

NO CALCULATORS

- $\begin{bmatrix} 7 & 3 & -2 \\ 8 & 6 & 12 \end{bmatrix} - \begin{bmatrix} 11 & -3 & 3 \\ 1 & 7 & -5 \end{bmatrix} = \begin{bmatrix} a & b & c \\ d & e & f \end{bmatrix}$. Find the value of $acd - 2cf$.
- Let $A = (\lambda - a)(\lambda - b)(\lambda - c)(\lambda - d) \cdots (\lambda - x)(\lambda - y)(\lambda - z)$, where A has 26 factors arranged alphabetically. If $\lambda = p$, find the value of A .
- Find the product of the distinct **rational** roots of $x^4 + 5x^3 - 17x^2 - 15x + 42 = 0$.
- A parabola has a directrix whose equation is $x = -2$ and has its focus at $(2, 2)$. The equation of this parabola can be expressed in the form $kx = (y - 2)^2$. Find the value of k .
- Find the value of k such that $4^k = 32^{\left(\frac{-3}{5}\right)}$. Express your answer as a **decimal**.
- Let $i = \sqrt{-1}$. If $(k + wi)(7 - 16i) = 94 + 3i$, find the value of w .
- Let $f(x) = 2x^2 - 15$ and let $g(x) = \sqrt{\frac{x+15}{2}}$. Find $f(g(36))$.
- A box contains orange marbles and blue marbles. You draw two of these marbles without replacement. If the probability of selecting an orange marble and a blue marble in that order is $\frac{17}{60}$, and the probability of drawing an orange marble on the first draw is $\frac{2}{3}$, find the probability of drawing a blue marble on the second draw if you know the first marble drawn was orange. Express your answer as a common fraction reduced to lowest terms.

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9. **(Always, Sometimes, or Never)** For your answer, write the whole word **Always**, **Sometimes**, or **Never**—whichever is correct.

If h , k , and j are real numbers such that $h > k$ and $k > j$, then $hk > kj$.

10. **(Multiple Choice)** For your answer write the capital letter that corresponds to the best answer.

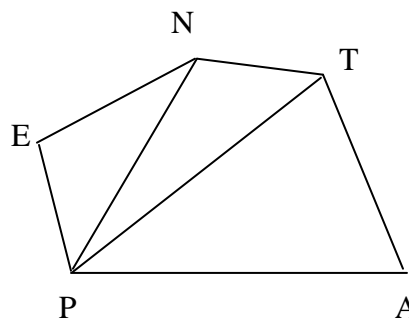
Which of the following lines are asymptotes of the graph of $y = \frac{x+7}{x-5}$?

- A) $x = 5$ only.
- B) $x = -7$ only.
- C) $y = 1$ only.
- D) $x = 5$ and $x = -7$.
- E) $x = 5$ and $y = -7$.
- F) $x = 5$ and $y = 1$.

Note: Be certain to write the correct capital letter as your answer.

11.

The perimeter of pentagon $PENTA$ is 40. $PN = 10$, $PT = 11$, and $PA = 12$. All sides of pentagon $PENTA$ have lengths which are integers. If 4 of the sides of $PENTA$ are congruent, then $\sin(\angle PAT) = \frac{k\sqrt{w}}{f}$ where k , w , and f are positive integers. Find the smallest possible value of $(k + w + f)$.



12. The average SAT score of a group of students was 600, and the standard deviation was 100. If each score had been increased by 20, find the sum of the new arithmetic mean and the new standard deviation.
13. Let n be a positive integer. For all $n \geq 1$, $t_{(n+1)} = 3t_n + 7$. If $t_5 = 163$, find the value of t_2 . Express your answer as an improper fraction reduced to lowest terms.

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14. Find the sum of all distinct values of x such that the three terms $x-2$, $x+1$, and $4x-8$ in that order will form a geometric progression.
15. All ages in this problem are in whole numbers of years. A father has three daughters whose ages form an arithmetic progression. The father is now 6 years older than the sum of the daughters' ages. Six years ago, the sum of the daughters' ages at that time was half of the father's present age and the youngest daughter was then $\frac{1}{3}$ as old as the oldest daughter was then. Find the number of years in the present age of the oldest daughter.
16. If $0^\circ < x < 180^\circ$, find the sum of all distinct values of x such that $\sin(6x)^\circ + \cos(4x)^\circ = 0$.
17. A parabola has its vertex at $(0,0)$, has its focus on the y -axis, and passes through the point $(-8,4)$. The equation of this parabola can be expressed in the form $(x-h)^2 = py$. Find the value of $(h+p)$.
18. A circle has the equation $(x-4)^2 + (y+2)^2 = k$. If the area of this circle is 324π , find the value of k .
19. When $37!$ is computed, it ends in 8 zeroes. Find the digit that immediately precedes these zeroes.
20. Let $i = \sqrt{-1}$. Let w and f be integers such that the 3 roots for x of $x^3 - 12x^2 + cx + dix + k + hi = 0$ are $4-i$, $3+wi$, and f . Find the value of $(c+d+k+h)$.

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Jr/Sr 8 Person

(Use full school name – no abbreviations)

_____ Correct X **5** pts. ea. =

Note: All answers must be written legibly in simplest form, according to the specifications stated in the Contest Manual. Exact answers are to be given unless otherwise specified in the question. No units of measurement are required.

1. _____ 310 _____

11. _____ 19 _____

2. _____ 0 _____

12. _____ 720 _____

3. _____ -14 _____

13. _____ $\frac{8}{3}$ (Must be this reduced improper fraction.) _____

4. _____ 8 _____

14. _____ 6 _____

5. _____ -1.5 (Must be decimal answer.) _____

15. _____ 18 (Years optional) _____

6. _____ 5 _____

16. _____ 495 (Degrees optional.) _____

7. _____ 36 _____

17. _____ 16 _____

8. _____ $\frac{17}{40}$ (Must be this reduced common fraction.) _____

18. _____ 324 _____

9. _____ Sometimes (Must be the whole word.) _____

19. _____ 4 _____

10. _____ F (Must be this capital letter.) _____

20. _____ -21 _____