OU Math Day 2024

Algebra II Test

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1. Two mystery numbers have sum 34 and product 253. What is the smaller mystery number?

   (A) 11 (B) 17 (C) 21 (D) 34 (E) None of the above

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2. Find the y-coordinate of the intersection point between the lines defined by the equations $y = 2x - 1$ and $y = -x + 5$.

   (A) -3 (B) 1 (C) 2 (D) 3 (E) None of the above

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3. You are blindly grabbing socks out of a drawer. If the drawer has 4 black socks and 6 white socks, how many socks do you have to grab before you are guaranteed to have 2 socks of the same color?

   (A) 2 (B) 3 (C) 4 (D) 6 (E) None of the above

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4. If $f(x) = x^2 - 1$, what is $f(f(2))$?

   (A) 3 (B) 6 (C) 8 (D) 27 (E) None of the above

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5. Which of the following is **not** a root of the polynomial $x^4 - x^3 - 4x^2 + 4x$?

   (A) -2 (B) -1 (C) 0 (D) 1 (E) 2

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6. Which of the following is equal to $(x+2)(3x+1)(x-1)$?

(A) x^3+4x^2+x-6 (B) $x^3+6x^2+11x+6$ (C) $3x^3+10x^2+9x+2$
(D) $3x^3+4x^2-5x-2$ (E) None of the above

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7. How many real solutions are there to the equation $x^2+y^2=-1$?

(A) 0 (B) 1 (C) 2 (D) Infinitely many (E) None of the above

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8. Which of the following numbers is **largest**?

(A) $\frac{24}{31}$ (B) $\frac{42}{13}$ (C) $\frac{4/2}{1/3}$ (D) $\frac{4+2}{1+3}$ (E) $\frac{4\cdot 2}{1\cdot 2}$

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9. How many perfect squares have exactly two digits?

(A) 4 (B) 5 (C) 6 (D) 7 (E) None of the above

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10. Jing's older brother is four times older than her. In three years, he will be three times older than her. How long from now until he is twice as old as her?

(A) Four years (B) Six years (C) Eight years
(D) Twelve years (E) None of the above

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11. Which of the following complex numbers is equal to $(1+2i)^3$?

(A) $1+8i$ (B) $4-6i$ (C) $-5+11i$ (D) $-11-2i$ (E) None of the above

12. Which of the following is **not** a divisor of 2024! (the factorial of 2024)?

(A) 23 (B) 91 (C) 243 (D) 1729 (E) None of the above

13. Three integers a, b, c satisfy equations $a+b=17$, $a+c=23$, and $b+c=28$. What is ac?

(A) 54 (B) 66 (C) 96 (D) 102 (E) None of the above

14. Four consecutive positive integers have the property that the product of the last two integers is equal to 6 times the sum of the first two integers. What is the sum of all four integers?

(A) 10 (B) 22 (C) 34 (D) 62 (E) None of the above

15. Let $f(x)=\frac{x}{2}+\frac{2}{x}$. Which of the following is closest to $f(f(f(f(\cdots f(4)\cdots))))$, where f has been applied 2024 times?

(A) .1 (B) 1 (C) $\sqrt{2}$ (D) 4 (E) 10

16. Let a, b, c be integers satisfying the Pythagorean Equation $a^2 + b^2 = c^2$. If you know that the three integers a, b, c are not all even, how many of them must be odd?

(A) 0 (B) 1 (C) 2 (D) 3 (E) None of the above

17. Which of the following is closest to the value of the sum $\frac{1}{1 \cdot 2} + \frac{1}{2 \cdot 3} + \frac{1}{3 \cdot 4} + \cdots + \frac{1}{9 \cdot 10}$?

(A) .1 (B) 1 (C) $\sqrt{2}$ (D) 4 (E) 10

18. What is the last digit of 2024^{2024} (that is, the one immediately left of the decimal point)?

(A) 0 (B) 2 (C) 4 (D) 6 (E) 8

19. Determine the sum of all integers N for which $N^2 - 3N - 5 < 0$.

(A) 9 (B) 10 (C) 15 (D) 20 (E) None of the above

20. If $x = \sqrt{3 + \sqrt{3 + \sqrt{3 + \cdots}}}$, what is $x^2 - x$?

(A) 3 (B) $3\sqrt{3}$ (C) $3 + \sqrt{3}$ (D) $6\sqrt{3}$ (E) None of the above

21. Abdul takes 4 hours to paint a room, Beatrice takes 6 hours to paint a room, and Carmine takes 8 hours to paint a room. How long does it take them to paint all 5 rooms in a house?

(A) Less than 3 hours (B) Between 3 and 5 hours (C) Between 5 and 7 hours
(D) Between 7 and 9 hours (E) More than 9 hours

22. If $3x - 2y = 12$, what is $\frac{8^x}{4^y}$?

(A) 2^{10} (B) 4^6 (C) 8^4
(D) More than one of A, B, C is correct (E) None of A, B, C are correct

23. Let λ be a real number whose square is one greater than itself; that is, $\lambda^2 = \lambda + 1$.

Which of the following is equal to λ^8?

(A) $21\lambda + 13$ (B) $8\lambda + 13$ (C) $34\lambda + 21$ (D) $16\lambda + 10$ (E) None of the above.