

Dick Schaff Math Superbowl XLI
Level 4: Algebra II Blitz – 2014

- Directions:** (1) Select the most correct answer for each question and mark it on your answer form.
(2) No calculators of any sort are allowed.
(3) Note that N.O.T. means “None of these.”

- If $i = \sqrt{-1}$, then $i^{2014} =$
a) 1 b) i c) $-i$ d) -1 e) N.O.T.
- If $f(x) = 5x + 7$, then $f^{-1}(x) =$
a) $\frac{x-7}{5}$ b) $\frac{7-x}{5}$ c) $\frac{1}{5x+7}$ d) $\frac{-1}{5x+7}$ e) N.O.T.
- The equation $x^2 + 4x + y^2 - 10y - 7 = 0$ represents which of the following?
a) Circle b) Ellipse c) Hyperbola d) Line e) N.O.T.
- If $\log(x) = \frac{3}{2}$, then $x =$
a) 15 b) $\frac{3}{2}$ c) $10\sqrt{10}$ d) $\sqrt{10}$ e) N.O.T.
- The range of $f(x) = -4x^2 + 6x + 11$ can be described in interval notation by
a) $[11, \infty)$ b) $(11, \infty)$ c) $(-\infty, -11)$ d) $(-\infty, -11]$ e) N.O.T.
- A pair of fair six-sided dice are rolled. The probability that the sum of the dice is nine is
a) $\frac{1}{8}$ b) $\frac{1}{9}$ c) $\frac{1}{10}$ d) $\frac{1}{12}$ e) N.O.T.
- The real part of the roots of the equation $x^2 - 7x + 20 = 0$ is
a) -7 b) 7 c) $-7/20$ d) $7/2$ e) N.O.T.
- The foci of the ellipse $16x^2 + 25y^2 = 400$ are found at
a) $(0, \pm 5)$ b) $(0, \pm 3)$ c) $(\pm 5, 0)$ d) $(\pm 3, 0)$ e) N.O.T.
- The value of $-64^{-2/3}$ is
a) $-\frac{1}{16}$ b) 16 c) $-21\frac{1}{3}$ d) $\frac{128}{3}$ e) N.O.T.

10. The value of the determinant $\begin{vmatrix} -4 & 0 & 3 \\ 2 & 1 & 6 \\ -1 & 5 & 2 \end{vmatrix}$ is

- a) 14 b) -8 c) 145 d) 79 e) N.O.T.

11. Let $f(x) = 6x + 5$ and $g(x) = x^2 - 3$. Then $(f - g)(x)$ is

- a) $x^2 + 6x + 8$ b) $-x^2 + 6x + 8$ c) $x^2 + 6x + 2$ d) $-x^2 - 6x - 2$ e) N.O.T.

12. Let $f(x) = 6x + 5$ and $g(x) = x^2 - 3$. Then $(f \circ g)(x)$ is

- a) $6x^2 - 13$ b) $36x^2 + 22$ c) $36x^2 + 60x + 22$ d) $6x^2 + 23$ e) N.O.T.

13. The product of the roots of the equation $\sqrt{x^2 - 3x} + 6 = 2x$ is

- a) 0 b) 1 c) 4 d) 12 e) N.O.T.

14. The x^2 term in the expansion of $(x - 2)^6$ is given by

- a) $15x^2$ b) $-16x^2$ c) $-240x^2$ d) $4x^2$ e) N.O.T.

15. The solution set of the equation $\log_2(x - 4) + \log_2(x) = 5$ is

- a) $\{-4, 8\}$ b) $\{8\}$ c) $\{4\}$ d) $\{4, -8\}$ e) N.O.T.

16. The maximum value of the function $f(x) = -4x^2 + 12x + 8$ is

- a) 20 b) 16 c) 12 d) 8 e) N.O.T.

17. The solution set to $(x + 7)(x + 4) < 28$ is

- a) $(-7, -4)$ b) $(-7, 0)$ c) $(-11, -4)$ d) $(-11, 0)$ e) N.O.T.

18. The value of $5^{-1} - 5^{-2}$ is

- a) $\frac{1}{5}$ b) $\frac{4}{25}$ c) $\frac{3}{25}$ d) $\frac{1}{25}$ e) N.O.T.

19. The sum of the solutions to $x^2 + 6x - 91 = 0$ is

- a) 7 b) -13 c) -6 d) 6 e) N.O.T.

20. Let $f(x) = x^2 - x$. Then $f(x - 2) =$

- a) $x^2 - 5x + 6$ b) $x^2 - 5x + 4$ c) $x^2 - x - 2$ d) $x^2 - x - 4$ e) N.O.T.

21. $\log_2(4) \times \log_4(8) \times \log_8(16) =$
 a) 2 b) 4 c) 8 d) 16 e) N.O.T.
22. Five friends went out to dinner. They decided to split the bill evenly. One person left early and forgot to pay, so the others had to pay an additional \$3. How much would each person have paid if all five had paid their share?
 a) \$60 b) \$15 c) \$12.50 d) \$10 e) N.O.T.
23. The parabola $x = -3(y + 4)^2 - 5$ opens which way?
 a) Up b) Down c) To the left d) To the right e) N.O.T.
24. If the line passing through the points $(x, 4)$ and $(2, -5)$ has a slope of $-\frac{9}{4}$, then the value of x is
 a) $-\frac{14}{9}$ b) -6 c) 2 d) 12 e) N.O.T.
25. The equation of the line containing the point $(2, -1)$ and perpendicular to the line with equation $5x - 2y = 4$ is
 a) $y = -\frac{2}{5}x - \frac{1}{5}$ b) $y = \frac{5}{2}x - 6$ c) $y = \frac{2}{5}x - \frac{9}{5}$ d) $y = -\frac{5}{2}x + 4$ e) N.O.T.
26. Let y be directly proportional to x and inversely proportional to the square of z . If $x = 3$ and $z = 4$, then $y = 15$. If $y = 12$ and $z = 2$, what is the value of x ?
 a) $\frac{2}{5}$ b) $\frac{1}{5}$ c) $\frac{6}{5}$ d) $\frac{3}{5}$ e) N.O.T.
27. The remainder when $2x^3 - 4x^2 + x - 7$ is divided by $x - 3$ is
 a) 54 b) 18 c) 14 d) -7 e) N.O.T.
28. The system of equations $\begin{cases} x^2 + 4y^2 = 25 \\ xy = 6 \end{cases}$ has exactly how many solutions?
 a) One b) Two c) Four d) Six e) N.O.T.
29. The graph of $f(x) = \sqrt{x + 4}$ is obtained by shifting the graph of $y = \sqrt{x}$ in which way?
 a) 4 units to the left b) 4 units to the right
 c) 4 units up d) 4 units down e) N.O.T.

30. The number of ways that four boys and three girls can be seated in a row of seven seats so that boys and girls occupy alternating seats is

- a) 12 b) 24 c) 72 d) 144 e) N.O.T.

31. What are the possible values of x that satisfy $|12 - 4x| = 2$?

- a) $x = -\frac{5}{2}$ or $x = -\frac{7}{2}$ b) $-\frac{7}{2} < x < -\frac{5}{2}$
c) $\frac{5}{2} < x < \frac{7}{2}$ d) $x = \frac{5}{2}$ or $x = \frac{7}{2}$ e) N.O.T.

32. Simplify $(3x^2 + x - 4)(2x - 5)$.

- a) $6x^3 + 13x^2 + 3x - 20$ b) $6x^3 + 13x^2 + 3x + 20$
c) $6x^3 - 13x^2 - 13x - 20$ d) $6x^3 - 13x^2 - 13x + 20$ e) N.O.T.

33. Factor $8a^3 + c^3$ completely.

- a) $(2a + c)(2a + c)(2a + c)$ b) $(2a + c)(4a^2 - 2ac + c^2)$
c) $(2a - c)(4a^2 + 4ac + c^2)$ d) $(2a - c)(4a^2 + 2ac + c^2)$ e) N.O.T.

34. Simplify $\frac{2x^2 - 10x}{x^2 + 8x + 16} \cdot \frac{4x + 16}{x^2 - 25}$.

- a) $\frac{8x}{(x + 4)(x - 5)}$ b) $\frac{2x + 4}{(x + 4)(x + 5)}$
c) $\frac{8x}{(x + 4)(x + 5)}$ d) $\frac{2x + 4}{x^2 + 20}$ e) N.O.T.

35. Emily is solving the equation $x^2 - 8x = 9$ by completing the square. What number should be added to both sides of the equation to complete the square?

- a) 12 b) 8 c) 4 d) 2 e) N.O.T.

36. Which statement describes the graph of the equation $x^2 + y^2 + 4x - 6y - 3 = 0$?

- a) A hyperbola with center $(-2, 3)$ and vertices $(4, -3)$ and $(-4, 3)$.
b) A hyperbola with center $(-2, 3)$ and vertices $(2, -3)$ and $(3, -2)$.
c) A circle with center $(-2, 3)$ and radius 8.
d) A circle with center $(-2, 3)$ and radius 4.
e) N.O.T.

37. The slope of any line that is parallel to the line $x = 70$ is

- a) 1 b) 70 c) undefined d) 0 e) N.O.T.

38. Given the equation $y = x^n$ where $x > 0$ and $n < 0$, which statement is valid for real values of y ?
- a) $y > 0$ b) $y = 0$ c) $y < 0$ d) $y \geq 0$ e) N.O.T.
39. If $f(x) = 3x^2 - 4$ and $g(x) = 2x - 6$, then what is the value of $g(f(2))$?
- a) -2 b) 6 c) 8 d) 10 e) N.O.T.
40. What is the solution of $5^x = 17$?
- a) $x = \frac{\log_{10} 17}{\log_{10} 5}$ b) $x = \log_{10} 17 + \log_{10} 5$
c) $\log_{10} 22$ d) $\log_{10} 12$ e) N.O.T.
41. If the 7th term of an arithmetic sequence is -5 and the 15th term is -21 , then determine the 10th term.
- a) -7 b) -11 c) -15 d) -19 e) N.O.T.
42. Let P be the point $(-5, 9)$ and Q be $(5, -3)$. The midpoint of the line segment PQ is
- a) $(10, 12)$ b) $(0, 6)$ c) $(0, 3)$ d) $(5, -6)$ e) N.O.T.
43. The area of the region defined by $y \geq 0$, $x \geq 0$, and $y + x - 1 \leq 0$ is
- a) $\frac{1}{2}$ b) 1 c) $\frac{3}{2}$ d) 2 e) N.O.T.
44. The ellipse whose equation is $x^2 + 4y^2 + 6x - 8y + 9 = 0$ has a major axis with length
- a) 2 b) 4 c) 6 d) 8 e) N.O.T.
45. The expression $e^{2 \ln(x)}$ in simplest form is equivalent to
- a) x b) 2 c) $2x$ d) x^2 e) N.O.T.

