

TWENTY-FOURTH ANNUAL MATHEMATICS CONTEST  
Sponsored by  
THE TENNESSEE MATHEMATICS TEACHERS' ASSOCIATION

ALGEBRA I TEST 1980

Scoring Formula:  $4R - W + 40$

Edited by Bruce Myers and Carolyn Pritchett,  
Austin Peay State University, Clarksville,  
Tennessee

This test was prepared from a list of Algebra I questions submitted by  
Roane State Community College.

---

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 there are listed 5 possible answers; one and only one is correct. You are to work each problem, determine the correct answer, and indicate your choice by making a heavy black mark in the correct place on the separate answer sheet provided. You must use a pencil with soft lead (No. 2 lead or softer).

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

If you should 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 your 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 be able to keep this booklet after the test is completed.

When told to do so, open your test booklet to page 2 and begin. When you have finished one page, go on to the next. The working time for the entire test is 80 minutes.

---

Contributors to TMTA for Annual Mathematics Contest:

Acme Boot Company, Clarksville, Tennessee  
Anderson Ford, Inc., Kingsport, Tennessee  
Berkline Company, Morristown, Tennessee  
Chattanooga Coca-Cola Bottling Company, Chattanooga, Tennessee  
Coca-Cola Bottling Company of Memphis, Memphis, Tennessee  
Commercial and Industrial Bank, Memphis, Tennessee  
Department of Mathematics, Shelby State Community College, Memphis, TN  
Exxon Company, U.S.A., Memphis, Tennessee  
First National Bank of Sullivan County, Kingsport, Tennessee  
First National Bank, Jefferson City, Tennessee  
First People's Bank, Jefferson City, Tennessee  
Fulton Syphon Division, Robertshaw Controls, Knoxville, Tennessee  
Great Lakes Research Corporation, Elizabethton, Tennessee  
Harris Foundation, Johnson City, Tennessee  
Holiday Inns, Inc. Memphis, Tennessee  
Home Federal Savings and Loan Association, Johnson City, Tennessee  
Home Federal Savings and Loan Association, Knoxville, Tennessee  
IBM Corporation, Chattanooga, Tennessee  
IBM Corporation, Kingsport, Tennessee  
IBM Corporation, Nashville, Tennessee  
Jefferson County Bank, Dandridge, Tennessee  
Johnson City Spring and Bedding Company, Johnson City, Tennessee  
Klopman Mills, Incorporated, Johnson City, Tennessee  
McDonald's Restaurants, Memphis, Tennessee  
Memphis Area Teachers of Mathematics (MAC-O-TOM), Memphis, Tennessee  
Morristown Rotary Club, Morristown, Tennessee  
New Jersey Zinc Company, Jefferson City, Tennessee  
Provident Life and Accident Insurance Company, Chattanooga, Tennessee  
Dr. Hal Ramer, President, Volunteer State Community College, Gallatin, TN  
Sears, Madison, Tennessee  
Shoney's Inc., Nashville, Tennessee  
Tennessee Eastman Company, Kingsport, Tennessee  
Tennessee Handbag Company, Dandridge, Tennessee  
Tri-State Container Corporation, Elizabethton, Tennessee  
TRW, Ross Gear Division, Lebanon, Tennessee  
Mr. Meeks B. Vaughan, Kingsport, Tennessee

1. Find the product  $(x + 2y + 1)(x + 2y - 1)$ .

(a)  $x^2 + 4xy + 4y^2 - 1$

(b)  $x^2 + 4y^2 - 1$

(c)  $x^2 + 4xy - 1$

(d)  $x^2 + 4xy - 2x + 4y + 4y^2 - 1$

(e)  $x^2 - 4xy + 2x - 4y + 4y^2 - 1$

2. The complex fraction  $\frac{\frac{x}{2} + \frac{y}{3}}{\frac{3}{y} + \frac{2}{x}}$  can be simplified to

(a)  $\frac{6}{x + y}$

(b) 1

(c)  $\frac{xy}{6}$

(d)  $\frac{3x + 2y}{6}$

(e) none of these

3.  $\sqrt{9}$  equals

(a) 3

(b) -3

(c) 3 or -3

(d) 3i

(e) none of these

4. The value of the determinant  $\begin{vmatrix} 1 & -3 & 2 \\ 2 & -2 & 6 \\ 3 & -1 & 1 \end{vmatrix}$  is:

(a) 0

(b) 36

(c) -36

(d) 18

(e) -18

5.  $(x^{-1}y^0)^{-2}$  can be simplified to:
- (a)  $\frac{1}{x^2y}$
  - (b)  $x^2y^{-2}$
  - (c)  $\frac{y}{x^2}$
  - (d)  $\frac{1}{x^2}$
  - (e)  $x^2$
6. If  $\frac{2x - 9}{3x + 2} < 0$ , then the values which  $x$  may be are:
- (a)  $x > -2/3$
  - (b)  $x < -2/3$  or  $x > 9/2$
  - (c)  $-2/3 < x < 9/2$
  - (d)  $x < 9/2$
  - (e)  $x < -2/3$  or  $x \geq 9/2$
7.  $\frac{x^3 - 1}{x^2 - 1}$  simplifies to
- (a)  $x + 1$
  - (b)  $x$
  - (c)  $x - 1$
  - (d)  $\frac{x^2 + x + 1}{x + 1}$
  - (e) none of these
8. The solution set for  $\frac{3}{\sqrt{4x + 1}} = -2$  is
- (a)  $\{5/16\}$
  - (b)  $\{16/5\}$
  - (c)  $\{\frac{5}{16}, -\frac{5}{16}\}$
  - (d)  $\emptyset$
  - (e) none of these

9. Mrs. Billings flew her own plane from her home town to a city due east where she attended a business meeting. After spending six hours in the city, she then flew back home. Her plane in still air had a speed of 156 miles per hour, and the wind blew from the west at 12 miles per hour all day. If  $10 \frac{1}{3}$  hours elapsed from the time she left her home airport until she returned, how far was the city from her town?
- (a) 338 miles
  - (b) 336 miles
  - (3) 340 miles
  - (4) 350 miles
  - (5) none of these
10.  $\frac{1}{\sqrt{x} - 1}$  equals
- (a)  $\frac{\sqrt{x}}{\sqrt{x} - 1}$
  - (b)  $\frac{\sqrt{x}}{x - 1}$
  - (c)  $\frac{\sqrt{x} - 1}{x + 1}$
  - (d)  $\frac{\sqrt{x} + 1}{x - 1}$
  - (e) none of these
11. If  $\log_a 2 = .1012$  and  $\log_a 3 = .1112$ , what is  $\log_a 12$ ?
- (a) .4248
  - (b) .6070
  - (c) .4448
  - (d) .3136
  - (e) .0011

12. If  $2(x - 5) = 3(2x + 1)$ , then  $x$  equals
- (a) 5
  - (b)  $-7/4$
  - (c)  $-1/2$
  - (d)  $-13/4$
  - (e) none of these
13.  $\frac{\sqrt{3} + \sqrt{27}}{\sqrt{3} - \sqrt{27}}$  can be simplified and expressed as
- (a)  $\frac{3 + 3\sqrt{3}}{-24}$
  - (b)  $-39/24$
  - (c)  $\frac{30 + 3\sqrt{3}}{-24}$
  - (d)  $\frac{\sqrt{30}}{-\sqrt{24}}$
  - (e) -2
14.  $\frac{16x^4y^{-2}z^{10}}{2x^{-1}y^4z^5}$  simplifies to
- (a)  $8x^3y^{-6}z^5$
  - (b)  $8x^3y^6z^5$
  - (c)  $14x^5y^{-6}z^5$
  - (d)  $\frac{8x^5z^5}{y^2}$
  - (e)  $\frac{8x^5z^5}{y^6}$
15. The graph of the equation  $x^2 + y^2 = 4$  is a
- (a) straight line
  - (b) parabola
  - (c) circle
  - (d) ellipse
  - (e) hyperbola

16. The expression  $\frac{4\sqrt{6} + 2\sqrt{150}}{\sqrt{3}}$  simplifies to
- (a)  $6\sqrt{52}$
  - (b)  $12\sqrt{13}$
  - (c)  $14\sqrt{2}$
  - (d)  $2\sqrt{14}$
  - (e) none of these
17. If  $a$ ,  $b$  and  $c$  belong to the set of real numbers and  $a < b$ , then which of the following is NOT always true?
- (a)  $b > a$
  - (b)  $ca < cb$
  - (c)  $a - b < 0$
  - (d)  $b - a > 0$
  - (e)  $a + c < b + c$
18. Simplify  $\frac{\frac{1}{x} - 1}{\frac{1}{x} + 1}$ .
- (a)  $\frac{1 - x}{1 + x}$
  - (b)  $\frac{1 - x^2}{1 + x^2}$
  - (c)  $-1$
  - (d)  $1$
  - (e)  $0$
19. The expression  $(3a - b)^2 - (2a + b)^2$  is equivalent to the factored expression
- (a)  $(a - 2b)5a$
  - (b)  $5a^2 - 10ab$
  - (c)  $[(3a - b) - (2a + b)]^2$
  - (d)  $5a^2 - 2ab + 2b^2$
  - (e) none of these

20. The numerator of a fraction is 7 less than the denominator. If the numerator is decreased by 2 and the denominator is increased by 3, the value of the fraction is then  $\frac{1}{3}$ . What is the fraction?
- (a)  $\frac{3}{5}$
  - (b)  $\frac{8}{15}$
  - (c)  $-\frac{1}{6}$
  - (d)  $\frac{3}{10}$
  - (e)  $\frac{1}{8}$
21. If each  $a$  and  $b$  represents a real number, which one of the following statements is always correct?
- (a)  $(a + b)^3 = a^3 + b^3$
  - (b)  $a^3 + b^3 = (a + b)(a^2 + ab + b^2)$
  - (c)  $a^3 - b^3 = (a - b)(a^2 + ab + b^2)$
  - (d)  $a^2 - b^2 = (a - b)(a - b)$
  - (e)  $a - b = (\sqrt{a} - \sqrt{b})(\sqrt{a} - \sqrt{b})$
22. Evaluate  $m(n^2 - p^2)$  when  $m = 2$ ,  $n = -4$ ,  $p = -3$ .
- (a) -28
  - (b) 14
  - (c) 50
  - (d) 98
  - (e) 28
23. Completely factor  $2x^3 + 2x^2 - 312x$ .
- (a)  $2x(x + 12)(x - 13)$
  - (b)  $x(2x + 24)(x - 13)$
  - (c)  $(2x^2 + 24x)(x + 13)$
  - (d)  $(x - 12)(2x^2 + 26)$
  - (e)  $2x(x - 12)(x + 13)$

24. The solution set of  $|x - 1| < 5$  is
- (a)  $\{6\}$
  - (b)  $\{x|x < 6\}$
  - (c)  $\{x|-4 < x < 6\}$
  - (d)  $\{x|x < -4 \text{ or } x > 6\}$
  - (e) none of these
25. The solution set for the system of equations  $\begin{matrix} 4x - 3y = -3 \\ 7x + 2y = 2 \end{matrix}$  is
- (a)  $\{(0, -1)\}$
  - (b)  $\{(-1, 0)\}$
  - (c)  $\{(1, 0)\}$
  - (d)  $\{(0, 1)\}$
  - (e) none of these
26. Given  $3^{x+y} = 81$  and  $3^{x-y} = 1/3$ , then
- (a)  $x = 2/3, y = 2/5$
  - (b)  $x = 2/5, y = 2/3$
  - (c)  $x = 5/2, y = 3/2$
  - (d)  $x = 3/2, y = 5/2$
  - (e) none of these
27. If  $a * b = c$  means  $c = a^2(b + 1)$ , then  $4 * 3$  is
- (a) 12
  - (b) 45
  - (c) 63
  - (d) b
  - (e) none of these



28.  $(\sqrt{6} - \sqrt{3})(\sqrt{6} + \sqrt{3})$  equals
- (a) 3
  - (b)  $3\sqrt{3}$
  - (c) 1
  - (d) 0
  - (e) none of these
29. The statement "If p, then q." has as its contrapositive
- (a) If q, then p
  - (b) If not p, then not q.
  - (c) If not q, then not p.
  - (d) p if and only if q.
  - (e) If not q, then p.
30. The solution set of  $x^2 - 2x + 1 = 0$  is
- (a) {1}
  - (b) {1, -1}
  - (c) {-1}
  - (d) {i, -i}
  - (e) none of these
31. Factor  $x^2y^2 - x^3y^3 + xy$  completely.
- (a)  $xy(xy - x^2y^2 + 1)$
  - (b)  $x(xy^2 - x^2y^3 + y)$
  - (c)  $y(x^2y - x^3y^2 + x)$
  - (d) 0
  - (e)  $x^2y^2(1 - xy) + 1$

32. If  $s = \frac{n}{2}(a + l)$ , then  $a$  is equal to

(a)  $\frac{2s}{n} - l$

(b)  $\frac{2s - l}{n}$

(c)  $\frac{l - 2s}{n}$

(d)  $2s - nl$

(e) none of these

33. Simplify  $2x(x + (3x - 1) - 2(x - 1)) + 2$ .

(a)  $x^2 + 2x + 1$

(b)  $2(2x^2 + x + 1)$

(c)  $4x^2 + 2x + 1$

(d)  $2(3x^3 - 3x^2 + 4x + 2)$

(e)  $4x^2 + 6$

34. If  $x < 0$ , then  $|x|$  is

(a)  $x$

(b)  $-x$

(c)  $0$

(d) undefined

(e) none of these

35. The solution set for  $|x - 1| \leq 0$  is

(a)  $\{x|x \leq 1\}$

(b)  $\{x|x \geq 1\}$

(c)  $\{x|x = 1\}$

(d)  $\emptyset$

(e)  $\{x|-1 \leq x \leq 1\}$

36. Completely factor  $x^3 - 2x^2 - 2x + 1$ .

- (a)  $(x + 1)(x^2 - x + 2)$
- (b)  $(x + 1)(x^2 - x - 2)$
- (c)  $x^2(x - 2) - 1(2x - 1)$
- (d)  $(x + 1)^2(x - 2)$
- (e)  $(x + 1)(x^2 - 3x + 1)$

37. The solution set for  $x^4 + 5x^2 - 36 = 0$  is

- (a)  $\{6, -6, 2i\sqrt{10}, -2i\sqrt{10}\}$
- (b)  $\{6i, -6i, 2i\sqrt{10}, -2i\sqrt{10}\}$
- (c)  $\{2i, -2i, 3, -3\}$
- (d)  $\{3i, -3i, 2, -2\}$
- (e) none of these

38.  $\frac{\frac{x}{3} - \frac{y}{5}}{\frac{5x^2}{3} - \frac{3y^2}{5}}$  may be simplified and expressed as

- (a)  $5x - 3y$
- (b)  $\frac{1}{5x + 3y}$
- (c)  $\frac{15}{5x + 3y}$
- (d)  $\frac{5x + 3y}{15}$
- (e) none of these

39. A(2, 4) and B(-1, 2) are two points in the coordinate plane. The slope of the line that contains A and B is

- (a)  $3/2$
- (b)  $2/3$
- (c) 2
- (d)  $1/2$
- (e) none of these

40. If  $h = \frac{1}{2}gt^2$ , then  $t$  is equal to

(a)  $\frac{2h}{gt}$

(b)  $\sqrt{\frac{g}{2h}}$

(c)  $\sqrt{\frac{2h}{g}}$

(d)  $-\sqrt{\frac{2h}{g}}$

(e) both (c) and (d)