

- Let (h, k) be the center of $x^2 + 4x + y^2 + 6y - 3 = 0$, and let r be the radius.
Let d be the distance between the vertex and the focus of $y^2 + 4x + 5 = 0$.
Let m be the slope of $6x + 2y + 1 = 0$.
What is $h + k + r + d + m$?
- Let $f(x) = 2x^3 + 3x^2 - 8x + 12$.
Let R be the sum of the reciprocals of the roots of f .
Let S be the sum of the squares of the roots of f .
What is $3R + 4S$?
- Suppose functions f and g are defined so that $f(x+y) = f(x)f(y)$ and $g(xy) = g(x) + g(y)$, and f is nowhere zero. What is $f(g(1))$?
- Let A be the number of intersection points between $xy = 1$ and $x^2 - 2x + y^2 + 2y + 1 = 0$.
Let B be the number of intersection points between $x^2 + 2x + y^2 = 0$ and $x^2 - y^2 = 1$.
What is $A + B^2$?
- How many of the following statements are true?
 - $f(x) = x^2 + 3$ is an even function.
 - $f(x) = \log x$ is an even function.
 - $x^2 + 2y^2 = 1$ is a hyperbola.
 - $2x^2 - 3y + 4 = 0$ has a latus rectum 6 units long.
 - $f(x) = |x|$ is one-to-one.
 - $(1-x)$ is a divisor of $1-x^9$.
- What value of B will cause the following function to have exactly five zeros?

$$f(x) = \left| \left| |x| - 1 \right| - 3 \right| - B$$

- Let A be the 34th term in the arithmetic sequence 1, 4, 7,
Let B be the sum of the first 21 terms of the arithmetic sequence 2, 6, 10,
Let C be the ninth term in the geometric sequence 1, $\sqrt{2}$, 2,
Let D be the sum of the infinite geometric series $\frac{2}{3}, \frac{4}{9}, \frac{8}{27}, \dots$.
Find $A + B + C + D$.

- Consider the following function.
 $\sigma(x)$ is the sum of the positive integer divisors of x .
Evaluate

$$\frac{\sigma(196)}{\sigma(4)\sigma(49)} \frac{\sigma(9)\sigma(25)}{\sigma(225)} \sigma(11)$$

9. Use each answer to determine the next.

Let A be the sum of the roots of $y = x^2 + 5x - 36$.

Let B be the positive solution of $\log_2(x^2) = A + 1$.

Let C be the slope of the line $x + By = 2$.

What is C ?

10. Suppose

$$x + y + z = 2$$

$$x - z = 4$$

$$2x - y + z = 3$$

What is $x^2 + xy - yz - z^2$?

11. Let A be the y -intercept of the line parallel to $4x + 3y = 5$ through the point $(6, -5)$.

Let B be the x -intercept of the line perpendicular to $3x - 2y = 1$ through the point $(4, -4)$.

Let C be the y -intercept of the parabola with focus at $(4, 3)$ and directrix $y = -1$.

What is $(A + B)(C)$?

12. Evaluate

$$1 + \log_2\left(-1 + 2^{1 + \log_2\left(-1 + 2^{1 + \log_2\left(-1 + 2^{1 + \log_2(-1 + \dots)}\right)}\right)}\right)$$

13. The eigenvalues of a matrix A are all the values of λ which satisfy

$$\det(A - \lambda I) = 0$$

where I is the identity matrix. Find the sum of the eigenvalues of

$$A = \begin{pmatrix} 1 & 3 \\ 3 & 1 \end{pmatrix}.$$

14. Let A be the solution set of

$$\left| |x + 1| - 1 \right| = 2$$

Let B be the solution set of

$$|x - 2| + |x + 2| \geq 6$$

How many integers between -5 and 5 inclusive are in $A \cup B$?

15. Let W be the number of ways 5 men and 4 women can be arranged in a line alternating men and women.

Let X be the number of ways 6 distinct keys can be arranged on a key ring with a clasp.

Let Y be the number of distinct ways to arrange the letters in MUALPHATHETA

Let Z be the number of ways to arrange 6 books chosen from a pile of 12 distinct books.

What is $\frac{WY}{XZ}$?