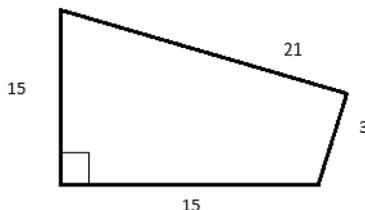


For all questions, answer choice (E) NOTA means that none of the given answers is correct. Good Luck!

- In geometry, formal definitions include other defined terms. However, there are three terms considered as undefined. Which of the following answer choices is not one of these undefined terms?
(A) Point (B) Line (C) Plane (D) Shape (E) NOTA
- What is the converse of the inverse of the contrapositive of the converse of the contrapositive of the following statement?
If Leana spills her coffee on Keerthana, then she will make Grace run to Starbucks.
(A) If Leana does not spill her coffee on Keerthana, then she will not make Grace run to Starbucks.
(B) If Leana does not make Grace run to Starbucks, then Leana did not spill her coffee on Keerthana.
(C) If Leana makes Grace run to Starbucks, then Leana spilled her coffee on Keerthana.
(D) If Leana does spill her coffee on Keerthana, then she will make Grace run to Starbucks.
(E) NOTA
- How many distinct alphabetic arrangements are there for *RICKINVITE*?
(A) 604,799 (B) 3,628,800 (C) 1,814,400 (D) 302,400 (E) NOTA
- Vishnu chooses a number between 1 and 1000 for Nihar to guess. His number has 6 odd factors and 24 total factors. What is the least possible number satisfying these conditions that Nihar can correctly guess?
(A) 243 (B) 360 (C) 600 (D) 240 (E) NOTA
- What is the real value of $a + b$, using the two equations below?
 $a^2 + b = 29$
 $a + b^2 = 21$
(A) 30 (B) 9 (C) 10 (D) 29 (E) NOTA
- What is the value of $\frac{(\cos 30^\circ)(\sin 45^\circ)}{(\cos 45^\circ)(\sin 30^\circ)}$?
(A) $\frac{\sqrt{3}}{2}$ (B) $\frac{1}{\sqrt{3}}$ (C) $\sqrt{3}$ (D) $\sqrt{2}$ (E) NOTA
- Let a cube be defined by vertices at $(0, 0, 0)$, $(0, 10, 0)$, $(10, 0, 0)$, and $(0, 0, 10)$. Find the number of distinct cubes with integer coordinates at each of its' vertices that are within the $10 \times 10 \times 10$ cube and have edges that are parallel to the x , y , and z -axis.
(A) 14399 (B) 12000 (C) 12001 (D) 13000 (E) NOTA
- Diyah drops a ball off a building that is 50 feet tall and it rebounds up to $\frac{9}{10}$ of its original height. What is the total distance the ball travels?
(A) 1000 (B) 500 (C) 850 (D) 450 (E) NOTA
- What is the sum of the positive divisors of 1290?
(A) 3168 (B) 3445 (C) 3300 (D) 3024 (E) NOTA
- In a triangle, what is the name of the circle which passes through the feet of the altitudes and the midpoints of the sides?
(A) Six-Point (B) Altitude-Midpoint (C) The Euler (D) Eight-Point (E) NOTA

11. Raksha and Chanda like to bake quadrilateral cookies. One of their cookies (modeled by the diagram below) has side lengths of 15, 21, 3, and 15 units, as shown below. What is the area of this cookie? Note: this cookie is not drawn to scale, and nor is it edible.



- (A) 144 (B) 288 (C) 225 (D) Lack of information. (E) NOTA
12. $f(x)$ is a quadratic function in which $f(1) = 9$ and $f(9) = 9$. What is the x -coordinate of the vertex of the graph of $f(x)$?
- (A) 7 (B) 9 (C) 5 (D) 0 (E) NOTA
13. Josh enjoys drawing hexagons in his free time. On one of Josh's hexagons, four sides are 30 cm long and the other two have a length of $15\sqrt{2}$. This hexagon also has two right angles. What is the area of this particular hexagon, in cm^2 ?
- (A) 1800 (B) 2025 (C) 1500 (D) 2000 (E) NOTA
14. In a senior game of kickball, Carson, Cherry, and Karthik were the team captains. Cherry has 5 more than twice as many seniors on her team as Carson does on his. Karthik has $\frac{1}{3}$ of the number of seniors than one more than twice the number of seniors on Cherry's team. Karthik also has $\frac{1}{2}$ of one less than the sum of the number of seniors on Cherry and Carson's teams. If every senior at the school participated and were all on either Karthik's, Cherry's, or Carson's team for the entire length of the match, how many seniors are there at James S. Rickards High School?
- (A) 35 (B) 52 (C) 51 (D) 27 (E) NOTA
15. What is the fifth term of $(\frac{x}{2} + 2)^{12}$, given that the sequence is organized by decreasing powers of x ?
- (A) $7280x^4$ (B) $198x^7$ (C) $196x^7$ (D) $\frac{454x^8}{16}$ (E) NOTA
16. Deekshita tries to be rad by solving this radical problem: What is x^2 , if $x = \sqrt{9 + \sqrt{17}} + \sqrt{9 - \sqrt{17}}$?
- (A) $\sqrt{34}$ (B) 34 (C) 26 (D) $\sqrt{26}$ (E) NOTA
17. What is the sum of the coefficients of $(7x - 3)^4$?
- (A) 64 (B) 256 (C) 255 (D) 254 (E) NOTA
18. What is $a + b$ such that the rational function $f(x) = \frac{ax^4 + bx^3 + 1}{x^3 + 2}$ has the oblique asymptote given by $y = 6x + 5$?
- (A) 8 (B) 7 (C) 6 (D) 5 (E) NOTA
19. Vishnav the chemist loves working with acids and bases, and gives you the following base conversion question: what is 10101_2 in base 16?
- (A) $2A_{16}$ (B) 15_{16} (C) 14_{16} (D) Does not exist (E) NOTA

20. Find the coefficient of the x^2 term of the polynomial that has roots that are the reciprocals of the roots of the following polynomial:

$$f(x) = x^3 + 4x^2 + 5x + 9$$

- (A) 9 (B) 4 (C) 2 (D) 1 (E) NOTA
21. What is the sum of $\frac{1}{2} + \frac{2}{4} + \frac{3}{8} + \frac{4}{16} + \frac{5}{32} + \dots$?
 (A) $\frac{3}{2}$ (B) $\frac{1}{2}$ (C) 1 (D) 2 (E) NOTA
22. What is the value of $|2 + 3i|^2$?
 (A) $13i$ (B) $\sqrt{13}$ (C) 13 (D) $-5 + 12i$ (E) NOTA
23. Rayyan is fighting for equality and is given this problem on inequalities to solve: given $9x + 12y = 108$, what is the minimum value of $\sqrt{x^2 + y^2}$?
 (A) $\frac{36}{5}$ (B) $\frac{109}{15}$ (C) 12 (D) 9 (E) NOTA

Tanvi and Sanjita are watching the movie, *The Matrix*, and found this matrix: $A = \begin{bmatrix} 1 & 2 \\ 2 & 1 \end{bmatrix}$. Use this matrix for questions 24 and 25.

24. What is $|A|$?
 (A) -5 (B) 3 (C) -3 (D) 5 (E) NOTA
25. What is A^{-1} ?
 (A) $\begin{bmatrix} -\frac{1}{3} & -\frac{2}{3} \\ -\frac{2}{3} & -\frac{1}{3} \end{bmatrix}$ (B) $\begin{bmatrix} \frac{1}{3} & -\frac{2}{3} \\ -\frac{2}{3} & \frac{1}{3} \end{bmatrix}$ (C) $\begin{bmatrix} \frac{1}{3} & \frac{2}{3} \\ \frac{2}{3} & \frac{1}{3} \end{bmatrix}$ (D) $\begin{bmatrix} -\frac{1}{3} & \frac{2}{3} \\ \frac{2}{3} & -\frac{1}{3} \end{bmatrix}$ (E) NOTA
26. Jeremy and Rohan have an obsession with parabolas. What is the foci of their favorite parabola, whose equation is given below?
 $y = \frac{1}{8}x^2 - x + 5$
 (A) (5, 8) (B) (4, 5) (C) (3, 0) (D) (8, 5) (E) NOTA
27. In a 60×72 rectangle, all of the 4320 unit squares are drawn. How many squares does the diagonal pass through?
 (A) 100 (B) 220 (C) 132 (D) 146 (E) NOTA
28. What is the volume of the frustum with base areas 64π and 9π along with a height of 5?
 (A) $\frac{485\pi}{3}$ (B) $\frac{490\pi}{3}$ (C) 485π (D) 162π (E) NOTA
29. Sri was chopping logs and RJ tried to stump him by giving him this log problem: what is x in terms of b when $\log_x \frac{x^2}{b^3} = \log_b \frac{b^4}{x}$?
 (A) b (B) b^2 (C) b^4 (D) b^3 (E) NOTA
30. Anvitha and Tanusri share three circular cookies with distinct radii for dessert. They place them in an arrangement such that the three circular cookies are externally tangent to a line and to each other. The two larger cookies have radii 9 and 36. What is the radius of the smallest cookie?
 (A) $9\sqrt{15}$ (B) 3 (C) 9 (D) 6 (E) NOTA