

1. Consider four distinct vowels and eight distinct consonants, one being b . How many five-letter "words" can be formed containing two different vowels and three different consonants if the word must contain b ? The "word" need not be an actual word.
A. 126 B. 15120 C. 20160 D. 4032 E. NOTA
2. The point equidistant from $(-4, 3)$, $(5, 6)$, and $(4, -1)$ is (a, b) . Find the value of $(b-a)^2 + (a-b)^3$.
A. 8 B. 12 C. -80 D. -4 E. NOTA
3. A linear transformation maps the graph of $y = \frac{1}{x}$ to $y = \frac{4x+5}{x+1}$. Find the equation of the image of $y = x^2 - 2x + 3$ under the same translation.
A. $y = x^2 - 4x + 3$ B. $y = x^2 - 4x + 10$ C. $y = x^2 + 6$ D. $y = x^2 - 2x + 7$ E. NOTA
4. The number $4^{14} - 1$ is divisible by 29 but $2^{14} - 1$ is not. What is the remainder when $2^{14} - 1$ is divided by 29?
A. 27 B. 14 C. 21 D. 16 E. NOTA
5. How many distinct prime numbers are in the first 50 rows of Pascal's Triangle?
A. 29 B. 15 C. 16 D. 28 E. NOTA
6. Simplify $\left(\frac{1+i}{1-i} - \frac{1-i}{1+i}\right)^5$ if $i = \sqrt{-1}$.
A. -32 B. -32i C. 0 D. 2 E. NOTA
7. A parallelogram has diagonals of length 10 and 20. Find the area enclosed by the circle inscribed in the parallelogram.
A. 12π B. 8π C. 20π D. 16π E. NOTA
8. The length of a rectangle increases by 40% and the width decreases by 25%. By what percentage does the area increase?
A. 115 B. 105 C. 120 D. 110 E. NOTA
9. Let $f(x) = \frac{2x-3}{x+3}$ and $g(x) = \frac{3x-4}{x+2}$. There are integers a, b, c , and d such that $f(g(x)) = \frac{ax+b}{cx+d}$.
What is the value of $\frac{b}{d}$?
A. $\frac{2}{3}$ B. $-\frac{1}{13}$ C. -7 D. -2 E. NOTA
10. Two of the roots of $x^3 + 6x^2 - 25x + c = 0$ are 1 and 2. What is the value of c ?
A. 6 B. -6 C. -18 D. 18 E. NOTA

11. The function $f(x) = ba^{-x} + c$ has horizontal asymptote $y = 32$, y -intercept 212, and passes through $(2, 112)$. Find the value of $a \cdot c + b$.
- A. 238 B. 88 C. 152 D. 302 E. NOTA
12. The first three terms of an arithmetic progression and a geometric progression (they are different progressions) are, in order, $3x - 2$, $-4x$, $-5x^2$. Find the sum of the second terms of all possible sequences.
- A. $-\frac{36}{5}$ B. $-\frac{48}{5}$ C. $-\frac{164}{5}$ D. $\frac{9}{5}$ E. NOTA
13. Find the sum of all real values of k so that the following system of equations is consistent.
- $$\begin{cases} kx + 2y + k = 0 \\ 3x + 14ky - 5k = 0 \\ 2kx + 5y + k = 0 \end{cases}$$
- A. $\frac{5}{14}$ B. -3 C. $-\frac{12}{7}$ D. $-\frac{45}{14}$ E. NOTA
14. Two perpendicular chords of a circle intersect at point M . One chord is 7 units long, divided at M into segments of length 3 and 4, while the other chord is divided into segments of length 2 and 6. What is the area enclosed by the circle?
- A. 14π B. $\frac{61}{4}\pi$ C. $\frac{65}{4}\pi$ D. $\frac{75}{4}\pi$ E. NOTA
15. Find the shortest distance between $\left(\frac{9}{2}, 0\right)$ and the curve $y = \sqrt{x-1}$.
- A. $\frac{\sqrt{13}}{2}$ B. $\sqrt{3}$ C. $\frac{\sqrt{7}}{2}$ D. $\frac{\sqrt{11}}{2}$ E. NOTA
16. A big-box store sells cans of eight tennis balls. The balls are stacked one on top of the other in a cylindrical can where the balls are tangent to the can. What fraction of the volume of the can is inside the balls?
- A. $\frac{2}{3}$ B. $\frac{1}{3}$ C. $\frac{3}{4}$ D. $\frac{3}{8}$ E. NOTA
17. The range of $y = \frac{3x^2 + 4}{2x + 1}$ can be written in interval notation as $\left(-\infty, \frac{a - \sqrt{b}}{c}\right) \cup \left(\frac{a + \sqrt{b}}{c}, \infty\right)$.
- Find the value of $\frac{a + b}{c}$.
- A. 30 B. 35 C. 29 D. 27 E. NOTA

25. A bug walks from the focus F of the graph of $x = \sqrt{\frac{1+9y^2}{4}}$ to a point on the graph. From there, it walks to the point $(-\frac{\sqrt{13}}{6}, 0)$. Find the positive difference between the distances of these two walks.
- A. $\frac{1}{2}$ B. 1 C. $\frac{2}{9}$ D. $\frac{1}{9}$ E. NOTA
26. If $r > 0$ and $(r+r^{-1}) = \sqrt{5}$, what is the value of $r^3 + r^{-3}$?
- A. 18 B. 10 C. $5\sqrt{5}$ D. $2\sqrt{5}$ E. NOTA
27. The solutions to $3\sqrt{2x^2 - 5x - 3} + 2x^2 - 5x = 7$ can be written in the form $x = \frac{a \pm \sqrt{b}}{c}$, where a , b , and c are positive integers. Find the value of $a+b+c$.
- A. 50 B. 66 C. 47 D. 57 E. NOTA
28. A class has four boys and three girls. If the students are called randomly to the office once at a time, what is the probability that they go in alternating boy/girl order?
- A. $\frac{1}{7}$ B. $\frac{1}{4}$ C. $\frac{2}{7}$ D. $\frac{1}{35}$ E. NOTA
29. Radii divide a circle into nine unequal sectors whose central angles each have an integral number of degrees. What is the maximum measure, in degrees, of the central angle of the smallest sector?
- A. 8 B. 36 C. 9 D. 12 E. NOTA
30. If $f(x) = a + bx$, where $a, b \in \mathbb{R}$ and $f(f(f(1))) = 29$ and $f(f(f(0))) = 2$, find the value of $a+b$.
- A. 4 B. $\frac{41}{13}$ C. $\frac{19}{6}$ D. $\frac{35}{12}$ E. NOTA