



 Raising A Mathematician Foundation®

ROOTS 2024

Cube Roots

September 22, 2024

Answers

1. What is 2024th letter in the word sequence:

cuberootscuberootscuberoots...

Submit the number of the letter in the alphabet, 1 for A, 2 for B and so on.

Answer: 20

2. Find the smallest prime number p such that $p + 2500$ is a perfect square.

Answer: 101

3. Find the value of CLEVER that is a solution to the equation:

$$SOLVE + MORE = CLEVER$$

Note: Each letter corresponds to a different digit. No number starts with a zero.

Answer: 102824

4. In a small company, there are four committees. The membership lists reveal that:

- Each employee is a member of two committees.
- Every set of two committees has only one member in common.

How many employees are there in the company?

Answer: 6

5. Sam starts playing with the regulator of his fan. The regulator has speeds 0, 1, 2, 3, 4 and 5. Initially the regulator is pointed at 0. In the first round, he stops at 1. Then he turns the regulator two times and the speed is at 3. He then turns it three times and the regulator is now pointed at 0. In this way, he keeps increasing the gap to 4 in the next turn, 5 in the turn after that, and so on until he stops at 15 gaps. What number will the regulator be pointed at when he stops after 15th gap?

Answer: 3

6. If we create a 4×4 Magic Square using the following numbers, what will be the sum of each row, column and diagonal?

1, 5, 9, 14
 7, 11, 15, 20
 10, 14, 18, 23
 21, 25, 29, 34

Note: A 4×4 Magic Square is an arrangement of 16 numbers in four rows and four columns such that the sum of the numbers in any row, column or diagonal is the same.

Answer: 64

7. How many triangles can be drawn on this grid such that the corner of every triangle is a black point on the grid?

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Answer: 17

8. Let $N = 888,888 \times 9,999,999$. Find the sum of the digits of N .

Answer: 63

9. How many four digit numbers can be made using the digits 0, 5, 6, 7, 8, 9 which are divisible by 4?

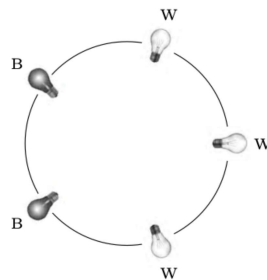
Note: Digits can be repeated.

Answer: 270

10. In a rectangle of side lengths 55 and 89 units, find the minimum number of squares that can fit in perfectly covering the rectangle.

Answer: 10

11. A DJ has a circle of lights that flash either blue or white. Each light is this exactly between two other lights. He wants to write a program to give a dashing sequence, changing every second, and tries the following rule: "At each change, a light turns (or remains) blue if it is between a white light and a blue light, and turns (or remains) white if it is between two white lights or two blue lights." If his starting pattern is



How many seconds will it take until the next time the lights display the starting pattern again?

Answer: 3

12. How many fractions in the below sequence have integral values?

$$\frac{1}{99}, \frac{2}{98}, \frac{3}{97}, \dots, \frac{97}{3}, \frac{98}{2}, \frac{99}{1}$$

Answer: 8

13. Let $\frac{a}{3} = \frac{b}{4} = \frac{c}{5}$ and $abc = 1620$. Find $a + b + c$

Answer: 36

14. The positive number N is the product of two primes. The sum of all positive divisors of N that are less than N is 2014. Find N .

Answer: 4022

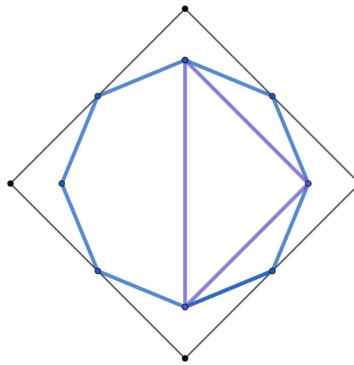
15. If all the natural numbers are listed in a series except for multiples of 3, find the 2024^{th} term in the series.

Answer: 3035

16. A set of consecutive natural numbers starting from 1 are written and one of them is erased. The average of the remaining numbers is $6\frac{7}{11}$. Which is the number that is erased?

Answer: 5

17. If the blue regular octagon has four of its vertices on the sides of the black square whose side is 4 units, find the area of the purple triangle.



Answer: 4

18. Find the number of integer pairs x, y such that

$$x^2 + y^2 = 100$$

Answer: 12

19. There was a fire in a house. It could only be started by the 3 people living inside. It was started through a fire (the size of the initial fire is irrelevant) that was not turned off and became a large fire. When the police came, Alice said: "I was in bed, lighting a candle, but I put it out before I went to bed."
 Bob said: "I started the fire in the fireplace, but I switched it off before dozing off."
 Charlie said: "After I went to bed, I remembered that I left a vessel containing boiling water."
 Alice said: "Charlie, your statement is a lie."
 Bob said: "No, Alice, your first statement is a lie."
 If 3 of the statements were false and the other 2 were true, who caused the fire?

- (a) Alice
 (b) Bob

- (c) Charlie
- (d) Can't be determined

Answer: *Bob*

20. Find the number of positive integers n such that $n \leq 100$ and n^n is a perfect square.

Answer: 55



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