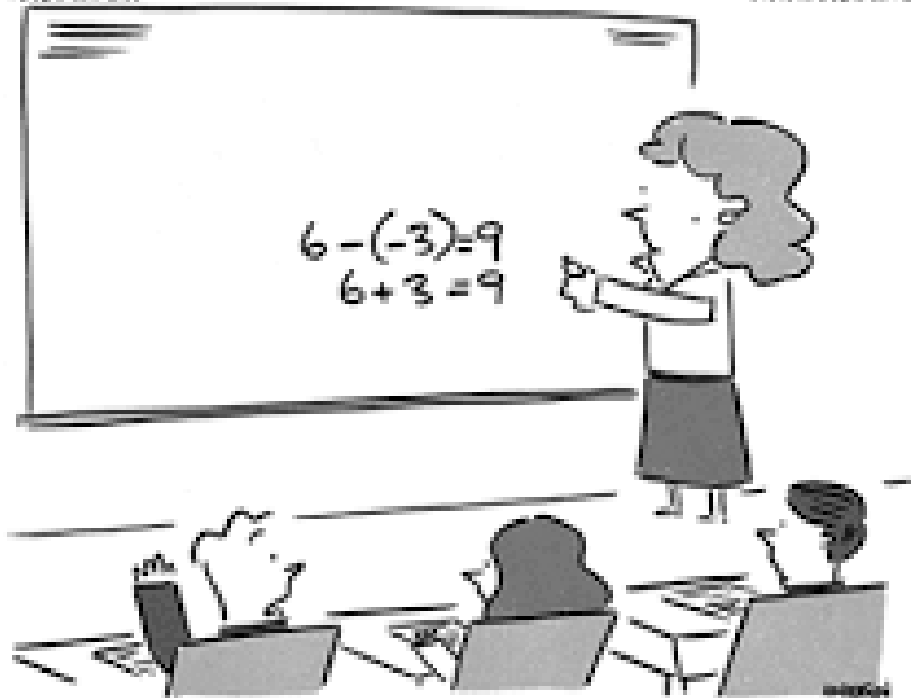


Fourteenth Annual PI Competition

Algebra Individual Test

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"So in English a double negative is bad,
but in math it's a positive?"

YOU WILL HAVE 60 MINUTES TO COMPLETE THIS TEST. THERE ARE 30 MULTIPLE CHOICE QUESTIONS. MARK YOUR ANSWER ON THE ANSWER SHEET. NO AIDS SUCH AS CALCULATORS, NOTES, BOOKS, ETC., MAY BE USED IN COMPLETING THIS TEST. ALL FRACTIONS MUST BE IN SIMPLEST FORM. **THE CHOICE E. NOTA, DENOTES “NONE OF THE ABOVE.” IF NONE OF THE ANSWERS ARE CORRECT, CHOOSE E.**

WATCH OUT FOR SILLY MISTAKES. REMEMBER THAT THESE QUESTIONS ARE MEANT TO BE CHALLENGING FOR EVEN THE TOP STUDENTS.

GOOD LUCK AND HAVE FUN!

1. Find the sum of the solutions to the following equation: $2x^2 + 7x + 3 = 0$

- A. $3\frac{1}{2}$ B. $-3\frac{1}{2}$ C. $7\frac{1}{3}$ D. $-7\frac{1}{2}$ E. NOTA

2. If $f(x) = x^2 + 2x + 1$, find the solution to $f(x + 3)$

- A. -1 B. -3 C. -4 D. 0 E. NOTA

3. Find the sum of the solutions to the polynomial $f(x) = x^3 + 5x^2 - x - 5$

- A. 1 B. -5 C. 0 D. -1 E. NOTA

4. Gordon is a professional chef who wants to make a cheesecake with a 25% concentration of cheese. However, he measures wrong and ends up with an 8 mL mixture with only 12.5% concentration of cheese. How many mL of 50% cheese should he add to his mixture to get his desired 25% concentration of cheese?

- A. 2 mL B. 4 mL C. 1 mL D. 3 mL E. NOTA

5. Simplify the following expression: $\left(\frac{6x^2+2x}{2x}\right)^2$

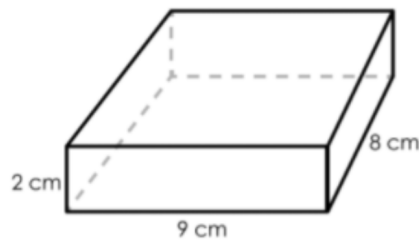
A. $\frac{36x^4+24x^3+4x^2}{4x^2}$ B. $3x^2 + 6x + 1$ C. $\frac{5x^3+2}{8x}$ D. $9x^2 + 1$ E. NOTA

6. Convert $y = \frac{-1}{9}x + 5$ to point-slope form.

A. $y - 0 = \frac{-1}{9}(x - 5)$ B. $y - 5 = -9(x - 0)$ C. $y - 0 = -9(x - 5)$

D. $y - 5 = \frac{-1}{9}(x - 0)$ E. NOTA

7. Find the sum of the volume and the surface area of the rectangular prism below.



A. 309 B. 327 C. 356 D. 378 E. NOTA

8. Which property is shown here: $21+0=21$?

A. Additive Identity Property B. Associative Property of Addition

B. C. Addition Property of Equality D. Additive Inverse Property E. NOTA

9. Given $f(x) = 3x^2 + 5x - 6$ and $g(x) = 3x + 2$, find $f(g(x))$

A. $5x^2+8x+9$ B. $5x+4$ C. $24x^2+10x+21$ D. $27x^2+51x+16$ E. NOTA

10. Find the degree and the leading coefficient of the following function:

$$y = (2x - 3)^2(4x + 2)(2x - 6)$$

A. 2, 14 B. 4, 16 C. 3, 32 D. 4, 32 E. NOTA

11. Given the following system of equations, find xy :

$$2x + 2y = 4$$

$$x - 2y = 2$$

- A. 1 B. 2 C. 3 D. 4 E. NOTA

12. Given the function $f(x) = 4(x - 2)(\frac{1}{2}x + 1)$, find the sum of the x coordinates of the x -intercept(s) and y -intercept(s).

- A. 2 B. -8 C. 0 D. -2 E. NOTA

13. Find the solution to $\frac{2022!+2023!}{2022!}$ (Hint: $3! = 3 \times 2 \times 1$)

- A. 2024 B. 2023 C. 2022 D. 1 E. NOTA

14. What is $a + b + c + d$, where $ax^3 + bx^2 + cx + d$ is the resulting product of $f(x)$, and $g(x)$ and $f(x) = 5x - 16$ and $g(x) = 3x^2 + 3$

- A. 15 B. -48 C. -66 D. 18 E. NOTA

15. What is the percent change if I initially had 24 chocolate bars and stole 6 more from my friends?

- A. 30% B. 24% C. 25% D. 20% E. NOTA

16. Find the absolute value of the product of the solutions to the following polynomial:

$$f(x) = x^3 - 4x^2 + x + 6$$

- A. -6 B. 4 C. -4 D. 6 E. NOTA

17. Solve the problem and rationalize: $2 \times \frac{3}{2+\sqrt{2}}$

- A. $1 - 3\sqrt{2}$ B. $3 - 3\sqrt{2}$ C. $5 - 3\sqrt{2}$ D. $6 - 3\sqrt{2}$ E. NOTA

18. Solve the following equation for y : $3(3y - 5) = 14y$

- A. -3 B. -5 C. -4 D. -2 E. NOTA

19. Find the slope of the line parallel to the function $8y - 5x = 21$

- A. $-\frac{5}{8}$ B. $\frac{5}{8}$ C. $-\frac{8}{5}$ D. $\frac{8}{5}$ E. NOTA

20. Which property is shown here: $a \times b \times c = c \times a \times b$

- A. Associative Property of Multiplication B. Commutative Property of Multiplication
C. Distributive Property of Multiplication D. Identity Property of Multiplication
E. NOTA

21. It takes Megan 20 minutes to paint a wall. It takes Dat 30 minutes to paint the wall.

Kaylee can paint the wall in 10 minutes. How long, in minutes, would it take all three of them to paint the wall if they combined their efforts and painted it simultaneously?

- A. 60 B. $\frac{32}{11}$ C. $\frac{55}{11}$ D. $\frac{60}{11}$ E. NOTA

22. Kathryn throws a ball from the ground to the top of a 1,400-foot-tall building. The

height of the object (measured in feet), t seconds after she throws it, is modeled by the equation $h(t) = -16t^2 + 160t + 1400$. How long does it take, in seconds, for the object to reach the top of the building?

- A. 20 B. 5 C. 15 D. 10 E. NOTA

23. In two years, Peter will be twice Ned's age. Four years ago, Peter was two years

younger than three times Ned's age. What is the sum of Peter's age and Ned's age four years after today?

- A. 46 B. 48 C. 38 D. 30 E. NOTA

24. The polynomial $6x^2 + x - 2$ can be factored into the form $(ax+b)(cx+d)$, where a , b , c , and d are integers. What is the mean of a , b , c , and d ?

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

25. A function, $f(x)$, is a line where $f(-4) = 5$ and $f(2) = 2$. What is the distance between the x-intercept and the y-intercept of this function?

- A. 5 B. $9\sqrt{5}$ C. $3\sqrt{5}$ D. $5\sqrt{3}$ E. NOTA

26. If $x - \frac{y^2}{k} = \frac{w}{v}$, which of the following expresses v in terms of k , w , x , and y ?

- A. $kxwy^2$ B. $\frac{w}{kx-y^2}$ C. $\frac{kw}{x-y^2}$ D. $\frac{kw}{kx-y^2}$ E. NOTA

27. What are the roots of the following equation: $2a^2 + 11a + 5$?

- A. $5, \frac{1}{2}$ B. $-10, -1$ C. $10, 1$ D. $-4, \frac{1}{2}$ E. NOTA

28. Roman is not very good at Spanish, but thankfully he is good at math. He earns an average score of 57 on 4 Spanish tests. What is the average test score he needs to make on his next 6 tests to boost his overall score average of all 10 tests to a passing grade of 72?

- A. 74 B. 78 C. 82 D. 84 E. NOTA

29. Which of the following lines is perpendicular to the line $y = 3(x - 3) + 6$?

- A. $3x - y = 4$ B. $x - 3y = 9$ C. $2x + 6y = 7$ D. $4x + 3y = 5$ E. NOTA

30. Congratulations! You have reached the last question. If $a+b=8$ and $a^2+b^2=60$, what is a^2b^2 ?

- A. 4 B. 2 C. 64 D. 16 E. NOTA