2022 Gauss Math Tournament Target Round (Div. 2)

June 11, 2022

1. $\begin{pmatrix} -2 & 2 \\ 0 & 1 \end{pmatrix} + \begin{pmatrix} -3 & 2 \\ 7 & -9 \end{pmatrix} = \begin{pmatrix} a & b \\ c & d \end{pmatrix}$. What is $a \cdot b - c \cdot d$?

2. What is the area of a triangle with coordinates of $(2, 1)$, $(-2, -3)$, and $(-3, 1)$ in units^2?

3. What is the sum of the roots of the cubic equation $x^3 + 4x^2 + 5x - 2 = 0$?

4. Dr. Blake is a chemist. He wants to make purple water, which requires a 4:9 ratio of red to blue. He is going to mix x L of Solution 1 with $(13 - x)$ L of Solution 2 together to make 13 L of purple. Solution 1 has a 1:3 ratio of red to blue and Solution 2 has a 2:3 ratio of red to blue. What is x?

5. Which of the following is equivalent to $\frac{1}{\sqrt{9x}} + \frac{\sqrt{x}}{3}$?

(A) $\frac{\sqrt{x}+3x\sqrt{x}}{3x}$ **(B)** $\frac{3\sqrt{x}+x\sqrt{x}}{3}$ **(C)** $\frac{3\sqrt{x}+x\sqrt{x}}{3x}$ **(D)** $\frac{\sqrt{x}+x\sqrt{x}}{3}$ **(E)** $\frac{\sqrt{x}+x\sqrt{x}}{3x}$

6. In right triangle ABC with hypotenuse AC, the perpendicular bisectors are drawn out and intersect at point D. Point E is the midpoint of side AB. If $AB = 18$ and $CA = 82$, what is the length of ED?

7. Leo has a standard deck of 52 cards. What are the odds of him drawing either a queen or a card from the suit of clubs? Write your answer as a ratio $a : b$.

8. In the diagram below, $\angle CAN = \angle WNA$ and $CB = WB$. If $CW = 28$, $CB = \frac{35}{2}$, and $NA = 8$, what is the length of WN?