

FORTY-EIGHTH ANNUAL MATHEMATICS CONTEST  
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THE TENNESSEE MATHEMATICS TEACHERS' ASSOCIATION

Algebra I 2004

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Scoring formula:  $4R - W + 40$

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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 head (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 80 minutes to work.

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Contributors to TMTA for the Annual Mathematics Contest:

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## ALGEBRA 1

1. Simplify:  $-4^2 + 5(1-7)^2$

- a) -560      b) -396      c) 164      d) 196      e) 756

2. Multiply:  $(4x-1)(2x+3)$

- a)  $8x^2 - 3$       b)  $6x^2 - 2x - 4$       c)  $6x^2 + 10x - 3$       d)  $8x^2 + 10x - 3$       e)  $15x^2$

3. Find the slope and the y-intercept of the equation  $5x - 3y = -9$ .

- a)  $m = -\frac{5}{3}$      $b = 3$   
b)  $m = -\frac{5}{3}$      $b = -3$   
c)  $m = \frac{5}{3}$      $b = 3$   
d)  $m = \frac{5}{3}$      $b = -3$   
e)  $m = \frac{3}{5}$      $b = -3$

4. If two lines are perpendicular, and one of the lines has a slope of  $-\frac{3}{2}$ , then the slope of the other line is

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

5. Electrical resistance is directly proportional to length. If 100 feet of wire has an electrical resistance of 7.3 ohms, find the electrical resistance of 40 feet of wire.

- a) 2.86 ohms      b) 2.92 ohms      c) 3.07 ohms      d) 7.3 ohms      e) 1.65 ohms

6. Solve:  $3x^2 = 6x - 1$

- a)  $\frac{3 \pm \sqrt{6}}{3}$       b)  $\pm \sqrt{6}$       c)  $\frac{-3 \pm 2\sqrt{3}}{3}$       d)  $\pm 2\sqrt{3}$       e)  $\frac{2 \pm 3\sqrt{2}}{2}$

7. Write the equation of the line that is perpendicular to the line  $y = 3x - 2$  and passes through the point  $(-3, -4)$ .

a)  $y = \frac{-x}{3} - 5$

b)  $y = -3x - 13$

c)  $y = 3x + 5$

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

e)  $y = \frac{1}{-3}x - 4$

8. Write an expression that could be used to model the water remaining in a 15000-gallon swimming pool that leaks at a rate of 4 gallons of water per hour.

a)  $15000 + 4h$       b)  $\frac{15000}{4h}$       c)  $4h(15000)$       d)  $15000 - 4h$       e)  $\frac{15000}{4} - h$

9. Solve the inequality  $|2x - 8| < 20$ .

a)  $x < 14$       b)  $-14 < x < 14$       c)  $-6 < x < 14$       d)  $x < -6$  or  $x > 14$       e)  $x > -6$

10. Which one of the following equations **does not** represent  $y$  as a function of  $x$  ?

a)  $6x^2 + 4y = 8$

b)  $3x - 5y = -30$

c)  $2x + 3y^2 = 6$

d)  $2y = x^3 - 8x^2 + 10x + 8$

e)  $y = 2^x + 3$

11. The parabola  $y = x^2 + 6x + 4$  is shifted 6 units to the right and 4 units up. Where is the vertex now?

a)  $(-9, -9)$       b)  $(3, -1)$       c)  $(6, 4)$       d)  $(1, 1)$       e)  $(-4, 1)$

12. A glass container in a lab contains 20 cells. If the number of cells increases 6% every hour, how many cells are in the container 4 days later?

a) 115      b) 606      c) 4847      d) 5375      e) 480

13. Solve for  $x$ :  $8^{2x} = \frac{1}{128}$

- a)  $x = -\frac{7}{6}$       b)  $x = \frac{7}{6}$       c)  $x = \frac{64}{3}$       d)  $x = 64$       e)  $\frac{1}{32}$

14. One shopper bought 2 loaves of bread and 6 cans of tuna for \$7.58. A different shopper bought 3 loaves of bread and 8 cans of tuna for \$10.48. What is the cost of five loaves of bread and four cans of tuna?

- a) \$ 9.01      b) \$ 8.12      c) \$ 8.45      d) \$ 7.57      e) \$ 9.16

15. An auditorium has 54 seats in the first row, 58 seats in the second row, 62 seats in the third row, and so on. Find the number of seats in the 20<sup>th</sup> row.

- a) 126      b) 134      c) 130      d) 138      e) 142

16. The length of a rectangular piece of carpet is 2 meters less than 5 times its width. The area of the carpet is 16 square meters. What is the length of the carpet in meters?

- a) 6      b) 8      c) 10      d) 12      e) 14

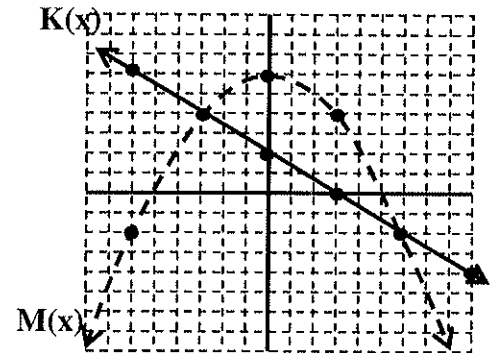
17. The maximum point of the parabola  $y = -2x^2 + 8x - 14$  is

- a)  $(-2, -38)$       b)  $(-2, -6)$       c)  $(2, -6)$       d)  $(2, -38)$       e)  $(2, 38)$

Use the graph to the right to answer the next question. Each axes has a scale of 1.

18. Which of the following values is a solution to the equation  $K(x) = M(x)$ ?

- a) -3      b) -2      c) 0      d) 4      e) 3



19. The equation  $x^2 + x^2 = x^4$  is

- a) true for all real number      b) false for all real numbers      c) true for one real number      d) true for three real numbers      e) true for four real numbers

20. The domain of the function  $f(x) = \frac{2x-4}{x^2-5x+6}$  includes all real numbers except which of the following?

- a) 0                      b) 4                      c) 2 and 3                      d) -2 and -3                      e) 5 and 6

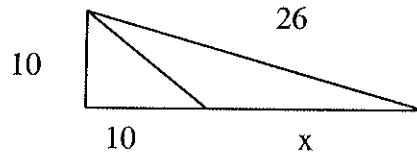
21. Solve for x:  $\sqrt{2x-4} - 7 = -3$

- a)  $x = 4$                       b)  $x = 10$                       c)  $x = 31$                       d)  $x = 52$                       e)  $x = 65$

22. Suppose we define  $a \Omega b$  as  $\frac{\frac{1}{a} + \frac{1}{b}}{\frac{1}{a} \cdot \frac{1}{b}}$ . Find  $2 \Omega 3$ .

- a)  $\frac{5}{36}$                       b)  $\frac{1}{6}$                       c)  $\frac{1}{5}$                       d) 5                      e)  $\frac{1}{8}$

23. Find x in the following right triangle :



- a) 14                      b) 16                      c)  $\sqrt{476}$                       d) 26                      e)  $\sqrt{695}$

24. Find the slope of the line that passes through the points  $(x, x^2)$  and  $((x+2), (x+2)^2)$ .

- a)  $\frac{x^2 + 2x + 2}{x + 1}$                       b)  $2x + 2$                       c)  $x + 2$                       d) 2                      e) 1

25. Which is a solution to the equation  $\frac{x}{x+1} = \frac{x+6}{4x}$ ?

- a)  $x = -3$                       b)  $x = 0$                       c)  $x = \frac{2}{3}$                       d)  $x = 3$                       e)  $x = \frac{3}{2}$

26. If two sides of a right triangle measure 12 and 13, the third side could be

- a) 5                      b) 14                      c) 25                      d) 313                      e) 11

27. Simplify:  $\frac{x^2 - 1}{x^2 - 9} \div \frac{x^2 + 4x + 3}{x^2 - 4x + 3}$

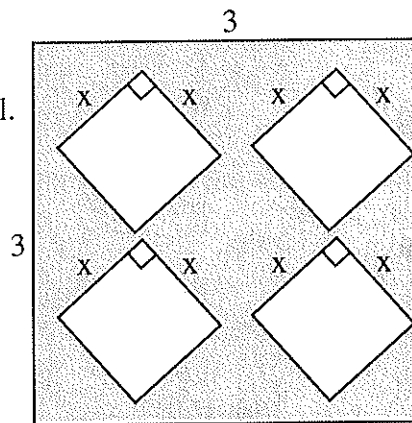
- a)  $\frac{-1}{9}$       b) 1      c)  $\frac{(x-1)^2}{(x+3)^2}$       d)  $\frac{(x+1)^2}{(x-3)^2}$       e)  $\frac{x}{(x-3)(x-1)}$

28. Simplify:  $\left(\frac{2x^3y^{-4}}{z^5}\right)^{-2}$

- a)  $\left(\frac{-4y^{16}z^{25}}{x^9}\right)$       b)  $\left(\frac{y^{16}z^{25}}{4x^9}\right)$       c)  $\left(\frac{-4y^8z^{10}}{x^6}\right)$       d)  $\left(\frac{y^8z^{10}}{4x^6}\right)$       e)  $\left(\frac{4y^8z}{x^3}\right)$

29. Express the area of the shaded region as a polynomial.

If the polynomial is factored completely,  
one of the factors is:



- a)  $3 + 2x$       b)  $3 - 4x$       c)  $3 - x$       d)  $4x - 3$       e)  $2x - 3$

30. A projectile is fired straight up from the ground with an initial velocity of 80 feet per second. Its height  $s(t)$  in feet at any time  $t$  is given by the function  $s(t) = -16t^2 + 80t$ , find the length of time for which the height of the projectile is greater than 96 feet.

- a) 1 second      b) 2 seconds      c) 3 seconds      d) 4 seconds      e) 5 seconds

31. Find the missing table value that will make this function linear.

$x$	$y$
$a$	13
$a+2$	7
$a+6$	?

- a) -5      b) 1      c) 4      d) 13      e) 3

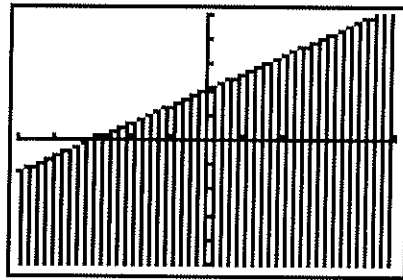
32. Troy began a stamp collection with 10 stamps. After 5 months he had 135 stamps and after 3 years he had 910 stamps. If he continues to collect stamps at this rate how many stamps will he have in 10 years?

- a) 270                      b) 3000                      c) 3010                      d) 3240                      e) 3260

33. If  $F(x) = 3x + 1$  and  $G(x) = 2|x| + 3$ , and,  $G(F(-1)) = \underline{\hspace{2cm}}$

- a) -5                      b) -1                      c) 11                      d) 16                      e) 7

34. The graph below can be described with which equation?



- a)  $3x - 2y \leq 6$     b)  $2x + 3y \leq 6$     c)  $2x - 3y \geq -6$     d)  $3x + 2y \geq -6$     e)  $4x + 5y \leq 20$

35. On the interval  $0 \leq x \leq 1$ , arrange these functions in order largest to smallest  $f(x) = x$

$g(x) = x^2$   $h(x) = x^{1/2}$   $j(x) = 2^x$

- a)  $x, x^{1/2}, x^2, 2^x$   
 b)  $2^x, x^{1/2}, x, x^2$   
 c)  $x^{1/2}, x, x^2, 2^x$   
 d)  $2^x, x^2, x^{1/2}, x$   
 e)  $2^x, x^{1/2}, x, x^2$

36. Given:  $\frac{3x+5}{x^2+5x+6} = \frac{a}{x+2} + \frac{b}{x+3}$ , Find the values for a and b.

- a)  $a=3, b=5$   
 b)  $a=1, b=2$   
 c)  $a=1, b=1$   
 d)  $a=2, b=3$   
 e)  $a=-1, b=4$

37. Find the inverse function for  $y = \frac{3x^2 + 2}{5}, x \geq 0$

a)  $y = \frac{5x^2}{3} + \frac{1}{2}$

b)  $y = \frac{5}{3x^2 + 2}$

c)  $y = -\left(\frac{3x^2 + 2}{5}\right)$

d)  $y = \pm \sqrt{\frac{5x - 2}{3}}$

e)  $y = \frac{\sqrt{15x - 6}}{3}$

38. Simplify:  $\frac{\frac{1}{x}}{\frac{1}{x + \frac{1}{x}}}$  ( $x \neq 0$ )

a)  $\frac{1}{x}$

b)  $\frac{1}{x+1}$

c)  $1 + \frac{1}{x^2}$

d)  $\frac{1}{x} + \frac{1}{x^3}$

e)  $x$

39. Simplify:  $\frac{\frac{1}{2^{x+1}}}{\frac{1}{2^x}}$

a)  $\frac{1}{2} \left(1 + \frac{1}{x}\right)$

b)  $x$

c)  $\frac{1}{2^{x+1}}$

d)  $2$

e)  $2^{-1}$

40. Solve the equation for  $x$ .  $rx^2 + sx + t = 0, r \neq 0$

a)  $x = \frac{4}{r} \pm \sqrt{\frac{s-t}{2r}}$

d)  $x = \frac{-s \pm \sqrt{s^2 - 4rt}}{2r}$

b)  $x = \frac{t}{4} \pm \sqrt{\frac{r^2 - s^2}{t}}$

e)  $x = \pm \sqrt{\frac{-s-t}{r}}$

c)  $x = \pm \sqrt{\frac{t}{r+s}}$