DE Exam

Texas A&M High School Math Contest

25 October, 2025

(NOTE: If units are appropriate, please include them in your answer. All answers must be simplified where possible.)

1. A rectangle has perimeter 17 and area 15. Find the length of the diagonal of this rectangle.

2. Solve for x: $\quad 12x^{7/5} + 3x^{2/5} = 13x^{9/10}$.

3. Find the largest solution x of the equation $\big|3|x| - 2\big| = 1 - 2x$.

4. Given $b_1 > b_2$, let $f_1(x) = 20x^2 + b_1 x + 250$ and $f_2(x) = 5x^2 + b_2 x - 125$. Given that the parabolas intersect in exactly one point find the value of $b_1 - b_2$.

5. What is the constant term when the expression $\left(x + 1 + \dfrac{1}{x}\right)^4$ is expanded?

6. Find a real solution x of the equation $\sqrt{x\sqrt{x\sqrt{x}}} = 8\sqrt{2}$.

7. Evaluate the sum $\dfrac{3}{1^2 \cdot 2^2} + \dfrac{5}{2^2 \cdot 3^2} + \dfrac{7}{3^2 \cdot 4^2} + \cdots + \dfrac{2025}{1012^2 \cdot 1013^2}$.

8. Let $a > b > 0$, $a^2 + b^2 = 3ab$. Find the value of $\dfrac{a+b}{a-b}$. Write your answer as a single term with no sums or differences.

9. A polynomial $f(x) = x^5 - 2x^4 + ax^2 + bx$, where a and b are unknown coefficients, is divisible by $x^2 - 3x + 2$. Find ab.

10. If $i = \sqrt{-1}$, find the sum

$$1 + i + i^2 + i^3 + \cdots + i^{2025}$$

11. Determine how many real solutions (x, y) the following system of equations has:

$$\begin{cases} x^2 + y^2 = 18, \\ \sin(x - y) = 0. \end{cases}$$

12. Find all solutions x of the equation $\log_3 x + \log_x 27 = \log_3(9x^3) + \log_x(9/x)$.

13. Find the exact value of

$$E = \sum_{k=1}^{8} \sin^6 \frac{(2k-1)\pi}{32}.$$

14. Find the largest integer N such that

$$\sum_{n=1}^{2025} \frac{1}{n^3 + 3n^2 + 2n} < \frac{1}{N}.$$

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15. A function $f : \mathbb{N} \to \mathbb{N}$ on the set of positive integers is defined recursively as follows: $f(1) = 1$, $f(n) = f(n-1) + 1$ for all odd numbers $n \geq 3$, and $f(n) = f(n/2)$ for all even n. Find $f(2025)$.

16. Evaluate the product $\cos \frac{\pi}{7} \cos \frac{3\pi}{7} \cos \frac{5\pi}{7}$.

17. Find the sum of the solutions of the equation

$$\sqrt{x + \sqrt{4x-3} + \frac{1}{4}} + \sqrt{x - \sqrt{4x-3} + \frac{1}{4}} = x.$$

18. Consider the trigonometric equation

$$(\sin 2x + \sqrt{3} \cos 2x)^2 - 5 = \cos\left(\frac{\pi}{6} - 2x\right).$$

Find the sum of all solutions of this equation which lie in the interval $[0, 4\pi]$.

19. Find $\left\lfloor \sqrt{2}^{\sqrt{3}} - \sqrt{3}^{\sqrt{2}} \right\rfloor$, that is, the largest integer not exceeding $\sqrt{2}^{\sqrt{3}} - \sqrt{3}^{\sqrt{2}}$.

20. Find all the triples of positive real numbers (x, y, z) that satisfy the equations

$$\frac{4\sqrt{x^2+1}}{x} = \frac{5\sqrt{y^2+1}}{y} = \frac{6\sqrt{z^2+1}}{z},$$
$$x + y + z = xyz.$$