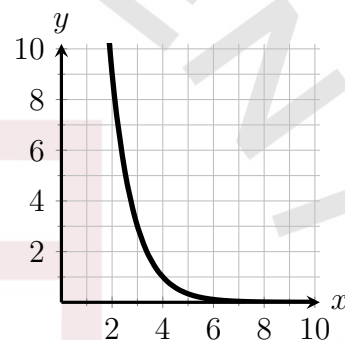
43. [June 2024]

Which of the following is a graph of a decreasing exponential function?

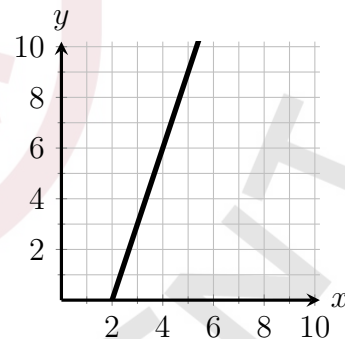
A)



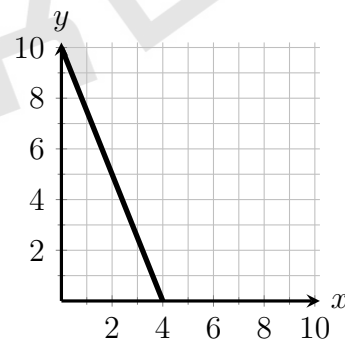
B)



C)



D)



44. [June 2024]

The function g is defined by $g(x) = 10^{3x-1}$. What is the value of x when $g(x)$ is equal to 10,000?

- A) $\frac{4}{3}$ C) 3
B) $\frac{5}{3}$ D) 4

45. [June 2024]

The function f is defined by

$$f(x) = a(3.1^x + 3.1^b),$$

where a and b are integer constants and $0 < a < b$. The functions g and h are equivalent to function f , where k and m are constants. Which of the following equations displays the y -coordinate of the y -intercept of the graph of $y = f(x)$ in the xy -plane as a constant or coefficient?

- I. $g(x) = a(3.1^x + k)$
II. $h(x) = a(3.1)^x + m$
A) I only
B) II only
C) I and II
D) Neither I nor II

46. [August 2024]

The y -intercept of the graph of $y = 81 + 65^x$ in the xy -plane is $(0, y)$. What is the value of y ?

47. [August US 2024]

For the exponential function f , the value of $f(1)$ is k , where k is a constant. Which of the following equivalent forms of the function f shows the value of k as the coefficient or the base?

- A) $f(x) = 50(1.4)^{x+1}$
B) $f(x) = 70(1.4)^x$
C) $f(x) = 98(1.4)^{x-1}$
D) $f(x) = 137.2(1.4)^{x-2}$

48. [June 2024]

The function $f(t) = 10,000(2)^{\frac{t}{50}}$ gives the number of bacteria in a population t minutes after an initial observation. How much time, in minutes, does it take for the number of bacteria in the population to double?

49. [August 2024]

The number of bacteria in a liquid medium doubles every day. There are 72,000 bacteria in the liquid medium at the start of an observation. Which of the following represents the number of bacteria, y , in the liquid medium t days after the start of the observation?

- A) $y = \frac{1}{2}(72,000)^t$
B) $y = 2(72,000)^t$
C) $y = 72,000(\frac{1}{2})^t$
D) $y = 72,000(2)^t$

50. [August 2024]

According to a model, the estimated volume of a certain Douglas fir tree increased by 15.5% for every increase of 100 centimeters in the tree's height. The equation

$$y = ab^{\frac{t}{100}}$$

represents this model, where y represents the estimated volume, in cubic centimeters, of this Douglas fir tree, x represents the tree's height, in centimeters, and a and b are constants. In this equation, what is the value of b ?

- A) 0.155 C) 1.155
B) 1 D) 15.5

51. [August US 2024]

$$f(x) = 7020(0.28)^{\frac{x}{12}}$$

The function f gives the value of a certain piece of equipment after x months of use. If the value of the equipment decreases each year by $p\%$ of its value the preceding year, what is the value of p ?

- A) 2 C) 28
B) 10 D) 72

52. [August 2024]

The functions f and g are defined by the given equations, where $x \geq 0$. Which of the following equations displays, as a constant or coefficient, the maximum value of the function it defines, where $x \geq 0$?

1. $f(x) = 16(1.24)^x + 43$

2. $g(x) = 8(0.72)^x$

- A) 1 only
- B) 2 only
- C) 1 and 2
- D) Neither 1 nor 2

53. [August 2024]

For the function h , the table gives three values of x and their corresponding values of $h(x)$. Which equation could define h ?

x	$h(x)$
0	30
1	31
2	33

- A) $y = 2^x$
- B) $y = 2^x + 2$
- C) $y = 2^x + 28$
- D) $y = 2^x + 29$

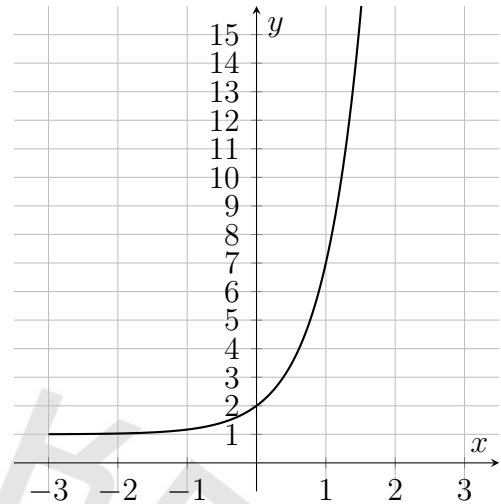
54. [August 2024]

$$f(x) = 240(2)^x$$

The function f is defined by the given equation. If $g(x) = f(x - 3)$, which of the following equations defines the function g ?

- A) $g(x) = 30(2)^x$
- B) $g(x) = 80(2)^x$
- C) $g(x) = 240(8)^x$
- D) $g(x) = 240(6)^x$

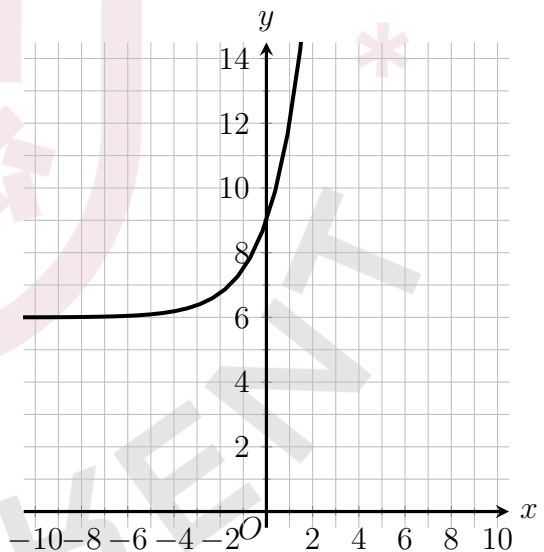
55. [August 2024]



The graph of $y = f(x) + 1$ is shown. Which equation defines the function f ?

- A) $f(x) = 6^x$
- B) $f(x) = 2^x$
- C) $f(x) = 6^x + 2$
- D) $f(x) = 2^x + 1$

56. [October US 2024]



What is the y-intercept of the graph shown?

- A) $(-9, 0)$
- B) $(-6, 0)$
- C) $(0, 6)$
- D) $(0, 9)$

57. [August US 2024]

Time(years)	Total amount (dollars)
0	867.00
1	870.47
2	873.95

Sam opened a savings account at a bank. The table shows the exponential relationship between the time t , in years, since Sam opened the account and the total amount n , in dollars, in the account. If Sam made no additional deposits or withdrawals, which of the following equations best represents the relationship between t and n ?

- A) $n = 0.004(1 + 867)^t$
- B) $n = 867(1 + 0.004)^t$
- C) $n = (1 + 0.004)^t$
- D) $n = (1 + 867)^t$

58. [October US 2024]

The function $f(x) = 242(1.040)^x$ models the value, in dollars, of a certain bank account from 1953 through 1968, where x is the number of years after the end of 1953. Which of the following is the best interpretation of $f(5)$, which is approximately equal to 294, in this context?

- A) The value of the bank account is estimated to be approximately 5 dollars greater at the end of 1958 than at the end of 1953.
- B) The value of the bank account is estimated to be approximately 294 dollars at the end of 1958.
- C) The value, in dollars, of the bank account is estimated to be approximately 5 times greater at the end of 1958 than at the end of 1953.
- D) The value of the bank account is estimated to increase by approximately 294 dollars every 5 years between the end of 1953 and the end of 1968.

59. [August US 2024]

The number of bacteria in a liquid medium doubles every hour. There are 44000 bacteria in the liquid medium at the start of the observation. Which of the following represents number of bacteria, y , in the liquid medium t hours after the the start of the observation?

- A) $y = \frac{1}{2}(44000)^t$
- B) $y = 2(44000)^t$
- C) $y = 44000(\frac{1}{2})^t$
- D) $y = 44000(2)^t$

60. [August US 2024]

The function f and g are defined by the equations, where $x > 0$. Which of the following equations displays, as a constant or a coefficient, the maximum value of the function it defines, where $x \geq 0$?

- I. $f(x) = 16(1.25)^x + 43$
- II. $g(x) = 6(0.75)^x$

- A) I only
- B) II only
- C) I and II
- D) Neither I nor II

61. [August US 2024]

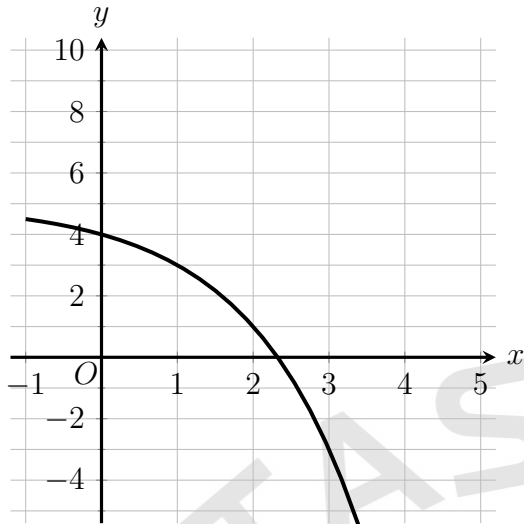
The function

$$f(t) = 80,000(2)^{\frac{t}{790}}$$

gives the number of bacteria in a population t minutes after an initial observation. How much time, in minutes, does it take for the number of bacteria in the population to double?

- A) 2
- B) 790
- C) 1,580
- D) 80,000

62. [October US 2024]



The graph of $y = f(x) + 2$ is shown. Which equation defines function f ?

- A) $f(x) = -2^x + 1$
- B) $f(x) = -2^x + 3$
- C) $f(x) = -2^x + 4$
- D) $f(x) = -2^x + 5$

63. [October US 2024]

The functions f and g are defined by the equations shown, where a and b are integer constants, $a < b$ and $b < 0$. If $y = f(x)$ and $y = g(x)$ are graphed in the xy -plane, which of the following equations displays, as a constant or coefficient, the y -coordinate of the y -intercept of the graph of the corresponding function?

I. $f(x) = a(3.3)^{x+b}$

II. $g(x) = a(3.3)^x + b$

- A) I only
- B) II only
- C) I and II
- D) Neither I nor II

64. [October 2024]

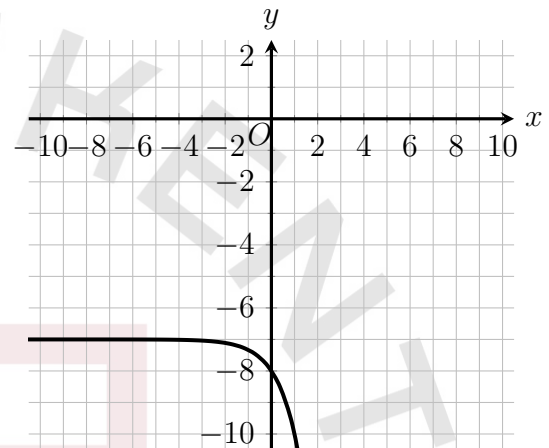
The functions f and g are defined by the given equations below, where $x \geq 0$. Which of the following equations displays, as a constant or coefficient, the minimum value of the function it defines, where $x \geq 0$?

I. $f(x) = 18(1.4)^{x+5}$

II. $g(x) = 18(1.16)(1.4)^{x+3}$

- A) I only
- B) II only
- C) I and II
- D) Neither I nor II

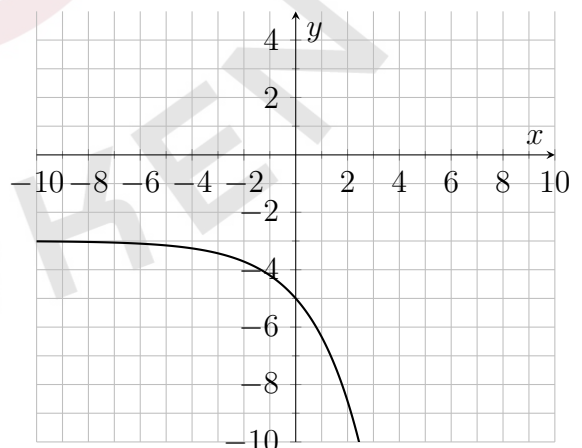
65. [October 2024]



The graph of $y = f(x)$ is shown, where $f(x) = ab^x + c$, and a , b , and c are constants. For how many values of x does $f(x) = 0$?

- A) Three
- B) Two
- C) One
- D) Zero

66. [October US 2024]



The graph of $y = f(x) = ab^x + c$ is shown, and a , b and c are constants. For how many value of x does $f(x) = 0$?

- A) Three
- B) Two
- C) One
- D) Zero

67. [October US 2024]

In a certain state, the population of pheasants, a type of bird, is estimated each year by counting the number of pheasants observed along certain roads in the state. On average, each year, from 2005 to 2015 the number of pheasants counted per mile of road decreased by 3.5% of the number of pheasants per mile of the road the previous year. Based on this average, if there were 6.32 pheasants per mile of road in this state in 2005, which of the following best approximates the number of pheasants per mile in 2015?

- A) $0.956(6.32)^{10}$
- B) $1.035(6.32)^{10}$
- C) $6.32(0.035)^{10}$
- D) $0.632(0.965)^{10}$

68. [November US 2024]

For an online trivia game, 490 points are awarded for a correct answer if a question is answered in less than 5 seconds from the time the question is asked. Each 5 seconds after the question is asked, the number of points awarded for a correct answer decreases by 20% of the number of points awarded for a correct answer in the previous 5 seconds. Which function gives the number of points awarded for a correct answer x seconds from the time the question is asked, where x is a multiple of 5?

- A) $f(x) = 490(0.80)^{\frac{x}{5}}$
- B) $f(x) = 490(0.80)^{5x}$
- C) $f(x) = 490(0.20)^{\frac{x}{5}}$
- D) $f(x) = 490(0.20)^{5x}$

69. [November US 2024]

What is the y -intercept of the graph of $y = 12(5)^{x+2}$ in the xy -plane?

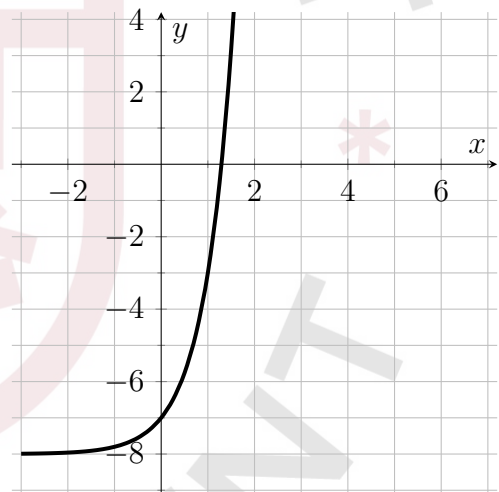
- A) (0, 12)
- B) (0, 120)
- C) (0, 300)
- D) (0, 3,600)

70. [November 2024]

In a certain state the population of pheasants, a type of bird, is measured by counting the number pheasants observed along certain roads in the state. On average, each year from 2005 to 2015 the number of pheasants counted per mile decreased by 3.5% of the number of pheasants per mile of road the previous year. Based on this average, if there were 6.22 pheasants per mile of road in this state in 2005, which of the following best approximates the number of pheasants per mile of road in 2015?

- A) $0.965(6.22)^{10}$
- B) $1.035(6.22)^{10}$
- C) $6.22(0.035)^{10}$
- D) $6.22(0.965)^{10}$

71. [October US 2024]



The graph of the equation $y = 5^x + k$ is shown, where k is a constant. What is the value of k ?

- A) -8
- B) -7
- C) 7
- D) 8

72. [October US 2024]

$$y = 7900(0.86)^x$$

The given equation gives the value, in dollars, of a certain car x years after it was purchased. According to the given equation, what is the estimated value, in dollars, of the car at the time it was purchased?

- A) 790 C) 7900
B) 6794 D) 8600

73. [October US 2024]

A model predicts that the population of a certain town was 3,000 in 2007. The model also predicts that each year for the next 5 years, the population p increased by 8% of the previous year's population. Which equation best represents this model, where t is the number of years after 2007, for $0 \leq t \leq 5$?

- (A) $p = 0.92(3,000)$
(B) $p = 1.08(3,000)$
(C) $p = 3,000(0.92)^t$
(D) $p = 3,000(1.08)^t$

74. [November US 2024]

In the xy -plane, the graph of the equation $y = 9^x$ is translated 8 units down. What is an equation of the resulting graph?

- A) $y = 9^x + 8$ C) $y = 9^{(x+8)}$
B) $y = 9^x - 8$ D) $y = 9^{(x-8)}$

75. [November 2024]

A baker containing a liquid is placed on a table. The function

$$g(t) = 294 + (363 - 294)(2.72)^{-0.103t}$$

gives the approximate temperature, in kelvins, of the liquid t minutes after the baker was placed on the table. According to this function, what was the approximate temperature, in kelvins, of the liquid when the baker was placed on the table?

76. [December US 2024]

The population of a certain city doubled every 25 years from 1660 to 1760. The population of this city was 208,000 in 1760. What was the population this city in 1660?

- A) 13,000 C) 104,000
B) 26,000 D) 416,000

77. [November 2024]

The function f is defined by

$$f(x) = a^x + b,$$

where a and b are constants and $a > 0$. In the xy -plane, the graph of $y = f(x)$ has a y -intercept at $(0, -20)$ and passes through the point $(2, 43)$. What is the value of $a - b$?

78. [December US 2024]

The function

$$f(x) = 600(0.5)^{\frac{x}{11}}$$

gives the predicted intensity of a beam $f(x)$, in number of photons in the beam, x millimeters below the surface of a certain material. What is the best interpretation of $f(11) = 300$?

- A) A beam at the surface of the material has a predicted intensity of 11 photons in the beam.
B) A beam at the surface of the material has a predicted intensity of 300 photons in the beam.
C) A beam 11 millimeters below the surface of the material has a predicted intensity of 300 photons in the beam.
D) A beam 300 millimeters below the surface of the material has a predicted intensity of 600 photons in the beam.

79. [December US 2024]

The function h is defined by

$$h(x) = 14(2)^{-x} + 7.$$

What is the value of $h(3)$?

- A) $\frac{42}{4}$ C) -77
B) $\frac{35}{4}$ D) -105

80. [December US 2024]

What is the y -intercept of the graph of $y = 16^{x+3}$ in the xy -plane?

- A) (0, 4,096) C) (0, 16)
B) (0, 0) D) (0, 3)

81. [December US 2024]

$$f(x) = 25(1.40)^{\frac{x}{3}}$$

For the given function f , the value of $f(x)$ increases by $p\%$ for every increase of x by 6. What is the value of p ?

- A) 40 C) 80
B) 49 D) 96

82. [December US 2024]

A computer program models the population of a certain insect in an environment where the insect has no natural predators. According to the model, the estimated total mass of the population of insects at the end of every 5-week period is 158% greater than the estimated total mass of the population of insects at the end of the previous 5-week period. The estimated total mass of the population of insects at the end of 15 weeks is 627.7 grams.

Which equation best represents this model, where M is the estimated total mass, in grams, of the population of insects at the end of t weeks?

- A) $M = 538.92(1.58)^{\frac{5}{t}}$
B) $M = 457.66(2.58)^{\frac{5}{t}}$
C) $M = 159.14(1.58)^{\frac{t}{5}}$
D) $M = 36.55(2.58)^{\frac{t}{5}}$

83. [December 2024]

The population of a certain city doubled every 75 years from 1902 to 1952. The population of this city was 160,000 in 1952. What was the population of this city in 1902?

84. [December 2024]

The relationship between the variables x and y is defined by an exponential equation. When $x = 0$, the value of y is 90, and for every increase in the value of x by 1, the corresponding value of y increases by 20% of its previous value. Which equation represents this relationship?

- A) $y = 90(1.20)^x$
B) $y = 90(1.02)^x$
C) $y = 20(1.90)^x$
D) $y = 20(1.09)^x$

85. [December 2024]

The equation $y = 500(2)^{2x}$ gives the estimated number of online newsletter subscribers at the end of every six-month period, x , starting from the end of January 1997, where $0 \leq x \leq 4$. Which statement is the best interpretation of the y -intercept of the graph of this equation in the xy -plane?

- A) The estimated number of online newsletter subscribers at the end of the first six-month period was 500.
B) The estimated number of online newsletter subscribers at the end of January 1997 was 500.
C) The estimated number of online newsletter subscribers at the end of January 1998 was 1,000.
D) The estimated number of online newsletter subscribers at the end of January 1997 was 1,000.

86. [December 2024]

$$g(x) = \frac{1}{9}(5)^x$$

If the given function g is graphed in the xy -plane, where $y = g(x)$, what is the y -intercept of the graph?

- A) (0,0) C) $(0, \frac{5}{9})$
B) $(0, \frac{1}{9})$ D) (0,5)

87. [December 2024]

$$z(w) = (0.829)^{2w}$$

The function z is defined by the equation shown. The value of $z(w)$ decreases by $p\%$ for each increase by 1 in the value of w . Which of the following is closest to the value of p ?

- A) 0.171 C) 17.1
B) 0.829 D) 31.3

91. [December 2024]

The equation $N(m) = 65(Q)^{\frac{m}{4}}$ gives the predicted population $N(m)$, in thousands, of a certain bacteria colony m minutes after the initial measurement, where Q is a constant greater than 1. The predicted population increases by $p\%$ every 120 seconds. What is the value of p in terms of Q ?

- A) $100(Q^{\frac{1}{2}} + 1)$ C) $100(Q^{\frac{1}{2}} - 1)$
B) $100(Q^{30} + 1)$ D) $100(Q^{30} - 1)$

88. [December 2024]

$$f(x) = 66(b)^x$$

In the given function, b is a positive constant. For every increase in the value of x by 1, the value of $f(x)$ increases by $c\%$, where $0 < c < 100$. Which expression gives the value of c in terms of b ?

- A) $1 + \frac{b}{100}$ C) $100(b + 1)$
B) $b + 100$ D) $100(b - 1)$

89. [December 2024]

The function d is defined by

$$d(x) = 200 - 6^x.$$

What is the value of $d(0)$

- A) 140 C) 199
B) 194 D) 200

90. [December 2024]

The function f is defined by

$$f(x) = (-7)(4)^x + 31.$$

What is the y -intercept of the graph of $y = f(x)$ in the xy -plane?

- A) (0,24) C) (0,31)
B) (0,4) D) (0,-7)

Answers: Exponential Functions

Number	Answer	Number	Answer
1	D	21	A
2	A	22	A
3	C	23	B
4	B	24	D
5	B	25	B
6	C	26	B
7	A	27	A
8	B	28	B
9	C	29	A
10	D	30	B
11	B	31	A
12	A	32	A
13	A	33	D
14	16	34	D
15	D	35	D
16	A	36	330
17	C	37	B
18	D	38	B
19	D	39	D
20	D	40	B

Number	Answer	Number	Answer
41	B	61	B
42	D	62	B
43	B	63	D
44	B	64	D
45	D	65	C
46	82	66	C
47	C	67	D
48	50	68	A
49	D	69	C
50	C	70	D
51	D	71	A
52	B	72	C
53	D	73	D
54	A	74	B
55	A	75	363
56	D	76	A
57	B	77	29
58	B	78	C
59	D	79	B
60	B	80	A

Number	Answer	Number	Answer
81	D	87	C
82	D	88	D
83	80000	89	C
84	A	90	A
85	B	91	C
86	B		



Quadratics

1. [March US 2023]

$$4x^2 + kx + 9 = 0$$

In the given equation, k is a positive constant. The equation has exactly one real solution. What is the value of k ?

2. [March US 2023]

$$x^2 - x - 12 = 0$$

What is the sum of the solutions to the given equation?

- A) -7
B) -1
C) 1
D) 7

3. [March US 2023]

$$3x^2 - 2x - 7 = 0$$

What is the sum of the solutions to the given equation?

4. [March US 2023]

$$h(t) = -4.9t^2 + 10t$$

The function h models the height $h(t)$, in meters, of a football t seconds after it is kicked. What is the interpretation of $h(2) = 0.40$ in this context?

- A) The football has a maximum height of 0.40 meter
B) The football has a maximum height of 2 meters
C) The football has a height of 0.40 meter 2 seconds after it is kicked
D) The football has a height of 2 meters 0.40 second after it is kicked

5. [June 2023]

$$18x^2 + 24x + c = 0$$

In the given equation, c is a constant. The equation has exactly one solution. What is the value of c ?

6. [June 2023]

The function g is a quadratic function. In the xy -plane, the graph of $y = g(x)$ has a vertex at $(-1, -4)$ and passes through the points $(-2, -43)$ and $(1, -160)$. What is the values of $g(0) - g(2)$?

- A) -121
B) 0
C) 117
D) 312

7. [June 2023]

An auditorium has seats for 3,200 people. Tickets to attend a show at the auditorium currently cost \$8.00. For each \$1.00 increase to the ticket price, 100 fewer tickets will be sold. This situation can be modeled by the equation $-100x^2 + 2,400x = 25600$ where x represents the increase in ticket price, in dollar, and y represents the revenue, in dollars, from ticket sales. If the equation is graphed in the xy -plane, at what value of x is the maximum of the graph?

- A) 32
B) 12
C) 24
D) 8

8. [June 2023]

$$\frac{x+1}{5x^2} = \frac{k}{x}$$

In the given equation, k is a constant. The solution to the given equation is $\frac{1}{174}$. What is the value of k ?

9. [June 2023]

If $(x+3)^2 = 30$, what is the value of $x^2 + 6x$?

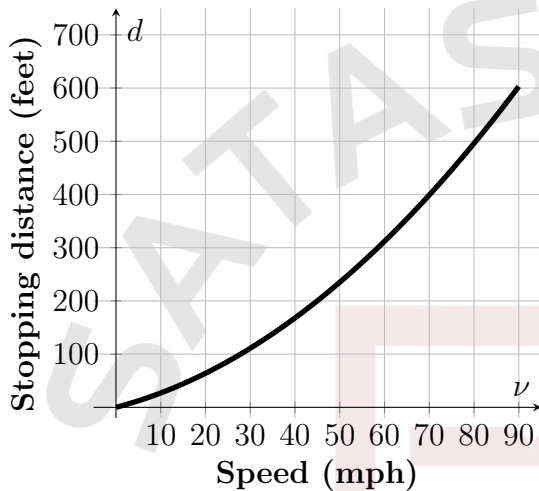
- A) 21
B) 30
C) 39
D) 60

10. [August US 2023]

What is the solution to the equation $2\sqrt{x} = 3$?

- A) 1
B) $\frac{3}{2}$
C) $\frac{9}{4}$
D) $\frac{9}{2}$

11. [August US 2023]



The graph quadratic function shown relates a car's stopping distance d , in feet, to its initial speed v , in miles per hour (mph). Which of the following could be an equation for d ?

- A) $d = 2.2v + 0.05v^2$
B) $d = 2.2v - 0.05v^2$
C) $d = 100 + 2.2v + 0.05v^2$
D) $d = 100 + 2.2v - 0.05v^2$

12. [August US 2023]

$$x^2 - 4x - 1 = 0$$

A solution to the given equation is $x = \sqrt{k} + 2$. What is the value of k ?

13. [December 2023]

$$0.24x^2 + 0.56x + 1.52$$

The given expression can be rewritten as $a(3x^2 + 7x + 19)$, a is a constant. What is the value of a ?

14. [August US 2023]

$$3x^2 - 4x + 7 = 0$$

How many distinct real solutions does the given equation have

- A) Zero
B) Exactly one
C) Exactly two
D) Infinitely many

15. [November 2023]

In the equation $10x^2 + 50x + c = 0$, c is a constant. If the equation has exactly one solution, what is the value of c ?

- A) 0
B) $\frac{5}{2}$
C) 60
D) $\frac{125}{2}$

16. [November 2023]

The solutions to $x^2 + 10x + 23 = 0$ are r and s , where $r < s$. The solutions to $x^2 + 10x + 17 = 0$ are t and u , where $t < u$. The solutions to $x^2 + 20x + c = 0$, where c is a constant are $r + u$ and $s + t$. What is the value of c ?

17. [December 2023]

$$\frac{1}{x} + \frac{1}{x-3} = \frac{6}{x^2 - 3x}$$

What are all the solutions to the given equation?

- A) -1 and 6
B) 0 and 3
C) 3
D) $\frac{9}{2}$

18. [December 2023]

$$x^2 - 12x + c = 0$$

In the given equation, c is a constant. The equation has no real solutions if $c > n$. What is the least possible value of n ?

- A) -36
B) -12
C) 12
D) 36

19. [December 2023]

$$22x^2 + (22s + r)x + rs = 0$$

In the given equation, r and s are positive constants. The product of the solutions to the given equation is krs , where k is a constant. What is the value of k ?

20. [December 2023]

$$y = -4x^2 - 23$$

$$y = qx - 19$$

In the given system of equations, q is a positive constant. The graphs of the equations in the given system intersect at exactly one point (x, y) , in the xy -plane. What is the value of x ?

A) -42

B) -27

C) -8

D) -1

21. [March 2024]

What value of x is the solution to the equation $20x + 24 = 28x^2$?

A) $\frac{1}{4}$ B) $\frac{1}{3}$

C) 3

D) 5

22. [March 2024]

$$\sqrt{k - x} = 52 - x$$

In the given equation, k is a constant. The equation has exactly one real solution. What is the minimum possible value of $4k$?

23. [March 2024]

The function f is defined by $f(x) = ax^2 + bx + c$ where a, b , and c are constants and $1 < a < 4$. The graph of $y = f(x)$ in the xy -plane passes through the points $(12, 0)$ and $(-4, 0)$. If a is an integer, what could be the value of $a + b$?

24. [March 2024]

$$y = -\frac{1}{4}x^2 + x + 28$$

The given equation models a company's active projects over 6 months, where y is the estimated number of active projects x months after the end of April 2012, where $0 \leq x \leq 6$. Which statement is the best interpretation of the y -intercept of the graph of this equation in the xy -plane?

A) At the end of April 2012, the estimated number of active projects was 0.

B) At the end of April 2012, the estimated number of active projects was 28.

C) At the end of May 2012, the estimated number of active projects was 0.

D) At the end of May 2012, the estimated number of active projects was 28.

25. [March 2024]

One of the factors of $4x^3 + 88x^2 + 468x$ is $x + b$, where b is a positive constant. What is the smallest possible value of b ?

26. [March 2024]

Function f is a quadratic function. The graph of $y = f(x)$ in the xy -plane has a vertex at $(-8, 1)$, contains the point $(9, -1)$, and has a y -intercept at $(0, a)$. The graph of $y = 6 \cdot f(x)$ has a y -intercept at $(0, b)$. What is the positive difference between a and b ?

27. [March 2024]

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

The given expression can be rewritten as

$$\frac{a}{6}x^2 + \frac{b}{6}x + \frac{c}{6},$$

where a, b , and c are constants. What is the value of $a + b + c$?

A) -360

B) -180

C) -60

D) -10

28. [March 2024]

$$-16(5x - 2)^2 + 6(5x - 3)^2$$

The given expression can be rewritten as

$$\frac{a}{6}x^2 + \frac{b}{6}x + \frac{c}{6},$$

where a, b , and c are constants. What is the value of $a + b + c$?

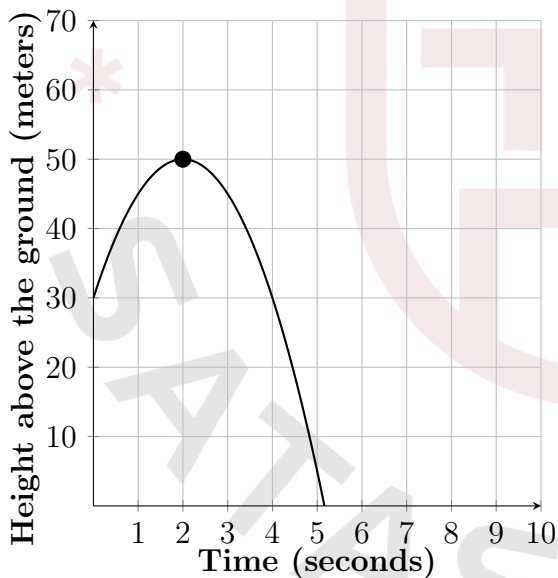
- A) -720 C) -120
B) -360 D) -20

29. [March 2024]

$$\sqrt{k - x} = 54 - x$$

In the given equation, k is a constant. The equation has exactly one real solution. What is the minimum possible value of $4k$?

30. [March 2024]



An object was launched upward from a platform. The graphs shown models the height, y , of the object x seconds after it was launched. For which of the following intervals of time was the height of the object increasing for the entire interval?

- A) From $x=0$ to $x=2$
B) From $x=0$ to $x=4$
C) From $x=2$ to $x=3$
D) From $x=4$ to $x=5$

31. [March 2024]

$$x^2 - 10x + 24 = 0$$

How many distinct real solutions does the given equation have?

- A) Exactly one
B) Exactly two
C) Infinitely many
D) Zero

32. [March 2024]

$$f(x) = 14x^2 - 35x + 7$$

The given equation defines the function f . For what values of x does $f(x)$ reach its minimum?

- A) 1.25 C) 7
B) 1.75 D) 35

33. [March 2024]

An object is kicked from a platform. The equation $h = -4.9t^2 + 13t + 15$ represents this situation, where the h is the height of the object above the ground, in meters, t seconds after it is kicked. Which number represents the height, in meters, from which the object was kicked?

- A) 0 C) 13
B) 4.9 D) 15

34. [March 2024]

The function f is defined by $f(x) = ax^2 + bx + c$, where a , b , and c are constants and $1 < a < 4$. The graph of $y = f(x)$ in the xy -plane passes through the points $(11, 0)$, and $(-5, 0)$. If a is an integer, what could be the value of $a + b$?

35. [May 2024]

The y -intercept of the graph of $y = 2x^2 + 27$ is $(0, y)$. What is the value of y ?

36. [March 2024]

$$y = 6x^2 - 48x + 98$$

$$y + 4 = 0$$

How many solutions are there to the given system of equations have?

- A) There is exactly 1 solution.
- B) There are exactly 2 solutions.
- C) There are exactly 3 solutions.
- D) There are no solutions.

37. [May 2024]

$$y = 5(x - 3)$$

$$y = (x - 3)^2$$

Which ordered pair (x, y) is a solution to the given system of equations?

- A) $(8, -5)$
- B) $(8, 25)$
- C) $(3, 8)$
- D) $(2, -5)$

38. [May US 2024]

The function f is a quadratic function. In the xy -plane, the graph of $y = f(x)$ has a vertex at $(1, 9)$ and passes through the points $(2, 33)$ and $(-1, 105)$. What is the value of $f(-2) - f(0)$?

- A) 81
- B) 129
- C) 192
- D) 225

39. [May US 2024]

$$y = x - c$$

$$y = -8(x - 10)^2$$

In the given system of equations, c is a constant. The system has two distinct real solutions. Which of the following could be the value of c ?

- A) 5
- B) 9
- C) $\frac{319}{32}$
- D) 15

40. [May US 2024]

$$y = -\frac{1}{4}x^2 + x + 29$$

The given equation models a company's active projects 6 months, where y is the estimated number of active projects x months after the end of April 2013, where $0 \leq x \leq 6$. Which statement is the best interpretation of the y -intercept of the graph of this equation in the xy -plane?

- A) At the end of April 2013, the estimated number of active projects was 0.
- B) At the end of April 2013, the estimated number of active projects was 29.
- C) At the end of May 2013, the estimated number of active projects was 0.
- D) At the end of May 2013, the estimated number of active projects was 29.

41. [May US 2024]

$$x^2 + 11x + 19 = 0$$

One solution to the given equation can be written as $x = \frac{-11 - \sqrt{k}}{2}$, where k is a constant. What is the value of k ?

42. [May 2024]

$$f(x) = \sqrt{5x + 6}$$

The function f is defined by the given equation. If $f(a) = -5a$, where a is a constant, what is the value of a ?

- A) $\frac{3}{5}$
- B) $\frac{2}{5}$
- C) $-\frac{2}{5}$
- D) $-\frac{3}{5}$

43. [May 2024]

$$x^2 = 2,601$$

How many distinct real solutions does the given equation have?

- A) Zero
- B) Exactly one
- C) Exactly two
- D) Infinitely many

44. [May 2024]

The expression $(9x - 28)(15x + 4)$ is equivalent to the expression $ax^2 + bx + c$, where a , b , and c are constants. What is the value of b ?

45. [May 2024]

Which of the following expressions is (are) a factor of $4x^2 + 31x - 45$?

I. $x - 9$

II. $4x - 5$

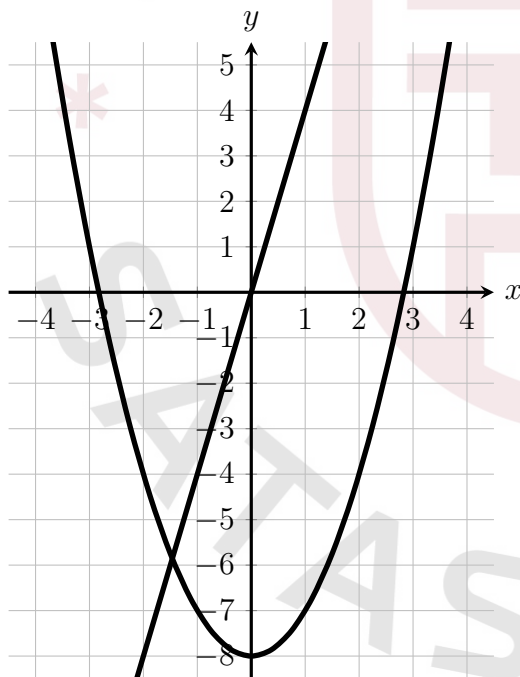
A) I only

B) II only

C) I and II

D) Neither I nor II

46. [May US 2024]



The graph of a system of a linear and a quadratic equation is shown. Which system of equations is represented by the graph?

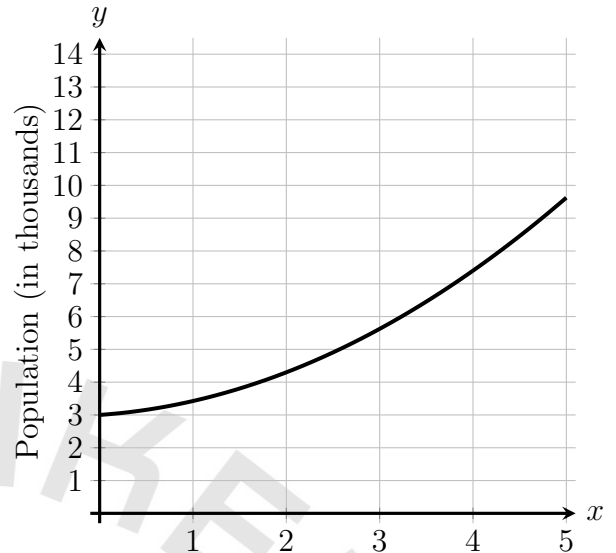
A) $y = -4x$
 $y = x^2 + 8$

B) $y = -4x$
 $y = x^2 - 8$

C) $y = 4x$
 $y = x^2 + 8$

D) $y = 4x$
 $y = x^2 - 8$

47. [May 2024]



In 2000, a census was taken to determine the population of a certain town. The graph gives the estimated population y , in thousands, of this town x years after the 2000 census was taken, where $0 \leq x \leq 5$. Based on the graph, which of the following is the closest to the estimated population 2 years after the 2000 census was taken?

A) 7,400

B) 6,200

C) 4,300

D) 3,000

48. [May 2024]

Which quadratic equation has exactly one distinct real solution?

A) $x^2 - 22 = 0$

B) $x^2 - 11x = 0$

C) $x^2 - 11x + 121 = 0$

D) $x^2 - 22x + 121 = 0$

49. [August US 2024]

The function f is defined by

$$f(x) = -5x^2 - 7.$$

What is the value of $f(-1)$?

A) -12

B) -2

C) 2

D) 12

50. [May 2024]

$$x(kx - 68) = -4$$

In the given equation, k is an integer constant. If the equation has no real solution, what is the least possible value of k ?

51. [May 2024]

$$f(x) = x + 4$$

$$g(x) = 3x^2 - rx + 48$$

The functions f and g are given. In function g , r is a constant. If $f(x) \cdot g(x) = 3x^3 + 192$, what is the value of r ?

52. [August US 2024]

$$y = -0.5$$

$$y = x^2 + 10x + a$$

In the given system of equations, a is a positive integer constant. The system has no real solutions. What is the least possible value of a ?

53. [August US 2024]

$$y = 2x^2 - 19x + 40$$

$$y = x + a$$

In the given system of equations, a is a constant. The graph of the equations in the given system intersect at exactly one point (x, y) , in the xy -plane. What is the value of x ?

A) -10

C) 5

B) -5

D) 10

54. [June 2024]

If $4x^2 - 24x - 36 = 0$, what is the value of $x^2 - 6x$?

A) 9

C) 4

B) 6

D) 0

55. [August US 2024]

The function f is defined by

$$f(x) = ax^2 + bx + c,$$

where a, b and c are constants. The graph of $y = f(x)$ in the xy -plane passes through the points $(9, 0)$ and $(-2, 0)$. If a is an integer greater than 1, which of the following could be the value of $a + b$?

A) 8

C) -6

B) 7

D) -12

56. [August US 2024]

A quadratic function models the height, in feet, of an object above the ground in terms of the time, in seconds, after the object was launched. According to the model, the object was launched from a height of 0 feet and reached its maximum height of 1,600 feet 10 seconds after it was launched. Based on the model, what was the height, in feet, of the object 15 seconds after it was launched?

57. [June 2024]

The function $f(x) = \frac{1}{9}(x - 4)^2 + 5$ gives a toy car's height above the ground $f(x)$ in inches, x seconds after it started moving on an elevated track, where $0 \leq x \leq 10$. Which of the following is the best interpretation of the vertex of the graph of $y = f(x)$ in the xy -plane?

A) The toy car's minimum height was 5 inches above the ground.

B) The toy car's minimum height was 4 inches above the ground.

C) The toy car's height was 5 inches above the ground when it started moving.

D) The toy car's height was 4 inches above the ground when it started moving.

58. [June 2024]

$$f(x) = (x - 2)^2 + 9$$

What is the minimum value of the given function?

- A) 2
B) 7
C) 9
D) 11

59. [June 2024]

What is the y -intercept of the graph of $y = 2x^2 + 6x + 3$ in the xy -plane?

- A) (0, 2)
B) (0, 3)
C) (0, 6)
D) (0, 9)

60. [August 2024]

$$y = x^2 - 18x + 51$$

The given equation relates the variables x and y . For what value of x does the value of y reach its minimum?

- A) -18
B) 9
C) 18
D) 51

61. [June 2024]

$$y = 2x^2 - 23x + 64$$

$$y = x + a$$

In the given system of equations, a is a constant. The graphs of the equations in the given system intersect at exactly one point, (x, y) , in the xy -plane. What is the value of x ?

- A) -8
B) -6
C) 6
D) 8

62. [June 2024]

$$\frac{1}{cx} = \frac{x}{152} + \frac{1}{c}$$

In the given equation, c is a constant. If the equation has exactly one solution, what is the value of c ?

63. [June 2024]

If $4x^2 - 12x - 24 = 0$, what is the value of $x^2 - 3x$?

- A) 0
B) 3
C) 4
D) 6

64. [June 2024]

$$f(x) = (x - 4)^2 + 11$$

What is the minimum value of the given function?

- A) 4
B) 7
C) 11
D) 15

65. [June 2024]

For the quadratic function f , the table shows three values of x and their corresponding values of $f(x)$. Which equation defines f ?

x	$f(x)$
-1	4
0	12
1	22

- A) $f(x) = 5x^2 + 5x + 12$
B) $f(x) = 9x^2 + x + 12$
C) $f(x) = 9x^2 - x + 12$
D) $f(x) = x^2 + 9x + 12$

66. [June 2024]

The function f is defined by $f(x) = 4x^2$. What is the value of $f(11)$?

- A) 44
B) 52
C) 88
D) 484

67. [June 2024]

$$-4x^2 + bx - 25 = 0$$

In the given equation, b is a positive integer. The equation has no real solution. What is the largest possible value of b ?

68. [August 2024]

The function f is defined by $f(x) = 5x^2$.
What is the value of $f(6)$?

- A) 30 C) 60
B) 40 D) 180

69. [August 2024]

An object is kicked from a platform. The equation $h = -4.9t^2 + 5t + 9$ represents this situation, where h is the height of the object above the ground, in meters, t seconds after it is kicked. Which number represent the height, in meters, from which the object was kicked?

- A) 0 C) 5
B) 4.9 D) 9

70. [August 2024]

$$3x^2 + x - 5 = 0$$

What is the greatest solution to the given equation?

- A) $-\frac{1}{6} - \frac{\sqrt{61}}{6}$
B) $-\frac{1}{6} + \frac{\sqrt{61}}{6}$
C) $-\frac{1}{3} - \frac{\sqrt{61}}{3}$
D) $-\frac{1}{3} + \frac{\sqrt{61}}{3}$

71. [August 2024]

$$33x^2 + (33s + r)x + rs = 0$$

In the given equation, r and s are positive constants. The product of the solutions to the given equation is kr , where k is a constant. What is the value of k ?

72. [August US 2024]

$$(v - 12)(v - 3) = 0$$

What are all possible solutions to the given equation?

- A) -12 and 3 C) -3 and 12
B) -12 and 9 D) 3 and 12

73. [August 2024]

$$f(x) = -8x^2 + 101x$$

The function f models the depth below sea level, in meters, of a certain seal x minutes after the seal dives into the water. What is the best interpretation of $f(2) = 170$ in this context?

- A) 2 minutes after the seal dives into the water, its estimated depth is 170 meters below the sea level.
B) Approximately 2 minutes after the diving into the water, the sea level returns to sea level.
C) The sea level reaches an estimated maximum depth of 170 meters below sea level.
D) 170 minutes after the seal dives into the water, its estimated depth is 2 meters below the sea level.

74. [August 2024]

If $(x+3)^2 = 33$, what is the value of $x^2 + 6x$?

75. [August US 2024]

Which expression is a factor of

$$7x^2 - 9x + 14x - 18?$$

- A) $x - 2$
B) $x + 9$
C) $7x - 9$
D) $7x + 2$

76. [August US 2024]

$$x^2 - y + 3 = 3$$

$$8x + 16 - y = 0$$

The solution to the given system of equations is (x, y) . What is the value of x ?

- A) -16
B) -4
C) 2
D) 8

77. [August 2024]

A machine launches a baseball from ground level. The baseball reaches a maximum height of 92.16 meters above the ground at 2.4 seconds and hits the ground at 4.8 seconds. Which equation represents the height above ground h , in meters, of the baseball t seconds after it is launched?

- (A) $h = -t^2 + 4.8$
- (B) $h = -t^2 + 92.16$
- (C) $h = -16(t - 2.4)^2 - 4.8$
- (D) $h = -16(t - 2.4)^2 + 92.16$

78. [August US 2024]

The function g is defined by

$$g(x) = (x + 17)(t - x),$$

where t is a constant. In the xy -plane, the graph of $y = g(x)$ passes through the point $(23, 0)$. What is the value of $g(0)$?

79. [August US 2024]

$$x^2 + 5x = 47$$

The solution to the given equation are $\frac{m + \sqrt{q}}{2}$ and $\frac{m - \sqrt{q}}{2}$, where m and q are integers. What is the value of $m + q$?

80. [August US 2024]

In the equation $7x^2 + 49x + c = 0$, c is a constant. If the equation has exactly one real solution, what is the value of c ?

- A) 0
- B) $\frac{7}{2}$
- C) 56
- D) $\frac{343}{4}$

81. [August US 2024]

$$\sqrt{k - x} = 57 - x$$

In the given equation, k is a constant. The equation has exactly one real solution. What is the minimum possible value of $4k$?

82. [August US 2024]

The y -intercept of the graph of $y = x^2 + 38$ in the xy -plane is $(0, y)$. What is the value of y .

83. [August US 2024]

The equation $-4.9(x - 9.1)^2 + 10700$ give the estimated height above the ground, y , in meters, of a plane, where x is the number of second since it started a parabolic maneuver. If this equation is graphed in the xy -plane, which of the following is the best interpretation of the vertex of the graph?

- A) The plane reached an estimated maximum height of 10700 meters 4.9 seconds after it started the parabolic maneuver.
- B) The plane reached an estimated maximum height of 10700 meters 9.1 seconds after it started the parabolic maneuver.
- C) The plane reached an estimated maximum height of 4.9 meters 10700 seconds after it started the parabolic maneuver.
- D) The plane reached an estimated maximum height of 9.1 meters 10700 seconds after it started the parabolic maneuver.

84. [August US 2024]

$$p(x) = 2x^2 + 20x + 15$$

What is the minimum value of the given function?

- A) -35
- B) -15
- C) -5
- D) 15

85. [August US 2024]

$$\begin{aligned}x + 47 &= y \\(x + 47)^2 &= y\end{aligned}$$

A solution to the given system of equations is (x, y) . What is a possible value of x ?

- A) 47
- B) 1
- C) 0
- D) -47

86. [August US 2024]

The function g is defined by

$$g(x) = (x + 17)(t - x),$$

where t is a constant. In the xy -plane, the graph of $y = g(x)$ passes through the point $(23, 0)$. What is the value of $g(0)$?

87. [August US 2024]

$$(x + 81)^2 = 256$$

How many distinct real solutions does the given equation have?

- A) Exactly one
- B) Exactly two
- C) Infinitely many
- D) Zero

88. [October US 2024]

$$(2x - 7)^2 - 8(2x - 7) + 15 = 0$$

What is a solution to the given equation?

89. [October US 2024]

The function $f(x)$ is defined by

$$f(x) = 10x^2 - 38x - 150.$$

What is the value of $f(0)$?

- A) -150
- B) -38
- C) 0
- D) 10

90. [October US 2024]

An object is launched into the air from ground level. According to a quadratic model, 2.1 seconds after the object is launched, it reaches its maximum height of 70.56 feet above ground level. Which equation represents this model, where $f(t)$ is the object's height, in feet, above ground level t seconds after it was launched?

- A) $f(t) = -16(t - 2.1)^2 + 70.56$
- B) $f(t) = 16(t + 2.1)^2 + 70.56$
- C) $f(t) = -16(t + 2.1) + 70.56$
- D) $f(t) = (t - 2.1)^2 + 70.56$

91. [October US 2024]

$$f(x) = 5x^2 + 60x + 181$$

The function g is defined by $g(x) = f(x + 8)$. What is the minimum value of $g(x)$?

- A) -14
- B) -6
- C) 1
- D) 9

92. [October US 2024]

$$-2x^2 + bx - 32 = 0$$

In the given equation, b is a positive integer. The equation has no real solution. What is the largest possible value of b ?

93. [October US 2024]

$$\frac{1}{cx} = \frac{x}{76} + \frac{1}{c}$$

In the given equation, c is a constant. If the equation has exactly one solution, what is the value of c ?

94. [October 2024]

$$r(t) = 55t - 2t^2$$

The function r is defined by the given equation. The function s is defined by $s(t) = r(t) + 1$. Which expression represents the maximum value of $s(t)$?

- A) $1 + \left(\frac{55}{2}\right)^2$
- B) $1 + 2\left(\frac{55}{4}\right)^2$
- C) $1 - 2\left(\frac{55}{4}\right)^2$
- D) $1 - \left(\frac{55}{2}\right)^2$

95. [October 2024]

$$y = 0.25x^2 - 6.5x$$

The equation gives the estimated stock price y , in dollars, for a certain company x days after the company went public, where $0 \leq x \leq 20$. Which statement is the best interpretation of $(x, y) = (1, 58)$ in this context?

- A) 1 day after the company went public, the company's estimated stock price is \$58.
- B) 58 days after the company went public, the company's estimated stock price is \$1.
- C) The company's estimated stock price increased \$58 every day after the company went public.
- D) The company's estimated stock price increased \$1 every 58 days after the company went public.

96. [October 2024]

$$x^2 - 5x - 24 = 0$$

What is the sum of the solutions to the given equation?

97. [October 2024]

Function f is a quadratic function where $f(-20) = 0$ and $f(-4) = 0$. The graph of $y = f(x)$ in the xy -plane has a vertex at $(r, -64)$. What is the value of r ?

98. [October 2024]

The function f gives the product of a number, x , and a number that is 91 more than x . Which equation defines f ?

- A) $f(x) = -x^2 + x + 91$
- B) $f(x) = x^2 + 91$
- C) $f(x) = x^2 + 91x$
- D) $f(x) = x^2 + 91x + 91$

99. [October 2024]

$$y = 2x^2 - 15x + 23$$

$$y = x + a$$

In the given system of equations, a is a constant. The graphs of the equations in the given system intersect at exactly one point, (x, y) , in the xy -plane. What is the value of x ?

- A) -9
- B) -4
- C) 4
- D) 9

100. [October US 2024]

$$x(x - 15) = 34$$

What is the positive solution to the given equation?

101. [October US 2024]

$$x^2 - 100 = 0$$

How many distinct real solutions does this given equation have?

- A) Zero
- B) Exactly one
- C) Exactly two
- D) Infinitely many

102. [October US 2024]

$$\frac{x}{(x-1)(x+1)} = \frac{81}{56x}$$

Which of the following is a solution to the given equation?

- A) $\frac{1}{5}$
- B) $\frac{9}{25}$
- C) 1
- D) $\frac{9}{5}$

103. [October US 2024]

$$x(9x - 2a) + b(9x - 2a) - (x + b) = 0$$

In the given equation, a and b are positive constants. A solution to the given equation is $x = 42$. What is the value of a ?

104. [October US 2024]

$$3w^2 + 11w - c = 0$$

In the given equation, c is a constant. A solution to the given equation is $\frac{-11+\sqrt{433}}{6}$. What is the value of c ?

105. [October US 2024]

$$f(x) = -16x^2 + 99$$

The function f gives the estimated height, in feet, of an acorn x seconds after the acorn fell from a tree. Based on the function, what is the estimated height, in feet, of an acorn before it fell from the tree?

106. [October US 2024]

The variable x and y have quadratic relationship. When $x = 0$, $y = 45$. When $x = 6$, $y = 81$. When $x = 15$, $y = 0$. Which equation represents this relationship?

- A) $y = x^2 - 18x + 45$
- B) $y = -x^2 + 12x + 45$
- C) $y = x^2 + 45$
- D) $y = -3x^2 - 48x + 45$

107. [October US 2024]

The function f is defined by

$$f(x) = 3\left(\frac{1}{4} - x\right)^2 + \frac{13}{4}.$$

What is the value of $f\left(\frac{1}{4}\right)$?

108. [October US 2024]

$$\frac{1}{x} + \frac{1}{x-3} = \frac{6}{x^2-3x}$$

What are all the solution to the given equation?

- A) -1 and 6
- B) 0 and 3
- C) 3
- D) $\frac{9}{2}$

109. [October US 2024]

$$x^2 - 2x - 18 = 0$$

One solution to the given equation can be written as $1 + \sqrt{k}$, where k is a constant. What is the value of k ?

- A) 17
- B) 19
- C) 38
- D) 76

110. [October US 2024]

For a certain type of rope, the equation $y = 900ax^2$, where a is a constant, gives the estimated breaking strength y , in pounds, of a rope with a circumference of x inches. Based on this equation, if a rope of this type has a circumference of 2.75 inches, it has an estimated breaking strength of 9,528.75 pounds. What is the estimated breaking strength, in pounds, of a rope of this type that has a circumference of 7.50 inches?

111. [October US 2024]

$$4x^2 + 21 = 48 + r$$

In the given equation, r is a constant. The equation has exactly one real solution. What is the value of r ?

112. [October US 2024]

The function f is defined by

$$f(x) = ax^2 + bx + c,$$

where a , b , and c are constants. The graph of $y = f(x)$ in the xy -plane passes through the points $(10, 0)$ and $(-5, 0)$. If a is an integer greater than 1, which of the following could be the value of $a + b$?

- A) -8
- A) 5
- A) -4
- A) 6

113. [November 2024]

$$f(x) = (2x - 20)(2x + 8)$$

What is the minimum value of the given function?

114. [November 2024]

Which expression is equivalent to

$$(w + 7)(3w - 10)?$$

- A) $4w^2 - 3w - 3$
- B) $4w^2 + 10w - 3$
- C) $3w^2 + 11w - 70$
- D) $3w^2 + 21w - 70$

115. [November 2024]

If

$$\left(\frac{1}{2}x - \frac{33}{2}\right)^2 - 64 = 0,$$

what is the value of $(x - 33)^2$?

- A) 8
- B) 33
- C) 128
- D) 256

116. [November 2024]

Which expression is equivalent to

$$(x + 8)^2 + 14(x + 8) + 49?$$

- A) $(x + 15)^2$
- A) $(x + 7)^2$
- A) $8(x + 7)^2$
- A) $7(x + 8)^2$

117. [November 2024]

$$2x^2 - 12x - 13 = 0$$

One solution to the given equation can be written as $h - \frac{1}{2}\sqrt{k}$, where h and k are integer constants. What is the value of $h + k$?

- A) 13
- B) 14
- C) 31
- D) 65

118. [November 2024]

The function $f(x) = \frac{1}{9}(x - 6)^2 + 3$ gives a toy car's height above the ground $f(x)$, in inches, x seconds after it started moving on an elevated track, where $0 \leq x \leq 10$. Which of the following is the best interpretation of the vertex of the graph of $y = f(x)$ in the xy plane?

- A) The toy car's minimum height was 3 inches above the ground.
- B) The toy car's minimum height was 6 inches above the ground.
- C) The toy car's height was 3 inches above the ground when it started moving.
- D) The toy car's height was 6 inches above the ground when it started moving.

119. [November 2024]

$$\frac{1}{cx} = \frac{x}{148} + \frac{1}{c}$$

In the given equation, c is a constant. If the equation has only one solution, what is the value of c ?

120. [November US 2024]

$$x^2 = (40)(40)$$

What is the positive solution to the given equation?

121. [November US 2024]

$$y = 4x + 12$$

$$y = (x + 2)^2$$

A solution to the given system of equation is (x, y) . What is the value of x^2 ?

122. [November US 2024]

$$x(kx - 40) = -8$$

In the given equation, k is an integer constant. If the equation has two distinct real solutions, what is the greatest possible value of k ?

123. [November US 2024]

$$f(x) = -9x^2 + 113x$$

The function f models the depth below sea level, in meters, of a certain seal x minutes after the seal dives into the water. What is the best interpretation of $f(2) = 190$ in this context?

- A) 190 minutes after the seal dives into the water, its estimated depth is 2 meters below sea level.
- B) The seal reaches an estimated maximum depth of 190 meters below sea level.
- C) 2 minutes after the seal dives into the water, its estimated depth is 190 meters below the sea level
- D) Approximately 2 minutes after diving into the water, the seal returns to sea level.

124. [November US 2024]

Which expression is equivalent to

$$(x^2 + 11)^2 + (x - 8)(x + 8)$$

- A) $x^4 + x^2 + 185$
- B) $x^4 + 12x^2 + 121$
- C) $x^4 + 23x^2 - 53$
- D) $x^4 + 23x^2 + 57$

125. [November US 2024]

$$x^2 + 2x = 72$$

What is one of the solutions to the given equation?

- A) $1 + \sqrt{73}$
- B) $1 + \sqrt{71}$
- C) $-1 + \sqrt{73}$
- D) $-1 + \sqrt{71}$

126. [November US 2024]

$$\sqrt{k - x} = 32 - x$$

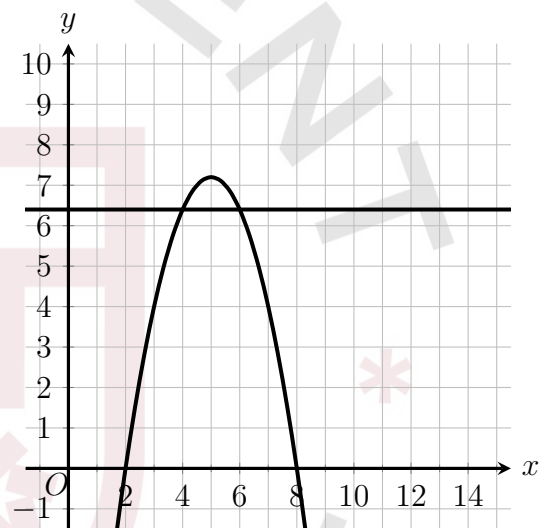
In the given equation, k is a constant. The equation has exactly one real solution. What is the minimum possible value of $4k$?

127. [November US 2024]

Which of the following expressions has a factor of $x + 2b$, where b is a positive integer constant?

- A) $3x^2 + 7x + 14b$
- B) $3x^2 + 16x + 14b$
- C) $3x^2 + 18x + 14b$
- D) $3x^2 + 25x + 14b$

128. [November US 2024]



The graph of a system of a linear equation and a quadratic equation is shown. A solution to the system is (x, y) . What is a possible value of x ?

- A) 4
- B) 5
- C) 6.4
- D) 7

129. [December US 2024]

Which expression is equivalent to

$$13(x^2 - 7)?$$

- A) $13x^2 - 91$
- B) $13x^2 - 20$
- C) $13x^2 - 7$
- D) $13x^2 + 6$

130. [December US 2024]

$$-(3x - 7)^2 = p + 16$$

In the equation, p is an integer constant. The equation has no real solution. What is the least possible value of p ?

- A) -18 C) -16
B) -17 D) -15

131. [December US 2024]

Which quadratic equation has no real solution?

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

132. [December US 2024]

If $121x^2 = -110x + 56$, what is the value of $11x + 5$, where $11x + 5 > 0$?

133. [December 2024]

$$21x^2 + (21s + r)x + rs = 0$$

In the given equation, r and s are positive constants. The product of the solutions to the given equation is krs , where k is a constant. What is the value of k ?

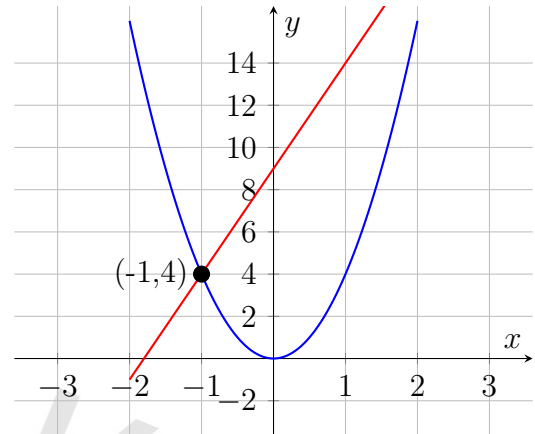
134. [December 2024]

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

The given expression can be rewritten as $\frac{a}{4}x^2 + \frac{b}{4}x + \frac{c}{4}$, where a , b , and c are constants. What is the value of $a + b + c$?

- A) -112 C) -28
B) -56 D) -7

135. [December 2024]



The graph of a system of a linear equation and a quadratic equation is shown. Which of the following is a solution (x, y) to the system?

- A) $(-1, 4)$ C) $(0, 9)$
B) $(0, 0)$ D)

136. [December 2024]

The function f is defined by $f(x) = 4x^2$. What is the value of $f(11)$?

- A) 44 C) 88
B) 52 D) 484

137. [December 2024]

Which expression is equivalent to

$$2\left(x - \frac{3}{2}\right)(x + 14)?$$

- A) $x^2 + 25x - 21$ C) $2x^2 + 25x - 42$
B) $2x^2 + 11x - 21$ D) $2x^2 - 42$

138. [December 2024]

$$-8x(x + 9) = 40$$

One solution to the given equation can be written as $x = -\frac{s+\sqrt{t}}{2}$, where s and t are positive integers. What is the value of $\frac{s}{t}$?

- A) $\frac{9}{101}$ C) $\frac{9}{61}$
B) $\frac{9}{76}$ D) $\frac{18}{61}$

139. [December 2024]

A quadratic function models the height, in feet, of an object above the ground in terms of the time, in seconds, after the object was launched. According to the model, the object was launched from a height of 0 feet and reached its maximum height of 1,600 feet 10 seconds after it was launched. Based on the model, what was the height, in feet, of the object 7 seconds after it was launched?

140. [December 2024]

$$(x - k)^2 = (k - 4a)(x - k)$$

In the given equation, a and k are constants, where $k > 4a$. The sum of the solutions to the equation is $3k + 35$. What is the value of a ?

Answers: Quadratics

Number	Answer	Number	Answer
1	12	21	B
2	C	22	207
3	$\frac{2}{3}$	23	-14 or -21
4	C	24	B
5	8	25	9
6	D	26	$\frac{805}{289}$
7	B	27	A
8	35	28	A
9	A	29	215
10	C	30	A
11	A	31	B
12	5	32	A
13	0.08	33	D
14	A	34	-10; -15
15	D	35	27
16	98	36	D
17	D	37	B
18	D	38	C
19	$\frac{1}{22}$	39	D
20	C	40	B

Number	Answer	Number	Answer
41	45	61	C
42	D	62	-38
43	C	63	D
44	-384	64	11
45	B	65	D
46	D	66	D
47	C	67	19
48	D	68	D
49	A	69	D
50	290	70	B
51	12	71	1/33
52	25	72	D
53	A	73	A
54	A	74	24
55	D	75	C
56	1200	76	D
57	C	77	D
58	C	78	391
59	B	79	208
60	B	80	D

Number	Answer	Number	Answer
81	227	101	C
82	38	102	D
83	B	103	188.5
84	-35	104	26
85	D	105	99
86	391	106	B
87	B	107	13/4
88	5	108	D
89	A	109	B
90	A	110	70875
91	C	111	-27
92	15	112	A
93	-19	113	-196
94	B	114	C
95	A	115	D
96	5	116	A
97	-12	117	D
98	C	118	A
99	A	119	-37
100	17	120	40

Number	Answer	Number	Answer
121	8	131	D
122	49	132	9
123	C	133	1/21
124	D	134	A
125	C	135	A
126	127	136	D
127	D	137	C
128	A	138	C
129	A	139	1456
130	D	140	-35/4



Problem solving

Percent; Ratio&Proportion

1. [March US 2023]

If $x > 0$ and $p\%$ of x is 13, which expression represents x in terms of p

- A) $13p$ C) $\frac{100p}{13}$
B) $\frac{13p}{100}$ D) $\frac{(100)(13)}{p}$

2. [March US 2023]

What is the 90% of 80?

- A) 10 C) 88
B) 72 D) 152

3. [June 2023]

A scientist analyzed a soil sample with a mass of 900 grams and determined that it contained 189 grams of water. What is the percentage of water, by mass, in this soil sample?

- A) 9% C) 18.9%
B) 9.9% D) 21%

4. [June 2023]

The ratio of green tiles to blue tile in a piece of artwork is 5 to 2. If there are 16 blue tiles in the piece of artwork, how many green tiles are there?

5. [August US 2023]

If

$$\frac{g}{h} = \frac{1}{100} \text{ and } \frac{10g}{kh} = \frac{1}{100},$$

what is the value of k ?

- A) 0.1 C) 100
B) 10 D) 1,000

6. [August US 2023]

The positive quantity r is increased by 20%, and then the resulting quantity is decreased by 25%. Which expression represents the result of these two changes?

- A) $0.90r$ C) $1.05r$
B) $0.95r$ D) $15.0r$

7. [November 2023]

Julia purchased 600 feet of fencing. She used 70% of this fencing to surround a vegetable garden. How many feet of fencing did Julia use to surround the vegetable garden?

- A) 14 C) 420
B) 35 D) 530

8. [November 2023]

The ratio 36 to m is equivalent to the ratio 2 to 12. What is the value of m ?

9. [December 2023]

A clothing store buys shirts at a wholesale price of 5.00 dollars each and resells them each at a price that is 270% of the wholesale price. At the end of the season, any remaining shirts are marked at a discounted price that is 70% of the retail price. What is the discounted price of each remaining shirt, in dollars?

10. [March 2024]

A real estate company offers a series of three webinars. 1,250 people attended the first webinar. 68% of the people who attended the first webinar attended the second webinar, and 32% of the people who attended the first and second webinars attended the third webinar. How many people attended all three webinars?

11. [March 2024]

If $\frac{2a}{b} = 5.8$ and $\frac{a}{bn} = 23.2$, what is the value of $\frac{1}{n}$?

12. [March 2024]

The speeds of particles A, B, and C are a meters per second, b meters per second, and c meters per second, respectively. If the speed of particle A is 7,900% of the speed of particle C and the speed of particle C is 0.008% of the speed of particle B, which expression represents the value of $a + b$ in terms of c ?

- A) $12.579c$ C) $7.908c$
B) $8.025c$ D) $2.040c$

13. [May 2024]

For a certain rectangular region, the ratio of its length to its width is 10 : 4. If the width of the rectangular region increases by 7 units, how must the length change to maintain this ratio?

- A) It must decrease by 7 units.
B) It must increase by 7 units.
C) It must increase by 17.5 units.
D) It must decrease by 17.5 units.

14. [May 2024]

The composition of an animal is defined as the muscles, bones, and fat of the animal. A scientist studied the composition of one young swamp buffalo and determined the buffalo had 133 kilograms of muscle, which made up approximately 65.9% of its composition. Of the remaining composition of this buffalo, approximately 46.2% was bone, and the remainder was fat. Based on these approximations, to the nearest tenth, how many kilograms of this buffalo's composition was bone?

15. [May 2024]

Raheem bought 9 shirts that were each the same price. He used a coupon for \$54 off the entire purchase. The cost for the entire purchase after using the coupon was \$108. What was the original price, in dollars, for 1 shirt?

16. [May 2024]

The combined original price for a towel and chair is \$36. After a 45% discount to the chair and a 25% discount to the towel are applied, the combined sale price for the two items is \$25. Which system of equations gives the original price t in dollars of the towel and c in dollars of the chair?

- A) $t + c = 36$
 $0.45t + 0.25c = 25$
B) $t + c = 36$
 $0.55t + 0.75c = 25$
C) $t + c = 36$
 $0.25t + 0.45c = 25$
D) $t + c = 36$
 $0.75t + 0.55c = 25$

17. [May US 2024]

After 20% of the original number of objects in a group were removed from the group, 180 objects remained in the group. How many objects were removed from the group?

- A) 36 C) 225
B) 45 D) 900

18. [May 2024]

When a collection of books is sorted, 52% are nonfiction and the remaining books are fiction. Of those that are fiction, 75% are westerns and the remaining fiction books are romance. If there are 933 romance books in this collection, what is the total number of books in the collection?

19. [May 2024]

The positive number a is 2,800% of the number c , and c is 20% of the number b . What is the value of $a - b$ in terms of c ?

- A) $23c$
- B) $140c$
- C) $560c$
- D) $2,240c$

20. [May 2024]

For each of two rectangles, the ratio of the rectangle's length to its width is 10 to 5. The width of rectangle X is 16.5 times the width of rectangle Y . How does the length of rectangle X compare to the length of rectangle Y ?

- A) The length of rectangle X is 0.5 times the length of rectangle Y .
- B) The length of rectangle X is 2 times the length of rectangle Y .
- C) The length of rectangle X is 16.5 times the length of rectangle Y .
- D) The length of rectangle X is 33 times the length of rectangle Y .

21. [June 2024]

The mass of object A is 498% of the mass of object B, and the mass of object A is 0.830% of the mass of object C. If the mass of object C is $p\%$ of the mass of object B, what is the value of p ?

22. [June 2024]

There is a proportional relationship between p and t . If $p = 2,340$ when $t = 3,120$, then what is the value of p when $t = 2,496$?

- A) 1,716
- B) 1,872
- C) 3,276
- D) 3,328

23. [August US 2024]

Which expression is equivalent to $\sqrt{x^{153}}$, where $x > 0$?

A) $x^{\frac{2}{153}}$

B) $x^{\frac{153}{2}}$

C) x^{151}

D) x^{306}

24. [August 2024]

A square map has a side length of 35 inches, and 1 inch on the map represents an actual distance of 17 miles. A smaller version of the same map is printed as a square with the side length 55% shorter than the side length of the previous map. On the smaller map, which of the following is closest to the actual distance, in miles, represented by 1 inch?

- A) 7.65
- B) 10.97
- C) 19.25
- D) 37.78

25. [August US 2024]

For the positive quantities h, j , and k . 94% of h is equivalent to 47% of j , and j is equivalent to 30% of k . What percentage of k is h ? (Disregard the % sign when entering your answer. For example, if you answer is 39%, enter 39)

26. [August Int 2024]

A company studied a random sample of 20 lawns in a small town. The company found that 4 of these lawns contain fertilizer. If there are 260 lawns in the town, which of the following is the best estimate of the number of lawns that contain fertilizer?

- A) 3
- B) 5
- C) 13
- D) 52

27. [August 2024]

Each side of square A has a length of 24 inches. Each side of square A is multiplied by a scale factor of 2 to create square B . What is the length, in inches, of each side of square B ?

- A) 22
- B) 24
- C) 26
- D) 48

28. [August 2024]

The table summarizes the number of objects in each group.

Group	Number of objects
A	325
B	68
C	572
D	102
Total	1067

The number of objects in group C is $p\%$ of the number of objects in group A . What is the value of p ?

29. [August 2024]

A clothing store buys shirts at a wholesale price of 4.00 dollars each and resells them each at a retail price that is 280% of the wholesale price. At the end of the season, any remaining shirts are marked at a discounted price that is 80% off the retail price. What is the discounted price of each remaining shirt, in dollars?

30. [August US 2024]

A clothing store buys shirts at a wholesale price of 7.00 dollars each and resells them each at a retail price that is 260% of the wholesale price. At the end of the season, any remaining shirts are marked at a discounted price that is 75% off the retail price. What is the discounted price of each remaining shirt, in dollars?

31. [June 2024]

The mass of object A is 483% of the mass of object B , and the mass of object A is 0.069% of the mass of object C . If the mass of object C is $p\%$ of the mass of object B , what is the value of $\frac{p}{1,000}$?

32. [October US 2024]

The positive number a is 3,700% of the number c , and c is 20% of the number b . If $a - b = wc$, where w is a constant, what is the value of w ?

33. [October 2024]

A clothing store buys shirts at a wholesale price of 5.00 dollars each and resells them each at a retail price that is 270% of the wholesale price. At the end of the season, any remaining shirts are marked at a discounted price that is 70% off the retail price. What is the discounted price of each remaining shirt, in dollars?

34. [October 2024]

The positive number a is 2,352% of the sum of the positive numbers b and c , and b is 84% of c . What percent of b is a ?

- A) 5,152% C) 51.52%
B) 2,436% D) 24.36%

35. [October US 2024]

The composition of an animal is defined as the muscles, bones, and fat of the animal. A scientist studied the composition of one young swamp buffalo and determined that the buffalo had 139.2 kilograms of muscle, which made up approximately 67.7% of its composition. Of the remaining composition of this buffalo, approximately 51.4% was bone, and the remainder was fat. Based on these approximations, to the nearest tenth, how many kilograms of this buffalo's composition was bone.

36. [November 2024]

A researcher surveyed undergraduate students, graduate students, and postgraduate students. The number of undergraduate students surveyed was 7450% of the number of postdoctoral students surveyed and the number of graduate students surveyed was 24% of the undergraduate students surveyed. If there were 3576 graduate students surveyed, what was the sum of the number of undergraduate students and postdoctoral students surveyed?

37. [October US 2024]

The ratio of 12 to x is equal to the ratio of 156 to y . Which expression represents y in terms of x ?

- A) $\frac{1}{13}x$ C) $\frac{1}{12}x$
 B) $13x$ D) $12x$

38. [October US 2024]

For the positive quantities h , j , and k , 27% of h is the equivalent of 24% of j , and j is equivalent to 45% of k . What percentage of k is h ? (Disregard the % sign when entering your answer. For example, if your answer is 39%, enter 39)

39. [November US 2024]

A chemist mixed x liters of a 2% saline solution with y liters of a 5% saline solution to produce a 3% saline solution. Which equation best represents this situation? (Assume the volumes of the solutions are additive.)

- A) $0.02x + 0.05y = 3(x + y)$
 B) $0.02x + 0.05y = 0.03(x + y)$
 C) $0.2x + 0.5y = 3(x + y)$
 D) $0.2x + 0.5y = 0.3(x + y)$

40. [November US 2024]

The ratio 5 to x is equivalent to the ratio y to 8. Which equation represents x in terms of y ?

- A) $x = \frac{5y}{8}$ C) $x = \frac{y}{40}$
 B) $x = \frac{8y}{5}$ D) $x = \frac{40}{y}$

41. [November US 2024]

The mass of object A is 416% of the mass of object B, and the mass of object A is 0.064% of the mass of object C. If the mass of object C is $p\%$ of the mass of object B, what is the value of $\frac{p}{1,000}$?

42. [December US 2024]

Julia purchased 800 feet of fencing. She used 60% of this fencing to surround a vegetable garden. How many feet of fencing did Julia use to surround a vegetable garden?

- A) 12 C) 480
 B) 30 D) 740

43. [December US 2024]

The value of an autographed baseball increased by 178% from the end of 2012 to the end of 2013 and then decreased by 21% from the end of 2013 to the end of 2014. What was the net percentage increase in the value of the autographed baseball from the end of 2012 to the end of 2014?

- A) 119.62% C) 157.00%
 B) 140.62% D) 236.38%

44. [December 2024]

On a plot of land, 52.0% of the square footage is farmland and the remaining square footage is pasture. There are buildings on exactly 21.5% of the square footage of the farmland, and there are buildings on exactly 14.0% of the square footage of the pasture. If there are buildings on exactly $p\%$ of the square footage of the plot of land, what is the value of p ?

45. [December 2024]

The speeds of particles A, B, and C are a meters per second, b meters per second, and c meters per second, respectively. If the speed of particle A is 6,000% of the speed of particle C and the speed of particle C is 0.008% of the speed of particle B, which expression represents the value of $a + b$ in terms of c ?

- A) $12,560c$ C) $6,008c$
 B) $6,125c$ D) $1,850c$

46. [December 2024]

If $x > 0$ and x is 33% of y , which expression represents y in terms of x ?

A) $\frac{100}{33}x$

B) $\frac{10}{33}x$

C) $\frac{1}{33}x$

D) $\frac{67}{100}x$

A) 23

B) 33

C) 41

D) 43

47. [December 2024]

Jasmin grows bean pods in her garden. This year, she harvested 330 bean pods and saved 10% of them to plant next year. How many of the harvested bean pods did Jasmin save to plant next year?

A) 230

B) 460

C) 920

D) 1,380

48. [December 2024]

Levi and Marissa each have stamp collections. The number of stamps in Levi's collection is 200% of the number of stamps in Marissa's collection. If there are 460 stamps in Marissa's collection, how many stamps are in Levi's collection?

Questions 49 and 50 refer to the following information

	Candidate 1	Candidate 2	Other candidates	Total
County A	35,954	34,777	1,640	72,371
County B	165,973	77,837	6,862	250,672
County C	46,475	54,235	2,026	102,736
Total	248,402	166,849	10,528	425,779

For three counties, the table summarizes the number of residents who voted, by county and by candidate, during a 2016 US gubernatorial election. In 2016, the total number of residents in all three of these counties was 960,000, and the total area of these three counties was 1,949 square miles.

49. [August US 2023]

To the nearest whole percent, the total number of residents who voted for Candidate 1 is what percent of the total number of residents who voted for Candidate 2?

A) 67%

B) 86%

C) 103%

D) 149%

50. [August US 2023]

For these three counties, which of the following is closest to the number of residents who voted per square mile?

A) 650

B) 493

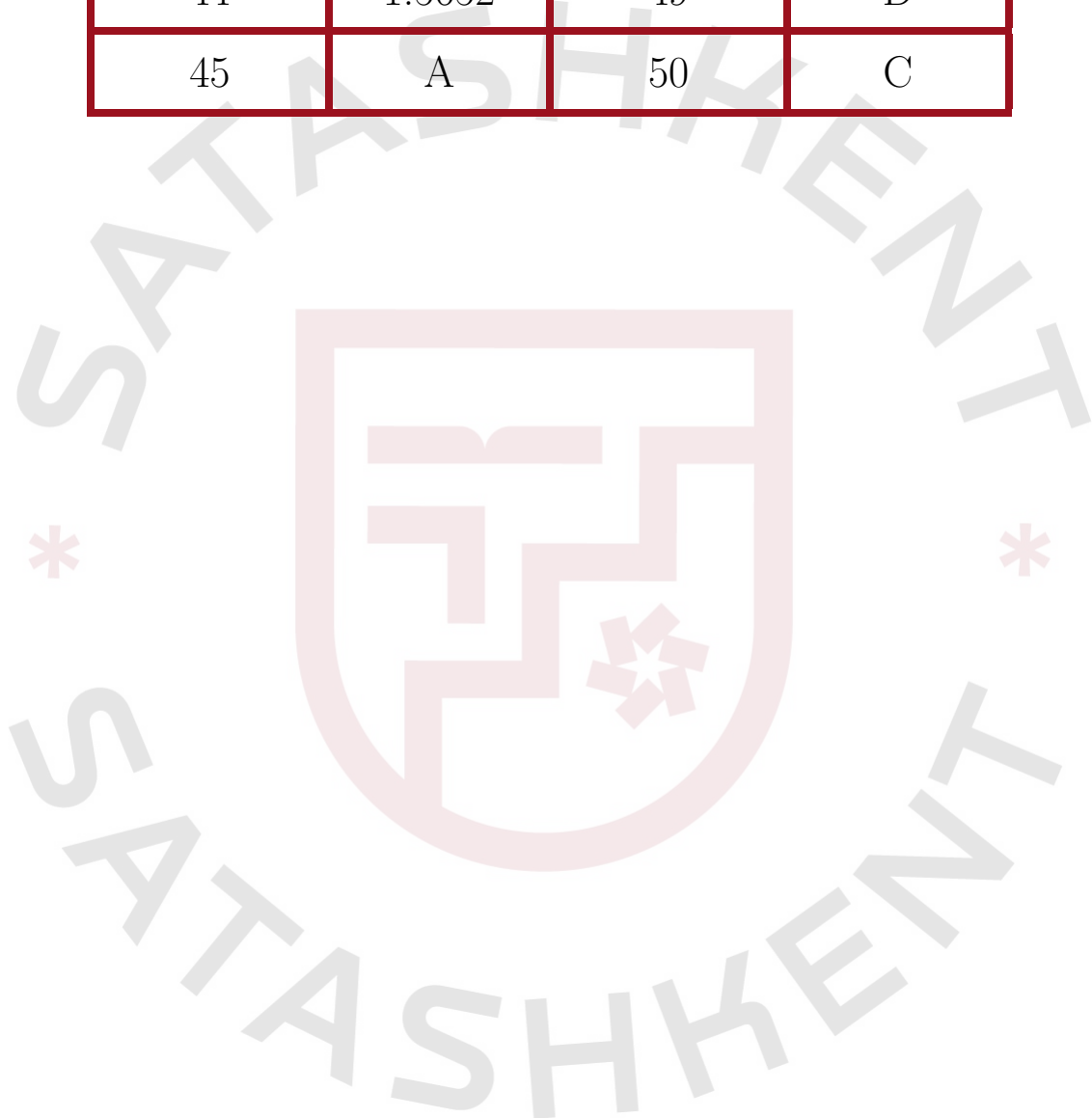
C) 218

D) 127

Answers: Percent, Ratio & Proportion

Number	Answer	Number	Answer
1	D	21	5.939
2	B	22	B
3	D	23	B
4	40	24	D
5	B	25	15
6	A	26	D
7	C	27	D
8	216	28	176
9	9.45	29	2.24
10	272	30	4.55
11	8	31	700
12	A	32	32
13	C	33	4.05
14	31.8	34	A
15	18	35	34.1
16	D	36	15100
17	B	37	B
18	7775	38	40
19	A	39	B
20	C	40	D

Number	Answer	Number	Answer
41	650	46	A
42	C	47	33
43	A	48	C
44	1.5652	49	D
45	A	50	C



Unit Conversion

1. [March US 2023]

A scientist takes two samples of Earth's crust, each with a mass of 3240 grams. Sample A has density of 3.0 grams per cubic centimeter, and sample B has a density of 2.7 grams per cubic centimeter. How much greater is the volume, in cubic centimeters, of sample B than sample A?

2. [March US 2023]

The walls of a small apartment were covered using exactly 3 gallons of paint. The paint was spread uniformly over a total area of 960 square feet. What was the rate, in gallons per square foot, at which the paint was used?

- A) $\frac{1}{960}$ C) 320
B) $\frac{1}{320}$ D) 960

3. [March US 2023]

The area of a rectangular region is increasing at a rate of 20 square feet per hour. Which of the following is closest to this rate in square meters per minute?
(Use 1 meter = 3.28 feet)

- A) 0.03 C) 1.09
B) 0.10 D) 2.03

4. [June 2023]

The speed of a white-throated needletail, a type of bird, in flight was measured to be 49 miles per hour. What was the white-throated needletail's measured speed, in kilometers per hour?
(Use 1 mile = 1.6 kilometers)

- A) 30.6 C) 50.6
B) 47.4 D) 78.4

5. [August US 2023]

An object traveled 30 miles in 2 hours. What was the average speed, in miles per hour, of the object?

6. [August US 2023]

An object's speed is increasing at a rate of 6.80 meters per second squared. What is this rate in miles per minute squared, rounded to the nearest tenth?
(Use 1 mile=1,609 meters.)

7. [November 2023]

A raised garden is in the shape of a right rectangular prism. Its base has a width of 3 feet and a length of 27 feet, and it will be filled 24 inches high with topsoil. The total cost of the topsoil needed to fill the garden to this height is 198 dollars. What is the unit cost, in dollars, per cubic yard, for the topsoil?
(1 yard= 3 feet; 1 foot = 12 inches)

8. [March 2024]

A certain town has an area of 3.99 square miles. What is the area, in **square yards**, of this town? (1 mile = 1,760 yards)

- A) 441 C) 776,341
B) 7,022 D) 12,359,424

9. [May 2024]

The area of a rectangular region is increasing at a rate of 260 square feet per hour. Which of the following is closest to this rate in square meters per minute?
(Use 1 meter = 3.28 feet.)

- A) 0.40 C) 14.21
B) 1.32 D) 24.17

10. [March 2024]

A remotely operated vehicle (ROV) is used for underwater ocean research. When the ROV is at a depth of 41 fathoms, what is the ROV's depth in feet? (1 fathom = 6 feet)

11. [May US 2024]

An object's speed is increasing at a rate of 3.9 meters per second squared. What is this rate, in miles per minute squared, rounded to the nearest tenth?
(Use 1 mile = 1,609 meters.)

- A) 0.1 C) 104.6
B) 8.7 D) 412.6

12. [August 2024]

A raised garden is in the shape of a right rectangular prism. Its base has a width of 3 feet and a length of 27 feet, and it will be filled 24 inches high with topsoil. The total cost of the topsoil needed to fill the garden to this height is 234 dollars. What is the unit cost, in dollars per **cubic yard**, for the topsoil?
(1 yard = 3 feet; 1 foot = 12 inches)

13. [August US 2024]

An object's speed is increasing at the rate of 12.1 meters per second squared. What is this rate, in miles per second squared, rounded to the nearest tenth?
(Use 1 mile=1,609 meters.)

- A) 0.5 C) 133
B) 27.1 D) 324.5

14. [November 2024]

An object's speed is increasing at a rate of 5.70 meter per second squared. What is this rate in miles per minute squared, rounded to the nearest tenth?
(Use 1 mile=1,609 meters.)

15. [October US 2024]

How many centimeters are equivalent to 35 meters?(1 meter = 100 centimeters)

16. [October US 2024]

An object's speed is increasing at a rate of 1.1 meters per second squared. What is this rate in miles per minutes squared, round to the nearest tenth?
(Use 1 mile= 1,609 meters.)

- A) 0 A) 29.5
A) 2.5 A) 1462.7

17. [December US 2024]

The area of a rectangular region is increasing at a rate of 280 square feet per hour. Which of the following is closest to this rate in square meters per minute?
(Use 1 meter = 3.28 feet.)

- A) 0.43 C) 15.31
B) 1.42 D) 26.03

18. [December 2024]

An object moves at a speed of $\frac{3}{50}$ feet per second. What is this speed, in yards per second? (3 feet = 1 yard)

- A) 50 C) $\frac{9}{50}$
B) 6 D) $\frac{1}{50}$

Answers: Unit Conversion

Number	Answer	Number	Answer
1	120	10	246
2	B	11	B
3	A	12	39
4	D	13	B
5	15	14	12.7
6	15.2	15	3500
7	33	16	A
8	D	17	A
9	A	18	D

Probability

1. [June 2023]

A certain book has 250 pages, and 21 of these pages have an illustration. If one of the book's pages is selected at random, what is the probability of selecting a page with an illustration? (Express your answer as a decimal or fraction, not as a percent.)

2. [March 2024]

At a convention center, there are a total of 325 visitors. Each visitor is located in either room A , room B , or room C . If one of these visitors is selected at random, the probability of selecting a visitor who is located in room A is 0.48, and the probability of selecting a visitor who is located in room B is 0.16. How many visitors are located in room C ?

- A) 25 C) 104
B) 36 D) 117

3. [March 2024]

There are 20 marbles in the bag: 8 red marbles, 10 green marbles, and 2 blue marbles. If one of these marbles is selected at random, what is the probability of selecting a red marble?

- A) $\frac{2}{20}$
B) $\frac{8}{20}$
C) $\frac{10}{20}$
D) $\frac{12}{20}$

4. [May 2024]

A choir of 48 singers has 12 members who sing bass. If one singer from the choir is selected at random, what is the probability of selecting a singer who sings bass?

- A) $\frac{1}{48}$ C) $\frac{36}{48}$
B) $\frac{12}{48}$ D) $\frac{48}{48}$

5. [May 2024]

The table shows the distribution of people in a certain city by age group.

Age group	Proportion
Less than 18 years old	27%
18–40 years old	24%
41–65 years old	28%
Greater than 65 years old	21%

If a person in this city is selected at random, which of the following is closest to the probability of selecting a person who is greater than 65 years old, given that the person is at least 18 years old?

- A) 0.21 C) 0.35
B) 0.29 D) 0.41

6. [May US 2024]

At a convention center, there are a total of 375 visitors. Each visitor is located in either room A , room B , or room C . If one of these visitors is selected at random, the probability of selecting a visitor who is located in room A is 0.48, and the probability of selecting a visitor who is located in room B is 0.32. How many visitors are located in room C ?

- A) 20 C) 60
B) 58 D) 75

7. [December US 2024]

A sleep study consisted of 59 participants, of which 53 participants each had an average of more than 120 minutes of rapid eye movement (REM) sleep per night. If a participant from this study is selected at random, what is the probability of selecting a participant that had an average of more than 120 minutes of REM sleep per night?

- A) $\frac{53}{100}$ C) $\frac{53}{59}$
B) $\frac{59}{100}$ D) $\frac{59}{53}$

8. [May US 2024]

At a convention center, there are a total of 375 visitors. Each visitor is located in either room A , room B , or room C . If one of these visitors is selected at random, the probability of selecting a visitor who is located in room A is 0.48, and the probability of selecting a visitor who is located in room B is 0.32. How many visitors are located in room C ?

- A) 20 B) 58 C) 60 D) 75

9. [August US 2023]

The table summarizes the distribution of age and assigned group for participants in a study.

	0-9 years	10-19 years	20+ years	Total
Group A	14	19	27	60
Group B	27	7	26	60
Group C	19	34	7	60
Total	60	60	60	180

One of these participants will be selected at random. What is the probability of selecting a participant from group A, given that the participant is at least 10 years of age? (Express your answer as a decimal or fraction, not as a percent.)

10. [August 2024]

A bin contains a mixture of T-shirts for two sports teams. The table shows the number of T-shirts in the bin, classified by size and sports team.

	Flames	Panthers	Total
Small	6	9	15
Medium	24	33	57
Large	18	24	42
Total	48	66	114

One T-shirt from the bin will be selected at random. What is the probability of selecting a T-shirt that is medium, given that the T-shirt is a Flames T-shirt? (Express your answer as a decimal or fraction, not as a percent.)

11. [June 2024]

The table summarizes the distribution of age and assigned group for 105 participants in a study.

	0-9 years	10-19 years	20+ years	Total
Group A	5	19	11	35
Group B	4	8	23	35
Group C	26	8	1	35
Total	35	35	35	105

One of these participants will be selected at random. What is the probability of selecting a participant from group A, given that the participant is at least 10 years of age

A) $\frac{2}{7}$

B) $\frac{3}{7}$

C) $\frac{19}{35}$

D) $\frac{6}{7}$

12. [October 2024]

	Live north of Center St.	Live south of Center St.	Total
Less than 45 years old	13	12	25
At least 45 years old	22	88	110
Total	35	100	135

The table summarizes members of a local organization by age and whether they live north or south of Center St. If a member of the organization is selected at random, what is the probability that the selected member is at least 45 years old?

A) $\frac{25}{135}$

B) $\frac{35}{135}$

C) $\frac{100}{135}$

D) $\frac{110}{135}$

13. [August US 2023]

A researcher calculated the mitochondrial genome sizes g , in kilobase pairs (kbp), and the number of mitochondrial genes for 34 different species. The table summarizes these data.

Number of mitochondrial genes	Mitochondrial Genome Size (kbp)				Total
	$g < 16$	$16 \leq g < 18$	$18 \leq g < 20$	$g \geq 20$	
36 or less	3	0	0	0	3
37	1	19	0	0	20
38 or more	2	0	4	0	6
Total	6	19	4	0	29

One of these species is selected at random. What is the probability of selecting a species with a mitochondrial genome size greater than or equal to 18 kbp, given that it has 37 or more mitochondrial genes?

(Express your answer as a decimal or fraction, not as a percent.)

14. [November US 2024]

For 100 neurons, the table summarizes the distribution of classification and cell body diameter:

Classification	Cell body diameter (micrometers)		
	Less than 20	20 to 30	Greater than 30
Sensory neuron	13	7	3
Motor neuron	0	15	18
Interneuron	10	34	0

One of these neurons will be selected at random. What is the probability of selecting a neuron with a cell body diameter that is less than or equal to 30 micrometers, given that it is not classified as a motor neuron?

15. [November 2024]

	Even integers	Odd integers	Total
List A	12	44	56
List B	40	4	44
Total	52	48	100

The given table shows the number of even and odd integers contained in list A and list B. No integer is contained in both lists. What fraction of even integers represented in the table are in list A?

A) $\frac{12}{52}$

B) $\frac{12}{56}$

C) $\frac{52}{100}$

D) $\frac{52}{56}$

Answers: Probability

Number	Answer	Number	Answer
1	$\frac{21}{150}$	9	$\frac{23}{60}$
2	D	10	$\frac{2}{13}$
3	B	11	B
4	D	12	$\frac{1}{2}$
5	B	13	C
6	D	14	A
7	C	15	$\frac{64}{67}$
8	B		

Mean, Median, Mode, Range

1. [March US 2023]

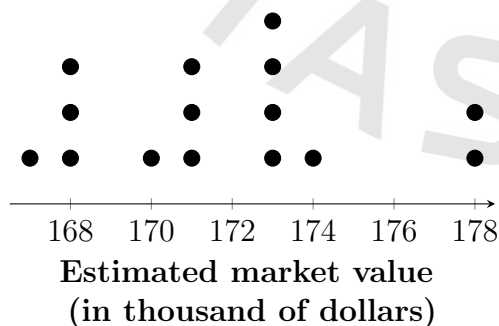
Each of the frequency tables represents a data set.

Data Set 1	
Value	Frequency
3	1
4	0
5	2
6	4
7	2
Data Set 2	
3	2
4	3
5	2
6	1
7	1

Which statement best compares the medians of two data sets?

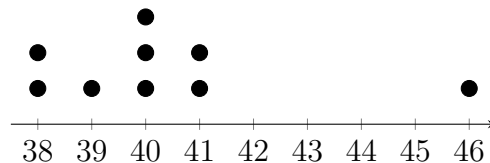
- A) The median of data set 2 is greater than the median of data set 1.
- B) The median of data set 1 is greater than the median of data set 2.
- C) The medians are the same.
- D) There is not enough information to compare the medians.

2. [March US 2023]



The dot plot shows the estimated market values for 15 houses in a neighborhood. What is the maximum estimated market value, in thousands of dollars, for the data set?

3. [March US 2023]



The dot plot shows the 9 values of a data set with a mean value of a and a median value of b . The value of 46 is removed to create a new data set of 8 values with a mean value of y and a median value of z . Which statement best compares the mean values and the median values for the two data sets.

- A) $a = y$ and $b < z$
- B) $a = y$ and $b > z$
- C) $a < y$ and $b = z$
- D) $a > y$ and $b = z$

4. [August US 2023]

Scientists examined water samples from different water springs. For these samples, the partial pressure of carbon dioxide in a closed system (limited carbon dioxide supply) had a minimum of 0.014 atmosphere (atm) and a maximum of 0.180 atm. The partial pressure of carbon dioxide in an open system (unlimited carbon dioxide supply) had a minimum of 0.00049 atm and a maximum of 0.05900 atm. Which statement best compares the range of the partial pressure of carbon dioxide for closed systems and open systems?

- A) The range for closed systems is less than the range for open systems.
- B) The range for closed systems is greater than the range for open systems.
- C) The ranges are equal.
- D) There is not enough information to compare the ranges.

5. [March US 2023]

The table shows the yearly snowfall in centimeters (cm) in Toronto for 9 years.

Year	Snowfall(cm)
2002	114.9
2003	129.6
2004	134.9
2005	162.6
2006	32.4
2007	114.1
2008	216.5
2009	89.0
2010	45.6

What was the median snowfall in cm in Toronto for these years?

- A) 32.4
- B) 114.9
- C) 115.5
- D) 184.1

6. [June 2023]

The table summarizes the UV index value recorded by a research assistant at noon each day for 49 days.

UV index	Number of days
1	9
2	15
3	12
4	13

According to the table, a UV index value of 1 was recorded on how many days?

- A) 4
- B) 9
- C) 40
- D) 49

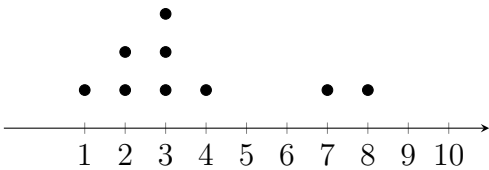
7. [May 2024]

The list gives the mass, in grams, of 5 ruffed lemurs:

3, 910; 3, 910; 3, 130; 3, 950; 3, 150.

What is the mean mass, in grams, of these 5 ruffed lemurs?

8. [August US 2023]

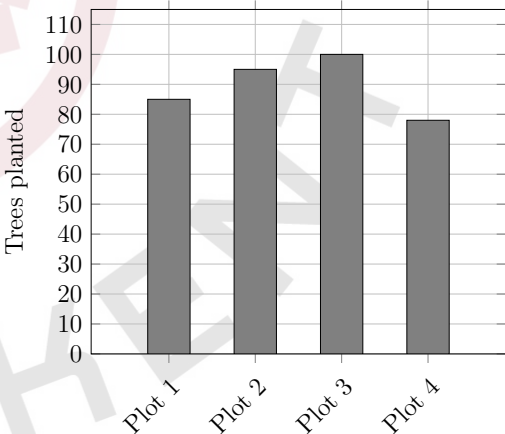


A data set containing 9 values is summarized in the dot plot shown. Which of the following statements about the relationship between the mean and the median of the data set must be true?

- A) The mean is equal to the median.
- B) The mean is less than to the median.
- C) The mean is greater than to the median.
- D) The relationship between the mean and the median cannot be determined from this dot plot.

9. [March 2024]

The bar graph shows the number of trees planted for 4 separate plots of land on a tree farm.

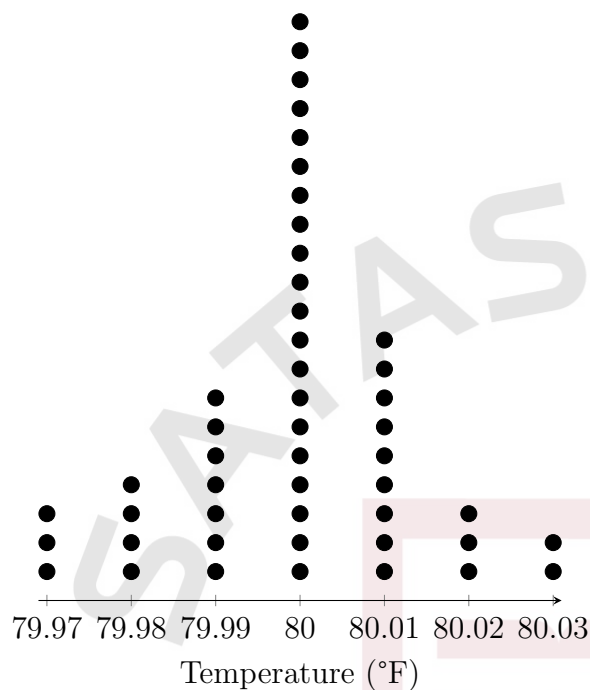


What is the maximum number of trees planted on one of these 4 plots of land?

- A) 100
- B) 95
- C) 85
- D) 78

10. [August US 2023]

Scientists placed 50 temperature probes along a coral reef. The dot plot gives the temperature readings from 49 of the 50 probes.



The temperature reading from the probe not recorded in the dot plot was 73.27 degrees Fahrenheit(°F). Which statement correctly compares the mean temperature reading of the 49 probes recorded in the dot plot to the mean temperature reading of all 50 probes?

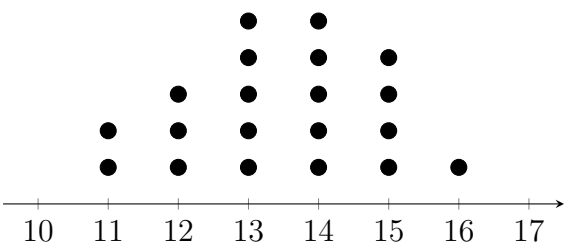
- A) The mean temperature reading of the 49 probes is greater than the mean temperature reading of all 50 probes.
- B) The mean temperature reading of the 49 probes is less than the mean temperature reading of all 50 probes.
- C) The mean temperature reading of the 49 probes is the same as the mean temperature reading of all 50 probes.
- D) There is not enough information to compare the means.

11. [May US 2024]

6, 6, 12, 16, 35

What is the median of the data shown?

12. [August US 2023]



The dot plot shown gives the distribution of values in a data set. What is the minimum value in the data set?

- A) 1
- B) 2
- C) 9
- D) 11

13. [March 2024]

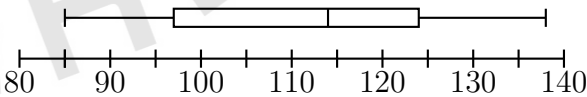
The table shows the frequency of values in a data set.

Value	Frequency
11	9
18	1
25	9
32	15

What is the minimum value of the data set?

- A) 1
- B) 9
- C) 11
- D) 18

14. [May 2024]



Number of units sold per day

A store owner recorded the number of units of a certain product that were sold per day for 28 days. What is the minimum number of units of this product sold per day for these 28 days?

15. [March 2024]

The table shows the frequency of values in a data set.

Value	Frequency
11	9
18	1
25	9
32	15

What is the minimum value of the data set?

- A) 1 C) 11
B) 9 D) 18

16. [August US 2024]

Ari examined a set of 86 plants. The lightest plant has a mass of 2.8 kilograms (kg) and the heaviest plant has a mass of 6.2 kg. Chihiro examined the same set of 86 plants and also an additional plant with a mass of 11.7 kg. Which of the following must be true about the set of plants that Ari examined and the set of plants that Chihiro examined?

- A) The standard deviation of the masses, in kg, of the plants that Ari examined is greater than the standard deviation of the masses, in kg, of the plants that Chihiro examined.
B) The range of the masses, in kg, of the plants that Ari examined is greater than the range of the masses, in kg, of the plants that Chihiro examined.
C) The median of the masses, in kg, of the plants that Ari examined is less than the median of the masses, in kg, of the plants that Chihiro examined.
D) The mean of the masses, in kg, of the plants that Ari examined is less than the mean of the masses, in kg, of the plants that Chihiro examined.

17. [May 2024]

The table shows the frequency of values in a data set.

Value	Frequency
13	8
20	1
27	8
34	6

What is the minimum value of the data set?

- A) 1 C) 13
B) 8 D) 20

18. [December 2024]

The list gives the number of individuals in each of 6 groups of ring-tailed lemurs.

17, 4, 20, 17, 18, 6

What is the range of the numbers of individuals for the 6 groups of ring-tailed lemurs?

19. [October US 2024]

Number of birds	Number of days
14	3
15	3
16	4
17	1
18	3
19	9

A science class studied the feeding behavior of the birds that visited a bird feeder each school day for a period of time. The table summarizes the number of birds the class observed visiting the bird feeder each school day during this period of time. What is the median number of birds the class observed visiting the bird feeder each school day during this period of time?

20. [May 2024]

Dataset A : 8, 11, 12, 15, 21, 27

Dataset B : 9, 12, 13, 16, 22, h

Data sets A and B each consist of 6 values as shown, where h is a constant. If the standard deviation of data set A is greater than the standard deviation of data set B , which of the following could be the value of h ?

- I. 23
- II. 28
- III. 29

- A) I only
- B) II only
- C) III only
- D) II or III

21. [May 2024]

The table shows the frequency of each value in a data set.

Value	Frequency
120	3
130	8
140	18
150	8
160	1

What is the minimum value of the data set?

- A) 1
- B) 3
- C) 120
- D) 160

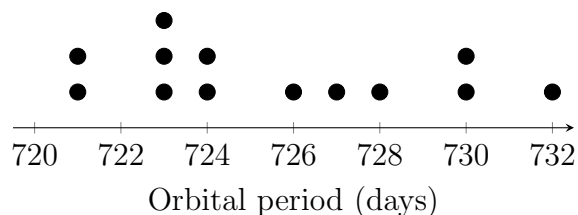
22. [December US 2024]

1, 4, 7, 10, 33

What is the mean of the data shown?

- A) 7
- B) 11
- C) 17
- D) 33

23. [May US 2024]



A data set of the orbital periods, rounded to the nearest whole number of Earth days for 13 of Jupiter's moons is represented in the dot plot. An additional moon with an orbital period of 628 days is added to the original data set to create a new data set of 14 orbital periods. Which statement best compares the mean and median of the new data set to the mean and median of the original data set?

- A) The mean of the new data set is equal to the mean of the original data set, and the median of the new data set is equal to the median of the original data set.
- B) The mean of the new data set is equal to the mean of original data set, and the median of the new data set is less than the median of the original data set.
- C) The mean of the new data set is less than the mean of the original data set, and the median of the new data set is less than the median of the original data set.
- D) The mean of the new data set is less than the mean of the original data set, and the median of the new data set is equal to the median of the original data set.

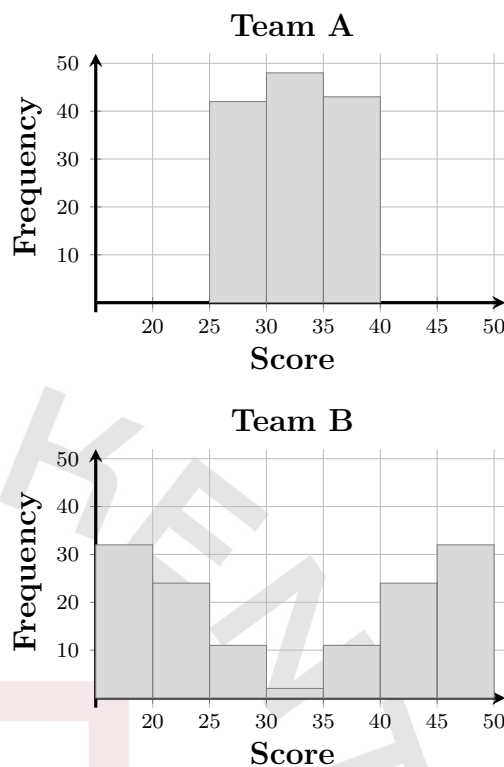
24. [October US 2024]

x	y
85	6
90	5
95	10
Total	51

Ari will add a 135-year-old stamp to her original collection, creating a new collection of 52 stamps. Which statement correctly compares the mean ages and median ages of Ari's original and new collections?

- A) The mean age for the new collection is greater than the mean age for the original collection, and the median age for the new collection is greater than the median age for the original collection.
- B) The mean age for the new collection is greater than the mean age for the original collection, but the median age is the same for the original and new collections.
- C) The mean age for the new collection is less than the mean age for the original collection, and the median age for the new collection is less than the median age for the original collection.
- D) The median age for the new collection is greater than the median age for the original collection, but the mean age is the same for the original and new collections.

25. [October 2024]



The histograms summarize the distributions of scores for team A and team B. Which statement best compares the standard deviations of scores for these teams?

- A) The standard deviation of scores for team A is less than the standard deviation of scores for team B.
- B) The standard deviation of scores for team A is greater than the standard deviation of scores for team B.
- C) The standard deviation of scores for team A is equal to the standard deviation of scores for team B.
- D) There is not enough information to compare the standard deviations.

26. [October US 2024]

The table shows the distribution of heights of, centimeters, of 25 objects.

Height	Frequency
0 to 100	8
101 to 200	6
201 to 300	5
301 to 400	4
401 to 500	2

Which of the following could be the median height of these objects?

- A) 355 C) 155
B) 255 D) 55

27. [June 2024]

Data set A: 5, 8, 11, 11, 14, 20

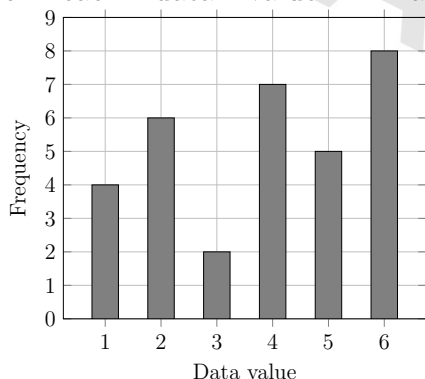
Data set B: 5, 8, 11, 11, 14, 20, 41

Two data sets are shown. Which statement best compares the medians of the data sets?

- A) The median of data set A is greater than the median of data set B.
B) The median of data set A is less than the median of data set B.
C) The medians of data sets A and B are equal.
D) There is not enough information to compare the medians.

28. [November US 2024]

The bar graph shows the frequency of each data value in a data set.



What is the frequency of data value 2 in this data set?

29. [October US 2024]

Weight(pounds)	Frequency
13	12
14	10
15	3
16	5
17	7
19	12
18	13
20	9

The frequency table summarizes a data set of the weights rounded to the nearest pound 71 *Ardeotis kori* birds. A weight of 32 pounds is added to the original data set, creating a new data set of the weights, rounded to the nearest pound, of 72 *Ardeotis kori* birds. Which statement best compares the mean and the median of the new data set to the mean and median of the original data set?

- A) The mean of the new data set is greater than the mean of the original data set, and the median of the new data set is greater than the median of the original data set.
B) The mean of the new data set is greater than the mean of the original data set, and the medians of the two data sets are equal.
C) The mean of the new data set is less than the mean of the original data set, and the median of the new data set is less than the median of the original data set.
D) The mean of the new data set is less than the mean of the original data set, and the median of the new data set is greater than the median of the original data set.

30. [June 2024]

An environmental scientist is investigating the volatility of 175 organic compounds by finding the boiling point of each compound. The mean boiling point of all 175 compounds is 167 degrees Celsius. The scientist classifies each of these compounds as either semivolatile or volatile. Of the 175 compounds, 50 compounds were classified as semivolatile, and these 50 compounds have a mean boiling point of 327 degrees Celsius. The remaining 125 compounds were classified as volatile. What is the mean boiling point, in degrees Celsius, of the 125 compounds classified as volatile compounds?

31. [October US 2024]

Number of queen ants	Number of colonies
1	11
2	9
3	7
4	6
5	6

Scientists collected acorns that each housed a colony of a particular species and then analyzed each colony’s structure. For these colonies, the table summarizes the number of queen ants per colony. For these colonies, what is the median number of queen ants per colony?

- A 6
- C 3
- B 4
- D 2

32. [October US 2024]

Each of the following frequency tables represent a data set. Which of the following frequency tables represents the data set with the smallest standard deviation?

A)

Value	Frequency
3	0
4	10
5	55
6	10
7	0

B)

Value	Frequency
3	11
4	17
5	19
6	17
7	11

C)

Value	Frequency
3	15
4	15
5	15
6	15
7	15

D)

Value	Frequency
3	28
4	7
5	5
6	7
7	28

33. [November 2024]

Data set F consists of 55 integers, where the value of each integer is between 150 and 260. Data set G consists of the same 55 integers in F as well as the integers 10. Which of the following must be less for data set G than for data set F ?

- I. The mean
- II. The median
- A) I only
- B) II only
- C) I and II
- D) Neither I nor II

34. [November US 2024]

Dataset A : 2, 2, 2, 5, 5, 8, 11, 11, 14, 14, 14

Dataset B : 2, 5, 5, 8, 8, 8, 8, 11, 11, 14

Data set A and data set B each have 11 values. Which of the following statements best compares the median of data set A and the median of data set B?

- A) The median of data set A is greater than the median of data set B.
- B) The median of data set A is less than the median of data set B.
- C) The medians of data sets A and B are equal
- D) There is not enough information to compare the medians.

35. [December 2024]

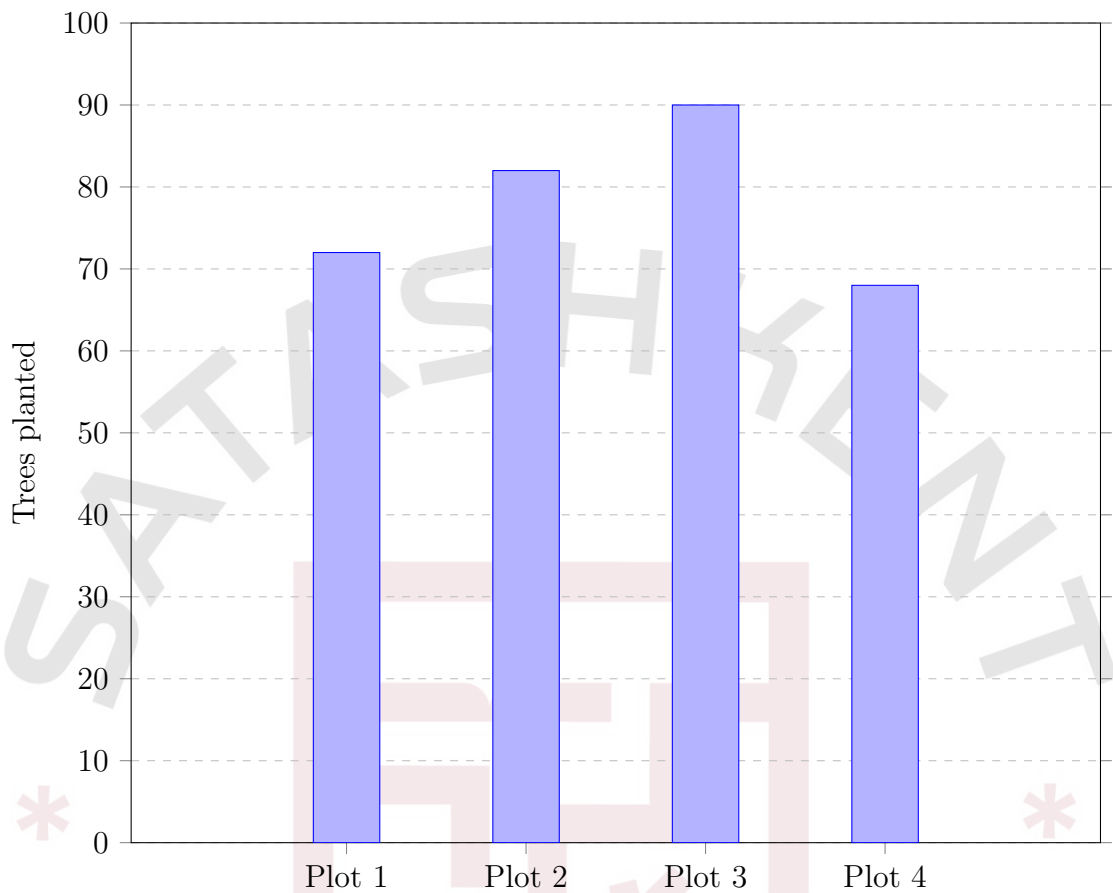
Task	Time (minutes)
A	8
B	6
C	14
D	11
E	11

The table shows the amount of time it took a participant in a study to complete each of 5 tasks. What was the mean time, in minutes, for this participant to complete a task?

- A) 8
- B) 10
- A) 11
- B) 9.5

36. [March 2024]

The bar graph shows the number of trees planted for 4 separate plots of and on a tree farm. What is the maximum number of trees on one of these plots of land?



37. [August 2024]

Values	Data set A frequency	Data set B frequency	Data set C frequency	Data set D frequency
40	0	0	8	8
43	2	3	3	4
46	4	3	3	2
49	8	8	0	0

The table shows the frequencies of the data values for four data sets. Which data set has the greatest mean?

- A) Data set A
- B) Data set B
- C) Data set C
- D) Data set D

38. [August 2024]

Value	Data set A frequency	Data set B frequency
40	2	8
43	4	7
46	5	5
49	7	4
52	8	2

Data set A and data set B each consist of 26 values. The table shows the frequencies of the values for each data set. Which of the following statements best compares the means of the two data sets?

- A) The mean of data set A is greater than the mean of data set B .
- B) The mean of data set A is less than the mean of data set B .
- C) The mean of data set A is equal to the mean of data set B .
- D) There is not enough information to compare the means of the data sets.

39. [November US 2024]

The values in data sets X and Y are shown in the table.

Data set X	13	13	14	14	15	16	16	17	17
Data set Y	2	2	3	3	4	5	5	6	6

The standard deviation of data set X is q , and the standard deviation of data set Y is s . Which of the following statements about the standard deviation of the data sets is true?

- A) $q < s$
- B) $q > s$
- C) $q = s$
- D) The relationship between q and s cannot be determined.

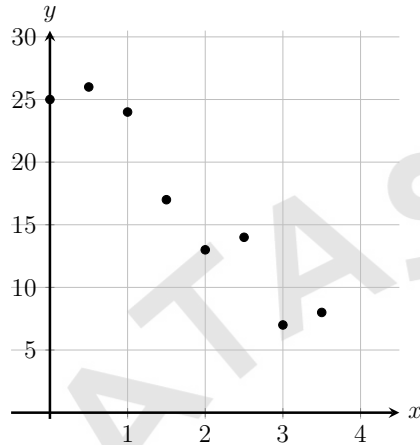
Answers: Mean, Median, Mode, Range

Number	Answer	Number	Answer
1	B	21	120
2	178	22	B
3	B	23	C
4	B	24	B
5	B	25	A
6	B	26	C
7	3610	27	C
8	B	28	6
9	A	29	B
10	A	30	103
11	12	31	2
12	D	32	C
13	C	33	A
14	85	34	C
15	C	35	B
16	D	36	90
17	13	37	A
18	16	38	A
19	18	39	A
20	A		

Scatterplots

1. [June 2023]

The scatterplot shows the relationship between two variables, x and y .

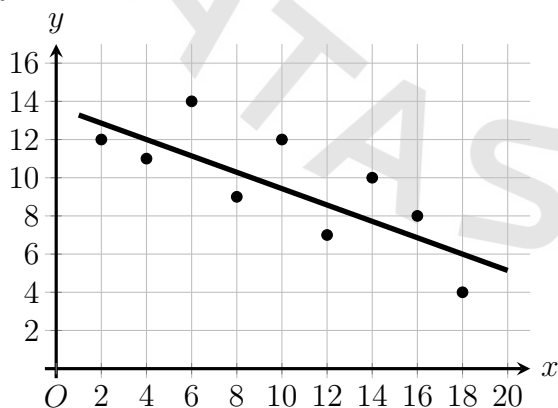


Which of the following equations is the most appropriate linear model for the data shown?

- A) $y = -6 + 28x$
- B) $y = 6 - 28x$
- C) $y = 28 + 6x$
- D) $y = 28 - 6x$

2. [August US 2023]

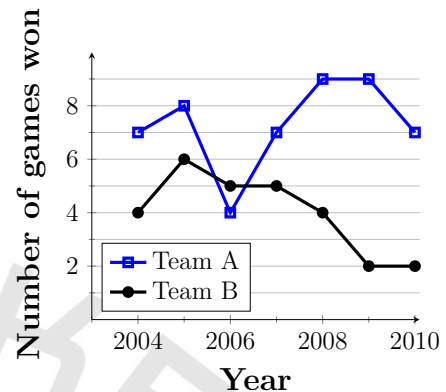
The scatterplot shows the relationship between two variables, x and y . A line of best fit is also shown.



What data point has an actual y -value that is 2 less than the y -value predicted by the line of best fit for corresponding x -value?

- A) (2,12)
- B) (6,14)
- C) (10,12)
- D) (18,4)

3. [August US 2023]

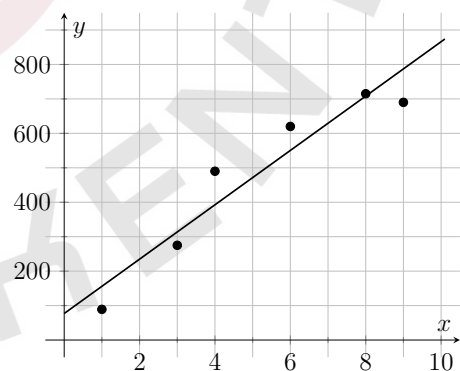


The line graphs show the number of games won by two football teams from 2004 to 2010. For how many of the years shown was the number of games won by Team A greater than the number of games won by Team B?

- A) 1
- B) 2
- C) 6
- D) 7

4. [March 2024]

The scatterplot shows the relationship between two variables, x and y . A line of best fit is also shown.

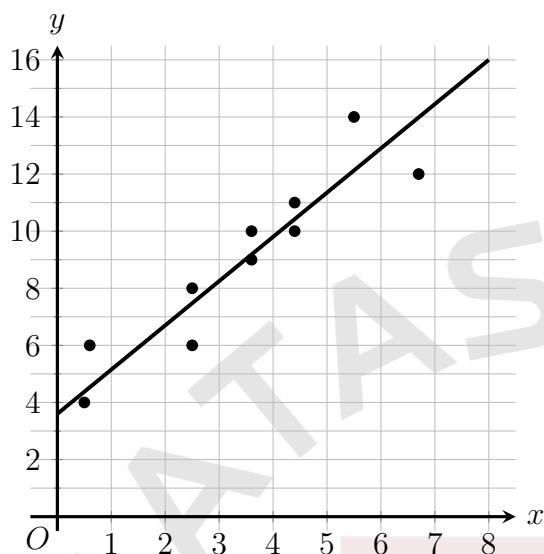


Which of the following best represents the line of best fit shown?

- A) $y = 77 + 0.01x$
- B) $y = 77 + 0.79x$
- C) $y = 77 + 68.9x$
- D) $y = 77 + 78.9x$

5. [March 2024]

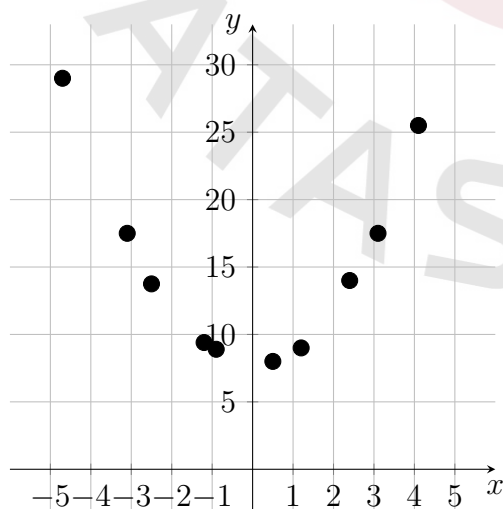
The scatterplot shows the relationship between two variables, x and y . A line of best fit is also shown.



Which of the following equations best represents the line of best fit shown?

- A) $y = 3.5 + 1.8x$
- B) $y = -2.4 + 1.55x$
- C) $y = 3.4 + 1.55x$
- D) $y = 2.4 - 1.5x$

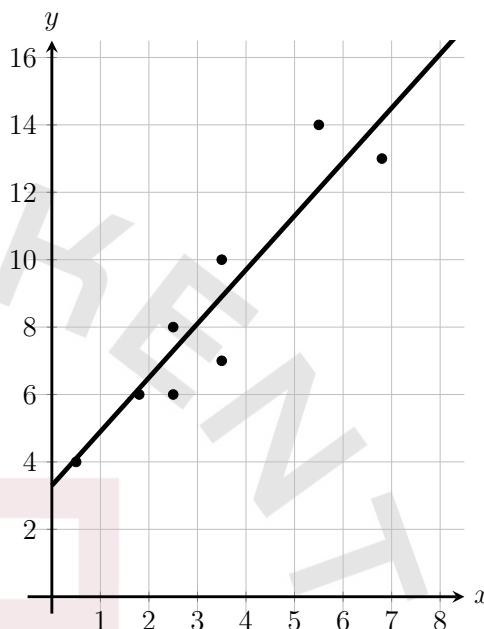
6. [March 2024]



The scatterplot shows the relationship between two variables, x and y . Which of the equations is the most appropriate model for the data shown?

- A) $y = x^2 - 8$
- B) $y = x^2 + 8$
- C) $y = (x - 8)^2$
- D) $y = (x + 8)^2$

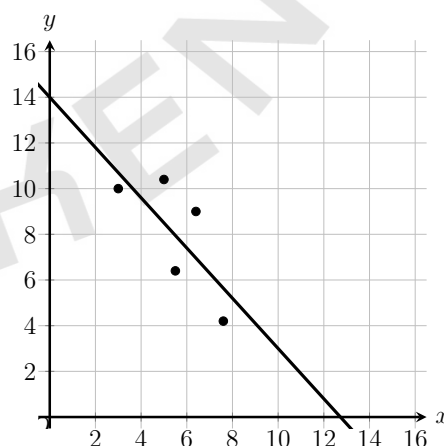
7. [May US 2024]



Which of the following equations best represents the of best fit shown?

- A) $y = 3.3 + 1.6x$
- B) $y = 3.3 - 1.6$
- C) $y = -3.3 + 1.6x$
- D) $y = -3.3 - 1.6x$

8. [October 2024]

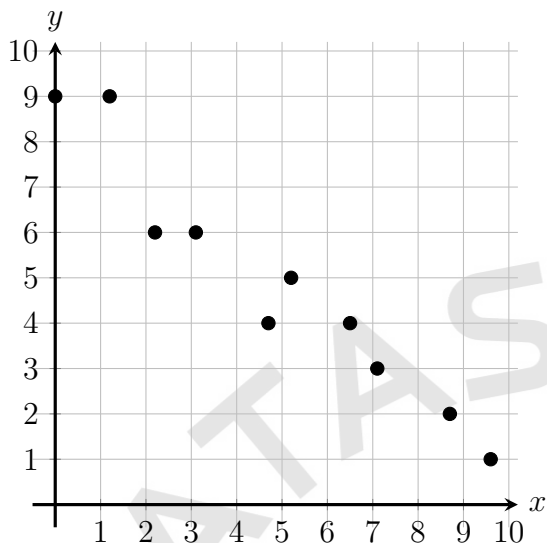


Which of the following is closest to the slope of this line of best fit?

- A) -3.3
- B) -1.1
- C) 1.1
- D) 3.3

9. [June 2024]

The scatterplot shows the relationship between two variables, x and y .

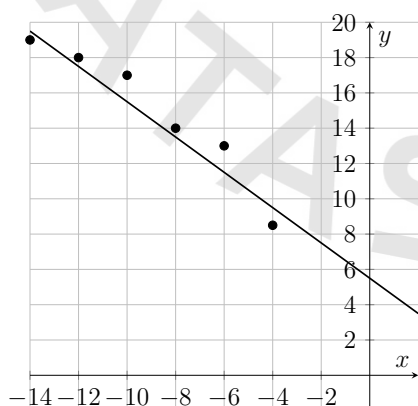


Which of the following equations is the most appropriate linear model for the data shown?

- A) $y = 0.8 + 8.7x$
- B) $y = 0.8 - 8.7x$
- C) $y = 8.7 + 0.8x$
- D) $y = 8.7 - 0.8x$

10. [August 2024]

The scatterplot shows the relationship between two variables, x and y . A line of best fit is also shown.

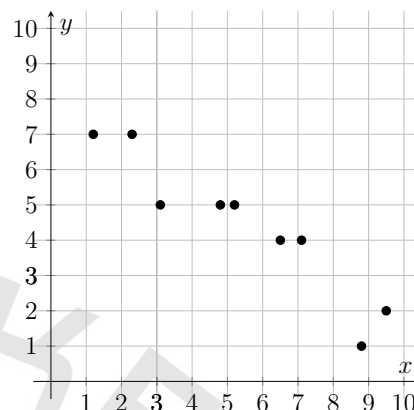


Which of the following equations best represents the line of best fit shown?

- A) $y = x - 19.9$
- B) $y = x - 19.9$
- C) $y = x - 5.7$
- D) $y = -x + 5.7$

11. [June 2024]

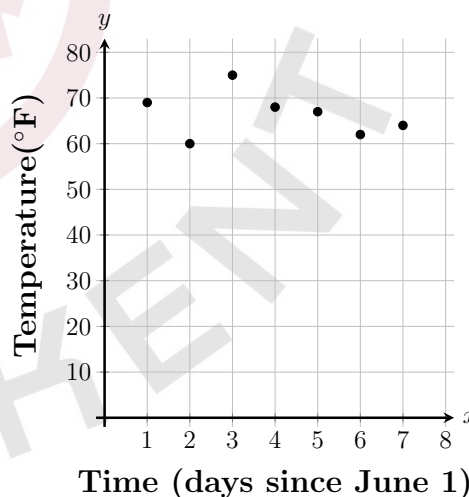
The scatterplot shows the relationship between two variables, x and y .



Which of the following equations is the most appropriate linear model for the data shown?

- A) $y = 0.8 + 8.7x$
- B) $y = 0.8 - 8.7x$
- C) $y = 8.7 + 0.8x$
- D) $y = 8.7 - 0.8x$

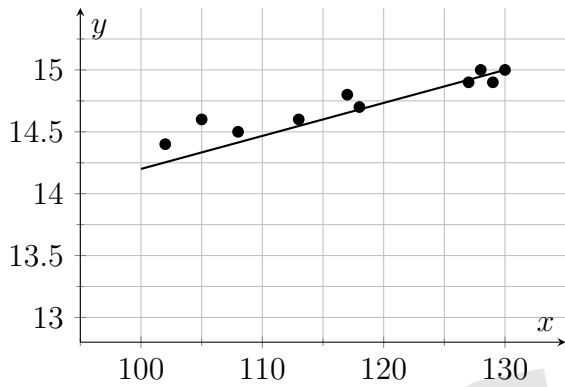
12. [August 2024]



During which of the following time periods did the greatest increase in recorded temperature take place?

- A) From $x = 6$ to $x = 7$
- B) From $x = 5$ to $x = 6$
- C) From $x = 2$ to $x = 3$
- D) From $x = 1$ to $x = 2$

13. [August US 2024]

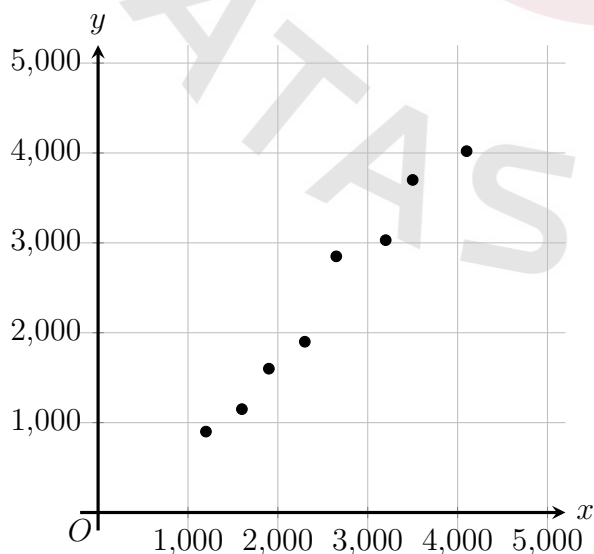


The scatterplot shows the relationship between two variables, x and y , for the dataset P. A line of best fit for the data is also shown. Data set Q is created by adding 540-units to the value of x for each data point from the data set P. Which of the following could be an equation of a line of best fit for the data set Q?

- A) $-3 + \frac{35}{1301}x$
- B) $9 + \frac{1}{131}x$
- C) $18 + \frac{1}{131}x$
- D) $26 + \frac{35}{1301}x$

14. [October US 2024]

The scatterplot shows the relationship between two variables, x and y .

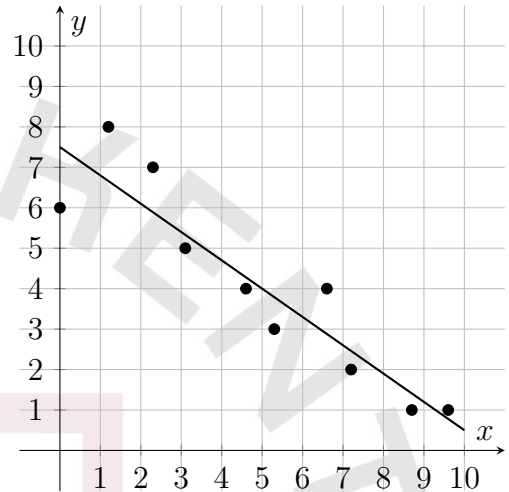


Which of the following equations is the most appropriate model for the data shown?

- A) $y = -582 + 1.2x$
- B) $y = 582 - 1.2x$
- C) $y = -582(1.2)^x$
- C) $y = 582(1.2)^x$

15. [October US 2024]

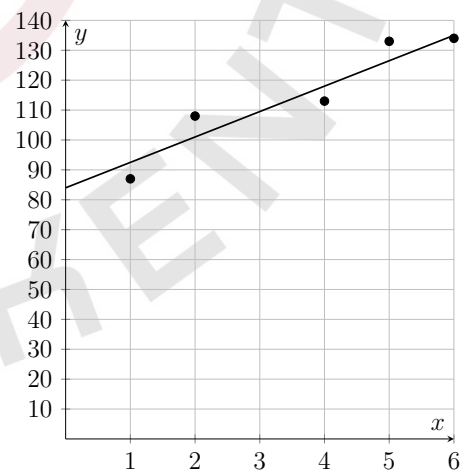
In the given scatterplot, a line of best fit for the data is shown.



Which of the following is closest to the slope of this line of best fit?

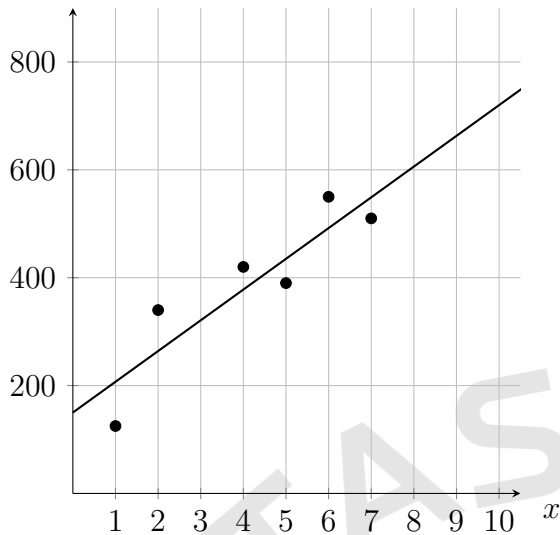
- A) -7
- B) -0.7
- C) 0.7
- D) 7

16. [October US 2024]



The scatterplot shows the body length, in centimeters (cm), of a New Zealand fur seal from an age of 1 to 6 years old. A line of best fit is also shown. For a New Zealand fur seal at an age of 3 years old, what is the body length in centimeters predicted by the line of best fit, to the nearest 10 cm?

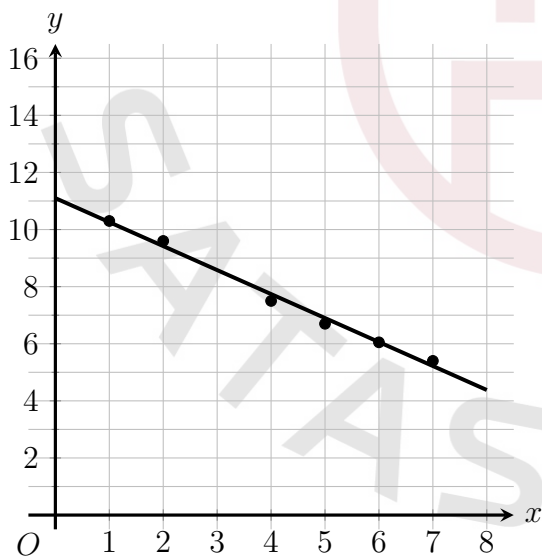
17. [November 2024]



Which of the following best represents the line of best fit shown?

- A) $y = 148.13 + 0.02x$
- B) $y = 148.13 + 0.59x$
- C) $y = 148.13 + 48.61x$
- D) $y = 148.13 + 58.61x$

18. [December 2024]

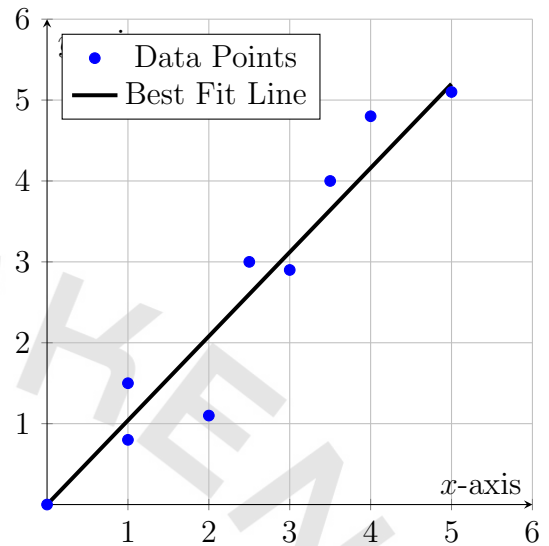


Which of the following is closest to the slope of the line of best fit shown?

- A) -11.19
- B) -0.84
- C) 0.84
- D) 11.19

19. [December 2024]

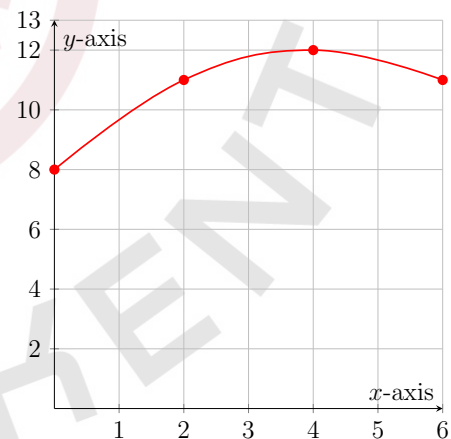
In the given scatterplot, a line of best fit for the data is shown.



Which of the following equations best represents this line of best fit?

- A) $y = 1.1x$
- B) $y = -1.1x$
- C) $y = 5.2$
- D) $y = -5.2$

20. [December 2024]



The graph models the number of active projects a company was working on x months after the end of November 2011, where $0 \leq x \leq 6$. According to the model, what is the predicted number of active projects the company was working on at the end of November 2011?

- A) 0
- B) 8
- C) 11
- D) 12

Questions 21 and 22 refer to the following information

The line graph shows the amount, in millions of dollars, that the National Science Foundation (NFS) granted to museums in Minnesota for the years 2000 through 2006.



21. [August US 2023]

In 2002, the NFS granted a total of approximately 39 million dollars to US museums. Which of the following is closest to the percentage of this total that was granted to museums in Minnesota?

- A) 0.1% C) 8.2%
B) 1.2% D) 12.2%

22. [August US 2023]

What is the approximate average rate of change of the amount, in millions of dollars per year, that the NFS granted to museums in Minnesota from 2000 to 2006?

- A) -2.07 C) 0.41
B) -0.48 D) 0.82
-

Answers: Scatterplots

Number	Answer	Number	Answer
1	D	12	C
2	D	13	A
3	C	14	A
4	D	15	B
5	C	16	110
6	B	17	D
7	A	18	B
8	B	19	A
9	D	20	B
10	D	21	C
11	D	22	B

Research organizing(Margin of Error; Outliers)

1. [November 2023]

In a random sample of 276 residents in a certain building, 9 residents reported that they take the train to work. If there are a total of 1,380 residents in this building, which of the following is the best estimate of the number of building residents who take the train to work?

- A) 9
- B) 45
- C) 276
- D) 1,095

2. [May 2024]

A company conducted a study concerning the time spent on extracurricular activities by students in grades 6, 7, and 8 and their level of school spirit. A total of 90 students were selected at random from all students in grades 6, 7, and 8 in a large school district in the US. The selected students were asked to report their level of school spirit as either low, medium, or high. The table summarizes the distribution of their selected students by grade.

Grade	6	7	8
Number of students	30	26	34

If the results of the study suggest a relationship between the self-reported level of school spirit and the amount of time spent on extracurricular activities by students in grades 6, 7, and 8, which of the following aspects of the study will prevent the results from being generalized to all students in grades 6, 7, and 8 in the US?

- A) The selected students are not all from the same school.
- B) The number of selected students is too small.
- C) The number of selected students from each grade is different.

- D) The students were not selected at random from all students in grades 6, 7, and 8.

3. [March 2024]

A machine fills bags with approximately 10 ounces of cranberries. To test the accuracy of the filling process, 148 bags of cranberries were selected at random and weighed. Based on the sample, it is estimated that the average weight of all bags of cranberries filled by the machine in an 8-hour period is 9.89 ounces, with an associated margin of error of 0.14 ounce. Which of the following is the best interpretation of this estimate?

- A) Plausible values for the average weight of all bags of cranberries filled by the machine are between 9.75 ounces and 10.03 ounces.
- B) Plausible values for the average weight of all bags of cranberries filled by the machine are less than 9.75 ounces or greater than 10.03 ounces.
- C) The average weight of all bags of cranberries filled by the machine is greater than 9.99 ounces.
- D) The average weight of all bags of cranberries filled by the machine is less than 9.99 ounces.

4. [June 2024]

A proposal for a construction project was included on a city election ballot. A TV news report stated that 8 times as many people voted in favor of the proposal as people who voted against it. An internet article reported that 24,500 more people voted in favor of the proposal than voted against it. Based on these data, how many people voted against the proposal?

5. [December 2023]

According to a set of standards, pure biodiesel fuel can contain a maximum of 0.001% phosphorus by mass, in grams, of phosphorus the sample can contain to meet these standards? A town manager selected 2 random samples of residents in the town to estimate the percentage of all residents that planned to vote in favor of a new business in the downtown area. Based on the first sample, he estimated that 75% of the residents in town planned to vote in favor, with an associated margin of error of 8.3%. Based on the second sample, he estimated that 83% of the residents in the town planned to vote in favor, with an associated margin of error of 6.7%. Assuming the margins of error were calculated the same way, which of the following best explains why the first sample obtained a larger margin of error than the second sample?

- A) The first sample contained fewer residents than the second sample.
- B) The first sample contained more residents than the second sample.
- C) The first sample contained a lower percentage of residents that planned to vote in favor of a new business in the downtown area
- D) The first sample contained higher percentage of residents that planned to vote in favor of a new business in the downtown area

6. [August US 2024]

A district board in a certain state is proposing a change to the time school starts to all high schools in the district. A sample of 353 high school students were selected from all high school students in the district. The selected students were asked if they approved of the proposed change, and 300 students responded that they did not approve. Which of the following is the largest population that the results of the survey can be generalized?

- A) All high school students in the district
- B) The 353 students who were surveyed
- C) The 300 students that responded that they did not approve of the proposed change
- D) All high school students in the state

7. [August US 2024]

A company that produces only one type of item wants to estimate the percent on the items produced in a typical week that are defective. A random sample of 400 of the items produced in a certain week were tested. Based on the sample, it is estimated that 8.5% of all items produced by the company in this week were defective, with an associated margin of error of 2.73%. Based on the estimate and associated margin of error, which of the following is the most appropriate conclusion about all items produced by the company during this week.

- A) 2.73% of all items are defective.
- B) It is plausible that between 5.77% and 11.23% of the items are defective.
- C) 8.5% of all items are defective.
- D) It is plausible that more than 11.23% of the items are defective.

8. [June 2024]

To estimate the proportion of a population that has a certain characteristic, a random sample was selected from the population. Based on the sample, it is estimated that the proportion of the population that has the characteristic is 0.2, with an associated margin of error of 0.08. Based on this estimate and margin of error, which of the following is the most appropriate conclusion about the proportion of the population that has the characteristic?

- A) It is plausible that the proportion is between 0.12 and 0.28.
- B) It is plausible that the proportion is less than 0.12.
- C) The proportion is exactly 0.2.
- D) It is plausible that the proportion is greater than 0.28.

9. [August US 2024]

The manager of a gym selected a sample of 139 members at random to estimate the percentage of the gym's members that would continue to pay for a membership if the price increased. From the survey, the manager estimates that 82% of the gym's members would continue to pay for membership if the price increased, with associated margin of error of 6.39%. If the survey is repeated with a random sample of 278 members and the results are calculated in the same way, which of the following will be the most likely effect of using the larger random sample compared to the smaller random sample?

- A) The margin of error will be lower
- B) The margin of error will be higher
- C) The estimate of the percentage of the gym's members that would continue to pay for a membership if the price increased will be lower
- D) The estimate of the percentage of the gym's members that would continue to pay for a membership if the price increased will be higher

10. [October US 2024]

A machine fills bags with approximately 29 ounces of walnuts. To test the accuracy of the filling process, 169 bags of walnuts were selected at random and weighed. Based on the sample, it is estimated that the average weight of all bags of walnuts filled by the machine in an 8-hour period is 28.88 ounces, with an associated margin of error of 0.13 ounce. Which of the following is the best interpretation of this estimate?

- A) Plausible values for the average weight of all bags of walnuts filled by the machine are between 28.75 ounces and 29.01 ounces.
- B) Plausible values for the average weight of all bags of walnuts filled by the machine are less than 28.75 ounces or greater than 29.01 ounces.
- C) The average weight of all bags of walnuts filled by the machine is less than 28.99 ounces.
- D) The average weight of all bags of walnuts filled by the machine is greater than 28.99 ounces.

11. [October US 2024]

A researcher is designing a study to investigate the average number of hours a student at a high school spends reading per day. The researcher will report the average number of hours a student at the high school spends reading with an associated margin of error. The researcher is considering using a random sample of either 105 or 210 students from the high school. Which of the following could be the most likely effect of using the larger random sample compared to the smaller random sample?

- A) The reported margin of error would be lower.
- B) The reported margin of error would be higher.
- C) The reported average number of hours would be lower.
- D) The reported average number of hours would be higher.

12. [October US 2024]

A survey was conducted in Franklin to estimate number of adult residents who supported the addition of a parking garage in their town. Based on the survey, it is estimated that 77% of all adult residents of Franklin support the addition of a parking garage in their town, with an associated margin of error of 5%. Which of the following is the most appropriate conclusion about all adult residents of Franklin?

- A) Plausible values for the percent of all adult residents of Franklin who support the addition of a parking garage in their town are between 73% and 82%
- B) The addition of a parking garage in the town is supported by exactly 72% of all adult residents of Franklin
- C) Plausible values for the percent of all adult residents of Franklin who support the addition of a parking garage in their town are either less than 73% or more than 82%
- D) The addition of a parking garage in the town is supported by more than 82% of all adult residents of Franklin

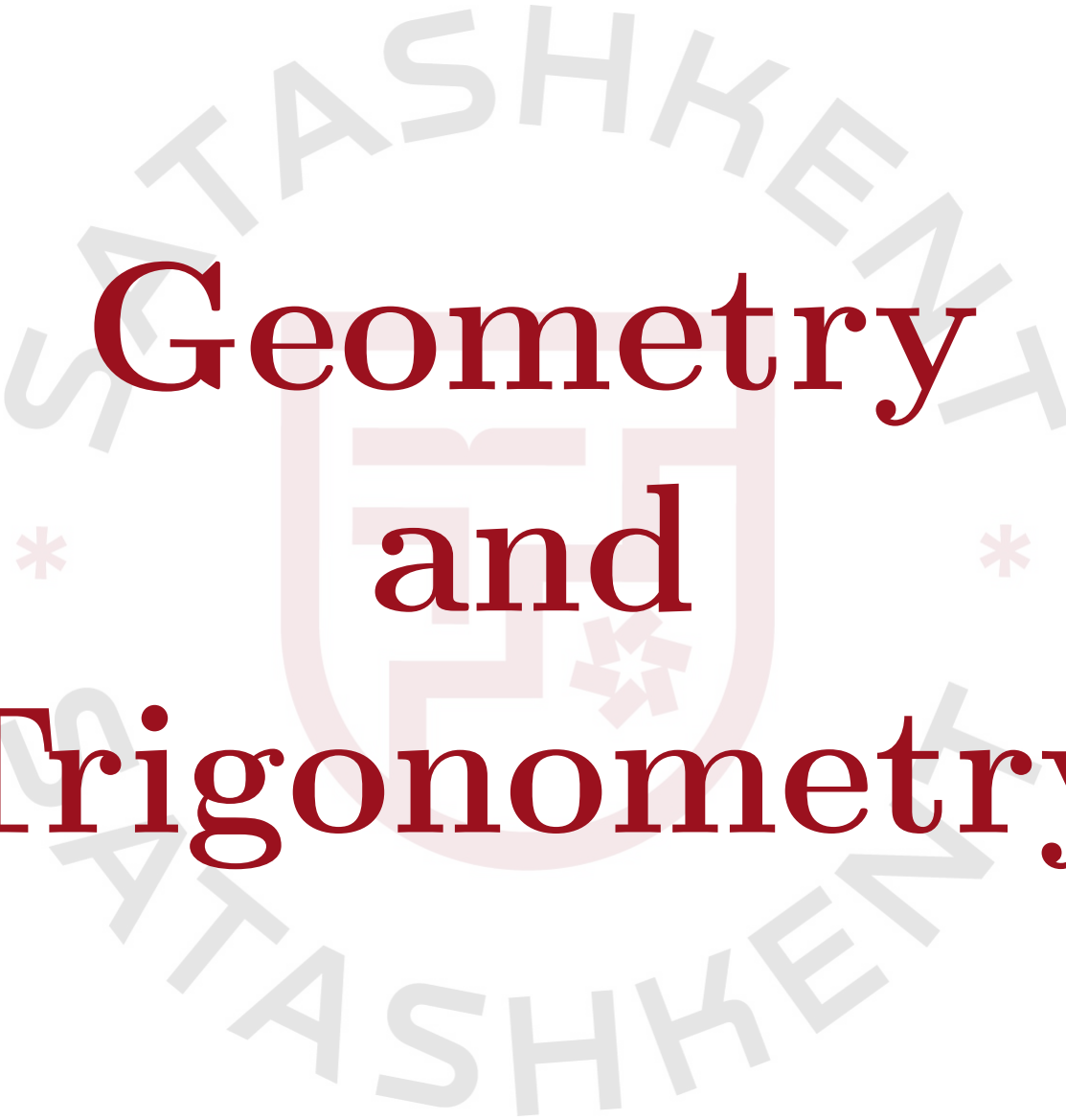
13. [December 2024]

A research manager selected 2 random samples of ovens of a certain type to estimate the average amount of time this type of oven takes to preheat to 325 degrees Fahrenheit ($^{\circ}F$). The research manager recorded the amount of time, in minutes, each oven takes to preheat to 325 ($^{\circ}F$). Based on the first sample, the research manager estimated that this type of oven takes an average of 15.2 minutes to preheat to 325 ($^{\circ}F$), with an associated margin of error of 1 minute. Based on the second sample, the research manager estimated that this type of oven takes an average of 15.4 minutes to preheat to 325 ($^{\circ}F$), with an associated margin of error of 2.2 minutes. Assuming the margins of error were calculated the same way, which of the following best explains why the first sample obtained a smaller margin of error than the second sample?

- A) The first sample contained more ovens than the second sample
- B) The first sample contained fewer ovens than the second sample.
- C) The first sample took more time on average to preheat to 325($^{\circ}F$) than the second sample.
- D) The first sample took less time on average to preheat to 325($^{\circ}F$) than the second sample.

Answers: Research Organizing

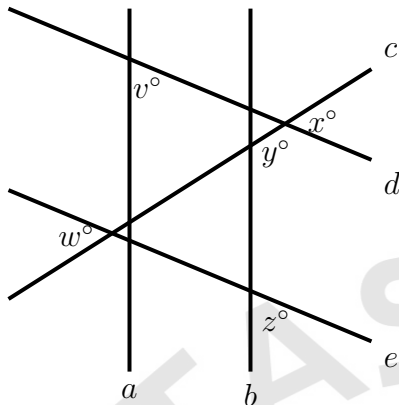
Number	Answer
1	B
2	D
3	A
4	3500
5	A
6	A
7	B
8	A
9	A
10	A
11	A
12	A
13	A



Geometry and Trigonometry

Lines&Angles

1. [June 2023]

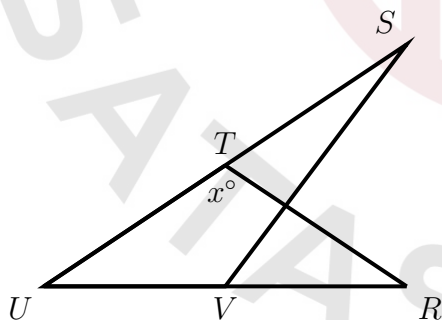


Note: Figure not drawn to scale

In the figure, parallel lines a and b are intersected by lines c , d , and e . If $x = 49$, $y = 136$, and $v < z$, which statement about x and w must be true?

- A) $x < w$
- B) $x > w$
- C) $x = w$
- D) $x + w = 90$

2. [November 2023]



In the figure, $RT = TU$, the measure of angle VST is 23° and the measure of angle RVS is 44° . What is the value of x ?

3. [March 2024]

A polygon has exactly 73 sides. If the measure of each of the 73 interior angles of this polygon is $(180p)^\circ$, what is the value of p ?

4. [August US 2023]

For two acute angles, $\angle A$ and $\angle B$, $\cos A = \sin B$. The measures, in degrees, of $\angle A$ and $\angle B$ are $x + 8$ and $4x + 2$, respectively. What is the value of x ?

- A) 37
- B) 34
- C) 16
- D) 2

5. [November 2023]

Quadrilaterals $PQRS$ and $WXYZ$ are similar, where P , Q , and R corresponds to W , X , and Y , respectively. The measure of $\angle S$ is 105° , $PS=25$, and $WZ=5$. What is the measure of $\angle Z$?

- A) 5°
- B) 21°
- C) 75°
- D) 105°

6. [December 2023]

For two acute angles $\angle Q$ and $\angle R$, $\cos Q = \sin R$. The measures, in degrees, of $\angle Q$ and $\angle R$ are $x + 21$ and $4x + 9$, respectively. What is the value of x ?

- A) 4
- B) 12
- C) 30
- D) 69

7. [March 2024]

Two lines intersect at exactly one point, forming two acute angles and two obtuse angles. The measure of one of these angles is $(9x - 190)^\circ$. Which of the following could NOT be the sum of the measures of any two of these angles?

- A) $(-18x + 380)^\circ$
- B) $(-18x + 740)^\circ$
- C) $(18x - 380)^\circ$
- D) 180°

8. [March 2024]

The measure of angle R is $\frac{2\pi}{3}$ radians. The measure of angle T is $\frac{13\pi}{18}$ radians greater than the measure of angle R . What is the measure of angle T , in degrees?

- A) 120 C) 250
B) 130 D) 500

9. [March 2024]

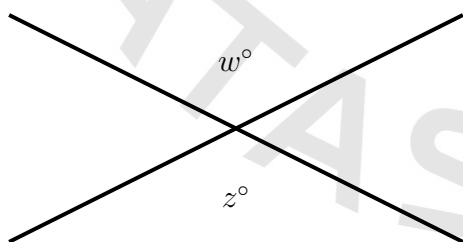
Quadrilaterals $PQRS$ and $WXYZ$ are similar where P, Q , and R correspond to W, X , and Y , respectively. The measure of $\angle S$ is 135° , $PS = 45$, and $WZ = 9$. What is the measure of $\angle Z$?

- A) 5° C) 45°
B) 27° D) 135°

10. [March 2024]

A polygon has exactly 83 sides. If the measures of each of the 83 interior angles of this polygon is $(180p)^\circ$, what value of p ?

11. [March 2024]

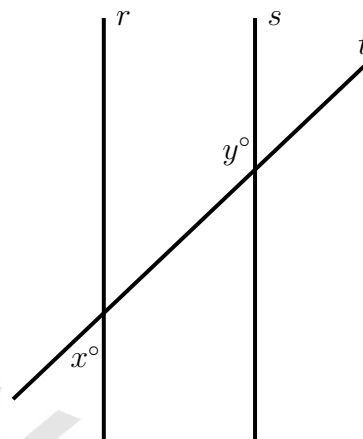


Note: Figure not drawn to scale.

In the figure, two lines intersect at a point. If $w = 150$, what is the value of z ?

- A) 30 C) 75
B) 50 D) 150

12. [May 2024]



Note: Figure not drawn to scale

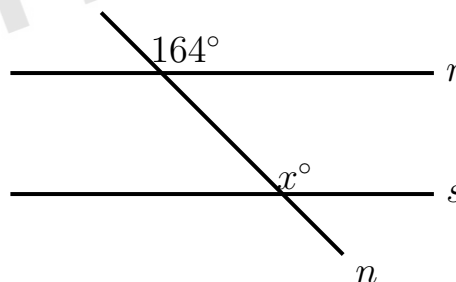
In the figure shown, line r is parallel to line s , and both lines are intersected by line t . If $x = 2w + 24$, $y = 5w + 29$, and $7w = a$, where a is a constant, what is the value of a ?

13. [May US 2024]

Quadrilateral $P'Q'R'S'$ is similar to quadrilateral $PQRS$ where P, Q, R , and S correspond to P', Q', R' , and S' , respectively. The measure of angle P is 45° , the measure of angle Q is 70° , and the measure of angle R is 90° . The length of each side of $P'Q'R'S'$ is 3 times the length of each corresponding side of $PQRS$. What is the measure of angle P' ?

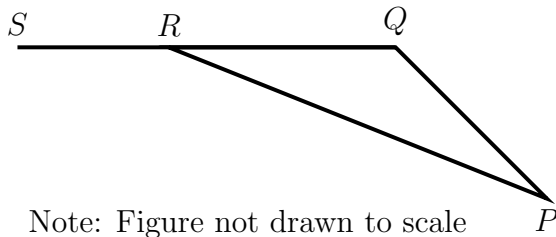
- A) 15° C) 60°
B) 45° D) 135°

14. [June 2024]



In the figure, line n intersects lines r and s . Line r is parallel to line s . What is the value of x ?

15. [June 2024]

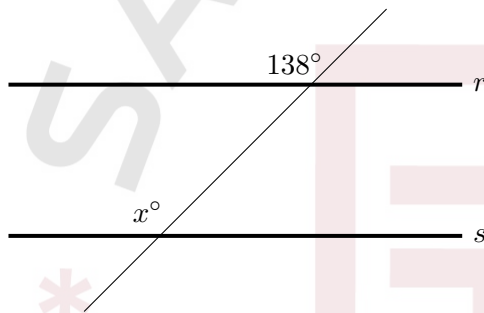


Note: Figure not drawn to scale

In triangle PQR , $\overline{QP}$ is extended to point S . The measure of $\angle PRS$ is 166° . What is the measure of $\angle QPR$?

- A) 14° C) 24°
B) 19° D) 38°

16. [June 2024]



In the figure, line n intersects lines r and s . Line r is parallel to line s . What is the value of x ?

17. [August 2024]

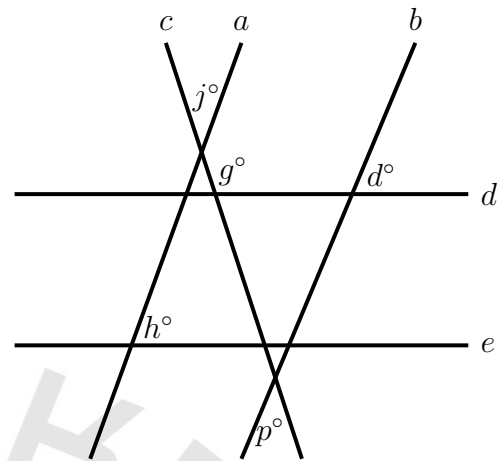
The difference between the measure of angle A and the measure of angle B is $-\frac{3}{4}\pi$ radians. Which expression shows the difference between the measure of angle A and the measure of angle B , in degrees?

- A) $-\frac{3}{4} \cdot \frac{180^\circ}{\pi}$
B) $-\frac{3}{4}\pi \cdot \frac{\pi}{180^\circ}$
C) $-\frac{3}{4}\pi \cdot \frac{180^\circ}{\pi}$
D) $-\frac{3}{4}\pi \cdot \frac{360^\circ}{\pi}$

18. [August US 2024]

In triangle PQR , the measures of angle P is $(3x+5)^\circ$, the measure of angle Q is $(2x+9)^\circ$, and the measure of angle R is $(4y+5)^\circ$. If side QR is extended through point R to point S , and the measure of angle PRS is $(x+y)^\circ$, what is the value of $x+y$?

19. [August 2024]

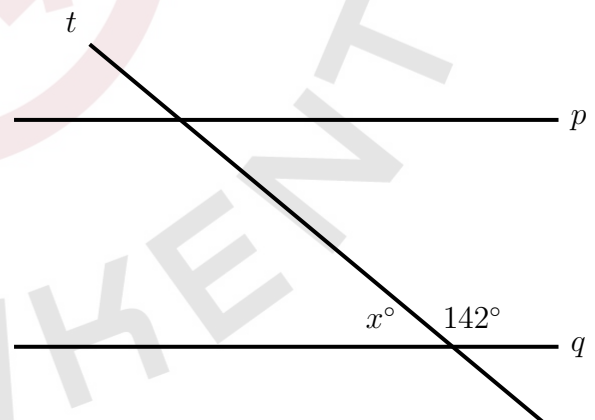


Note: Figure not drawn to scale

In the figure, parallel lines r and s are intersected by lines t , u , and w . If $d = 42$, $g = 143$, and $h > d$, which statement about j and p must be true?

- A) $j = p$ C) $j > p$
B) $j + p = 90$ D) $j < p$

20. [August US 2024]

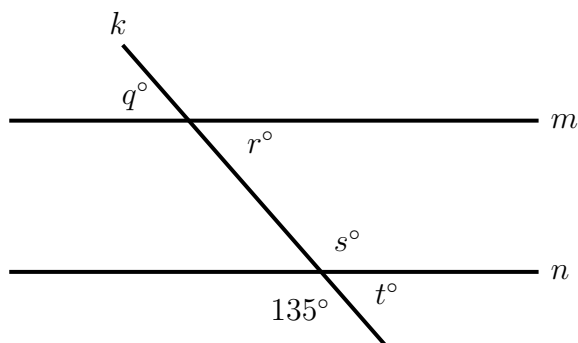


Note: Figure drawn not to scale

In the figure, line p is parallel to line q , and t intersects both of them. What is the value of $x + 142$?

- A) 52 C) 142
B) 90 D) 180

21. [August US 2024]



In the figure shown, line m is parallel to line n , and line k intersects both lines. Which of the following statements is true?

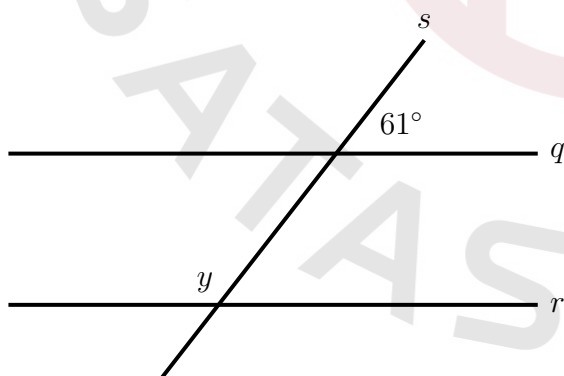
- A) $q = 135$ C) $s = 135$
 B) $r = 135$ D) $t = 135$

22. [October US 2024]

In $\triangle JKL$, the measures of both $\angle J$ and $\angle K$ are equal, and the measure of $\angle L$ is 134° . What is the measure of $\angle J$?

- A) 23° C) 67°
 B) 46° D) 90°

23. [October US 2024]



Note: Figure not drawn to scale

In the figure, line q is parallel to line r , and both lines are intersected by line s . If $y = 2x + 9$, what is the value of x ?

- A) 26 C) 55
 B) 35 D) 65

24. [October 2024]

In triangle ABC , the measure of angle A is 47° , the measure of angle B is 90° , and the measure of angle C is $(\frac{k}{2})^\circ$. What is the value of k ?

- A) 43 C) 86
 B) 45 D) 94

25. [October 2024]

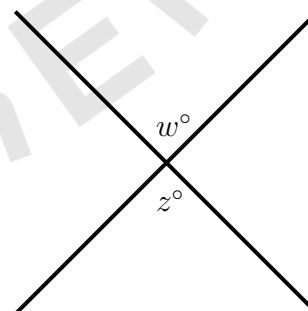
A line intersects two parallel lines, forming four acute angles and four obtuse angles. The measure of one of these eight angles is $(7x - 250)^\circ$. The sum of the measures of four of the eight angles is k . Which of the following could **NOT** be equivalent to k , for all values of x ?

- A) $-14x + 1,540$ C) $-28x + 1,720$
 B) $14x - 320$ D) 360

26. [October US 2024]

A line intersects two parallel lines, forming four acute and four obtuse angles. The measure of one of the acute angles is $(7x - 619)^\circ$. The sum of the measure of one of the acute and three of the obtuse angles is $(-14x + w)^\circ$. What is the value of w ?

27. [December 2024]

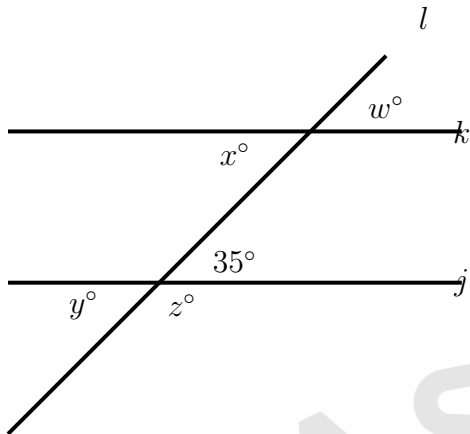


Note: Figure not drawn to scale.

In the figure, two lines intersect at a point. If $w = 128$, what is the value of z ?

- A) 28 C) 64
 B) 52 D) 128

28. [October US 2024]



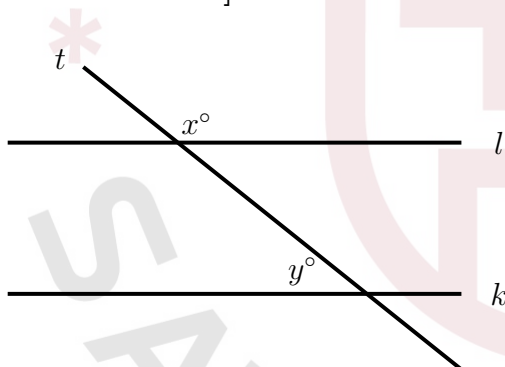
Note: Figure not drawn to scale

In the figure shown, line l intersects lines j and k . Which additional piece of information is sufficient to prove that lines j and k are parallel?

- A) $w = 35^\circ$
- B) $x = 145^\circ$

- C) $y = 35^\circ$
- D) $z = 145^\circ$

29. [November 2024]

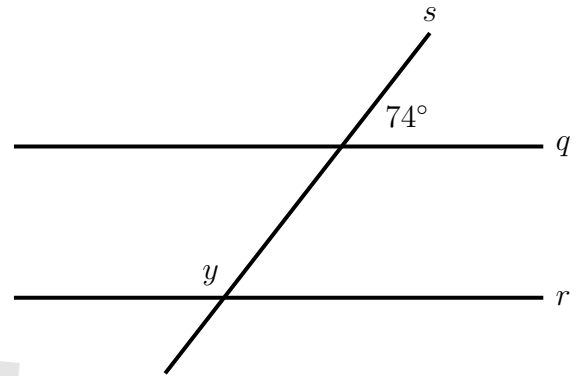


In the figure shown, the lines l and k are parallel and line t intersects both lines. If $x > 154$, which of the following must be true?

- A) $y < 26$
- B) $y > 26$

- C) $x + y < 180$
- D) $x + y > 180$

30. [December 2024]



Note: Figure not drawn to scale

In the figure, line q is parallel to line r , and both lines are intersected by line s . If $y = 2x + 8$, what is the value of x ?

- A) 33
- B) 41

- C) 49
- D) 59

Answers: Lines&Angles

Number	Answer	Number	Answer
1	B	16	42
2	113	17	C
3	71/73	18	39
4	16	19	D
5	D	20	D
6	B	21	C
7	C	22	A
8	C	23	C
9	D	24	C
10	81/83	25	C
11	D	26	1778
12	127	27	D
13	B	28	C
14	16	29	A
15	A	30	C

Triangles

1. [June 2023]

Triangles ABC and DEF are congruent, where A corresponds to D , and B and E are right angles. The measure of angle A is 62° . What is the value of angle F ?

- A) 28° C) 90°
B) 62° D) 118°

2. [June 2023]

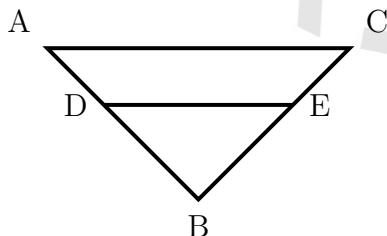
Triangle ABC is similar to triangle DEF , where angle A corresponds to angle D and angles C and F are right angles. The length $\overline{AB}$ is 2.4 times the length of $\overline{DE}$. If $\tan A = \frac{21}{20}$, what is the value of $\sin D$?

3. [June 2023]

In triangle RST , the measure of angle R is 10 degrees and the measure of angle T is 50 degrees. Point L lies on $\overline{RS}$, point K lies on $\overline{ST}$, and $\overline{LK}$ is parallel to $\overline{RT}$. What is the measure, in degrees, of angle SKL ? (Disregard the degree symbol when entering your answer.)

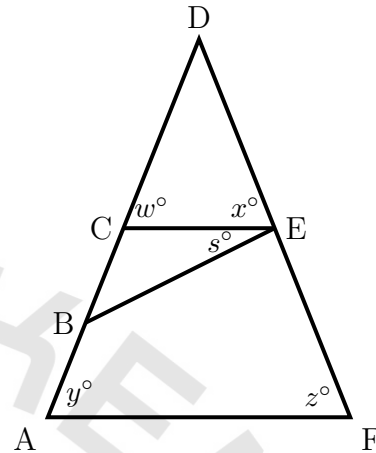
4. [August US 2023]

In the figure shown, line segments AC and DE are parallel. The measure of angle ACB is 58° , and $AB = 1.5DB$.



What is the measure, in degrees, of angle DEB ?
(Disregard the degree symbol when entering your answer.)

5. [August US 2023]



In figure shown, B and C lie on $\overline{AD}$, E lies on $\overline{DF}$, and $\overline{CE}$ is parallel to $\overline{AF}$. Which of the following is enough to prove that $\triangle BDE$ is similar to $\triangle EDC$?

- A) $w + y = x + z$
B) $w + x = y + z$
C) $s + x = z$
D) $s + x = y$

6. [August US 2023]

The area of a triangle is equal to x^2 square inches. The base of triangle is $5 + 2x$ inches, and the height of the triangle is $x - 2$ inches. What is the value of x ?

- A) 2.5 C) 5
B) 2.7 D) 10

7. [November 2023]

A triangle has a base length of 82 centimeters and a height of 164 centimeters. What is the area, in square centimeters, of the triangle?

- A) 246 C) 6,724
B) 3,362 D) 13,448

8. [December 2023]

In triangle RST , the measure of angle R is 11 degrees and the measure of angle T is 77 degrees. Point L lies on $\overline{RS}$, point K lies on $\overline{ST}$, and $\overline{LK}$ is parallel to $\overline{RT}$. What is the measure, in degrees, of angle SKL ? (Disregard the degree symbol when entering the answer.)

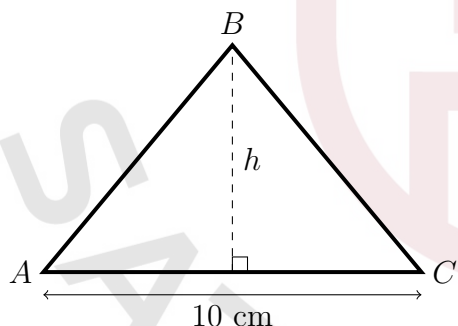
9. [December 2023]

The area of a triangle is equal to x^2 square centimeters. The length of the base of the triangle is $2x + 16$ centimeters, and the height of the triangle $x - 6$ centimeters. What is the value of x ?

10. [March 2024]

Triangles ABC and DEF are congruent, where A corresponds to D , and B and E are right angles. The measure of angle A is 27° . What is the measure, in degrees, of angle F ?

11. [March 2024]



The area of triangle ABC is 30 square centimeters. What is the height h , in centimeters, of this triangle?

- A) 3 C) 10
B) 6 D) 12

12. [May US 2024]

Triangles ABC and DEF are congruent, where A corresponds to D , and D , and B and E are right angles. The measure of angle A is 71° . What is the measure, in degrees, of angle F ?

13. [March 2024]

In right triangle RST , the sum of the measures of angle R and angle S is 90 degrees. The value of $\sin(R)$ is $\frac{4\sqrt{2}}{9}$. What is the value of $\cos(S)$?

- A) $\frac{4\sqrt{2}}{9}$ C) $\frac{7\sqrt{2}}{8}$
B) $\frac{4\sqrt{2}}{7}$ D) $\frac{9\sqrt{2}}{8}$

14. [March 2024]

In $\triangle ABC$, $\angle B$ is a right angle and the length of $\overline{BC}$ is 248 millimeters. If $\cos A = \frac{3}{5}$, what is the length, in millimeters, of $\overline{AB}$?

- A) 62 C) 248
B) 186 D) 310

15. [May 2024]

In triangle ABC and triangle DEF , sides AB and DE each have a side length of 6 inches, and angles A and D each have an angle measure of 40° . Which of the following additional pieces of information is(are) sufficient to prove whether triangle ABC is congruent to triangle DEF ?

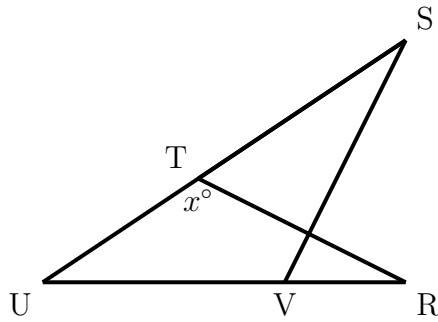
- I. The measures of angles B and C are equal.
II. The lengths of sides AC and DF are equal.
III. The lengths of sides BC and EF are equal.

- A) I is sufficient, but II and III are not.
B) II is sufficient, but I and III are not.
C) III is sufficient, but I and II are not.
D) I is sufficient and III is sufficient, but I is not.

16. [May US 2024]

Triangles ABC and DEF are similar. Each side length of triangle ABC is 2 times the corresponding side length of triangle DEF . The area of triangle ABC is 300 square centimeters. What is the area, in square centimeters, of triangle DEF ?

17. [May 2024]



Note: Figure not drawn to scale

In the figure, $RT = TU$, the measure of angle VST is 23° , and the measure of angle RVS is 34° . What is the value of x ?

18. [May 2024]

In isosceles triangle ABC , sides AB and AC are congruent. Point D divides BC such that the length of $\overline{BD}$ is $\frac{5}{7}$ of the length of $\overline{BC}$. Point E lies on side AB and point F lies on side AC such that when segments DE and DF are drawn, angle BED is congruent to angle CFD . If the length of $\overline{BE}$ is 10, what is the length of $\overline{CF}$?

- A) 4
B) 14
C) 50
D) 70

19. [May US 2024]

In a triangle ABC , the measure of angle A is 48° , the measure of angle B is 90° , and the measure of angle C is $(\frac{k}{2})^\circ$. What is the value of k ?

- A) 42
B) 45
C) 84
D) 96

20. [May US 2024]

A perimeter of an isosceles right triangle is $38 + 38\sqrt{2}$ inches. What is the length, in inches, of the hypotenuse of this triangle?

- A) 19
B) $19\sqrt{2}$
C) 38
D) $38\sqrt{2}$

21. [June 2024]

In right triangle ABC , angles A and B are acute, side AC has a length of 21.7, and $\tan B = \frac{1}{8}$. What is the length of side BC , rounded to the nearest tenth?

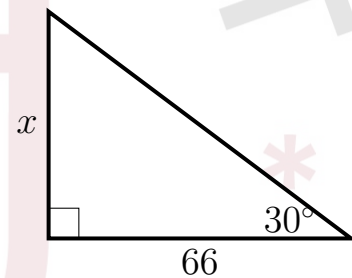
- A) 470.9
B) 173.6
C) 4.7
D) 2.7

22. [June 2024]

In right triangle ABC , angles A and B are acute. Side AC has a length of 21.2, and $\tan B = \frac{1}{6}$. What is the length of side BC , rounded to the nearest tenth?

- A) 3.5
B) 4.6
C) 127.2
D) 449.4

23. [June 2024]



Note: Figure not drawn to scale. In the triangle shown, what is the value of x ?

- A) 22
B) $22\sqrt{3}$
C) $66\sqrt{3}$
D) 132

24. [June 2024]

For triangle PQR and triangle STU , angles P and S each measure 30° . $QR = 16$ and $TU = 12$. Which additional piece(s) of information is(are) sufficient to prove that triangle PQR is similar to triangle STU ?

- I. The length of PQ is $\frac{1}{3}$ the length of ST .
II. The length of PR is $\frac{1}{3}$ the length of SU .
A) I is sufficient, but II is not.
B) II is sufficient, but I is not.
C) I is sufficient, and II is sufficient.
D) Neither I nor II is sufficient.

25. [August 2024]

Triangle QRS is similar to triangle FGH such that Q, R , and S correspond to F, G , and H , respectively. Each side of triangle FGH has $\frac{1}{4}$ the length of its corresponding side in triangle QRS . In triangle FGH , the measure of angle F is 35° , the measure of angle G is 8° , and $FG = a$. In triangle QRS , the measure of angle Q is b° and $QR = 20$. What is the value of $a + b$?

26. [August 2024]

The area of a triangle is equal to x^2 square centimeters. The length of the base of the triangle is $2x + 12.5$ centimeters, and the height of the triangle is $x - 5$ centimeters. What is the value of x ?

27. [August 2024]

In triangle FGH and triangle KLM , the measures of angles G and L are each 60° . The lengths of GH and LM are each 34 centimeters, and $\frac{GH}{GF} = \frac{LM}{LK}$. Which additional piece of information would be necessary to prove that triangle FGH is congruent to triangle KLM ?

- A) The lengths of FG and KM are each 17 centimeters.
- B) The measures of angles H and M are each 30° .
- C) The measures of angles F and K are each 90° .
- D) No additional information is necessary.

28. [August US 2024]

Triangles ABC and DEF are similar, where A corresponds to D , and B corresponds to E . The measure of angle A is 26° , and $AB = 4$. Which of the following statements must be true?

- I. The measure of angle D is 26°
- II. $DE = 4$

- A) I only
- A) I and II
- A) II only
- A) Neither I nor II

29. [August 2024]

If the perimeter of an equilateral triangle with a height of 46 units is $a\sqrt{3}$ units, what is the value of a ?

- A) 46
- B) 92
- C) $\frac{2,116}{3}$
- D) $\frac{4,232}{3}$

30. [August US 2024]

A triangle inequality theorem states that the sum of any two sides of a triangle must be greater than the length of the third side. If a triangle has side length of 8 and 13, which of inequality represents the possible length, x , of the third side of the triangle?

- A) $x < 21$
- B) $x > 21$
- C) $5 < x < 21$
- D) $x < 5$ or $x > 21$

31. [August 2024]

The perimeter of an equilateral triangle is 642 centimeters. The three vertices of the triangle lie on a circle. The radius of the circle is $w\sqrt{3}$ centimeters. What is the value of w ?

32. [October 2024]

The perimeter of an isosceles right triangle is $18 + 18\sqrt{2}$ inches. What is the length, in inches, of the hypotenuse of this triangle?

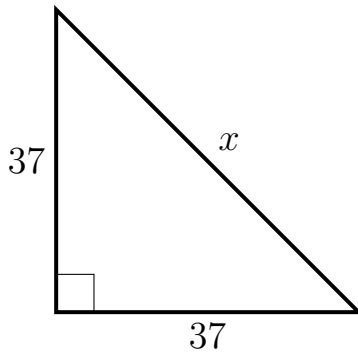
- A) 9
- B) $9\sqrt{2}$
- C) 18
- D) $18\sqrt{2}$

33. [October US 2024]

In $\triangle FGH$, the measure of $\angle F$ and $\angle G$ are each 39° . What is the measure of $\angle H$?

- A) 78°
- B) 102°
- C) 129°
- D) 141°

34. [October US 2024]



In the right triangle shown, what is the value of x ?

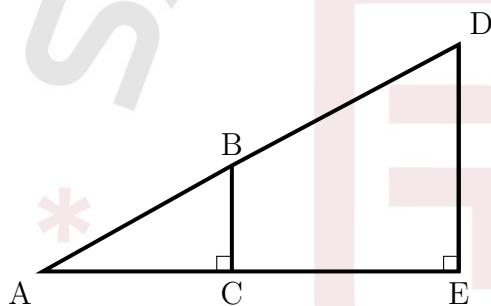
A) $\sqrt{2}$

A) $\sqrt{74}$

A) $\sqrt{37}$

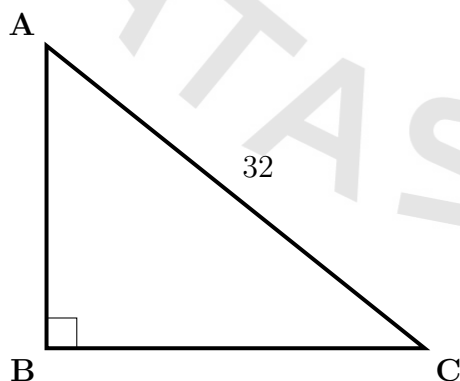
A) $37\sqrt{2}$

35. [October US 2024]



In the figure shown $AB = \sqrt{89}$ units, $AC = 8$ units, and $CE = 24$ units. What is the area, in square units, of triangle ADE ?

36. [November 2024]



For triangle ABC , the length of AB is 11 less than the length of AC . Point D (not shown) lies on AC such that BD (not shown) is perpendicular to AC . What is the value of $\frac{BC}{BD}$?

37. [November 2024]

In triangle ABC , angle B is a right angle. The length of side AB is $10\sqrt{39}$ and the length of side BC is $24\sqrt{39}$. What is the length of side AC ?

A) $14\sqrt{39}$

C) $34\sqrt{39}$

B) $26\sqrt{39}$

D) $\sqrt{24 \cdot 39}$

38. [November US 2024]

In triangle ABC and triangle DEF , AB and DE are each equal to 5 centimeters, and angles A and D each have measure 35° . Which additional piece of information is sufficient to prove that triangle ABC is congruent to triangle DEF ?

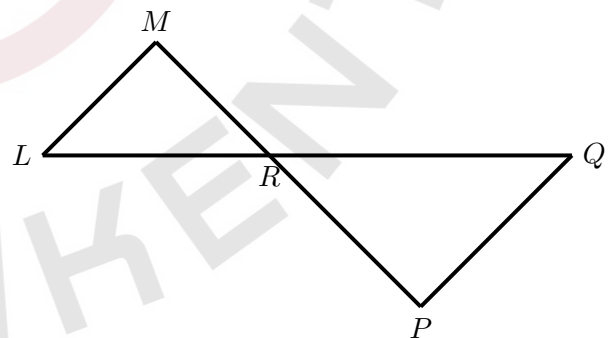
A) The lengths of sides BC and EF are equal.

B) The lengths of sides AC and DF are equal.

C) The measures of angles B and C are equal.

D) No additional information is necessary to prove that the two triangles are congruent.

39. [November US 2024]



Note: Figure not drawn to scale

In the figure, LQ intersects MP at point R , and $\overline{LM}$ is parallel to $\overline{PQ}$. The lengths of MR , LR , and RP are 9, 10, and 19, respectively. What is the length of LQ ?

A) $\frac{280}{19}$

C) $\frac{271}{9}$

B) $\frac{190}{9}$

D) $\frac{280}{9}$

40. [November US 2024]

The table gives the perimeters of similar triangles TUV and XYZ , where TU corresponds to XY . The length of TU is 16.

	Perimeter
Triangle TUV	44
Triangle XYZ	352

What is the length of XY ?

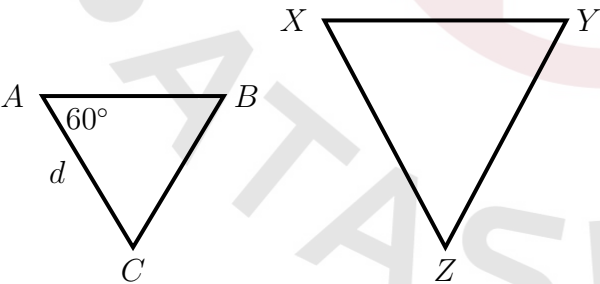
- A) 2
- C) 60
- B) 16
- D) 128

41. [November US 2024]

The area of a triangle is 270 square centimeters. The length of the base of the triangle is 12 centimeters greater than the height of the triangle. What is the height, in centimeters, of the triangle?

- A) 15
- C) 30
- B) 18
- D) 36

42. [December US 2024]

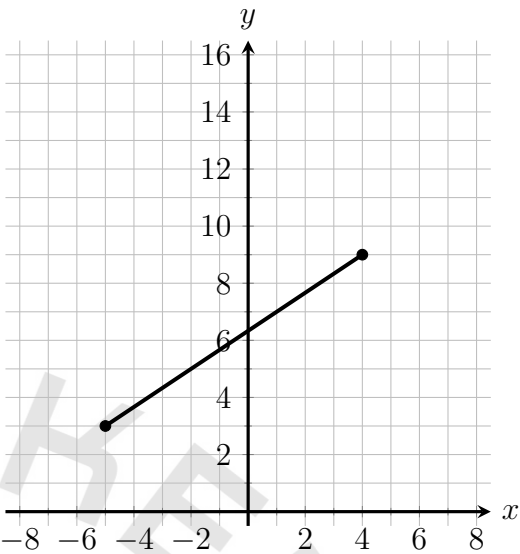


Note: Figure not drawn to scale

For the triangles shown, triangle ABC dilated by a factor of 5 to obtain triangle XYZ , where $d = 19$. What is the measure, in degrees, of angle X ?

- A) 12
- C) 60
- B) 55
- D) 65

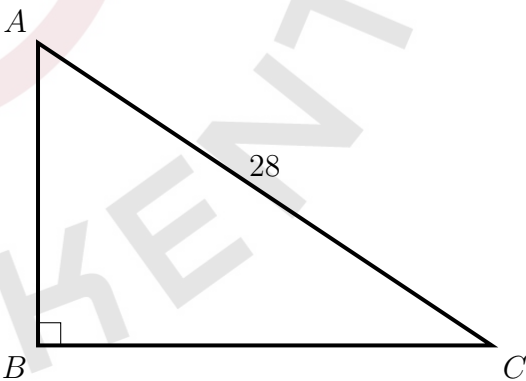
43. [November US 2024]



The line segment shown in the xy -plane represents one of the legs of a right triangle. The area of this triangle is $48\sqrt{13}$ square units. What is the length, in units, of the other leg of this triangle?

- A) 16
- C) $3\sqrt{13}$
- B) 32
- D) 24

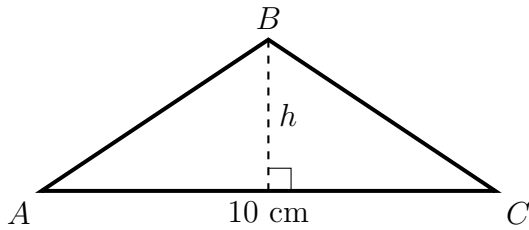
44. [December US 2024]



Note: Figure not drawn to scale

For triangle ABC , the length of $\overline{AB}$ is 11 less than the length of $\overline{AC}$. Point D (not shown) lies on $\overline{AC}$ such that BD (not shown) is perpendicular to $\overline{AC}$. What is the value of $\frac{BC}{BD}$?

45. [December US 2024]

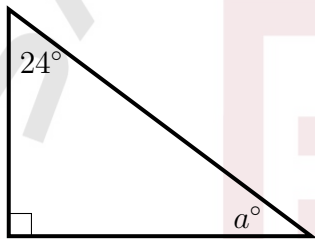


Note: Figure not drawn to scale

The area of triangle ABC is 220 square centimeters. What is the height h , in centimeters, of this triangle?

- A) 10
B) 22
C) 44
D) 88

46. [December 2024]

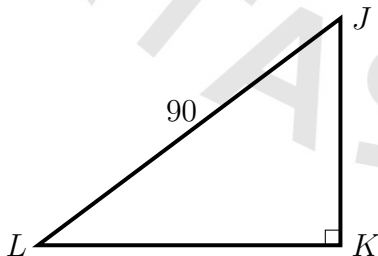


Note: Figure not drawn to scale

In the right triangle shown, what is the value of a ?

- A) 24
B) 66
C) 90

47. [December 2024]

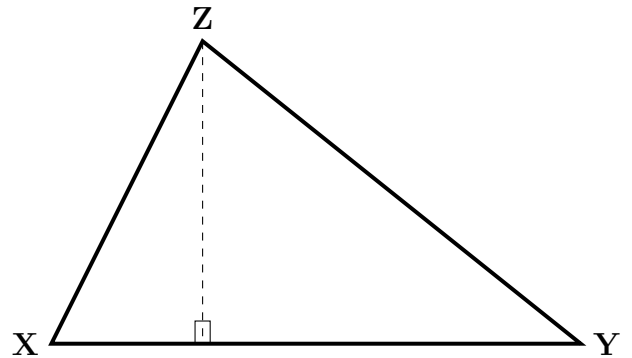


Note: Figure not drawn to scale

In right triangle JKL , the tangent of $\angle L$ is $\frac{3}{4}$. What is the length of JK ?

- A) $\frac{35}{16}$
B) $\frac{15}{4}$
C) 54
D) 72

48. [December 2024]

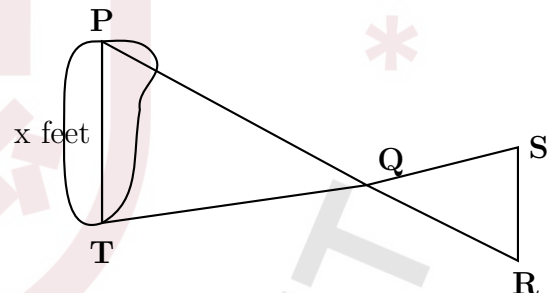


Note: Figure not drawn to scale.

In the figure shown, the measure of angle X is 52° . The length of $\overline{XY}$ is 24 units and the length of $\overline{XZ}$ is 17 units. What is the, in square units, of triangle XYZ ?

- A) 204
B) 408
C) $204\sin 52^\circ$
D) $408\sin 52^\circ$

49. [December 2024]



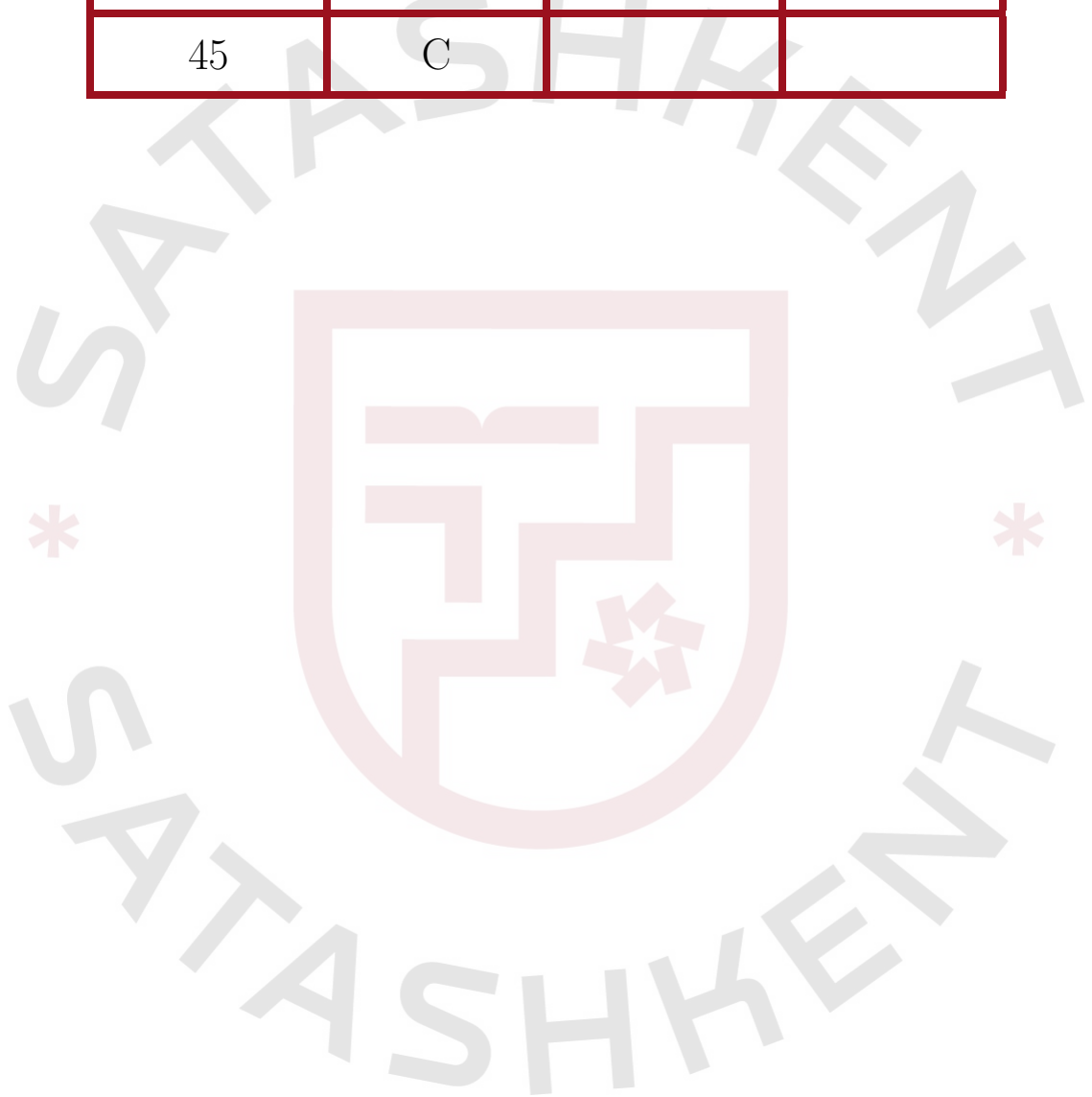
Note: Figure not drawn to scale.

A property owner wants to find the length x , in feet, across a pond as represented in the figure. PR intersects ST at point Q , and $\angle PTQ$ is congruent to $\angle RSQ$. The length represented by PQ , TQ , QS , and RS were determined to be 4,200 feet, 8,400 feet, 1,400 feet, and 1,600 feet, respectively. What is the value of x ?

Answers: Triangles

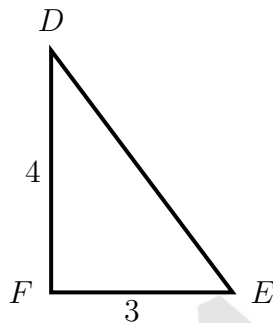
Number	Answer	Number	Answer
1	A	21	B
2	21/29	22	C
3	50	23	B
4	58	24	D
5	C	25	40
6	D	26	25
7	C	27	D
8	77	28	A
9	24	29	B
10	63	30	C
11	B	31	214/3
12	29	32	C
13	A	33	B
14	B	34	D
15	D	35	320
16	1200	36	32/21
17	158	37	B
18	B	38	B
19	C	39	D
20	C	40	D

Number	Answer	Number	Answer
41	B	46	B
42	C	47	C
43	B	48	C
44	28/17	49	9600
45	C		



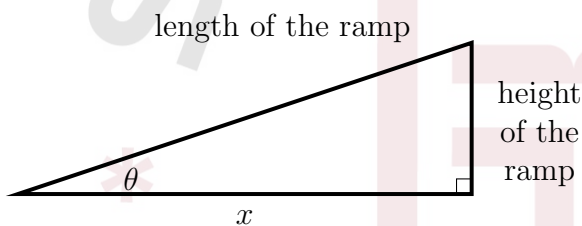
Trigonometry

1. [March US 2023]



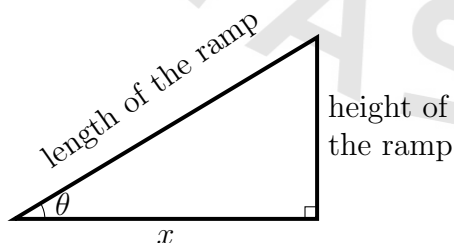
In triangle DEF , point G (not shown) lies on $\overline{DE}$. If the measure of $\angle DFG$ is x° , and the measure of $\angle GFE$ is y° , what is the value of $\cos x^\circ - \sin y^\circ$?

2. [November 2023]



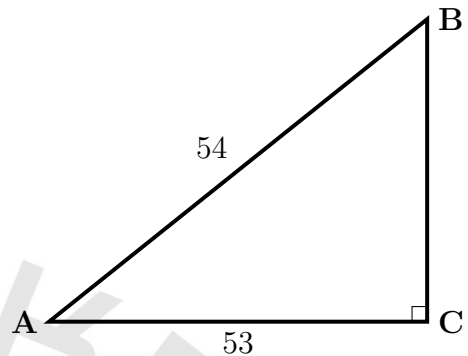
According to a US law ramps for use by the general public must form an angle with level ground such that $\tan \theta < \frac{1}{12}$. If the ramp in the figure conforms to this law and has a height of 22.3 inches, what is the least possible value of x , in inches?

3. [March 2024]



According to a US law, ramps for use by the general public must form an angle with ground such that $\tan \theta \leq \frac{1}{12}$. If the ramp in the figure above conforms to this law and height of the ramp is 28.2 inches, what is the least possible value of x in inches?

4. [March 2024]

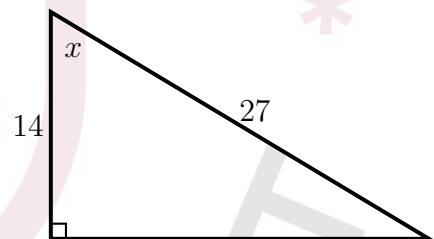


Note: Figure not drawn to a scale. What is the value of $\cos A$ in the triangle shown?

- A) $\frac{1}{53}$
B) $\frac{1}{54}$

- C) $\frac{53}{54}$
D) $\frac{54}{53}$

5. [May 2024]



Note: Figure not drawn to scale

In the triangle shown. What is the value of $\cos x$?

6. [May US 2024]

In $\triangle ABC$, $\angle B$ is a right angle and the length of $\overline{BC}$ is 204 millimeters. If

$$\cos A = \frac{3}{5},$$

what is the length, in millimeters, of $\overline{AB}$?

- A) 255
B) 204

- C) 153
D) 51

7. [May 2024]

In triangle XYZ , angle Y is a right angle, the measure of angle Z is 39° , and the length of $\overline{YZ}$ is 22 units. If the area, in square units, of triangle XYZ can be represented by the expression $k \tan 39^\circ$, where k is a constant, what is the value of k ?

8. [May 2024]

In right triangle RST , the sum of the measures of angle R and angle S is 90 degrees. The value of $\sin(R)$ is $\frac{3\sqrt{17}}{13}$. What is the value of $\cos(S)$?

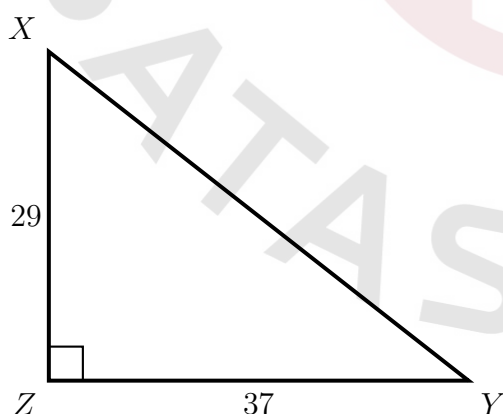
- A) $\frac{4\sqrt{17}}{51}$ C) $\frac{13\sqrt{17}}{51}$
 B) $\frac{3\sqrt{17}}{13}$ D) $\frac{3\sqrt{17}}{4}$

9. [August 2024]

The measure of angle C is $\frac{5\pi}{4}$ radians. What is the value of $\cos(C)$?

- A) $-\frac{\sqrt{2}}{2}$ C) $\frac{\sqrt{2}}{2}$
 B) $-\frac{1}{2}$ D) $\frac{\sqrt{3}}{2}$

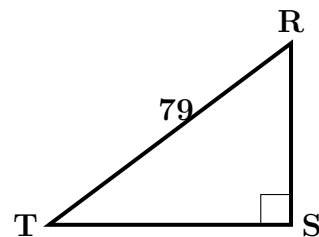
10. [August US 2024]



Triangle XYZ shown is a right triangle. Which of the following has the same value as $\sin X$?

- A) $\cos Y$ C) $\tan Y$
 B) $\cos X$ D) $\tan X$

11. [August US 2024]



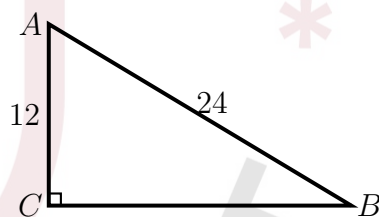
In the triangle shown $RS = \sqrt{157}$. What is the value of $\sin R$?

12. [August US 2024]

$$2 \cos (90 - a)^\circ \cdot \cos b^\circ + \sin (a + y)^\circ \cdot \sin (90 - b)^\circ$$

In the given expression, a and b are constants such that $\sin a^\circ = 0.5$, $\cos b^\circ = 0.99$, and $0 < b < 90$. What is the value of the given expression when $y = 0$?

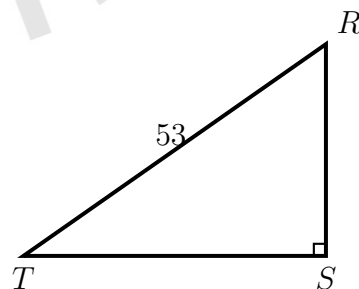
13. [October US 2024]



Note: Figure not drawn to scale

Right triangle ABC is shown. What is the value of $\sin A$?

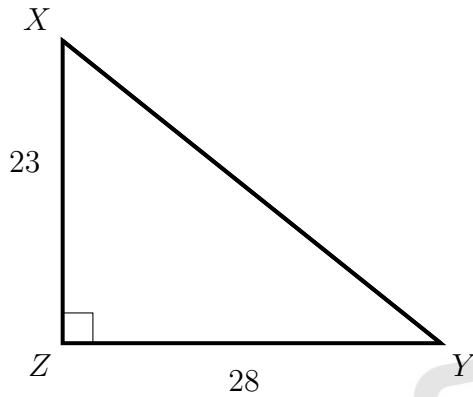
14. [October 2024]



Note: Figure not drawn to scale

In the triangle shown, $RS = \sqrt{105}$. What is the value of $\sin R$?

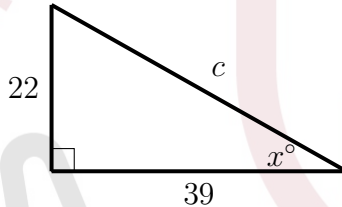
15. [October US 2024]



Triangle XYZ shown is a right triangle. Which of the following has the same value as $\sin X$?

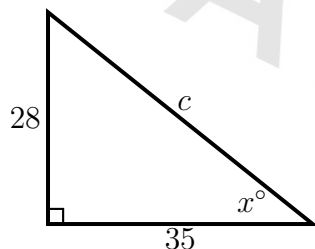
- A) $\tan X$
- B) $\tan Y$
- C) $\cos X$
- D) $\cos Y$

16. [November 2024]



In the right triangle shown, c is a constant. The value of $\sin x^\circ = \frac{k}{c}$, where k is a constant. What is the value of k ?

17. [November US 2024]



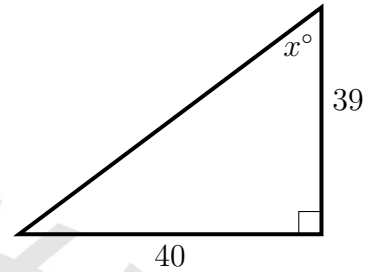
Note: Figure not drawn to scale

In the right triangle shown, c is a constant. The value of $\sin x^\circ = \frac{k}{c}$, where k is a constant. What is the value of k ?

18. [October US 2024]

In triangle JKL , $\cos(K) = \frac{36}{60}$ and angles J is a right angle. What is the value of $\cos(L)$?

19. [December US 2024]



Note: Figure not drawn to scale

In the right triangle shown, the value of $\tan x^\circ$ is $\frac{c}{39}$. What is the value of c ?

- | | |
|-------|-------|
| A) 79 | C) 39 |
| B) 40 | D) 1 |

20. [December 2024]

In the right triangle RST , the sum of the measures of angle R and S is 90 degrees. The value of $\sin(R)$ is $\frac{2\sqrt{10}}{7}$. What is the value of $\cos(S)$?

- | | |
|----------------------------|----------------------------|
| A) $\frac{3\sqrt{10}}{20}$ | C) $\frac{7\sqrt{10}}{20}$ |
| B) $\frac{2\sqrt{10}}{7}$ | D) $\frac{2\sqrt{10}}{3}$ |

Answers: Trigonometry

Number	Answer	Number	Answer
1	0	11	$78/79$
2	268	12	1.485
3	339	13	0.866
4	C	14	$52/53$
5	$14/27$	15	A
6	C	16	22
7	242	17	28
8	B	18	$4/5$
9	A	19	B
10	A	20	B

Circles

1. [March US 2023]

What is the diameter of the circle in the xy -plane with equation

$$(x - 5)^2 + (y - 4)^2 = 64.$$

2. [March US 2023]

$$x^2 - 10x + y^2 - 6y - 47 = 0$$

In the xy -plane, the graph of the given equation is a circle. If this circle is inscribed in a square, what is the perimeter of the square?

- A) 18 C) 72
B) 36 D) 188

3. [June 2023]

$$(x + 3)^2 + (y - 4)^2 = 25$$

In the xy -plane, the graph of the given equation is a circle. Which point lies on this circle?

- A) $(-3, 4)$
B) $(3, -4)$
C) $(\sqrt{11} + 3, \sqrt{14} - 4)$
D) $(\sqrt{11} - 3, \sqrt{14} + 4)$

4. [August US 2023]

Circle A has equation

$$(x - 3)^2 + (y + 1)^2 = 16.$$

In the xy -plane, circle B is obtained by translating circle A to the right 2 units. Which equation represents circle B?

- A) $(x - 5)^2 + (y + 1)^2 = 16$
B) $(x - 3)^2 + (y - 1)^2 = 16$
C) $(x - 3)^2 + (y + 3)^2 = 16$
D) $(x - 1)^2 + (y + 1)^2 = 16$

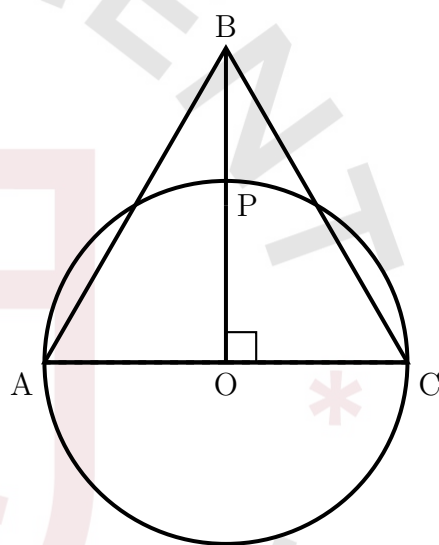
5. [August US 2023]

A circle in the xy -plane has its center at $(2, -5)$ and has a radius of 3. An equation of this circle is

$$x^2 + y^2 + ax + by + c = 0,$$

where a , b , and c are constants. What is the value of c ?

6. [August US 2023]



In the figure, $\overline{AC}$ is a diameter of the circle with center O , and $AC = 10$. Triangle $\triangle ACB$ is equilateral. The length of $\overline{BP}$ is n times the length of $\overline{AO}$. What is the value of n ?

- A) $\sqrt{5}$ C) $\sqrt{3} - 1$
B) $\sqrt{3}$ D) $\sqrt{5} - 1$

7. [November 2023]

$$x^2 - 4x + y^2 - 12y - 81 = 0$$

In the xy -plane, the graph of the given equation is a circle. If this circle is inscribed in a square, what is the perimeter of the square?

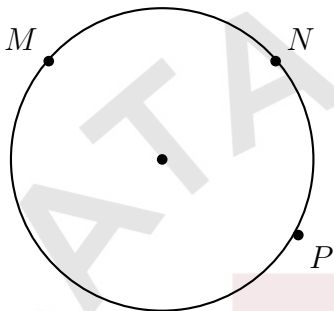
- A) 22 C) 88
B) 44 D) 324

8. [November 2023]

A circle in the xy -plane has its center at $(-3,-8)$. Line k is tangent to this circle at the point $(-5,-9)$. What is the slope of line k ?

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

9. [December 2023]



Points M , N , and P lie on the circle shown. On this circle, minor arc MN has a length of 39 centimeters and major arc MPN has a length of 195 centimeters. What is the circumference, in centimeters, of the circle shown?

- A) 39 C) 195
 B) 156 D) 234

10. [March 2024]

What is the center of the circle in the xy -plane defined by the equation $(x-9)^2 + (y+6)^2 = 81$?

- A) $(-9, -6)$ C) $(9, -6)$
 B) $(-9, 6)$ D) $(9, 6)$

11. [March 2024]

$$x^2 - 4x + y^2 - 12y - 81 = 0$$

In the xy -plane, the graph of the given equation is a circle. If this circle is inscribed in a square, what is the perimeter of the square?

- A) 22 C) 88
 B) 44 D) 324

12. [March 2024]

Circle A in the xy -plane has the equation $(x+7)^2 + (y-7)^2 = 9$. Circle B has the same center as circle A. The radius of circle B is two times the radius of circle A. The equation defining circle B in the xy -plane is $(x+7)^2 + (y-7)^2 = k$, where k is a constant. What is the value of k ?

13. [May US 2024]

What is the center of the circle in the xy -plane defined by the equation

$$(x-1)^2 + (y+7)^2 = 1?$$

- A) $(-1, -7)$ C) $(1, -7)$
 B) $(-1, 7)$ D) $(1, 7)$

14. [May 2024]

A circle has diameters $\overline{AC}$ and $\overline{BD}$. The circumference of the circle is 84π , and the length of arc DA is 2 times the length of arc AB . What is the length of arc BC ?

- A) 2π C) 21π
 B) 14π D) 28π

15. [May 2024]

Point N lies on a unit circle in the xy -plane and has coordinates $(1, 0)$. Point O is the center of the circle and has coordinates $(0, 0)$. Point M also lies on the unit circle, and the measure of angle NOM is $\frac{272\pi}{3}$ radians. If the coordinates of point M are (a, b) , where a and b are constants, what is the value of a ?

- A) $\frac{1}{2}$ C) $-\frac{1}{2}$
 B) $\frac{\sqrt{3}}{2}$ D) $-\frac{\sqrt{3}}{2}$

16. [May 2024]

A circle in the xy -plane has its center at $(-2, -4)$. Line k is tangent to this circle at the point $(-5, -5)$. What is the slope of line k ?

- A) -3 C) $\frac{1}{3}$
 B) $-\frac{1}{3}$ D) 3

17. [June 2024]

$$x^2 - 6x + y^2 - 12y - 36 = 0$$

In the xy -plane, the graph of the given equation is a circle. If this circle is inscribed in a square, what is the perimeter of the square?

- A) 18 C) 72
 B) 36 D) 144

18. [June 2024]

Point F lies on a unit circle in the xy -plane and has coordinates $(1, 0)$. Point G is the center of the circle and has coordinates $(0, 0)$. Point H also lies on the circle and has coordinates $(-1, y)$, where y is a constant. Which of the following could be the positive measure of angle FGH , in radians?

- A) $\frac{27\pi}{2}$ C) 24π
 B) $\frac{29\pi}{2}$ D) 25π

19. [June 2024]

Point F lies on a unit circle in the xy -plane and has coordinates $(1, 0)$. Point G is the center of the circle and has coordinates $(0, 0)$. Point H also lies on the circle and has coordinates $(-1, y)$, where y is a constant. Which of the following could be the positive measure of angle FGH , in radians?

- A) $\frac{27\pi}{2}$ C) 22π
 B) $\frac{27\pi}{2}$ D) 23π

20. [August US 2024]

$$(x - 3)^2 + (y + 7)^2 = 25$$

The given equation represents circle P in the xy -plane. Circle Q has a center that is 1 unit to the right of the and 2 units below the center of the circle P . Circle Q has a diameter that is double the diameter of circle P . Which equation represents circle Q ?

- A) $(x - 2)^2 + (y + 5)^2 = 50$
 A) $(x - 4)^2 + (y + 9)^2 = 50$
 A) $(x - 2)^2 + (y + 5)^2 = 100$
 A) $(x - 4)^2 + (y + 9)^2 = 100$

21. [August US 2024]

Circle A has a radius of $2x$ and the circle B has a radius of $94x$. The area of circle B is how many times the area of circle A ?

22. [August US 2024]

A circle in the xy -plane has a diameter with endpoints $(a, 11)$ and (a, d) , where a and d are constants. An equation of this circle is $(x - a)^2 + (y - 17)^2 = r^2$, where r is a positive constant. What is the value of d ?

- A) 5 C) 17
 B) 12 D) 23

23. [October US 2024]

Circle A has equation

$$(x - 7)^2 + (y + 3)^2 = 1.$$

In the xy -plane, circle B is obtained by translating circle A to the right 4 units. Which equation represents circle B ?

- A) $(x - 7)^2 + (y + 7)^2 = 1$
 B) $(x - 3)^2 + (y + 3)^2 = 1$
 C) $(x - 11)^2 + (y + 3)^2 = 1$
 D) $(x - 7)^2 + (y - 1)^2 = 1$

24. [October US 2024]

$$(x + 3)^2 + (y - 18)^2 = 169$$

The graph of the given equation is a circle in the xy -plane. The point (a, b) lies on the circle. Which of the following is a possible value for a ?

- A) -17 C) 13
B) -12 D) 18

25. [October 2024]

A circle in the xy -plane has its center at $(16, 17)$ and has a radius of $7k$. Which equation represents this circle?

- A) $(x - 16)^2 + (y - 17)^2 = 49k$
B) $(x - 16)^2 + (y - 17)^2 = 49k^2$
C) $(x - 16)^2 + (y - 17)^2 = 7k$
D) $(x - 16)^2 + (y - 17)^2 = 7k^2$

26. [October 2024]

Parallelogram $ABCD$ is similar to parallelogram $PQRS$. The length of each side of parallelogram $PQRS$ is 2 times the length of its corresponding side of parallelogram $ABCD$. The area of parallelogram $ABCD$ is 5 square centimeters. What is the area, in square centimeters, of parallelogram $PQRS$?

- A) 7 C) 20
B) 10 D) 25

27. [November 2024]

A circle has center O , and a points A and B lie on the circle. The measure of arc AB is 20° , and the length of this arc is 4 inches. What is the circumference, in inches, of the circle?

- A) 4 C) 16
B) 8 D) 72

28. [November US 2024]

What is the radius of the circle in the xy -plane defined by $(x + 4)^2 + (y + 8)^2 = 169$?

29. [October US 2024]

Circle A in the xy -plane has the equation $(x + 2)^2 + (y - 2)^2 = 9$. Circle B has the same center as the circle A. The radius of circle B is two times the radius of a circle A. The equation defining circle B in the xy -plane is $(x + 2)^2 + (y - 2)^2 = k$, where k is a constant. What is the value of k ?

30. [November US 2024]

A circle in the xy -plane has its center at $(3, 7)$. Line t is tangent to this circle at the point $(a, -4)$, where a is a constant. The slope of line t is $\frac{5}{4}$. What is the value of a ?

- A) $-\frac{43}{4}$ C) $\frac{59}{5}$
B) $-\frac{29}{5}$ D) $\frac{67}{4}$

31. [December US 2024]

In the xy -plane, the graph of the equation $(x - 6)^2 + (y - 2)^2 = 36$ is a circle. The point $(12, c)$, where c is constant, lies on the circle. What is the value of the c ?

32. [December US 2024]

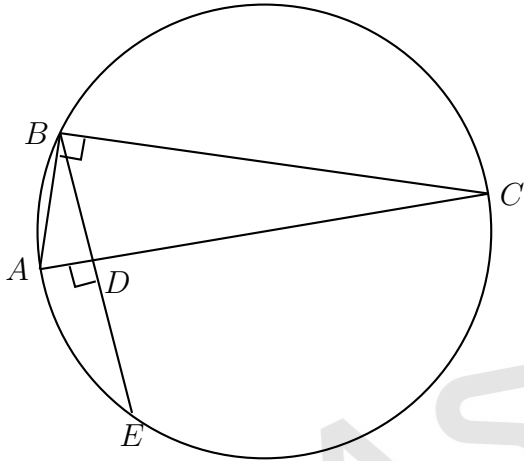
$$c(r) = \frac{2}{5}(2\pi r)$$

The function c gives the partial length, in centimeters (cm), of the circumference of a circle with a radius that measures r cm. According to the function, for each increase 18 cm in the length of radius, this partial length of circumference increases by $k\pi$ cm. What is the value of k ?

33. [December 2024]

A circle has a circumference of 42π centimeters. What is the diameter, in centimeters, of the circle?

34. [December 2024]



Note: Figure not drawn to scale

In the figure shown, points A, B, C , and E lie on the circle, and $AB < BC$. Segment AC is perpendicular to segment BE at point D , and $BD = \sqrt{346}$. The diameter of the circle is 175. If $\frac{CD}{AD} = r$, what is the value of r ?

35. [December 2024]

The circle K has a radius of 2 millimeters (mm). Circle L has an area of $144\pi \text{ mm}^2$. What is the total area, in mm^2 , of circle K and L ?

- A) 14π
- B) 28π
- C) 56π
- D) 148π

36. [December 2024]

In the xy -plane, an equation of circle A is $(x - 2)^2 + (y - 3)^2 = 9$. Circle B has the same center as circle A but has a radius that is twice the radius of circle A. Which equation represents circle B?

- A) $(x - 2)^2 + (y - 3)^2 = 18$
- B) $(x - 2)^2 + (y - 3)^2 = 36$
- C) $(x - 2)^2 + (y - 3)^2 = 54$
- D) $(x - 2)^2 + (y - 3)^2 = 81$

Answers: Circles

Number	Answer	Number	Answer
1	16	19	D
2	C	20	C
3	D	21	2209
4	A	22	D
5	20	23	C
6	B	24	B
7	C	25	B
8	A	26	C
9	D	27	D
10	C	28	13
11	C	29	36
12	36	30	D
13	C	31	2
14	D	32	14.4
15	C	33	42
16	A	34	$173/2$
17	C	35	D
18	D	36	B

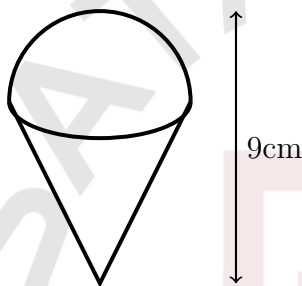
Areas&Volumes

1. [March US 2023]

A right circular cylinder has a height of 6 inches. The radius of the base of the cylinder is 5 inches. What is the volume, in cubic inches, of the cylinder?

- A) 10π C) 50π
B) 30π D) 150π

2. [March US 2023]



A hemisphere and a cone have circular bases of equal circumference and have been connected at their bases, as shown in the figure. The diameter of the base of the hemisphere is 6 centimeters(cm) and the total height of the figure is 9 cm. What is the total volume, in cm^3 , of the cone and hemisphere

- A) 18π C) 45π
B) 36π D) 162π

3. [June 2023]

The area of a triangle is equal to x^2 square centimeters. The length of the base of the triangle is $2x+6$ centimeters, and the height of the triangle is $x-2$ centimeters. What is the values of x ?

4. [June 2023]

A right circular cylinder has a height of 4 meters(m) and a base with a radius of 18m. What is the volume, in m^3 , of cylinder?

- A) 4π C) 288π
B) 22π D) 1296π

5. [June 2023]

The volume of a right rectangular prism with a square base is 2.448 cubic centimeters. If the area of the square base is 144 square centimeters, what is the area, in square centimeters, of one of the four lateral faces of the prism?

- A) 17 C) 540
B) 204 D) 816

6. [November 2023]

The volume of right rectangular prism with a square base is 1,792 cubic centimeters. If the area of the square base is 64 square centimeters, what is the area, in square centimeters, one of the four lateral faces of the prism?

- A) 28 C) 416
B) 224 D) 896

7. [December 2023]

The area of a rectangle is 630 square inches. The length of the rectangle is 90 inches. What is the width, in inches, of this rectangle?

- A) 7 C) 315
B) 90 D) 540

8. [March 2024]

A hemisphere is half of a sphere. If a hemisphere has a radius of 50 inches, which of the following is closest to the volume, in cubic inches, of this hemisphere?

- A) 5,200 C) 196,300
B) 20,900 D) 261,800

9. [December 2023]

The table gives the areas and perimeters of two similar rectangles, where n is a constant.

	Area (square inches)	Perimeter (inches)
Rectangle A	2,450	490
Rectangle B	9,800	n

What is the value of n ?

- A) 980
B) 1,960
C) 3,920
D) 4,900

10. [March 2024]

To study fluctuations in leaf water potential, samples of wood were taken from 25 trees and cut in the shape of a cube. The length of the edge of one of these cubes is 2.00 centimeters. If this cube has a mass of 2.72 grams, what is the density of this cube, in grams per cubic centimeter?

11. [March 2024]

The length of the diagonal of a square is $\frac{148\sqrt{2}}{2}$ units. What is the area, in square units, of the square?

- A) 74
B) 296
C) 5,476
D) 10,952

12. [March 2024]

The floor of a school has an area of 2,025 square meters. An architect creates a scale model of the floor of the school, where the length of each side of the model is $\frac{1}{15}$ times the length of the corresponding side of the actual floor of the school. What is the area, in square meters, of the scale model?

- A) 9
B) 15
C) 135
D) 225

13. [March 2024]

	Volume (cubic units)
Right circular cylinder A	112π
Right circular cylinder B	$3,024\pi$

The table shows the volume of two similar solids, right circular cylinder A and right circular cylinder B. The radius of right circular cylinder A is 4 units. The surface area of right circular cylinder A is $k\pi$ square units, and the surface area of right circular cylinder B is $n\pi$ square units, where k and n are constants. What is the value of $n - k$? (The surface area of a right circular cylinder with radius r and height h is $2\pi r^2 + 2\pi rh$.)

14. [March 2024]

$$\frac{4}{7}(4x + 7)(x + \sqrt{4k + 7})(x - \sqrt{4k + 7}) = 0$$

In the given equation, k is a positive constant. The product of the solutions to the equation is 77. What is the value of k ?

15. [March 2024]

Each side of square A has a length of 11 inches. Each side of square A is multiplied by a scale factor of 3 to create square B . What is the length, in inches, of each side of square B ?

- A) 8
B) 11
C) 14
D) 33

16. [March 2024]

The width of a rectangle is 7 centimeters. The length of the rectangle is 40 centimeters longer than the width. What is the area, in square centimeters, of this rectangle?

- A) 7
B) 14
C) 54
D) 329

17. [March 2024]

A polygon has 16 sides has a perimeter of 126. The length of one side is 6 inches. The other 15 sides have equal lengths. What is the length, in inches, of one of the 15 sides with equal lengths?

18. [March 2024]

The length of the diagonal of a square is $\frac{158\sqrt{2}}{2}$ units. What is the area, in square units, of the square?

- A) 79 C) 6241
B) 316 D) 12482

19. [March 2024]

The floor of a school has an area of 4400 square meters. An architect creates a scale model of the floor of the school, where the length of each side of the model is $\frac{1}{20}$ times the length of the corresponding sides of the actual floor of the school. What is the area, in square meters, of the scale model?

- A) 11 C) 220
B) 20 D) 275

20. [May US 2024]

A hemisphere is half of a sphere. If a hemisphere has a radius of 20 inches, which of the following is closest to the volume, in cubic inches, of this hemisphere?

- A) 800 C) 12,600
B) 3,400 D) 16,800

21. [May 2024]

A sphere has a radius of $\frac{13}{5}$ feet. What is the volume, in cubic feet, of the sphere?

- A) $\frac{8,788\pi}{375}$ C) $\frac{52\pi}{15}$
B) $\frac{28\pi}{5}$ D) $\frac{5\pi}{13}$

22. [May 2024]

A cube has an edge length of 82 inches. A solid sphere with a radius of 41 inches is inside the cube, such that the sphere touches the center of each face of the cube. To the nearest cubic inch, what is the volume of the space in the cube not taken up by the sphere?

- A) 262,672 C) 334,846
B) 288,532 D) 546,087

23. [May 2024]

Rectangles $ABCD$ and $EFGH$ are similar. The length of each side of $EFGH$ is 6 times the length of the corresponding side of $ABCD$. The area of $ABCD$ is 96 square units. What is the area, in square units, of $EFGH$?

- A) 16 C) 576
B) 36 D) 3,456

24. [May US 2024]

The study fluctuations in leaf water potential, samples of wood were taken from 24 trees and cut in the shape of a cube. The length of the edge of one of those cubes is 2.00 centimeters. If this cube has a mass of 3.04 grams, what is the density of this cube, in grams per cubic centimeter?

25. [May 2024]

A circle is inscribed in a square such that the circumference of the circle touches the midpoint of each side of the square. The length of the diagonal of the square is 176 units. What is the area, in square units, of the circle?

- A) $3,872\pi$ C) $15,488\pi$
B) $7,744\pi$ D) $30,976\pi$

26. [May 2024]

Rectangle $ABCD$ is similar to rectangle $EFGH$. The area of rectangle $ABCD$ is 648 square inches, and the area of rectangle $EFGH$ is 72 square inches. The length of the longest side of rectangle $ABCD$ is 36 inches. What is the length, in inches, of the longest side of rectangle $EFGH$?

- A) 4
- B) 9
- C) 12
- D) 36

27. [June 2024]

A chemist combines water and isopropanol to make a mixture with a volume of **52 milliliters(mL)**. The volume of isopropanol in the mixture is **10mL**. What is the volume of water, in **mL**, in the mixture?(Assume that the volume of the mixture is the sum of the volumes of water and isopropanol before they were mixed.)

28. [June 2024]

A rectangular banner has an area of 2,500 square inches. A copy of the banner is made in which the length and width of the original banner are each increased by 40%. What is the area of the copy, in. square inches?

- A) 2,540
- B) 2,580
- C) 3,500
- D) 4,900

29. [June 2024]

A chemist combines water and isopropanol to make a mixture with a volume of **45 milliliters (mL)**. The volume of isopropanol in the mixture is **10 mL**. What is the volume of water, in **mL**, in the mixture? (Assume that the volume of the mixture is the sum of the volumes of water and isopropanol before they were mixed.)

30. [June 2024]

A cube has a volume of 79,507 cubic units. What is the surface area, in square units, of the cube?

31. [June 2024]

A cylinder has a diameter of 14 inches and a height of 8 inches. What is the volume, in cubic inches, of the cylinder?

- A) 49π
- B) 112π
- C) 392π
- D) $1,568\pi$

32. [August 2024]

A right rectangular prism has a length of 26 centimeters(cm), a width of 16cm, and a height of 14cm. What is the surface area, in cm^2 , of the right rectangular prism?

33. [August 2024]

Rectangle $ABCD$ and $EFGH$ are similar. The length of each side of $EFGH$ is 10 times the length of the corresponding side of $ABCD$. The area of $ABCD$ is 100 square units. What is the area, in square units, of $EFGH$?

- A) 10
- B) 100
- C) 1,000
- D) 10,000

34. [August 2024]

A right circular cylinder has a radius of 12 centimeters and a volume of $2,448\pi$ cubic centimeters. What is the height, in centimeters, of the cylinder?

35. [August US 2024]

Square P has a side length of x inches. Square Q has a perimeter that is 32 inches greater than the perimeter of square P . The function f gives the area of square Q , in square inches. Which of the following defines f ?

- A) $f(x) = (x + 8)^2$
- B) $f(x) = (x + 32)^2$
- C) $f(x) = (32x + 8)^2$
- D) $f(x) = (32x + 32)^2$

36. [August 2024]

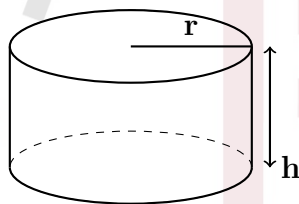
The floor of a library has an area of 9375 square feet. An architect creates a scale model of the floor of the library, where the length of each side of the model is $\frac{1}{25}$ times the length of the corresponding side of the floor of the actual library. What is the area, in square feet, of the scale model?

37. [August 2024]

A right square pyramid has a total surface area of 36,864 square inches, and the combined surface area of the four lateral faces of this pyramid is 20,480 square inches. What is the height, in inches, of this pyramid?

- A) 48 C) 80
B) 64 D) 128

38. [August US 2024]



The figure shown is a right circular cylinder with a radius r and a height of h . A second right circular cylinder (not shown) has a volume that is 576 times as large as the volume of the cylinder shown. Which of the following could represent the radius R , in terms of r , and the height H , in terms of h , of the second cylinder?

- A) $R = 9r$ and $H = 8h$
B) $R = 9r$ and $H = 64h$
C) $R = 8r$ and $H = 9h$
D) $R = 64r$ and $H = 9h$

39. [August US 2024]

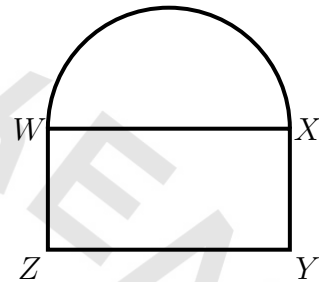
A right circular cone has a volume of $2,700\pi$ cubic centimeters and the area of its base is 225π square centimeters. What is the slant height, in centimeters, of this cone?

- A) 12 C) 36
B) 15 D) 39

40. [August US 2024]

The length of each side of a box is 94 centimeter. Each side of the box is in the shape of a square. The box does not have a lid. What is the exterior surface area, in square meters, of this box without a lid? (1 meter = 100 centimeters)

41. [October US 2024]



Note: Figure not drawn to scale

The figure shown consists of a rectangle and a semicircle, where the length of $\overline{WX}$ is 20 units and the length of $\overline{WZ}$ is 5 units. The diameter of the semicircle is $\overline{WX}$. Which of the following expressions represents the area, in square units, of the figure?

- A) $20 + 5 + 10\pi$ C) $20 \times 5 + 50\pi$
B) $20 \times 5 + 10\pi r$ D) $20 \times 5 + 100\pi$

42. [October US 2024]

To study fluctuations in leaf water potential, samples of wood were taken from 27 trees and cut in the shape of a cube. The length of the edge of one of these cubes is 3.000 centimeters. This cube has a density of 0.170 grams per cubic centimeter. What is the mass of this cube, in grams?

43. [October US 2024]

The volume of a right rectangular prism with a square base is 539 cubic centimeters. If the area of each of the four lateral faces is 77 square centimeters, what is the height, in centimeters, of the prism?

- A) 77 C) 11
B) 49 D) 7

44. [October 2024]

To study fluctuations in leaf water potential, samples of wood were taken from 22 trees and cut in the shape of a cube. The length of the edge of one of these cubes is 3.000 centimeters. This cube has a density of 0.250 grams per cubic centimeter. What is the mass of this cube, in grams?

45. [October 2024]

A right triangular pyramid has exactly six edges. Each of these edges is 96 centimeters long. If the surface area of the pyramid is $k\sqrt{3}$ square centimeters, what is the value of k ?

46. [October US 2024]

The length of square M is 9 times bigger than one side of square N . The area of the square N is 25 square centimeters. What is the area, in square centimeters, of square M ?

- A) 2025 C) 405
B) 810 D) 225

47. [October US 2024]

The height of a right-angled cylinder is 6 inches longer than its radius, and the surface area of the cylinder is 1080π square inches. What is the cylinder's radius, in inches?

- A) 15 C) 21
B) 18 D) 24

48. [October US 2024]

To study fluctuations in the leaf water potential, samples of wood were taken from 26 trees and cut in the shape of a cube. The length of the edge of one of these cubes is 2.00 centimeters. If this cube has a mass of 5.12 grams, what is the density of this cube in grams per cubic centimeter?

49. [October US 2024]

A right triangular prism has a base of $28p$ square centimeters (cm^2). The length of the rectangular prism is 12 cm, and the height of the rectangular prism is 4 cm. Which expression represents the surface area, in cm^2 , of the right rectangular prism?

- A) $\frac{512p}{3}$
A) $\frac{224p}{3} + 96$
A) $56p + 192$
A) $560p + 96$

50. [October US 2024]

Rectangle $ABCD$ and $EFGH$ are similar. The length of each side of $EFGH$ is 6 times the length of the corresponding side of $ABCD$. The area of $ABCD$ is 102 square units. What is the area, in square units, of $EFGH$?

- A) 17 C) 612
B) 36 D) 3672

51. [October US 2024]

A hemisphere is half of a sphere. If a hemisphere has a radius of 70 inches, which of the following is closest to the volume of this hemisphere?

- A) 10300 C) 538800
B) 41100 D) 718400

52. [November 2024]

A right square pyramid has a height of 11 centimeters (cm). A second right square pyramid has a height of 22 centimeters. The area of the base of each of the two pyramids is 100 cm^2 . Which of the following is closest to the difference in the surface area of the second pyramid and the surface area of the first pyramid, in cm^2 ?

- A) 209 D) 367
B) 220 C) 551

53. [December US 2024]

The circumference of the base of a right circular cylinder is 6π meters, and the height of the cylinder is 19 meters. What is the volume, in cubic meters, of the cylinder?

- A) 57π C) 171π
B) 114π D) 684π

54. [December 2024]

A right circular cone has a height of 13 centimeters (cm) and a base with a radius of 6 cm. What is the volume, in cm^3 , of this cone?

- A) 26π C) 156π
B) 78π D) 468π

55. [December 2024]

A sphere has a radius of $\frac{8}{3}$ feet. What is the volume, in cubic feet, of the sphere?

- A) $\frac{3\pi}{8}$ C) $\frac{17\pi}{3}$
B) $\frac{32\pi}{9}$ D) $\frac{2018\pi}{81}$

Answers: Areas&Volumes

Number	Answer	Number	Answer
1	D	21	A
2	B	22	C
3	6	23	D
4	D	24	0.38
5	B	25	A
6	B	26	C
7	A	27	42
8	B	28	D
9	C	29	35
10	0.34	30	11,094
11	B	31	C
12	A	32	2008
13	704	33	D
14	$37/4$	34	17
15	D	35	A
16	D	36	15
17	8	37	A
18	C	38	C
19	A	39	D
20	D	40	4.418

Number	Answer	Number	Answer
41	C	49	C
42	4.59	50	D
43	C	51	D
44	6.75	52	A
45	9216	53	C
46	A	54	C
47	A	55	D
48	0.64		

Acknowledgements

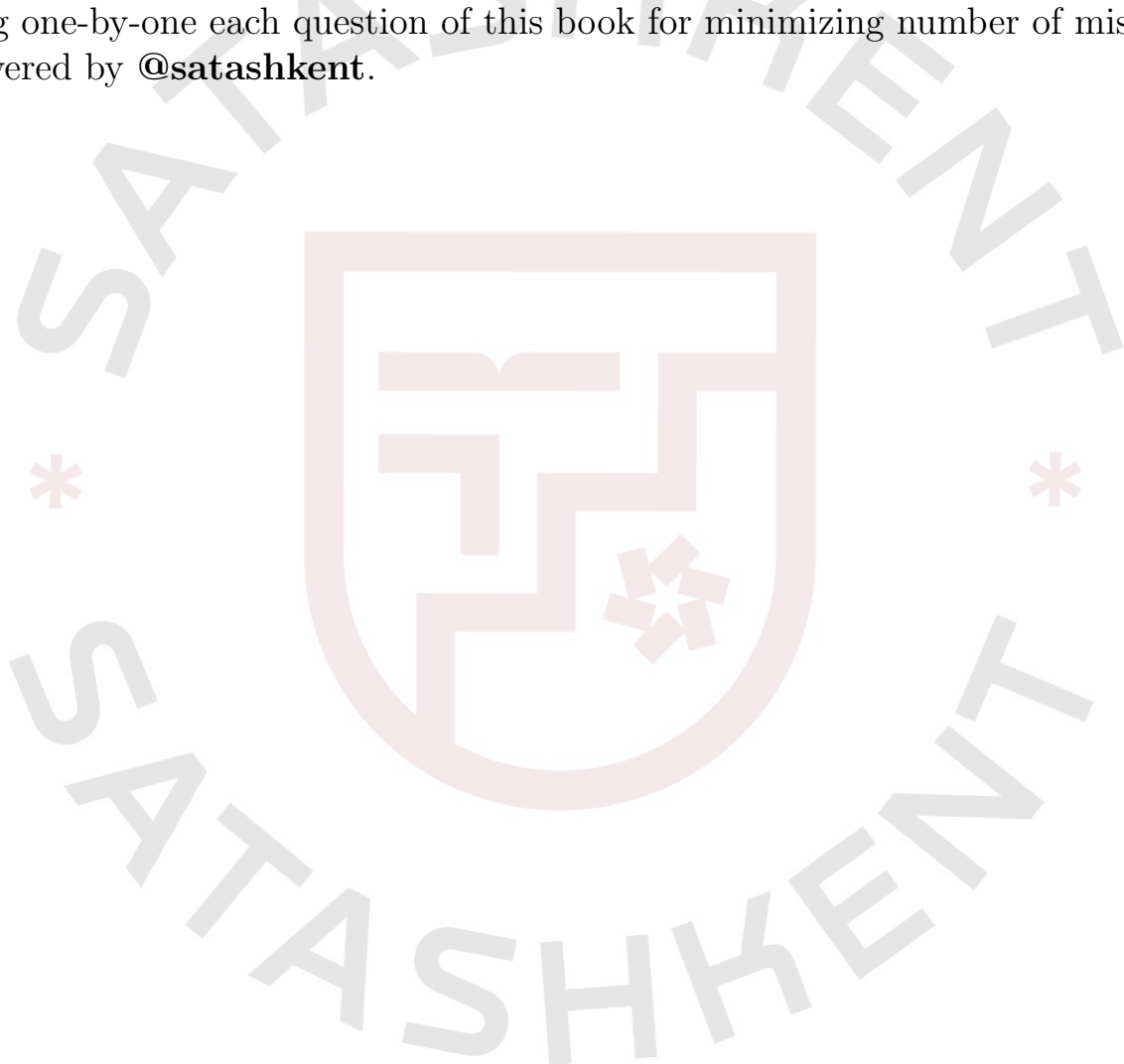
We've reached the end of "MathBook by @satashkent". Before we close, let's applaud the brilliant team who brought this project to life.

Directed by Ollonazar Mukhitdinov – The mastermind behind the project, ensuring seamless coordination and execution.

Content Entry by Oyatillo Boqijonov, Bahriddin Kamoliddinov, Raxmonjon Muxammadjonov & Sardor Nu'monov – Responsible for the biggest part of the project, carefully compiling and structuring the content.

Answer Sheet Contributors: Shoxrux Abduganiev, Muhammadrasul Batirov, Firdavs Ismailov, Jahongir Luqmonov & Shavkat Sadulloyev – Solving one-by-one each question of this book for minimizing number of mistakes.

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Recognizing this challenge, our team created *MathBook*—a structured collection of *real exam questions from the past years, categorized by topic*. This book is designed for *all SAT learners* who want an efficient and organized approach to mastering Digital SAT Math. We have dedicated countless hours to compiling and structuring these questions to ensure you get the most relevant and targeted practice.

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