# TENNESSEE MATHEMATICS TEACHERS' ASSOCIATION

# SIXTY-SEVENTH ANNUAL MATHEMATICS CONTEST

# 2025

## Algebra I/ Integrated Math 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 of 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.

1. For $f(x) = |x - 4|$, what is the value of $f(2) - f(4) - f(5)$?
    a. $-3$
    b. $-1$
    c. $0$
    d. $1$
    e. $3$

2. Two natural numbers have a sum of 15 and a product of 56. What is the sum of their squares?
    a. $30$
    b. $80$
    c. $113$
    d. $225$
    e. $840$

3. What is the median of these quiz scores: 95, 90, 85, 75, 88, 95?
    a. $80$
    b. $85$
    c. $88$
    d. $89$
    e. $95$

4. What is the degree of the polynomial $p(x) = 127 - 23x + 47x^3 - 19x^5$?
    a. $-23$
    b. $-19$
    c. $1$
    d. $5$
    e. $127$

5. The mean of four numbers is 20. If the sum of three of the numbers is 55, what is the fourth number?
    a. $5$
    b. $18.75$
    c. $20$
    d. $25$
    e. $80$

6. The exchange rate is $1$ US Dollar $=$ $0.94$ euros. What is the value in dollars of $750$ euros?
    a. $\$705.00$
    b. $\$798.00$
    c. $\$795.00$
    d. $\$797.87$
    e. $\$750.94$

7. A ride-sharing service calculates fares using the formula:

    $$\text{Total Fare} = \$1.50\ (\text{base fare}) + \$1.10 \times (\text{miles}) + \$0.25 \times (\text{minutes}) + \$2.00\ (\text{booking fee})$$

    If a passenger lives 12 miles from the airport and estimates the ride will take 20 minutes, what is the approximate total fare?

    a. $\$20$
    b. $\$22$
    c. $\$23$
    d. $\$25$
    e. $\$29$

8. When the expression $(x^3 - 5x + 2)(x^2 + 7x - 4)$ is expanded and simplified, what is the coefficient of $x$?
    a. $-35$
    b. $-6$
    c. $2$
    d. $14$
    e. $34$

9. What is the greatest common factor (GCF) of the terms in the polynomial $88a^4b^2 + 16a^3b - 144a^2$?
    a. $4a$
    b. $8ab$
    c. $8a^2$
    d. $16a^2$
    e. $16a^4$

10. What is the complete factorization of $2x^3 + 3x^2 - 32x - 48$ ?

a. $(2x + 3)(x^2 + 16)$
b. $(2x + 3)(x + 8)(x - 8)$
c. $2x(x^2 + 3x - 16) + 24$
d. $(2x - 3)(x - 4)^2$
e. $(2x + 3)(x + 4)(x - 4)$

11. Using the table below, for what value of $x$ does $f(x) = 3$?

| $x$ | 0 | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|---|
| $f(x)$ | 74 | 28 | 1 | 53 | 56 | 3 |

a. $56$
b. $53$
c. $1$
d. $3$
e. $5$

12. What is the value of $x$ that satisfies the equation: $\frac{3}{4}x - 8 = \frac{2}{5}x - 10$?

a. $x = -\frac{7}{40}$
b. $x = \frac{2}{7}$
c. $x = \frac{40}{7}$
d. $x = -\frac{40}{7}$
e. $x = \frac{360}{7}$

13. What is the $x$-intercept of the line $6y - 5x = 30$?

a. $(0, 5)$
b. $(0, -6)$
c. $(5, 0)$
d. $(30, 0)$
e. $(-6, 0)$

14. A right triangle has legs of lengths 2 in. and $\sqrt{3}$ in. What is the length of the hypotenuse?

a. $5$ in.

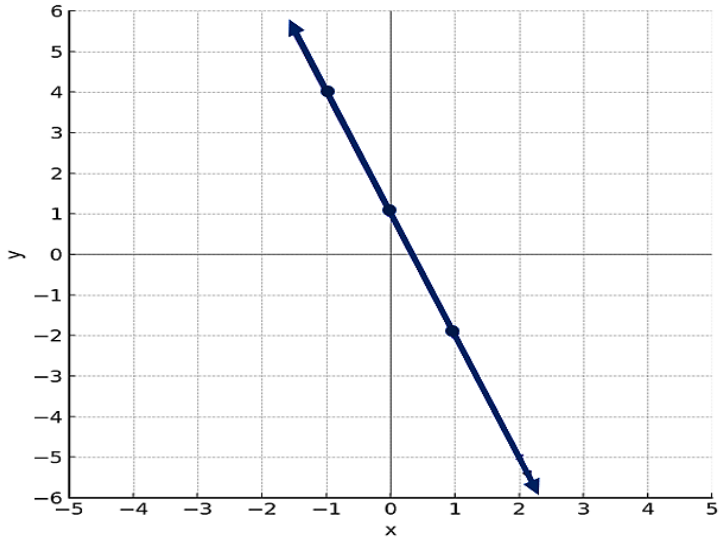
b. $7$ in.

c. $49$ in.

d. $\sqrt{5}$ in.

e. $\sqrt{7}$ in.

15. What is the slope of the line shown in the graph?




a. $-2$

b. $-1/2$

c. $-3$

d. $1/3$

e. $3$

16. What is the equation of the line passing through the points $(0, -2)$ and $(3, 0)$ in standard form?
    a. $y = \frac{3}{2}x - 2$
    b. $3x - 2y = 6$
    c. $2x + 3y = -6$
    d. $3x - 2y = 0$
    e. $2x - 3y = 6$

17. What is the solution to inequality $|3x - 4| \geq 8$ using interval notation?
    a. $\left[-\frac{4}{3}, \frac{4}{3}\right]$
    b. $\left(-\infty, -\frac{8}{3}\right) \cup (4, \infty)$
    c. $(-\infty, -\frac{4}{3}] \cup [4, \infty)$
    d. $(-\infty, -4] \cup \left[\frac{4}{3}, \infty\right)$
    e. $\left[\frac{4}{3}, \frac{8}{3}\right]$

18. A gaming console operates best at a temperature of $24°$ Celsius. For optimal performance and safety, the temperature should differ from this optimal temperature by less than $3°$ Celsius. Using $T$ to represent the operating temperature, which absolute value inequality represents the acceptable temperature range for the console?
    a. $|T - 24| \leq 3$
    b. $|T - 24| \geq 3$
    c. $|T + 3| < 24$
    d. $|T - 3| > 24$
    e. $|T - 24| < 3$

19. A Wi-Fi router broadcasts a signal in a circular pattern. The radius (in meters) grows according to the function $\mathrm{r}(t) = 2t + 4$, where $t$ is time in minutes. What is the area of signal coverage after $t = 3$ minutes?

    a. $10\ \mathrm{m}^2$
    b. $20\pi\ \mathrm{m}$
    c. $20\pi\ \mathrm{m}^2$
    d. $100\pi\ \mathrm{m}$
    e. $100\pi\ \mathrm{m}^2$

20. What is the maximum value of the function $f(x) = 5 + 8x - x^2$ ?

    a. $4$
    b. $5$
    c. $18$
    d. $21$
    e. $53$

21. Suppose the range of a function $f$ is [−5, 10]. What is the range of $|f(x)|$?

    a. $[-5, 10]$
    b. $[-5, 5]$
    c. $[5, 10]$
    d. $[0, 10]$
    e. $(5, \infty)$

22. What is the domain of $f(x) = \frac{x-2}{x^2+6x-16}$ ?

    a. $\{x \mid x \neq 8\}$
    b. $\{x \mid x \neq -2 \text{ and } x \neq 8\}$
    c. $\{x \mid x \neq 2 \text{ and } x \neq 8\}$
    d. $\{x \mid x \neq -2 \text{ and } x \neq -8\}$
    e. $\{x \mid x \neq 2 \text{ and } x \neq -8\}$

23. Given $f(x) = x^2 - 3x + 2$ and $g(x) = 2x - 1$, what is the value of $f\big(g(3)\big)$?

    a. $-3$
    b. $2$
    c. $3$
    d. $10$
    e. $12$

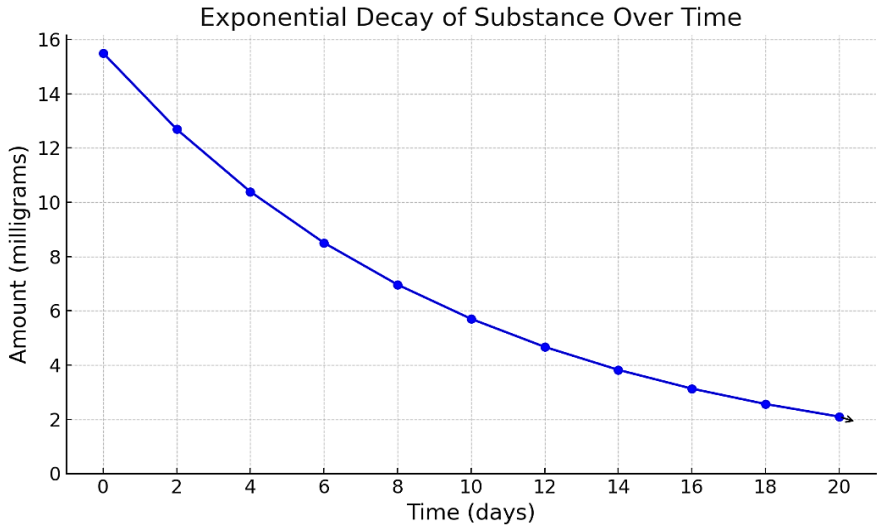
24. A store offers customers a $20\%$ discount on the price $x$ of selected items. Then, the store takes off an additional $10\%$ at the register. What is a price function $P(x)$ that computes the final price of the item in terms of the original price $x$?

    a. $P(x) = 0.30x$
    b. $P(x) = 0.70x$
    c. $P(x) = 0.72x$
    d. $P(x) = 1 - 0.30x$
    e. $P(x) = 0.90(1 - 0.80x)$

25. A radioactive substance starts with 50 grams and has a half-life of 2 hours. Approximately how much of the substance remains after 8 hours?

    a. 34 grams
    b. 25 grams
    c. 12.5 grams
    d. 8 grams
    e. 3 grams

26. Using the graph, what is best estimate of the average rate of change from Day 8 to Day 14?




a. $-\frac{1}{2}$ mg per day
b. $-\frac{1}{3}$ mg per day
c. $-2$ mg per day
d. $-3$ mg per day
e. $-6$ mg per day

27. In 2020, the population of a city was $415{,}638$. The population decreases by $1.3\%$ per year. Which function models the town's population $P(x)$ when $x$ = number of years after 2020?

a. $P(x) = 415638 \cdot (1.13)^x$
b. $P(x) = 415638 \cdot (1.013)^x$
c. $P(x) = 415638 \cdot (1.013)^{x-2020}$
d. $P(x) = 415638 \cdot (0.987)^{x-2020}$
e. $P(x) = 415638 \cdot (0.987)^x$

28. What are the coordinates of the vertex of the parabola $f(x) = 2x^2 - 8x + 3$?

a. $(2, -5)$
b. $(5, -2)$
c. $(4, 3)$
d. $(2, 3)$
e. $(-2, 27)$

29. What values of $x$ satisfy the equation $6x^2 + 6x - 120 = 0$?

a. $x = -10, 2$
b. $x = -6, 20$
c. $x = -2, 10$
d. $x = -5, 4$
e. $x = -4, 5$

30. What is formula for the function obtained when the graph of $f(x) = \sqrt{4x + 5}$ is shifted right 2 units and down 1 unit?

a. $f(x) = \sqrt{4(x-1)+5} + 2$
b. $f(x) = \sqrt{4(x+2)+5} - 1$
c. $f(x) = \sqrt{4(x-2)+5} - 1$
d. $f(x) = \sqrt{4(x+1)+5} + 2$
e. $f(x) = \sqrt{4x + 7} - 1$

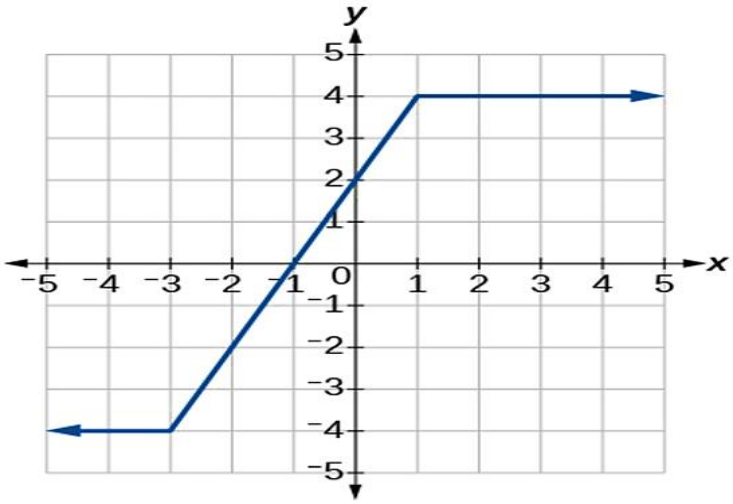
31. What is the inverse of $f(x) = (x+4)^3$?

a. $f^{-1}(x) = \sqrt{x} - 4$
b. $f^{-1}(x) = \sqrt[3]{x} - 4$
c. $f^{-1}(x) = \sqrt[3]{x} + 4$
d. $f^{-1}(x) = \sqrt[3]{x-4}$
e. $f^{-1}(x) = \sqrt[3]{x+4}$

32. What is the distance from the point $(-3,4)$ to the origin?

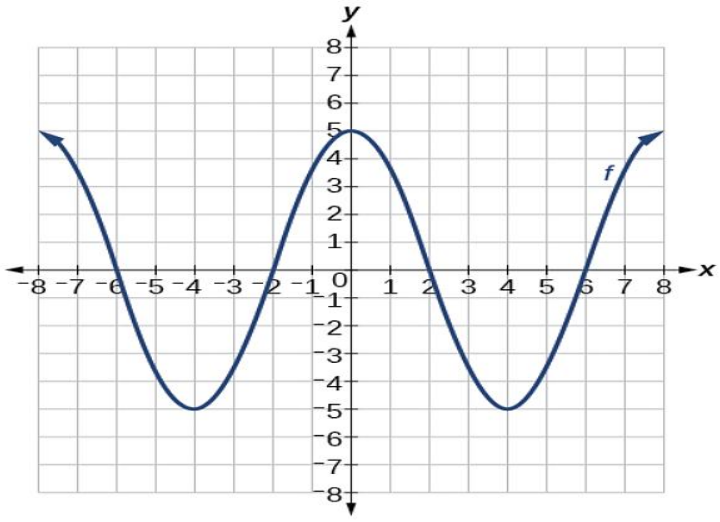
a. 1 unit
b. 5 units
c. 7 units
d. 13 units
e. 25 units

33. Use the graph to determine the interval(s) on which the function $f(x)$ is constant.




a. $(-\infty, -4) \cup (4, \infty)$
b. $(-\infty, -3) \cup (1, \infty)$
c. $(-4, 4)$
d. $(-3, -1)$
e. $(-5, -3) \cup (1, 5)$

34. Using the graph, what is the minimum value of $f(x)$?




a. $-5$
b. $-4$
c. $0$
d. $4$
e. $5$

35. Suppose $x$ varies directly with $y$ and inversely with $z$. If $x = 12$ when $y = 3$ and $z = 2$, what is the value of $x$ when $y = 8$ and $z = 4$?

a. $4$
b. $16$
c. $24$
d. $64$
e. $256$

36. What value of $x$ satisfies the equation $\frac{2}{x+2} + \frac{1}{x-2} = \frac{5}{x^2-4}$?

a. $x = 2$
b. $x = -2$
c. $x = {}^{-1}/_{3}$
d. $x = {}^{7}/_{3}$
e. No solution

37. The formula $S = \frac{1}{1-r}$ can be used to determine the sum of an infinite geometric series with 1 as its first term and common ratio $r$. If $S = 5$, what is the value $r$?

a. $-4$
b. $-{}^{1}/_{4}$
c. ${}^{1}/_{5}$
d. ${}^{4}/_{5}$
e. ${}^{5}/_{4}$

38. How can the given formula $T = 2\pi \cdot \sqrt{\frac{L}{g}}$ be rewritten to solve for $L$?

a. $L = g \cdot \frac{T}{2\pi}$
b. $L = 2\pi gT$
c. $L = g \cdot \left(\frac{T}{2\pi}\right)^2$
d. $L = \frac{gT^2}{4\pi}$
e. $L = g \cdot (T - 2\pi)^2$

39. Corey shops for apples and bananas. Apples cost \$0.90 each, and bananas cost \$0.45 each. If he buys a total of 7 pieces of fruit and spends \$4.50, how many apples did he buy?

a. 2 apples
b. 3 apples
c. 4 apples
d. 5 apples
e. 6 apples

40. For what value(s) of $k$ will this system have infinitely many solutions?

$$\begin{cases} 3x + 2y = 8 \\ 6x + ky = 16 \end{cases}$$

a. $k = -2$
b. $k = 0$
c. $k = 4$
d. $k = 6$
e. All real numbers