

Algebra Written Test - Theta Division
 (for students who have NOT had more math than Algebra I, Algebra II, and Geometry)

NO CALCULATORS

1. Find all real roots of:

$$\frac{x+1}{x^2(x-2)^2} = 0$$

- A) -1 B) 0 C) 2 D) all of these E) none of these

2. If $ab = c$ and $\frac{1}{a^2} + \frac{1}{b^2} = d$, then $(a+b)^2 =$

- A) $(c+2d)^2$ B) (c^2+d^2) C) $c(cd+2)$ D) $cd(c+2)$ E) $\frac{1}{d} + 2c$

3. The altitude to the base of an isosceles triangle is 8, while the perimeter is 32. What is the area of the triangle?

- A) 24 B) 32 C) 40 D) 48 E) 56

4. A cube is made by gluing together, at the vertices, twelve 3 inch paper straws. If an ant starts crawling at one of the vertices and then walks only on the edges, what is the greatest distance it could travel before coming to any of the vertices a second time without retracing any distance?

- A) 12 in. B) 18 in. C) 24 in. D) 30 in. E) 36 in.

5. The smaller angle formed by the hour hand and the minute hand of a clock at 3:15 is:

- A) 0° B) 5° C) $7\frac{1}{2}^\circ$ D) 15° E) none of these

6. The numbers x, y, z are proportional to 2, 3, 5. $x + y + z = 100$ and $y = ax - 10$. Find a .

- A) $\frac{3}{2}$ B) 2 C) $\frac{5}{2}$ D) 3 E) 4

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7. What is the square of the remainder when $(x^4 - 2x^3 - 3x^2 - 5) \div (x^2 + 1)$?

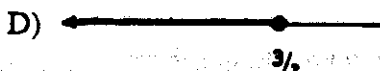
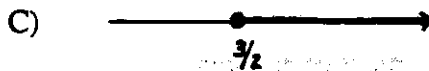
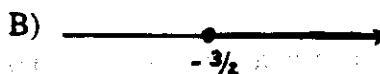
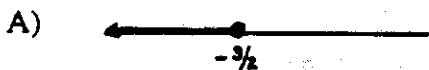
- A) 4 B) $2x - 1$ C) $x^2 - 2x - 4$ D) $4x^2 - 4x + 1$ E) none of these

8. Simplify:

$$(64x^6y^{12})^{-\frac{2}{3}}$$

- A) $\frac{1}{512x^9y^{18}}$ B) $-16x^4y^8$ C) $\frac{1}{8x^{\frac{1}{2}}y^4}$ D) $\frac{1}{16x^4y^8}$ E) none of these

9. Solve the inequality $|x+2| \geq |x+1|$ and graph the solution set.



E) none of these

10. Find the equation of the line perpendicular to the line $y = 2x + 3$ and passing through the midpoint of the line segment joining $(2, 4)$ and $(-6, 10)$.

- A) $x + y = 5$ B) $x + 2y = 10$ C) $y = -2x + 3$ D) $y = -\frac{1}{2}x + 3$ E) none of these

11. Let $f(x) = x + 1$ and $g(x) = 3x + 4$. Find $g(f(2))$.

- A) 3 B) 10 C) 11 D) 13 E) none of these

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12. The average of two numbers is $2y - 6$. One of the numbers is y . What is the other number?
 A) $3y - 4$ B) $\frac{3}{2}y - 3$ C) $3y - 6$ D) $5y - 12$ E) none of these
13. If a square has a side of length s and a diagonal of length d , then what is $\frac{s^2}{d^2}$?
 A) $\frac{1}{4}$ B) $\frac{1}{2}$ C) 1 D) 2 E) none of these
14. It is 185 miles from Chicago to Indianapolis. If a truck takes two hours to travel the first 85 miles, how long must the truck take to travel the final 100 miles in order to average 50 mph for the entire trip?
 A) 60 min B) 75 min C) 94 min D) 102 min E) 112 min
15. If x and y are both odd numbers, which of the following must be an even number?
 A) $x + y$ B) xy C) $xy + 2$ D) $x + y + 1$ E) $2x + y$
16. A penny, a nickel, a dime, and a quarter are each tossed once. What is the probability of getting exactly two heads?
 A) $\frac{1}{16}$ B) $\frac{3}{8}$ C) $\frac{1}{2}$ D) $\frac{5}{16}$ E) none of these
17. When the repeating decimal $0.484848\dots$ is written in simplest fractional form, what is the sum of the numerator and the denominator?
 A) 32 B) 49 C) 137 D) 147 E) none of these

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18. If $(A \cap B) \cup (A \cap C) = D$, find $B \cup (A \cap C)$
 A) B B) $B \cup C$ C) $D \cap B$ D) $D \cup B$ E) $A \cup D$
19. If the square root of the square root of the square root of a number is 3, then the number is:
 A) 3^6 B) $\sqrt[3]{3}$ C) 3^8 D) 3^4 E) $\sqrt[4]{3}$
20. How many different palindromes exist between 10 and 100,000? (A palindrome is an integer that reads the same backwards as forwards.)
 A) 900 B) 1059 C) 1098 D) 1100 E) none of these
21. x and y are positive integers such that $\frac{1}{x} + \frac{1}{y} = \frac{1}{12}$. Find the largest possible value for $x + y$.
 A) 48 B) 64 C) 144 D) 169 E) none of these
22. If $a * b = (a+b-1)/ab$, find $\frac{1}{2} * 3$
 A) $\frac{1}{2}$ B) 1 C) $\frac{3}{2}$ D) $\frac{5}{2}$ E) none of these
23. Determine the sum $1 + 3\left(\frac{1}{2}\right) + 5\left(\frac{1}{2}\right)^2 + 7\left(\frac{1}{2}\right)^3 + \dots$
 A) 5 B) 6 C) 7 D) 8 E) none of these

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24. Find the determinant:

$$\begin{vmatrix} 1 & 2 & 3 \\ 1 & 0 & -2 \\ -3 & 1 & 4 \end{vmatrix}$$

- A) -7 B) 0 C) 1 D) 9 E) 28

25. The pair of equations $3^{x+y} = 81$ and $81^{x-y} = 3$ has:

- A) solutions $x=2, y=2$ B) no common solution C) solutions $x=2\frac{1}{2}, y=1\frac{1}{2}$
 D) solutions $x=2\frac{1}{2}, y=-1\frac{1}{2}$ E) none of these

26. If the length of a rectangle is increased by 20% and the width is decreased by 20%, then the area of the rectangle:

- A) decreases by 20% B) decreases by 4% C) is unchanged
 D) increases by 4% E) increases by 20%

27. In the base five numeration system, the number that is equal to 38 in the base ten numeration system can be described as a number with:

- A) two consecutive digits B) two non-consecutive digits C) three consecutive digits
 D) three non-consecutive digits E) none of the above

28. $x^2 - 3cx + 2c^2 - 1 = 0$

The product of the roots = 7. The roots may be described as:

- A) integral and positive B) integral and negative C) rational, but not integral
 D) irrational E) imaginary

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29. A farmer spends \$1000 to buy pigs at \$25 each and cows at \$26 each. If the number of pigs and the number of cows are both integers greater than or equal to one,
- A) the cows grew curly tails and the pigs started giving milk so you couldn't tell them apart.
 - B) there is no unique solution to this problem.
 - C) there are exactly two solutions with the number of pigs $>$ the number of cows.
 - D) there is exactly one solution with the number of pigs $<$ the number of cows.
 - E) there is exactly one solution with the number of pigs $=$ the number of cows.
30. Which of the following is not true?
- A) No scalene triangles are isosceles triangles.
 - B) Every triangle has at least two acute angles.
 - C) The union of any three segments is a triangle.
 - D) A right triangle can be an isosceles triangle.
 - E) No equilateral triangle can have an obtuse angle.