



TENNESSEE MATHEMATICS TEACHER' ASSOCIATION

## SIXTY-FOURTH ANNUAL MATHEMATICS CONTEST

2022

### Algebra I/Integrated I

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Scoring formula:  $4 \times (\text{Number Right}) - (\text{Number Wrong}) + 40$

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Directions:

Do not open this booklet until you are told to do so

This is a test of your competence in high school mathematics. For each problem, determine the best answer and indicate your choice by making a heavy black mark in the proper place on the separate answer sheet provided. You must use a pencil with a soft lead (No. 2 lead or softer).

This test has been constructed so that most of you are not expected to answer all the questions. Do your best on the questions you feel you know how to work. You will be penalized for incorrect answers, so wild guesses are not advisable.

If you change your mind about an answer, be sure to erase completely. Do not mark more than one answer for any problem. Make no stray marks of any kind on the answer sheet. The answer sheets will not be returned to you; if you wish a record of your performance, mark your answers in this booklet also. You will keep the booklet after the test is completed.

When told to do so, open your test booklet and begin. You will have exactly eighty minutes to work.

2022 TMTA Algebra 1/Integrated I

1. Given that  $|2 - b| + |b - 2| = 10$ , solve for  $b$ . The product of the two solutions is:
  - a. -32
  - b. -21
  - c. 3
  - d. 4
  - e. 10
  
2. If  $8x^3 + 27y^3$  factors to  $(Ax + By)(A^2x^2 - ABxy + B^2y^2)$ , then  $A - B =$ 
  - a. 0
  - b. 1
  - c. -15
  - d. 5
  - e. -1
  
3.  $h = vt - 5t^2$  is the formula for finding the height ( $h$ ) of an object launched upward, given an initial velocity ( $v$ ) and at any certain time ( $t$ ). Use this formula to find the time,  $t$ , when an object shot upward with an initial velocity of 50 m/s will be 110 m above the earth.
  - a. 4 or 6 seconds
  - b.  $5 \pm \sqrt{3}$  seconds
  - c. 6.4 seconds
  - d.  $11 \pm \sqrt{21}$  seconds
  - e. 0 and 10 seconds
  
4. Solve for  $n$ :  $5\sqrt{3n - 2} = 4\sqrt{4n + 1}$ 
  - a. 4.5
  - b. -14
  - c. 9
  - d. -6
  - e. 6

5. Find the sum of the solutions to the equation  $4x^2 - 6x + 9 = 0$ .
- a.  $\frac{9}{4}$
  - b. 11
  - c.  $\frac{-6}{4}$
  - d.  $\frac{3}{2}$
  - e. -108
6. A line has a slope of  $-\frac{3}{4}$  and passes through (4, 3). What is the equation for the line?
- a.  $y = -\frac{3}{4}x$
  - b.  $3x + 4y = 25$
  - c.  $3x + 4y = 6$
  - d.  $3x + 4y - 24 = 0$
  - e.  $4x + 3y = 24$
7. If  $\frac{4x^2 - 5x - 30}{x - 3} = 4x + A + \frac{R}{x - 3}$  when completed by long division, what term would you have in position A?
- a. -17
  - b. 17
  - c.  $-7x$
  - d. 7
  - e.  $8x$

8. Graph  $y = 2x - 3$ . Now graph each of the following equations over it. Which equation intersects  $y = 2x - 3$  at  $(4, 5)$ ?

- a.  $x - 4y + 16 = 0$
- b.  $x - y = -1$
- c.  $2y = x + 6$
- d. All of these
- e. None of these

9. A straight line passes through the points  $(5, -2)$  and  $(3, 0)$ . The slope is:

- a.  $(4, -1)$
- b.  $\sqrt{8}$
- c.  $-1$
- d.  $2$
- e.  $1$

10. Given  $y = 2x^2 - 2$ . In order to graph this equation, a data table is prepared. The incomplete table is:

$x$	$y$
0	A
1	0
-1	0
2	B
-3	C

Find the values of A, B, and C which satisfy the equation. When A, B, and C are added, the result is:

- a. 20
- b. 40
- c. -16
- d. 50
- e. 16

11. Simplify and write without negative exponents:  $\left(\frac{x^3}{y^9}\right)^{-\frac{4}{3}}$

a.  $x^{12}y^{36}$

b.  $\frac{y^{12}}{x^4}$

c.  $\frac{1}{x^4y^{12}}$

d.  $\frac{-x^4}{y^{12}}$

e.  $\frac{1}{x^{12}y^{36}}$

12. If  $2x^3 - 9x - 7$  subtracted from  $8x^3 - 2x^2 + 5x - 6$  is equal to  $Ax^3 + Bx^2 + Cx + D$ , then  $A + B + C + D =$

a. 23

b. -19

c. 1

d. -9

e. 19

13.  $\frac{x^{2C}-36}{x^{2C}+10x^C+24} =$

a.  $\frac{-3}{10x^C+12}$

b.  $\frac{x^C-6}{x^C+4}$

c.  $\frac{x^C-18}{x^C+5x+12}$

d.  $\frac{x^C-9}{x^C+6}$

e.  $\frac{x^C+6}{x^C+4}$

14. Solve for  $a$ :  $\sqrt[4]{\frac{a+3}{2a-1}} = \sqrt[4]{\frac{2}{3}}$ . If 5 is subtracted from the solution, the result is:

- a. 7
- b. 1
- c.  $\frac{-37}{7}$
- d. 6
- e. -6

15. For what values of  $k$  will  $x^2 + (k + 2)x + 4 = 0$  have only one solution? The sum of the 2 values for  $k$  is:

- a. 0
- b. -4
- c. -7
- d.  $3\frac{2}{3}$
- e. 4

16. A line passing through points  $(2, -2)$  and  $(-2, n)$  has a slope of  $\frac{3}{4}$ . What is  $n$ ?

- a. -5
- b.  $3\frac{1}{3}$
- c. 1
- d. 5
- e. -1

17. Use the "Addition method" to solve this system:  $4x - 3y = 15$   
 $3x - 4y = 13$

Add the coordinates. If  $x + y = k$ , then  $k =$

- a. 0  
b. -2  
c. 2  
d. 4  
e. 9
18.  $\frac{(4.2 \times 10^{12})(2.4 \times 10^{-20})}{1.2 \times 10^{-4}} = A \times 10^C$  Find  $A + C$ .
- a. 10.4  
b. -3.6  
c. 4.4  
d. 12.4  
e. -12.4
19. Find 3 consecutive positive even integers such that twice the product of the first and second integers is equal to the product of the second and third integers. The sum of the 3 consecutive positive even integers is:
- a. 2  
b. 18  
c. 0  
d. 22  
e. 20
20. The expression  $\sqrt[3]{x^5}$  is the same as
- a.  $\left(x^{\frac{2}{3}}\right)^5$   
b.  $x^{15}$   
c.  $x^{\frac{3}{5}}$   
d.  $x^{\frac{5}{3}}$   
e.  $x^{\frac{15}{2}}$

21. A plane flew 100 miles in 30 minutes with a tailwind and returned against the same wind in 50 minutes. How fast is the wind blowing?
- a.  $\frac{2}{3}$  mi/min
  - b.  $2\frac{2}{3}$  mi/min
  - c.  $1\frac{1}{3}$  mi/min
  - d.  $5\frac{1}{3}$  mi/min
  - e.  $\frac{3}{4}$  mi/min
22. The length of a rectangle is 4 more than 3 times the width. The area of the rectangle is equal to 20 more than twice the perimeter. What is the area of the rectangle?
- a. 144 square units
  - b. 56 square units
  - c. 64 square units
  - d. 132 square units
  - e. 100 square units
23. Hunk and the Bruisers can move a pile of bricks in 50 minutes. Wimp and the Skinnies would take 1 hour and 40 minutes to move the same pile. If Wimp and the Skinnies work for 20 minutes and are then joined by Hunk and the Bruisers, what total time is needed to move the pile of bricks?
- a.  $26\frac{2}{3}$  minutes
  - b.  $46\frac{2}{3}$  minutes
  - c. 55 minutes
  - d.  $13\frac{2}{3}$  minutes
  - e.  $31\frac{2}{3}$  minutes



24. If the equation  $x^2 + Bx + C = 0$  has  $1 \pm \sqrt{7}$  as its solution, what is the value of  $C$ ?

- a. 7
- b. 8
- c. -6
- d. -7
- e. 6

25. If  $2x^2 - 28 = x$ , then  $x = a$  or  $x = b$ . The sum of  $a$  and  $b =$

- a.  $\frac{1}{2}$
- b. 12
- c. -3
- d. 3
- e.  $-\frac{1}{2}$

26. For what values of  $n$  is  $\frac{n^2+2n-35}{n^2-10n+24}$  undefined?

- a. 6, 4
- b. -10, 24
- c. 5, -7
- d. -5, 7
- e. -6, -4

27.  $(3xy^2)^{2r} =$

- a.  $9^r x^{2r} y^{4r}$
- b.  $3 x^{2r} y^{4r}$
- c.  $3^{2r} x^{2r+1} y^{2r+2}$
- d.  $3^{2r} y^{2r+2}$
- e.  $3 x^{2r} y^{2r+2}$

28. Simplify:  $3\sqrt[5]{1024a^9}$

- a.  $7a\sqrt[5]{a^4}$
- b.  $4a^2\sqrt[5]{a}$
- c.  $12a\sqrt[5]{a^4}$
- d.  $12a^2\sqrt[5]{a^4}$
- e.  $96a^4\sqrt[5]{a}$

29. Solve for  $y$ :  $\sqrt{y+3} - 7 = \sqrt{3y-2}$

- a. 49
- b. 15
- c. 6
- d. 97
- e. No solution

30. Solve for  $c$ :  $\log c + \log(c-2) - \log c = \log 4$

- a. 2
- b. 4
- c. 6
- d. 1
- e. 5

31. Given  $-a + 2b + c = 1$  Solve this system of equations:  $2a + b + 3c = 8$   
 $3a + b + 2c = 5$

The value of  $b$  is:

- a. 0
- b. 3
- c. -1
- d. 5
- e. 1

32. Find the equation for the axis of symmetry for  $y = x^2 + 4x + 7$

- a.  $x = -1$
- b.  $y = 7$
- c.  $x = 2$
- d.  $x = -2$
- e.  $x = 1$

33. Find the difference between the sum and product of the solutions to the equation  $2x^2 + 16x - 14 = 0$

- a. -1
- b. -2
- c. 15
- d. -15
- e. -30

34. Write in expanded form:  $\log \frac{5l^2}{w^3}$

- a.  $2 \log 5 + 2 \log l - 3 \log w$
- b.  $10 \log l - 3 \log w$
- c.  $\log 5 + \log l + \log 2 - \log w + \log 3$
- d.  $\log 5 + 2 \log l - 3 \log w$
- e.  $2 \log 5l - 3 \log w$

35. At Clearwater High School, there are 16 students in the Government club, 16 students in the Pep Club and 20 students in the Math Club. Of these students, there are 5 students in both the Government and Pep club, 6 students in both the Pep and Math Clubs, and 8 in both the Government and Math Clubs. If only 2 students are in all three clubs, how many students are in at least one of the clubs?

- a. 52
- b. 35
- c. 30
- d. 20
- e. Not possible to compute

36. If  $f(x) = -x^2 + 4x$  and  $g(x) = x^3 - x$ , what is the value of  $g(f(-2))$ ?
- a. -1716
  - b. -36
  - c. 68
  - d. 1740
  - e. 1716
37. If the diagonal of a square is 9 inches, how many inches are in the perimeter of the square?
- a. 9.5
  - b.  $9\sqrt{2}$
  - c.  $18\sqrt{2}$
  - d.  $36\sqrt{2}$
  - e.  $\frac{9\sqrt{2}}{2}$
38. Suppose  $f(x)$  is a linear function and  $f(2) = 3$  and  $f(-5) = 4$ . If  $g(x)$  is a linear function whose graph is perpendicular to the graph of  $f(x)$ , what is the slope of  $g(x)$ ?
- a.  $-\frac{1}{7}$
  - b. 7
  - c. -7
  - d.  $\frac{1}{7}$
  - e. 3
39. The sum of a man's age and his daughter's age is 65. 11 years from now, the man will be twice as old as his daughter will be then. Find the present age of each.
- a. man 47, daughter 18
  - b. man 45, daughter 20
  - c. man 49, daughter 16
  - d. man 46, daughter 19
  - e. man 48, daughter 17

40. An office manager is buying filing cabinets. Small file cabinets cost \$9 each and large file cabinets cost \$13 each, and the manager cannot spend more than \$107 on file cabinets. A small cabinet takes up 6 square feet of floor space and a large cabinet takes up 7 square feet, and the office has no more than 78 square feet of floor space for file cabinets. The manager must buy at least 8 file cabinets in order to get free delivery. Let  $x$  = the number of small file cabinets bought and  $y$  = the number of large file cabinets. Which system of inequalities describes these constraints?

a. 
$$\begin{cases} 9x + 13y \leq 107 \\ 7x + 6y \leq 78 \\ x \geq 8 \end{cases}$$

b. 
$$\begin{cases} 9x + 13y \leq 107 \\ 6x + 7y \leq 78 \\ x + y \geq 8 \end{cases}$$

c. 
$$\begin{cases} 9x + 13y \leq 107 \\ 6x + 7y \leq 78 \\ x + y \leq 8 \end{cases}$$

d. 
$$\begin{cases} 13x + 9y \leq 107 \\ 7x + 6y \leq 78 \\ y \geq 8 \end{cases}$$

e. 
$$\begin{cases} 13x + 9y \leq 107 \\ 7x + 6y \leq 78 \\ x + y \geq 8 \end{cases}$$