2017 AMC 10A Problems

2017 AMC 10A (Answer Key)
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Instructions

1. This is a 25-question, multiple choice test. Each question is followed by answers marked A, B, C, D and E. Only one of these is correct.
2. You will receive 6 points for each correct answer, 2.5 points for each problem left unanswered if the year is before 2006, 1.5 points for each problem left unanswered if the year is after 2006, and 0 points for each incorrect answer.
3. No aids are permitted other than scratch paper, graph paper, ruler, compass, protractor and erasers (and calculators that are accepted for use on the SAT if before 2006. No problems on the test will *require* the use of a calculator).
4. Figures are not necessarily drawn to scale.
5. You will have **75 minutes** working time to complete the test.

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Contents

Problem 1

What is the value of $(2(2(2(2(2(2+1)+1)+1)+1)+1)+1)$?

$\textbf{(A) } 70 \qquad \textbf{(B) } 97 \qquad \textbf{(C) } 127 \qquad \textbf{(D) } 159 \qquad \textbf{(E) } 729$

Solution

Problem 2

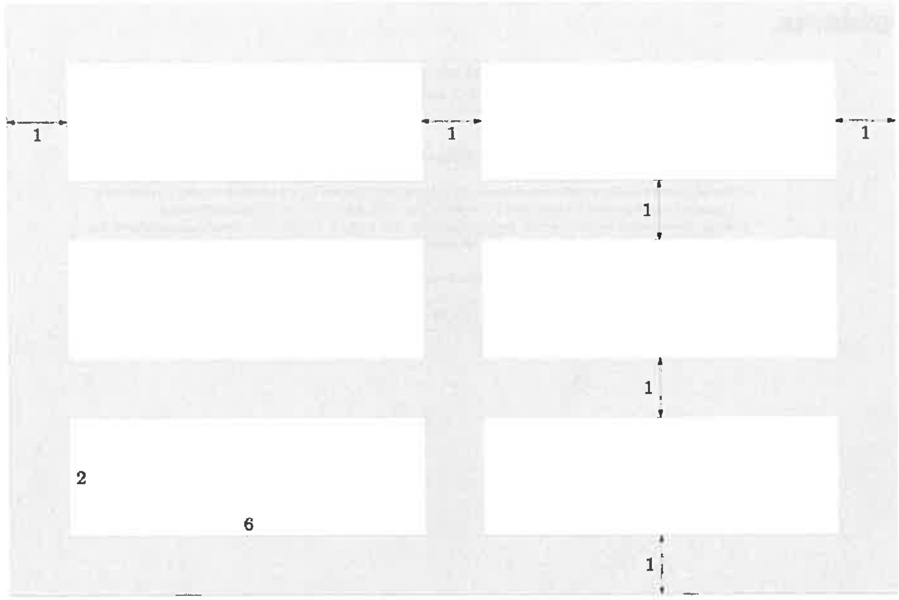
Pablo buys popsicles for his friends. The store sells single popsicles for $\$1$ each, 3-popsicle boxes for $\$2$ each, and 5-popsicle boxes for $\$3$. What is the greatest number of popsicles that Pablo can buy with $\$8$?

$\textbf{(A) } 8 \qquad \textbf{(B) } 11 \qquad \textbf{(C) } 12 \qquad \textbf{(D) } 13 \qquad \textbf{(E) } 15$

Solution

Problem 3

Tamara has three rows of two 6-feet by 2-feet flower beds in her garden. The beds are separated and also surrounded by 1-foot-wide walkways, as shown on the diagram. What is the total area of the walkways, in square feet?



$\textbf{(A) } 72 \qquad \textbf{(B) } 78 \qquad \textbf{(C) } 90 \qquad \textbf{(D) } 120 \qquad \textbf{(E) } 150$

Solution

Problem 4

Mia is "helping" her mom pick up 30 toys that are strewn on the floor. Mia's mom manages to put 3 toys into the toy box every 30 seconds, but each time immediately after those 30 seconds have elapsed, Mia takes 2 toys out of the box. How much time, in minutes, will it take Mia and her mom to put all 30 toys into the box for the first time?

$\textbf{(A) } 13.5 \qquad \textbf{(B) } 14 \qquad \textbf{(C) } 14.5 \qquad \textbf{(D) } 15 \qquad \textbf{(E) } 15.5$

Solution

Problem 5

The sum of two nonzero real numbers is 4 times their product. What is the sum of the reciprocals of the two numbers?

$\textbf{(A) } 1 \qquad \textbf{(B) } 2 \qquad \textbf{(C) } 4 \qquad \textbf{(D) } 8 \qquad \textbf{(E) } 12$

Solution

Problem 6

Ms. Carroll promised that anyone who got all the multiple choice questions right on the upcoming exam would receive an A on the exam. Which of these statements necessarily follows logically?

(A) If Lewis did not receive an A, then he got all of the multiple choice questions wrong.
(B) If Lewis did not receive an A, then he got at least one of the multiple choice questions wrong.
(C) If Lewis got at least one of the multiple choice questions wrong, then he did not receive an A.
(D) If Lewis received an A, then he got all of the multiple choice questions right.
(E) If Lewis received an A, then he got at least one of the multiple choice questions right.

Solution

Problem 7

Jerry and Silvia wanted to go from the southwest corner of a square field to the northeast corner. Jerry walked due east and then due north to reach the goal, but Silvia headed northeast and reached the goal walking in a straight line. Which of the following is closest to how much shorter Silvia's trip was, compared to Jerry's trip?

$\textbf{(A) } 30\% \qquad \textbf{(B) } 40\% \qquad \textbf{(C) } 50\% \qquad \textbf{(D) } 60\% \qquad \textbf{(E) } 70\%$

Solution

Problem 8

At a gathering of 30 people, there are 20 people who all know each other and 10 people who know no one. People who know each other hug, and people who do not know each other shake hands. How many handshakes occur?

$\textbf{(A) } 240 \qquad \textbf{(B) } 245 \qquad \textbf{(C) } 290 \qquad \textbf{(D) } 480 \qquad \textbf{(E) } 490$

Solution

Problem 9

Minnie rides on a flat road at 20 kilometers per hour (kph), downhill at 30 kph, and uphill at 5 kph. Penny rides on a flat road at 30 kph, downhill at 40 kph, and uphill at 10 kph. Minnie goes from town A to town B, a distance of 10 km all uphill, then from town B to town C, a distance of 15 km all downhill, and then back to town A, a distance of 20 km on the flat. Penny goes the other way around using the same route. How many more minutes does it take Minnie to complete the 45-km ride than it takes Penny?

$\textbf{(A) } 45 \qquad \textbf{(B) } 60 \qquad \textbf{(C) } 65 \qquad \textbf{(D) } 90 \qquad \textbf{(E) } 95$

Solution

Problem 10

Joy has 30 thin rods, one each of every integer length from 1 cm through 30 cm. She places the rods with lengths 3 cm, 7 cm, and 15 cm on a table. She then wants to choose a fourth rod that she can put with these three to form a quadrilateral with positive area. How many of the remaining rods can she choose as the fourth rod?

$\textbf{(A)}\ 16 \qquad\textbf{(B)}\ 17 \qquad\textbf{(C)}\ 18 \qquad\textbf{(D)}\ 19 \qquad\textbf{(E)}\ 20$

Solution

Problem 11

The region consisting of all points in three-dimensional space within 3 units of line segment $\overline{AB}$ has volume 216π. What is the length AB?

$\textbf{(A)}\ 6 \qquad\textbf{(B)}\ 12 \qquad\textbf{(C)}\ 18 \qquad\textbf{(D)}\ 20 \qquad\textbf{(E)}\ 24$

Solution

Problem 12

Let S be a set of points (x,y) in the coordinate plane such that two of the three quantities $3,~x+2,$ and $y-4$ are equal and the third of the three quantities is no greater than this common value. Which of the following is a correct description for $S?$

$\textbf{(A)}\ \text{a single point} \qquad\textbf{(B)}\ \text{two intersecting lines}$
$\textbf{(C)}\ \text{three lines whose pairwise intersections are three distinct points}$
$\textbf{(D)}\ \text{a triangle} \qquad\textbf{(E)}\ \text{three rays with a common endpoint}$

Solution

Problem 13

Define a sequence recursively by $F_{0}=0,~F_{1}=1,$ and $F_{n}=$ the remainder when $F_{n-1}+F_{n-2}$ is divided by $3,$ for all $n\geq 2.$ Thus the sequence starts $0,1,1,2,0,2,\ldots$ What is $F_{2017}+F_{2018}+F_{2019}+F_{2020}+F_{2021}+F_{2022}+F_{2023}+F_{2024}?$

$\textbf{(A)}\ 6 \qquad\textbf{(B)}\ 7 \qquad\textbf{(C)}\ 8 \qquad\textbf{(D)}\ 9 \qquad\textbf{(E)}\ 10$

Solution

Problem 14

Every week Roger pays for a movie ticket and a soda out of his allowance. Last week, Roger's allowance was A dollars. The cost of his movie ticket was 20% of the difference between A and the cost of his soda, while the cost of his soda was 5% of the difference between A and the cost of his movie ticket. To the nearest whole percent, what fraction of A did Roger pay for his movie ticket and soda?

$\textbf{(A)}\ 9\% \qquad\textbf{(B)}\ 19\% \qquad\textbf{(C)}\ 22\% \qquad\textbf{(D)}\ 23\% \qquad\textbf{(E)}\ 25\%$

Solution

Problem 15

Chloé chooses a real number uniformly at random from the interval $[0, 2017]$. Independently, Laurent chooses a real number uniformly at random from the interval $[0, 4034]$. What is the probability that Laurent's number is greater than Chloé's number?

$\textbf{(A)}\ \frac{1}{2} \qquad\textbf{(B)}\ \frac{2}{3} \qquad\textbf{(C)}\ \frac{3}{4} \qquad\textbf{(D)}\ \frac{5}{6} \qquad\textbf{(E)}\ \frac{7}{8}$

Solution

Problem 16

There are 10 horses, named Horse 1, Horse 2, . . ., Horse 10. They get their names from how many minutes it takes them to run one lap around a circular race track: Horse k runs one lap in exactly k minutes. At time 0 all the horses are together at the starting point on the track. The horses start running in the same direction, and they keep running around the circular track at their constant speeds. The least time $S > 0$, in minutes, at which all 10 horses will again simultaneously be at the starting point is $S = 2520$. Let $T > 0$ be the least time, in minutes, such that at least 5 of the horses are again at the starting point. What is the sum of the digits of T?

$\textbf{(A)}\ 2 \qquad\textbf{(B)}\ 3 \qquad\textbf{(C)}\ 4 \qquad\textbf{(D)}\ 5 \qquad\textbf{(E)}\ 6$

Solution

Problem 17

Distinct points P, Q, R, S lie on the circle $x^{2}+y^{2}=25$ and have integer coordinates. The distances PQ and RS are irrational numbers. What is the greatest possible value of the ratio $\frac{PQ}{RS}$?

$\textbf{(A)}\ 3 \qquad\textbf{(B)}\ 5 \qquad\textbf{(C)}\ 3\sqrt{5} \qquad\textbf{(D)}\ 7 \qquad\textbf{(E)}\ 5\sqrt{2}$

Solution

Problem 18

Amelia has a coin that lands heads with probability $\frac{1}{3}$, and Blaine has a coin that lands on heads with probability $\frac{2}{5}$. Amelia and Blaine alternately toss their coins until someone gets a head; the first one to get a head wins. All coin tosses are independent. Amelia goes first. The probability that Amelia wins is $\frac{p}{q}$, where p and q are relatively prime positive integers. What is $q-p$?

$\textbf{(A)}\ 1 \qquad\textbf{(B)}\ 2 \qquad\textbf{(C)}\ 3 \qquad\textbf{(D)}\ 4 \qquad\textbf{(E)}\ 5$

Solution

Problem 19

Alice refuses to sit next to either Bob or Carla. Derek refuses to sit next to Eric. How many ways are there for the five of them to sit in a row of 5 chairs under these conditions?

$\textbf{(A)}\ 12 \qquad\textbf{(B)}\ 16 \qquad\textbf{(C)}\ 28 \qquad\textbf{(D)}\ 32 \qquad\textbf{(E)}\ 40$

Solution

Problem 20

Let $S(n)$ equal the sum of the digits of positive integer n. For example, $S(1507) = 13$. For a particular positive integer n, $S(n) = 1274$. Which of the following could be the value of $S(n+1)$?

$\textbf{(A)}\ 1 \qquad\textbf{(B)}\ 3\qquad\textbf{(C)}\ 12\qquad\textbf{(D)}\ 1239\qquad\textbf{(E)}\ 1265$

Solution

Problem 21

A square with side length x is inscribed in a right triangle with sides of length 3, 4, and 5 so that one vertex of the square coincides with the right-angle vertex of the triangle. A square with side length y is inscribed in another right triangle with sides of length 3, 4, and 5 so that one side of the square lies on the hypotenuse of the triangle. What is $\frac{x}{y}$?

$\textbf{(A)}\ \frac{12}{13} \qquad \textbf{(B)}\ \frac{35}{37} \qquad \textbf{(C)}\ 1 \qquad \textbf{(D)}\ \frac{37}{35} \qquad \textbf{(E)}\ \frac{13}{12}$

Solution

Problem 22

Sides $\overline{AB}$ and $\overline{AC}$ of equilateral triangle ABC are tangent to a circle at points B and C respectively. What fraction of the area of $\triangle ABC$ lies outside the circle?

$\textbf{(A)}\ \frac{4\sqrt{3}\pi}{27}-\frac{1}{3}\qquad \textbf{(B)}\ \frac{\sqrt{3}}{2}-\frac{\pi}{8}\qquad \textbf{(C)}\ \frac{1}{2}\qquad \textbf{(D)}\ \sqrt{3}-\frac{2\sqrt{3}\pi}{9}\qquad \textbf{(E)}\ \frac{4}{3}-\frac{4\sqrt{3}\pi}{27}$

Solution

Problem 23

How many triangles with positive area have all their vertices at points (i,j) in the coordinate plane, where i and j are integers between 1 and 5, inclusive?

$\textbf{(A)}\ 2128 \qquad\textbf{(B)}\ 2148 \qquad\textbf{(C)}\ 2160 \qquad\textbf{(D)}\ 2200 \qquad\textbf{(E)}\ 2300$

Solution

Problem 24

For certain real numbers a, b, and c, the polynomial

$$g(x) = x^3 + ax^2 + x + 10$$

has three distinct roots, and each root of $g(x)$ is also a root of the polynomial

$$f(x) = x^4 + x^3 + bx^2 + 100x + c.$$

What is $f(1)$?

$\textbf{(A)}\ -9009 \qquad\textbf{(B)}\ -8008 \qquad\textbf{(C)}\ -7007 \qquad\textbf{(D)}\ -6006 \qquad\textbf{(E)}\ -5005$

Solution

Problem 25

How many integers between 100 and 999, inclusive, have the property that some permutation of its digits is a multiple of 11 between 100 and $999?$ For example, both 121 and 211 have this property.

$\textbf{(A)}\ 226 \qquad\textbf{(B)}\ 243 \qquad\textbf{(C)}\ 270 \qquad\textbf{(D)}\ 469 \qquad\textbf{(E)}\ 486$

Solution

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10. B
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13. D
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15. C
16. B
17. D
18. D
19. C
20. D
21. D
22. E
23. B
24. C
25. A

2017 AMC 10B Problems

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Instructions

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Contents

Problem 1

Mary thought of a positive two-digit number. She multiplied it by 3 and added 11. Then she switched the digits of the result, obtaining a number between 71 and 75, inclusive. What was Mary's number?

$\textbf{(A)}\ 11\qquad\textbf{(B)}\ 12\qquad\textbf{(C)}\ 13\qquad\textbf{(D)}\ 14\qquad\textbf{(E)}\ 15$

Solution

Problem 2

Sofia ran 5 laps around the 400-meter track at her school. For each lap, she ran the first 100 meters at an average speed of 4 meters per second and the remaining 300 meters at an average speed of 5 meters per second. How much time did Sofia take running the 5 laps?

$\textbf{(A)}\ \text{5 minutes and 35 seconds}\qquad\textbf{(B)}\ \text{6 minutes and 40 seconds}\qquad\textbf{(C)}\ \text{7 minutes and 5 seconds}\qquad\textbf{(D)}\ \text{7 minutes and 25 seconds}$
$\textbf{(E)}\ \text{8 minutes and 10 seconds}$

Solution

Problem 3

Real numbers x, y, and z satify the inequalities $0<x<1$, $-1<y<0$, and $1<z<2$. Which of the following numbers is necessarily positive?

$\textbf{(A)}\ y+x^2\qquad\textbf{(B)}\ y+xz\qquad\textbf{(C)}\ y+y^2\qquad\textbf{(D)}\ y+2y^2\qquad\textbf{(E)}\ y+z$

Solution

Problem 4

Supposed that x and y are nonzero real numbers such that $\frac{3x+y}{x-3y}=-2$. What is the value of $\frac{x+3y}{3x-y}$?

$\textbf{(A)}\ -3\qquad\textbf{(B)}\ -1\qquad\textbf{(C)}\ 1\qquad\textbf{(D)}\ 2\qquad\textbf{(E)}\ 3$

Solution

Problem 5

Camilla had twice as many blueberry jelly beans as cherry jelly beans. After eating 10 pieces of each kind, she now has three times as many blueberry jelly beans as cherry jelly beans. How many blueberry jelly beans did she originally have?

$\textbf{(A)}\ 10\qquad\textbf{(B)}\ 20\qquad\textbf{(C)}\ 30\qquad\textbf{(D)}\ 40\qquad\textbf{(E)}\ 50$

Solution

Problem 6

What is the largest number of solid 2 in. by 2 in. by 1 in. blocks that can fit in a 3 in. by 2 in. by 3 in. box?

$\textbf{(A)}\ 3\qquad\textbf{(B)}\ 4\qquad\textbf{(C)}\ 5\qquad\textbf{(D)}\ 6\qquad\textbf{(E)}\ 7$

Solution

Problem 7

Samia set off on her bicycle to visit her friend, traveling at an average speed of 17 kilometers per hour. When she had gone half the distance to her friend's house, a tire went flat, and she walked the rest of the way at 5 kilometers per hour. In all it took her 44 minutes to reach her friend's house. In kilometers rounded to the nearest tenth, how far did Samia walk?

$\textbf{(A)}\ 2.0\qquad\textbf{(B)}\ 2.2\qquad\textbf{(C)}\ 2.8\qquad\textbf{(D)}\ 3.4\qquad\textbf{(E)}\ 4.4$

Solution

Problem 8

Points $A(11, 9)$ and $B(2, -3)$ are vertices of $\triangle ABC$ with $AB=AC$. The altitude from A meets the opposite side at $D(-1, 3)$. What are the coordinates of point C?

$\textbf{(A)}\ (-8, 9)\qquad\textbf{(B)}\ (-4, 8)\qquad\textbf{(C)}\ (-4, 9)\qquad\textbf{(D)}\ (-2, 3)\qquad\textbf{(E)}\ (-1, 0)$

Solution

Problem 9

A radio program has a quiz consisting of 3 multiple-choice questions, each with 3 choices. A contestant wins if he or she gets 2 or more of the questions right. The contestant answers randomly to each question. What is the probability of winning?

$\textbf{(A)}\ \frac{1}{27}\qquad\textbf{(B)}\ \frac{1}{9}\qquad\textbf{(C)}\ \frac{2}{9}\qquad\textbf{(D)}\ \frac{7}{27}\qquad\textbf{(E)}\ \frac{1}{2}$

Solution

Problem 10

The lines with equations $ax-2y=c$ and $2x+by=-c$ are perpendicular and intersect at $(1, -5)$. What is c?

$\textbf{(A)}\ -13\qquad\textbf{(B)}\ -8\qquad\textbf{(C)}\ 2\qquad\textbf{(D)}\ 8\qquad\textbf{(E)}\ 13$

Solution

Problem 11

At Typico High School, 60% of the students like dancing, and the rest dislike it. Of those who like dancing, 80% say that they like it, and the rest say that they dislike it. Of those who dislike dancing, 90% say that they dislike it, and the rest say that they like it. What fraction of students who say they dislike dancing actually like it?

$\textbf{(A)}\ 10\%\qquad\textbf{(B)}\ 12\%\qquad\textbf{(C)}\ 20\%\qquad\textbf{(D)}\ 25\%\qquad\textbf{(E)}\ 33\frac{1}{3}\%$

Solution

Problem 12

Elmer's new car gives 50% better fuel efficiency. However, the new car uses diesel fuel, which is 20% more expensive per liter than the gasoline the old car used. By what percent will Elmer save money if he uses his new car instead of his old car for a long trip?

$\textbf{(A)}\ 20\%\qquad\textbf{(B)}\ 26\tfrac{2}{3}\%\qquad\textbf{(C)}\ 27\tfrac{7}{9}\%\qquad\textbf{(D)}\ 33\tfrac{1}{3}\%\qquad\textbf{(E)}\ 66\tfrac{2}{3}\%$

Solution

Problem 13

There are 20 students participating in an after-school program offering classes in yoga, bridge, and painting. Each student must take at least one of these three classes, but may take two or all three. There are 10 students taking yoga, 13 taking bridge, and 9 taking painting. There are 9 students taking at least two classes. How many students are taking all three classes?

$\textbf{(A)}\ 1\qquad\textbf{(B)}\ 2\qquad\textbf{(C)}\ 3\qquad\textbf{(D)}\ 4\qquad\textbf{(E)}\ 5$

Solution

Problem 14

An integer N is selected at random in the range $1\leq N \leq 2020$. What is the probability that the remainder when N^{16} is divided by 5 is 1?

$\textbf{(A)}\ \frac{1}{5}\qquad\textbf{(B)}\ \frac{2}{5}\qquad\textbf{(C)}\ \frac{3}{5}\qquad\textbf{(D)}\ \frac{4}{5}\qquad\textbf{(E)}\ 1$

Solution

Problem 15

Rectangle $ABCD$ has $AB=3$ and $BC=4$. Point E is the foot of the perpendicular from B to diagonal $\overline{AC}$. What is the area of $\triangle AED$?

$\textbf{(A)}\ 1\qquad\textbf{(B)}\ \frac{42}{25}\qquad\textbf{(C)}\ \frac{28}{15}\qquad\textbf{(D)}\ 2\qquad\textbf{(E)}\ \frac{54}{25}$

Solution

Problem 16

How many of the base-ten numerals for the positive integers less than or equal to 2017 contain the digit 0?

$\textbf{(A)}\ 469\qquad\textbf{(B)}\ 471\qquad\textbf{(C)}\ 475\qquad\textbf{(D)}\ 478\qquad\textbf{(E)}\ 481$

Solution

Problem 17

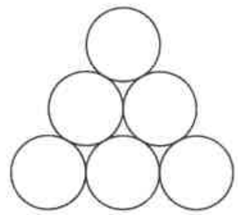
Call a positive integer $monotonous$ if it is a one-digit number or its digits, when read from left to right, form either a strictly increasing or a strictly decreasing sequence. For example, 3, 23578, and 987620 are monotonous, but 88, 7434, and 23557 are not. How many monotonous positive integers are there?

$\textbf{(A)}\ 1024 \qquad \textbf{(B)}\ 1524 \qquad \textbf{(C)}\ 1533 \qquad \textbf{(D)}\ 1536 \qquad \textbf{(E)}\ 2048$

Solution

Problem 18

In the figure below, 3 of the 6 disks are to be painted blue, 2 are to be painted red, and 1 is to be painted green. Two paintings that can be obtained from one another by a rotation or a reflection of the entire figure are considered the same. How many different paintings are possible?



$\textbf{(A)}\ 6 \qquad \textbf{(B)}\ 8 \qquad \textbf{(C)}\ 9 \qquad \textbf{(D)}\ 12 \qquad \textbf{(E)}\ 15$

Solution

Problem 19

Let ABC be an equilateral triangle. Extend side $\overline{AB}$ beyond B to a point B' so that $BB' = 3AB$. Similarly, extend side $\overline{BC}$ beyond C to a point C' so that $CC' = 3BC$, and extend side $\overline{CA}$ beyond A to a point A' so that $AA' = 3CA$. What is the ratio of the area of $\triangle A'B'C'$ to the area of $\triangle ABC$?

$\textbf{(A)}\ 9:1 \qquad \textbf{(B)}\ 16:1 \qquad \textbf{(C)}\ 25:1 \qquad \textbf{(D)}\ 36:1 \qquad \textbf{(E)}\ 37:1$

Solution

Problem 20

The number $21! = 51,090,942,171,709,440,000$ has over $60,000$ positive integer divisors. One of them is chosen at random. What is the probability that it is odd?

$\textbf{(A)}\ \frac{1}{21} \qquad \textbf{(B)}\ \frac{1}{19} \qquad \textbf{(C)}\ \frac{1}{18} \qquad \textbf{(D)}\ \frac{1}{2} \qquad \textbf{(E)}\ \frac{11}{21}$

Solution

Problem 21

In $\triangle ABC$, $AB=6$, $AC=8$, $BC=10$, and D is the midpoint of $\overline{BC}$. What is the sum of the radii of the circles inscribed in $\triangle ADB$ and $\triangle ADC$?

$\textbf{(A)}\ \sqrt{5} \qquad \textbf{(B)}\ \frac{11}{4} \qquad \textbf{(C)}\ 2\sqrt{2} \qquad \textbf{(D)}\ \frac{17}{6} \qquad \textbf{(E)}\ 3$

Solution

Problem 22

The diameter AB of a circle of radius 2 is extended to a point D outside the circle so that $BD=3$. Point E is chosen so that $ED=5$ and line ED is perpendicular to line AD. Segment AE intersects the circle at a point C between A and E. What is the area of $\triangle ABC$?

$\textbf{(A)}\ \frac{120}{37} \qquad \textbf{(B)}\ \frac{140}{39} \qquad \textbf{(C)}\ \frac{145}{39} \qquad \textbf{(D)}\ \frac{140}{37} \qquad \textbf{(E)}\ \frac{120}{31}$

Solution

Problem 23

Let $N = 123456789101112\dots4344$ be the 79-digit number that is formed by writing the integers from 1 to 44 in order, one after the other. What is the remainder when N is divided by 45?

$\textbf{(A)}\ 1 \qquad \textbf{(B)}\ 4 \qquad \textbf{(C)}\ 9 \qquad \textbf{(D)}\ 18 \qquad \textbf{(E)}\ 44$

Solution

Problem 24

The vertices of an equilateral triangle lie on the hyperbola $xy=1$, and a vertex of this hyperbola is the centroid of the triangle. What is the square of the area of the triangle?

$\textbf{(A)}\ 48 \qquad \textbf{(B)}\ 60 \qquad \textbf{(C)}\ 108 \qquad \textbf{(D)}\ 120 \qquad \textbf{(E)}\ 169$

Solution

Problem 25

Last year Isabella took 7 math tests and received 7 different scores, each an integer between 91 and 100, inclusive. After each test she noticed that the average of her test scores was an integer. Her score on the seventh test was 95. What was her score on the sixth test?

$\textbf{(A)}\ 92 \qquad \textbf{(B)}\ 94 \qquad \textbf{(C)}\ 96 \qquad \textbf{(D)}\ 98 \qquad \textbf{(E)}\ 100$

Solution

See also

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2016 AMC 10A Problems

Contents

Problem 1

What is the value of $\frac{11!-10!}{9!}$?

$\textbf{(A)}\ 99 \qquad \textbf{(B)}\ 100 \qquad \textbf{(C)}\ 110 \qquad \textbf{(D)}\ 121 \qquad \textbf{(E)}\ 132$

Solution

Problem 2

For what value of x does $10^x \cdot 100^{2x} = 1000^5$?

$\textbf{(A)}\ 1 \qquad \textbf{(B)}\ 2 \qquad \textbf{(C)}\ 3 \qquad \textbf{(D)}\ 4 \qquad \textbf{(E)}\ 5$

Solution

Problem 3

For every dollar Ben spent on bagels, David spent 25 cents less. Ben paid $\$12.50$ more than David. How much did they spend in the bagel store together?

$\textbf{(A)}\ \$37.50 \qquad \textbf{(B)}\ \$50.00 \qquad \textbf{(C)}\ \$87.50 \qquad \textbf{(D)}\ \$90.00 \qquad \textbf{(E)}\ \$92.50$

Solution

Problem 4

The remainder can be defined for all real numbers x and y with $y \neq 0$ by

$$\text{rem}(x, y) = x - y\left\lfloor \frac{x}{y} \right\rfloor$$

where $\left\lfloor \tfrac{x}{y} \right\rfloor$ denotes the greatest integer less than or equal to $\tfrac{x}{y}$. What is the value of $\text{rem}(\tfrac{3}{8}, -\tfrac{2}{5})$?

$\textbf{(A)}\ -\frac{3}{8} \qquad \textbf{(B)}\ -\frac{1}{40} \qquad \textbf{(C)}\ 0 \qquad \textbf{(D)}\ \frac{3}{8} \qquad \textbf{(E)}\ \frac{31}{40}$

Solution

Problem 5

A rectangular box has integer side lengths in the ratio $1 : 3 : 4$. Which of the following could be the volume of the box?

$\textbf{(A)}\ 48 \qquad \textbf{(B)}\ 56 \qquad \textbf{(C)}\ 64 \qquad \textbf{(D)}\ 96 \qquad \textbf{(E)}\ 144$

Solution

Problem 6

Ximena lists the whole numbers 1 through 30 once. Emilio copies Ximena's numbers, replacing each occurrence of the digit 2 by the digit 1. Ximena adds her numbers and Emilio adds his numbers. How much larger is Ximena's sum than Emilio's?

$\textbf{(A)}\ 13 \qquad \textbf{(B)}\ 26 \qquad \textbf{(C)}\ 102 \qquad \textbf{(D)}\ 103 \qquad \textbf{(E)}\ 110$

Solution

Problem 7

The mean, median, and mode of the 7 data values $60, 100, x, 40, 50, 200, 90$ are all equal to x. What is the value of x?

$\textbf{(A)}\ 50 \qquad \textbf{(B)}\ 60 \qquad \textbf{(C)}\ 75 \qquad \textbf{(D)}\ 90 \qquad \textbf{(E)}\ 100$

Solution

Problem 8

Trickster Rabbit agrees with Foolish Fox to double Fox's money every time Fox crosses the bridge by Rabbit's house, as long as Fox pays 40 coins in toll to Rabbit after each crossing. The payment is made after the doubling, Fox is excited about his good fortune until he discovers that all his money is gone after crossing the bridge three times. How many coins did Fox have at the beginning?

$\textbf{(A)}\ 20 \qquad \textbf{(B)}\ 30 \qquad \textbf{(C)}\ 35 \qquad \textbf{(D)}\ 40 \qquad \textbf{(E)}\ 45$

Solution

Problem 9

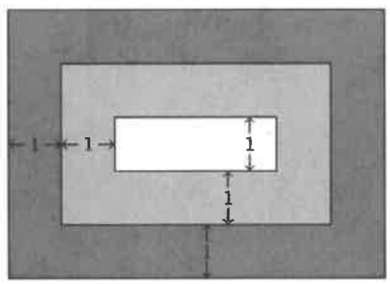
A triangular array of 2016 coins has 1 coin in the first row, 2 coins in the second row, 3 coins in the third row, and so on up to N coins in the Nth row. What is the sum of the digits of N?

$\textbf{(A)}\ 6 \qquad \textbf{(B)}\ 7 \qquad \textbf{(C)}\ 8 \qquad \textbf{(D)}\ 9 \qquad \textbf{(E)}\ 10$

Solution

Problem 10

A rug is made with three different colors as shown. The areas of the three differently colored regions form an arithmetic progression. The inner rectangle is one foot wide, and each of the two shaded regions is 1 foot wide on all four sides. What is the length in feet of the inner rectangle?

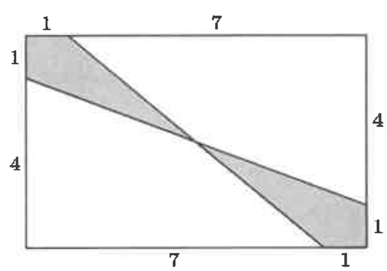


$\textbf{(A)}\ 1 \qquad \textbf{(B)}\ 2 \qquad \textbf{(C)}\ 4 \qquad \textbf{(D)}\ 6 \qquad \textbf{(E)}\ 8$

Solution

Problem 11

What is the area of the shaded region of the given 8×5 rectangle?



$\textbf{(A)}\ 4\frac{3}{5} \qquad \textbf{(B)}\ 5 \qquad \textbf{(C)}\ 5\frac{1}{4} \qquad \textbf{(D)}\ 6\frac{1}{2} \qquad \textbf{(E)}\ 8$

Solution

Problem 12

Three distinct integers are selected at random between 1 and 2016, inclusive. Which of the following is a correct statement about the probability p that the product of the three integers is odd?

$\textbf{(A)}\ p<\dfrac{1}{8}\qquad\textbf{(B)}\ p=\dfrac{1}{8}\qquad\textbf{(C)}\ \dfrac{1}{8}<p<\dfrac{1}{3}\qquad\textbf{(D)}\ p=\dfrac{1}{3}\qquad\textbf{(E)}\ p>\dfrac{1}{3}$

Solution

Problem 13

Five friends sat in a movie theater in a row containing 5 seats, numbered 1 to 5 from left to right. (The directions "left" and "right" are from the point of view of the people as they sit in the seats.) During the movie Ada went to the lobby to get some popcorn. When she returned, she found that Bea had moved two seats to the right, Ceci had moved one seat to the left, and Dee and Edie had switched seats, leaving an end seat for Ada. In which seat had Ada been sitting before she got up?

$\textbf{(A)}\ 1 \qquad \textbf{(B)}\ 2 \qquad \textbf{(C)}\ 3 \qquad \textbf{(D)}\ 4 \qquad \textbf{(E)}\ 5$

Solution

Problem 14

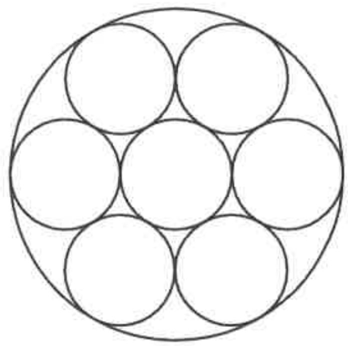
How many ways are there to write 2016 as the sum of twos and threes, ignoring order? (For example, $1008 \cdot 2 + 0 \cdot 3$ and $402 \cdot 2 + 404 \cdot 3$ are two such ways.)

$\textbf{(A)}\ 236 \qquad\textbf{(B)}\ 336 \qquad\textbf{(C)}\ 337 \qquad\textbf{(D)}\ 403 \qquad\textbf{(E)}\ 672$

Solution

Problem 15

Seven cookies of radius 1 inch are cut from a circle of cookie dough, as shown. Neighboring cookies are tangent, and all except the center cookie are tangent to the edge of the dough. The leftover scrap is reshaped to form another cookie of the same thickness. What is the radius in inches of the scrap cookie?



$\textbf{(A) } \sqrt{2} \qquad \textbf{(B) } 1.5 \qquad \textbf{(C) } \sqrt{\pi} \qquad \textbf{(D) } \sqrt{2\pi} \qquad \textbf{(E) } \pi$

Solution

Problem 16

A triangle with vertices $A(0, 2)$, $B(-3, 2)$, and $C(-3, 0)$ is reflected about the x-axis, then the image $\triangle A'B'C'$ is rotated counterclockwise about the origin by 90° to produce $\triangle A''B''C''$. Which of the following transformations will return $\triangle A''B''C''$ to $\triangle ABC$?

$\textbf{(A)}$ counterclockwise rotation about the origin by 90°.

$\textbf{(B)}$ clockwise rotation about the origin by 90°.

$\textbf{(C)}$ reflection about the x-axis

$\textbf{(D)}$ reflection about the line $y = x$

$\textbf{(E)}$ reflection about the y-axis.

Solution

Problem 17

Let N be a positive multiple of 5. One red ball and N green balls are arranged in a line in random order. Let $P(N)$ be the probability that at least $\tfrac{3}{5}$ of the green balls are on the same side of the red ball. Observe that $P(5)=1$ and that $P(N)$ approaches $\tfrac{4}{5}$ as N grows large. What is the sum of the digits of the least value of N such that $P(N) < \tfrac{321}{400}$?

$\textbf{(A) } 12 \qquad \textbf{(B) } 14 \qquad\textbf{(C) }16 \qquad \textbf{(D) } 18 \qquad \textbf{(E) } 20$

Solution

Problem 18

Each vertex of a cube is to be labeled with an integer 1 through 8, with each integer being used once, in such a way that the sum of the four numbers on the vertices of a face is the same for each face. Arrangements that can be obtained from each other through rotations of the cube are considered to be the same. How many different arrangements are possible?

$\textbf{(A) } 1 \qquad \textbf{(B) } 3 \qquad \textbf{(C) } 6 \qquad \textbf{(D) } 12 \qquad \textbf{(E) } 24$

Solution

Problem 19

In rectangle $ABCD$, $AB=6$ and $BC=3$. Point E between B and C, and point F between E and C are such that $BE=EF=FC$. Segments $\overline{AE}$ and $\overline{AF}$ intersect $\overline{BD}$ at P and Q, respectively. The ratio $BP:PQ:QD$ can be written as $r:s:t$ where the greatest common factor of r, s and t is 1. What is $r+s+t$?

$\textbf{(A) } 7 \qquad \textbf{(B) } 9 \qquad \textbf{(C) } 12 \qquad \textbf{(D) } 15 \qquad \textbf{(E) } 20$

Solution

Problem 20

For some particular value of N, when $(a+b+c+d+1)^N$ is expanded and like terms are combined, the resulting expression contains exactly 1001 terms that include all four variables $a, b, c,$ and d, each to some positive power. What is N?

$\textbf{(A) }9 \qquad \textbf{(B) } 14 \qquad \textbf{(C) } 16 \qquad \textbf{(D) } 17 \qquad \textbf{(E) } 19$

Solution

Problem 21

Circles with centers P, Q and R, having radii $1, 2$ and 3, respectively, lie on the same side of line l and are tangent to l at P', Q' and R', respectively, with Q' between P' and R'. The circle with center Q is externally tangent to each of the other two circles. What is the area of triangle PQR?

$\textbf{(A) } 0 \qquad \textbf{(B) } \sqrt{\frac{2}{3}} \qquad \textbf{(C) } 1 \qquad \textbf{(D) } \sqrt{6}-\sqrt{2} \qquad \textbf{(E) } \sqrt{\frac{3}{2}}$

Solution

Problem 22

For some positive integer n, the number $110n^3$ has 110 positive integer divisors, including 1 and the number $110n^3$. How many positive integer divisors does the number $81n^4$ have?

$\textbf{(A) } 110 \qquad \textbf{(B) } 191 \qquad \textbf{(C) } 261 \qquad \textbf{(D) } 325 \qquad \textbf{(E) } 425$

Solution

Problem 23

A binary operation $\diamondsuit$ has the properties that $a \diamondsuit (b \diamondsuit c) = (a \diamondsuit b) \cdot c$ and that $a \diamondsuit a = 1$ for all nonzero real numbers $a, b,$ and c. (Here $\cdot$ represents multiplication). The solution to the equation $2016 \diamondsuit (6 \diamondsuit x) = 100$ can be written as $\frac{p}{q}$, where p and q are relatively prime positive integers. What is $p + q$?

$\textbf{(A) } 109 \qquad \textbf{(B) } 201 \qquad \textbf{(C) } 301 \qquad \textbf{(D) } 3049 \qquad \textbf{(E) } 33,601$

Solution

Problem 24

A quadrilateral is inscribed in a circle of radius $200\sqrt{2}$. Three of the sides of this quadrilateral have length 200. What is the length of the fourth side?

$\textbf{(A) } 200 \qquad \textbf{(B) } 200\sqrt{2} \qquad \textbf{(C) } 200\sqrt{3} \qquad \textbf{(D) } 300\sqrt{2} \qquad \textbf{(E) } 500$

Solution

Problem 25

How many ordered triples (x,y,z) of positive integers satisfy $\text{lcm}(x,y) = 72, \text{lcm}(x,z) = 600$ and $\text{lcm}(y,z) = 900$?

$\textbf{(A) } 15 \qquad \textbf{(B) } 16 \qquad \textbf{(C) } 24 \qquad \textbf{(D) } 27 \qquad \textbf{(E) } 64$

Solution

2016 AMC 10A Answer Key

1. B
2. C
3. C
4. B
5. D
6. D
7. D
8. C
9. D
10. B
11. D
12. A
13. B
14. C
15. A
16. D
17. A
18. C
19. E
20. B
21. D
22. D
23. A
24. E
25. A

2016 AMC 10B Problems

Problem 1

What is the value of $\frac{2a^{-1}+\frac{a^{-1}}{2}}{a}$ when $a=\frac{1}{2}$?

$\textbf{(A)}\ 1\qquad\textbf{(B)}\ 2\qquad\textbf{(C)}\ \frac{5}{2}\qquad\textbf{(D)}\ 10\qquad\textbf{(E)}\ 20$

Solution

Problem 2

If $n\heartsuit m=n^3m^2$, what is $\frac{2\heartsuit 4}{4\heartsuit 2}$?

$\textbf{(A)}\ \frac{1}{4}\qquad\textbf{(B)}\ \frac{1}{2}\qquad\textbf{(C)}\ 1\qquad\textbf{(D)}\ 2\qquad\textbf{(E)}\ 4$

Solution

Problem 3

Let $x=-2016$. What is the value of $\Bigg\vert\Big\vert |x|-x\Big\vert-|x|\Bigg\vert-x$?

$\textbf{(A)}\ -2016\qquad\textbf{(B)}\ 0\qquad\textbf{(C)}\ 2016\qquad\textbf{(D)}\ 4032\qquad\textbf{(E)}\ 6048$

Solution

Problem 4

Zoey read 15 books, one at a time. The first book took her 1 day to read, the second book took her 2 days to read, the third book took her 3 days to read, and so on, with each book taking her 1 more day to read than the previous book. Zoey finished the first book on a Monday, and the second on a Wednesday. On what day the week did she finish her 15th book?

$\textbf{(A)}\ \text{Sunday}\qquad\textbf{(B)}\ \text{Monday}\qquad\textbf{(C)}\ \text{Wednesday}\qquad\textbf{(D)}\ \text{Friday}\qquad\textbf{(E)}\ \text{Saturday}$

Solution

Problem 5

The mean age of Amanda's 4 cousins is 8, and their median age is 5. What is the sum of the ages of Amanda's youngest and oldest cousins?

$\textbf{(A)}\ 13\qquad\textbf{(B)}\ 16\qquad\textbf{(C)}\ 19\qquad\textbf{(D)}\ 22\qquad\textbf{(E)}\ 25$

Solution

Problem 6

Laura added two three-digit positive integers. All six digits in these numbers are different. Laura's sum is a three-digit number S. What is the smallest possible value for the sum of the digits of S?

$\textbf{(A)}\ 1\qquad\textbf{(B)}\ 4\qquad\textbf{(C)}\ 5\qquad\textbf{(D)}\ 15\qquad\textbf{(E)}\ 20$

Solution

Problem 7

The ratio of the measures of two acute angles is $5:4$, and the complement of one of these two angles is twice as large as the complement of the other. What is the sum of the degree measures of the two angles?

$\textbf{(A)}\ 75\qquad\textbf{(B)}\ 90\qquad\textbf{(C)}\ 135\qquad\textbf{(D)}\ 150\qquad\textbf{(E)}\ 270$

Solution

Problem 8

What is the tens digit of $2015^{2016}-2017?$

$\textbf{(A)}\ 0\qquad\textbf{(B)}\ 1\qquad\textbf{(C)}\ 3\qquad\textbf{(D)}\ 5\qquad\textbf{(E)}\ 8$

Solution

Problem 9

All three vertices of $\triangle ABC$ are lying on the parabola defined by $y=x^2$, with A at the origin and $\overline{BC}$ parallel to the x-axis. The area of the triangle is 64. What is the length of BC?

$\textbf{(A)}\ 4\qquad\textbf{(B)}\ 6\qquad\textbf{(C)}\ 8\qquad\textbf{(D)}\ 10\qquad\textbf{(E)}\ 16$

Solution

Problem 10

A thin piece of wood of uniform density in the shape of an equilateral triangle with side length 3 inches weighs 12 ounces. A second piece of the same type of wood, with the same thickness, also in the shape of an equilateral triangle, has side length of 5 inches. Which of the following is closest to the weight, in ounces, of the second piece?

$\textbf{(A)}\ 14.0\qquad\textbf{(B)}\ 16.0\qquad\textbf{(C)}\ 20.0\qquad\textbf{(D)}\ 33.3\qquad\textbf{(E)}\ 55.6$

Solution

Problem 11

Carl decided to fence in his rectangular garden. He bought 20 fence posts, placed one on each of the four corners, and spaced out the rest evenly along the edges of the garden, leaving exactly 4 yards between neighboring posts. The longer side of his garden, including the corners, has twice as many posts as the shorter side, including the corners. What is the area, in square yards, of Carl's garden?

$\textbf{(A)}\ 256\qquad\textbf{(B)}\ 336\qquad\textbf{(C)}\ 384\qquad\textbf{(D)}\ 448\qquad\textbf{(E)}\ 512$

Solution

Problem 12

Two different numbers are selected at random from $(1, 2, 3, 4, 5)$ and multiplied together. What is the probability that the product is even?

$\textbf{(A)}\ 0.2\qquad\textbf{(B)}\ 0.4\qquad\textbf{(C)}\ 0.5\qquad\textbf{(D)}\ 0.7\qquad\textbf{(E)}\ 0.8$

Solution

Problem 13

At Megapolis Hospital one year, multiple-birth statistics were as follows: Sets of twins, triplets, and quadruplets accounted for 1000 of the babies born. There were four times as many sets of triplets as sets of quadruplets, and there was three times as many sets of twins as sets of triplets. How many of these 1000 babies were in sets of quadruplets?

$\textbf{(A)}\ 25\qquad\textbf{(B)}\ 40\qquad\textbf{(C)}\ 64\qquad\textbf{(D)}\ 100\qquad\textbf{(E)}\ 160$

Solution

Problem 14

How many squares whose sides are parallel to the axis and whose vertices have coordinates that are integers lie entirely within the region bounded by the line $y=\pi x$, the line $y=-0.1$ and the line $x=5.1?$

$\textbf{(A)}\ 30\qquad\textbf{(B)}\ 41\qquad\textbf{(C)}\ 45\qquad\textbf{(D)}\ 50\qquad\textbf{(E)}\ 57$

Solution

Problem 15

All the numbers $1, 2, 3, 4, 5, 6, 7, 8, 9$ are written in a 3×3 array of squares, one number in each square, in such a way that if two numbers are consecutive then they occupy squares that share an edge. The numbers in the four corners add up to 18. What is the number in the center?

$\textbf{(A)}\ 5\qquad\textbf{(B)}\ 6\qquad\textbf{(C)}\ 7\qquad\textbf{(D)}\ 8\qquad\textbf{(E)}\ 9$

Solution

Problem 16

The sum of an infinite geometric series is a positive number S, and the second term in the series is 1. What is the smallest possible value of $S?$

$\textbf{(A)}\ \frac{1+\sqrt{5}}{2}\qquad\textbf{(B)}\ 2\qquad\textbf{(C)}\ \sqrt{5}\qquad\textbf{(D)}\ 3\qquad\textbf{(E)}\ 4$

Solution

Problem 17

All the numbers $2, 3, 4, 5, 6, 7$ are assigned to the six faces of a cube, one number to each face. For each of the eight vertices of the cube, a product of three numbers is computed, where the three numbers are the numbers assigned to the three faces that include that vertex. What is the greatest possible value of the sum of these eight products?

$\textbf{(A)}\ 312\qquad\textbf{(B)}\ 343\qquad\textbf{(C)}\ 625\qquad\textbf{(D)}\ 729\qquad\textbf{(E)}\ 1680$

Solution

Problem 18

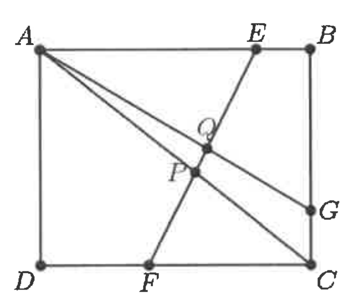
In how many ways can 345 be written as the sum of an increasing sequence of two or more consecutive positive integers?

$\textbf{(A)}\ 1\qquad\textbf{(B)}\ 3\qquad\textbf{(C)}\ 5\qquad\textbf{(D)}\ 6\qquad\textbf{(E)}\ 7$

Solution

Problem 19

Rectangle $ABCD$ has $AB=5$ and $BC=4$. Point E lies on $\overline{AB}$ so that $EB=1$, point G lies on $\overline{BC}$ so that $CG=1$. and point F lies on $\overline{CD}$ so that $DF=2$. Segments $\overline{AG}$ and $\overline{AC}$ intersect $\overline{EF}$ at Q and P, respectively. What is the value of $\frac{PQ}{EF}$?



$\textbf{(A)}~\frac{\sqrt{13}}{16} \qquad \textbf{(B)}~\frac{\sqrt{2}}{13} \qquad \textbf{(C)}~\frac{9}{82} \qquad \textbf{(D)}~\frac{10}{91}\qquad \textbf{(E)}~\frac19$

Solution

Problem 20

A dilation of the plane—that is, a size transformation with a positive scale factor—sends the circle of radius 2 centered at $A(2,2)$ to the circle of radius 3 centered at $A'(5,6)$. What distance does the origin $O(0,0)$, move under this transformation?

$\textbf{(A)}\ 0\qquad\textbf{(B)}\ 3\qquad\textbf{(C)}\ \sqrt{13}\qquad\textbf{(D)}\ 4\qquad\textbf{(E)}\ 5$

Solution

Problem 21

What is the area of the region enclosed by the graph of the equation $x^2+y^2=|x|+|y|?$

$\textbf{(A)}\ \pi+\sqrt{2}\qquad\textbf{(B)}\ \pi+2\qquad\textbf{(C)}\ \pi+2\sqrt{2}\qquad\textbf{(D)}\ 2\pi+\sqrt{2}\qquad\textbf{(E)}\ 2\pi+2\sqrt{2}$

Solution

Problem 22

A set of teams held a round-robin tournament in which every team played every other team exactly once. Every team won 10 games and lost 10 games; there were no ties. How many sets of three teams $\{A, B, C\}$ were there in which A beat B, B beat C, and C beat $A?$

$\textbf{(A)}\ 385 \qquad \textbf{(B)}\ 665 \qquad \textbf{(C)}\ 945 \qquad \textbf{(D)}\ 1140 \qquad \textbf{(E)}\ 1330$

Solution

Problem 23

In regular hexagon $ABCDEF$, points W, X, Y, and Z are chosen on sides $\overline{BC}$, $\overline{CD}$, $\overline{EF}$, and $\overline{FA}$ respectively, so lines AB, ZW, YX, and ED are parallel and equally spaced. What is the ratio of the area of hexagon $WCXYFZ$ to the area of hexagon $ABCDEF$?

$\textbf{(A)}\ \frac{1}{3}\qquad\textbf{(B)}\ \frac{10}{27}\qquad\textbf{(C)}\ \frac{11}{27}\qquad\textbf{(D)}\ \frac{4}{9}\qquad\textbf{(E)}\ \frac{13}{27}$

Solution

Problem 24

How many four-digit integers $abcd$, with $a \neq 0$, have the property that the three two-digit integers $ab<bc<cd$ form an increasing arithmetic sequence? One such number is 4692, where $a=4$, $b=6$, $c=9$, and $d=2$.

$\textbf{(A)}\ 9\qquad\textbf{(B)}\ 15\qquad\textbf{(C)}\ 16\qquad\textbf{(D)}\ 17\qquad\textbf{(E)}\ 20$

Solution

Problem 25

Let $f(x)=\sum_{k=2}^{10}(\lfloor kx \rfloor -k \lfloor x \rfloor)$, where $\lfloor r \rfloor$ denotes the greatest integer less than or equal to r. How many distinct values does $f(x)$ assume for $x \ge 0$?

$\textbf{(A)}\ 32\qquad\textbf{(B)}\ 36\qquad\textbf{(C)}\ 45\qquad\textbf{(D)}\ 46\qquad\textbf{(E)}\ \text{infinitely many}$

Solution

See also

2016 AMC 10B (Problems • Answer Key • Resources)	
Preceded by **2016 AMC 10A Problems**	Followed by **2017 AMC 10A Problems**
1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9 • 10 • 11 • 12 • 13 • 14 • 15 • 16 • 17 • 18 • 19 • 20 • 21 • 22 • 23 • 24 • 25	
All AMC 10 Problems and Solutions	

- AMC 10
- AMC 10 Problems and Solutions
- 2016 AMC 10A
- Mathematics competition resources

2016 AMC 10B Answer Key

1. D
2. B
3. D
4. B
5. D
6. B
7. C
8. A
9. C
10. D
11. B
12. D
13. D
14. D
15. C
16. E
17. D
18. E
19. D
20. C
21. B
22. A
23. C
24. D
25. A

2015 AMC 10A Problems

Problem 1

What is the value of $(2^0 - 1 + 5^2 + 0)^{-1} \times 5$?

$\textbf{(A)}\ -125 \qquad \textbf{(B)}\ -120 \qquad \textbf{(C)}\ \frac{1}{5} \qquad \textbf{(D)}\ \frac{5}{24} \qquad \textbf{(E)}\ 25$

Solution

Problem 2

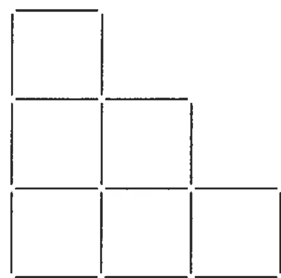
A box contains a collection of triangular and square tiles. There are 25 tiles in the box, containing 84 edges total. How many square tiles are there in the box?

$\textbf{(A)}\ 3 \qquad \textbf{(B)}\ 5 \qquad \textbf{(C)}\ 7 \qquad \textbf{(D)}\ 9 \qquad \textbf{(E)}\ 11$

Solution

Problem 3

Ann made a 3-step staircase using 18 toothpicks as shown in the figure. How many toothpicks does she need to add to complete a 5-step staircase?



$\textbf{(A)}\ 9 \qquad \textbf{(B)}\ 18 \qquad \textbf{(C)}\ 20 \qquad \textbf{(D)}\ 22 \qquad \textbf{(E)}\ 24$

Solution

Problem 4

Pablo, Sofia, and Mia got some candy eggs at a party. Pablo had three times as many eggs as Sofia, and Sofia had twice as many eggs as Mia. Pablo decides to give some of his eggs to Sofia and Mia so that all three will have the same number of eggs. What fraction of his eggs should Pablo give to Sofia?

$\textbf{(A)}\ \frac{1}{12} \qquad \textbf{(B)}\ \frac{1}{6} \qquad \textbf{(C)}\ \frac{1}{4} \qquad \textbf{(D)}\ \frac{1}{3} \qquad \textbf{(E)}\ \frac{1}{2}$

Solution

Problem 5

Mr. Patrick teaches math to 15 students. He was grading tests and found that when he graded everyone's test except Payton's, the average grade for the class was 80. After he graded Payton's test, the test average became 81. What was Payton's score on the test?

$\textbf{(A)}\ 81 \qquad \textbf{(B)}\ 85 \qquad \textbf{(C)}\ 91 \qquad \textbf{(D)}\ 94 \qquad \textbf{(E)}\ 95$

Solution

Problem 6

The sum of two positive numbers is 5 times their difference. What is the ratio of the larger number to the smaller number?

$\textbf{(A)}\ \frac{5}{4} \qquad \textbf{(B)}\ \frac{3}{2} \qquad \textbf{(C)}\ \frac{9}{5} \qquad \textbf{(D)}\ 2 \qquad \textbf{(E)}\ \frac{5}{2}$

Solution

Problem 7

How many terms are there in the arithmetic sequence $13, 16, 19, \dots, 70, 73$?

$\textbf{(A)}\ 20 \qquad \textbf{(B)}\ 21 \qquad \textbf{(C)}\ 24 \qquad \textbf{(D)}\ 60 \qquad \textbf{(E)}\ 61$

Solution

Problem 8

Two years ago Pete was three times as old as his cousin Claire. Two years before that, Pete was four times as old as Claire. In how many years will the ratio of their ages be $2 : 1$?

$\textbf{(A)}\ 2 \qquad \textbf{(B)}\ 4 \qquad \textbf{(C)}\ 5 \qquad \textbf{(D)}\ 6 \qquad \textbf{(E)}\ 8$

Solution

Problem 9

Two right circular cylinders have the same volume. The radius of the second cylinder is 10% more than the radius of the first. What is the relationship between the heights of the two cylinders?

$\textbf{(A)}$ The second height is 10% less than the first.
$\textbf{(B)}$ The first height is 10% more than the second.
$\textbf{(C)}$ The second height is 21% more than the first.
$\textbf{(D)}$ The first height is 21% more than the second.
$\textbf{(E)}$ The second height is 80% of the first.

Solution

Problem 10

How many rearrangements of $abcd$ are there in which no two adjacent letters are also adjacent letters in the alphabet? For example, no such rearrangements could include either ab or ba.

$\textbf{(A)}\ 0\qquad\textbf{(B)}\ 1\qquad\textbf{(C)}\ 2\qquad\textbf{(D)}\ 3\qquad\textbf{(E)}\ 4$

Solution

Problem 11

The ratio of the length to the width of a rectangle is $4:3$. If the rectangle has diagonal of length d, then the area may be expressed as kd^2 for some constant k. What is k?

$\textbf{(A)}\ \frac{2}{7}\qquad\textbf{(B)}\ \frac{3}{7}\qquad\textbf{(C)}\ \frac{12}{25}\qquad\textbf{(D)}\ \frac{16}{25}\qquad\textbf{(E)}\ \frac{3}{4}$

Solution

Problem 12

Points $(\sqrt{\pi}, a)$ and $(\sqrt{\pi}, b)$ are distinct points on the graph of $y^2 + x^4 = 2x^2 y + 1$. What is $|a-b|$?

$\textbf{(A)}\ 1\qquad\textbf{(B)}\ \frac{\pi}{2}\qquad\textbf{(C)}\ 2\qquad\textbf{(D)}\ \sqrt{1+\pi}\qquad\textbf{(E)}\ 1+\sqrt{\pi}$

Solution

Problem 13

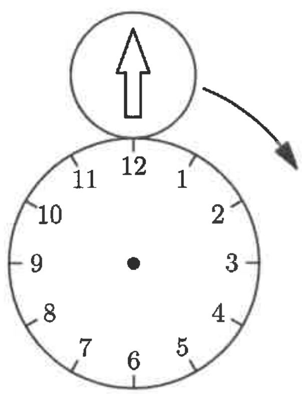
Claudia has 12 coins, each of which is a 5-cent coin or a 10-cent coin. There are exactly 17 different values that can be obtained as combinations of one or more of her coins. How many 10-cent coins does Claudia have?

$\textbf{(A)}\ 3\qquad\textbf{(B)}\ 4\qquad\textbf{(C)}\ 5\qquad\textbf{(D)}\ 6\qquad\textbf{(E)}\ 7$

Solution

Problem 14

The diagram below shows the circular face of a clock with radius 20 cm and a circular disk with radius 10 cm externally tangent to the clock face at 12 o'clock. The disk has an arrow painted on it, initially pointing in the upward vertical direction. Let the disk roll clockwise around the clock face. At what point on the clock face will the disk be tangent when the arrow is next pointing in the upward vertical direction?



$\textbf{(A)}\ 2o'clock\qquad\textbf{(B)}\ 3o'clock\qquad\textbf{(C)}\ 4o'clock\qquad\textbf{(D)}\ 6o'clock\qquad\textbf{(E)}\ 8o'clock$

Solution

Problem 15

Consider the set of all fractions $\frac{x}{y}$, where x and y are relatively prime positive integers. How many of these fractions have the property that if both numerator and denominator are increased by 1, the value of the fraction is increased by 10%?

$\textbf{(A)}\ 0\qquad\textbf{(B)}\ 1\qquad\textbf{(C)}\ 2\qquad\textbf{(D)}\ 3\qquad\textbf{(E)}\ \text{infinitely many}$

Solution

Problem 16

If $y+4 = (x-2)^2, x+4 = (y-2)^2$, and $x \neq y$, what is the value of x^2+y^2?

$\textbf{(A)}\ 10\qquad\textbf{(B)}\ 15\qquad\textbf{(C)}\ 20\qquad\textbf{(D)}\ 25\qquad\textbf{(E)}\ 30$

Solution

Problem 17

A line that passes through the origin intersects both the line $x = 1$ and the line $y = 1 + \frac{\sqrt{3}}{3}x$. The three lines create an equilateral triangle. What is the perimeter of the triangle?

$\textbf{(A)}\ 2\sqrt{6} \qquad\textbf{(B)}\ 2+2\sqrt{3} \qquad\textbf{(C)}\ 6 \qquad\textbf{(D)}\ 3 + 2\sqrt{3} \qquad\textbf{(E)}\ 6 + \frac{\sqrt{3}}{3}$

Solution

Problem 18

Hexadecimal (base-16) numbers are written using numeric digits 0 through 9 as well as the letters A through F to represent 10 through 15. Among the first 1000 positive integers, there are n whose hexadecimal representation contains only numeric digits. What is the sum of the digits of n?

$\textbf{(A) }17\qquad\textbf{(B) }18\qquad\textbf{(C) }19\qquad\textbf{(D) }20\qquad\textbf{(E) }21$

Solution

Problem 19

The isosceles right triangle ABC has right angle at C and area 12.5. The rays trisecting $\angle ACB$ intersect AB at D and E. What is the area of $\triangle CDE$?

$\textbf{(A) }\dfrac{5\sqrt{2}}{3}\qquad\textbf{(B) }\dfrac{50\sqrt{3}-75}{4}\qquad\textbf{(C) }\dfrac{15\sqrt{3}}{8}\qquad\textbf{(D) }\dfrac{50-25\sqrt{3}}{2}\qquad\textbf{(E) }\dfrac{25}{6}$

Solution

Problem 20

A rectangle with positive integer side lengths in cm has area A cm^2 and perimeter P cm. Which of the following numbers cannot equal $A+P$?

$\textbf{(A) }100\qquad\textbf{(B) }102\qquad\textbf{(C) }104\qquad\textbf{(D) }106\qquad\textbf{(E) }110$

NOTE: As it originally appeared in the AMC 10, this problem was stated incorrectly and had no answer; it has been modified here to be solvable.

Solution

Problem 21

Tetrahedron $ABCD$ has $AB=5$, $AC=3$, $BC=4$, $BD=4$, $AD=3$, and $CD=\tfrac{12}5\sqrt2$. What is the volume of the tetrahedron?

$\textbf{(A) }3\sqrt2\qquad\textbf{(B) }2\sqrt5\qquad\textbf{(C) }\dfrac{24}5\qquad\textbf{(D) }3\sqrt3\qquad\textbf{(E) }\dfrac{24}5\sqrt2$

Solution

Problem 22

Eight people are sitting around a circular table, each holding a fair coin. All eight people flip their coins and those who flip heads stand while those who flip tails remain seated. What is the probability that no two adjacent people will stand?

$\textbf{(A)}\dfrac{47}{256}\qquad\textbf{(B)}\dfrac{3}{16}\qquad\textbf{(C) }\dfrac{49}{256}\qquad\textbf{(D) }\dfrac{25}{128}\qquad\textbf{(E) }\dfrac{51}{256}$

Solution

Problem 23

The zeroes of the function $f(x)=x^2-ax+2a$ are integers. What is the sum of the possible values of a?

$\textbf{(A)}\ 7\qquad\textbf{(B)}\ 8\qquad\textbf{(C)}\ 16\qquad\textbf{(D)}\ 17\qquad\textbf{(E)}\ 18$

Solution

Problem 24

For some positive integers p, there is a quadrilateral $ABCD$ with positive integer side lengths, perimeter p, right angles at B and C, $AB=2$, and $CD=AD$. How many different values of $p<2015$ are possible?

$\textbf{(A) }30\qquad\textbf{(B) }31\qquad\textbf{(C) }61\qquad\textbf{(D) }62\qquad\textbf{(E) }63$

Solution

Problem 25

Let S be a square of side length 1. Two points are chosen at random on the sides of S. The probability that the straight-line distance between the points is at least $\tfrac12$ is $\tfrac{a-b\pi}c$, where a, b, and c are positive integers with $\gcd(a,b,c)=1$. What is $a+b+c$?

$\textbf{(A) }59\qquad\textbf{(B) }60\qquad\textbf{(C) }61\qquad\textbf{(D) }62\qquad\textbf{(E) }63$

Solution

See also

- 2015 AMC 10A
- Mathematics competition resources

2015 AMC 10A Answer Key

1. C
2. D
3. D
4. B
5. E
6. B
7. B
8. B
9. D
10. C
11. C
12. C
13. C
14. C
15. B
16. B
17. D
18. E
19. D
20. B (Note: This problem was originally stated incorrectly, and all contestants received full credit regardless of their answer.)
21. C
22. A
23. C
24. B
25. A

2015 AMC 10B Problems

Problem 1

What is the value of $2-(-2)^{-2}$?

$\textbf{(A)}\ -2\qquad\textbf{(B)}\ \frac{1}{16}\qquad\textbf{(C)}\ \frac{7}{4}\qquad\textbf{(D)}\ \frac{9}{4}\qquad\textbf{(E)}\ 6$

Solution

Problem 2

Marie does three equally time-consuming tasks in a row without taking breaks. She begins the first task at 1:00 PM and finishes the second task at 2:40 PM. When does she finish the third task?

$\textbf{(A)}\ \text{3:10 PM}\qquad\textbf{(B)}\ \text{3:30 PM}\qquad\textbf{(C)}\ \text{4:00 PM}\qquad\textbf{(D)}\ \text{4:10 PM}\qquad\textbf{(E)}\ \text{4:30 PM}$

Solution

Problem 3

Isaac has written down one integer two times and another integer three times. The sum of the five numbers is 100, and one of the numbers is 28. What is the other number?

$\textbf{(A)}\ 8\qquad\textbf{(B)}\ 11\qquad\textbf{(C)}\ 14\qquad\textbf{(D)}\ 15\qquad\textbf{(E)}\ 18$

Solution

Problem 4

Four siblings ordered an extra large pizza. Alex ate $\frac15$, Beth $\frac13$, and Cyril $\frac14$ of the pizza. Dan got the leftovers. What is the sequence of the siblings in decreasing order of the part of pizza they consumed?

$\textbf{(A)}\ \text{Alex, Beth, Cyril, Dan}\ \textbf{(B)}\ \text{Beth, Cyril, Alex, Dan}\ \textbf{(C)}\ \text{Beth, Cyril, Dan, Alex}\ \textbf{(D)}\ \text{Beth, Dan, Cyril, Alex}\ \textbf{(E)}\ \text{Dan, Beth, Cyril, Alex}$

Solution

Problem 5

David, Hikmet, Jack, Marta, Rand, and Todd were in a 12-person race with 6 other people. Rand finished 6 places ahead of Hikmet. Marta finished 1 place behind Jack. David finished 2 places behind Hikmet. Jack finished 2 places behind Todd. Todd finished 1 place behind Rand. Marta finished in 6th place. Who finished in 8th place?

$\textbf{(A)}\ \text{David}\qquad\textbf{(B)}\ \text{Hikmet}\qquad\textbf{(C)}\ \text{Jack}\qquad\textbf{(D)}\ \text{Rand}\qquad\textbf{(E)}\ \text{Todd}$

Solution

Problem 6

Marley practices exactly one sport each day of the week. She runs three days a week but never on two consecutive days. On Monday she plays basketball and two days later golf. She swims and plays tennis, but she never plays tennis the day after running or swimming. Which day of the week does Marley swim?

$\textbf{(A)}\ \text{Sunday}\qquad\textbf{(B)}\ \text{Tuesday}\qquad\textbf{(C)}\ \text{Thursday}\qquad\textbf{(D)}\ \text{Friday}\qquad\textbf{(E)}\ \text{Saturday}$

Solution

Problem 7

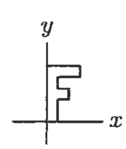
Consider the operation "minus the reciprocal of," defined by $a\diamond b=a-\frac{1}{b}$. What is $((1\diamond 2)\diamond 3)-(1\diamond(2\diamond 3))$?

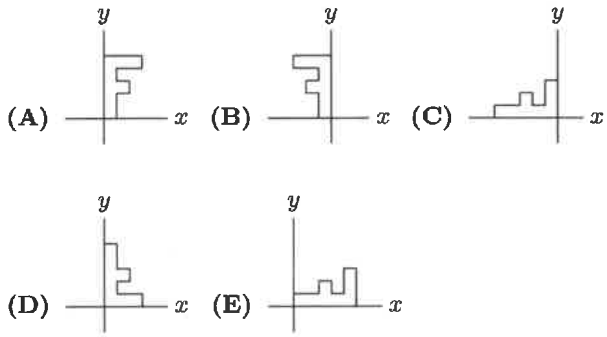
$\textbf{(A)}\ -\frac{7}{30}\qquad\textbf{(B)}\ -\frac{1}{6}\qquad\textbf{(C)}\ 0\qquad\textbf{(D)}\ \frac{1}{6}\qquad\textbf{(E)}\ \frac{7}{30}$

Solution

Problem 8

The letter F shown below is rotated 90° clockwise around the origin, then reflected in the y-axis, and then rotated a half turn around the origin. What is the final image?

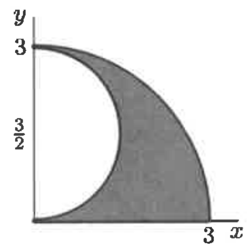




Solution

Problem 9

The shaded region below is called a shark's fin falcata, a figure studied by Leonardo da Vinci. It is bounded by the portion of the circle of radius 3 and center $(0,0)$ that lies in the first quadrant, the portion of the circle with radius $\frac{3}{2}$ and center $(0,\frac{3}{2})$ that lies in the first quadrant, and the line segment from $(0,0)$ to $(3,0)$. What is the area of the shark's fin falcata?



$\textbf{(A) } \frac{4\pi}{5} \qquad\textbf{(B) } \frac{9\pi}{8} \qquad\textbf{(C) } \frac{4\pi}{3} \qquad\textbf{(D) } \frac{7\pi}{5} \qquad\textbf{(E) } \frac{3\pi}{2}$

Solution

Problem 10

What are the sign and units digit of the product of all the odd negative integers strictly greater than -2015?

$\textbf{(A) }$ It is a negative number ending with a 1.

$\textbf{(B) }$ It is a positive number ending with a 1.

$\textbf{(C) }$ It is a negative number ending with a 5.

$\textbf{(D) }$ It is a positive number ending with a 5.

$\textbf{(E) }$ It is a negative number ending with a 0.

Solution

Problem 11

Among the positive integers less than 100, each of whose digits is a prime number, one is selected at random. What is the probability that the selected number is prime?

$\textbf{(A) } \frac{8}{99} \qquad\textbf{(B) } \frac{2}{5} \qquad\textbf{(C) } \frac{9}{20} \qquad\textbf{(D) } \frac{1}{2} \qquad\textbf{(E) } \frac{9}{16}$

Solution

Problem 12

For how many integers x is the point $(x,-x)$ inside or on the circle of radius 10 centered at $(5,5)$?

$\textbf{(A) } 11 \qquad\textbf{(B) } 12 \qquad\textbf{(C) } 13 \qquad\textbf{(D) } 14 \qquad\textbf{(E) } 15$

Solution

Problem 13

The line $12x+5y=60$ forms a triangle with the coordinate axes. What is the sum of the lengths of the altitudes of this triangle?

$\textbf{(A) } 20 \qquad\textbf{(B) } \frac{360}{17} \qquad\textbf{(C) } \frac{107}{5} \qquad\textbf{(D) } \frac{43}{2} \qquad\textbf{(E) } \frac{281}{13}$

Solution

Problem 14

Let a, b, and c be three distinct one-digit numbers. What is the maximum value of the sum of the roots of the equation $(x-a)(x-b)+(x-b)(x-c)=0$?

$\textbf{(A) } 15 \qquad\textbf{(B) } 15.5 \qquad\textbf{(C) } 16 \qquad\textbf{(D) } 16.5 \qquad\textbf{(E) } 17$

Solution

Problem 15

The town of Hamlet has 3 people for each horse, 4 sheep for each cow, and 3 ducks for each person. Which of the following could not possibly be the total number of people, horses, sheep, cows, and ducks in Hamlet?

$\textbf{(A) }41\qquad\textbf{(B) }47\qquad\textbf{(C) }59\qquad\textbf{(D) }61\qquad\textbf{(E) }66$

Solution

Problem 16

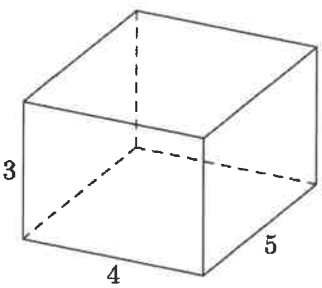
Al, Bill, and Cal will each randomly be assigned a whole number from 1 to 10, inclusive, with no two of them getting the same number. What is the probability that Al's number will be a whole number multiple of Bill's and Bill's number will be a whole number multiple of Cal's?

$\textbf{(A) } \dfrac{9}{1000} \qquad\textbf{(B) } \dfrac{1}{90} \qquad\textbf{(C) } \dfrac{1}{80} \qquad\textbf{(D) } \dfrac{1}{72} \qquad\textbf{(E) } \dfrac{2}{121}$

Solution

Problem 17

When the centers of the faces of the right rectangular prism shown below are joined to create an octahedron, what is the volume of the octahedron?



$\textbf{(A) } \dfrac{75}{12} \qquad\textbf{(B) } 10 \qquad\textbf{(C) } 12 \qquad\textbf{(D) } 10\sqrt2 \qquad\textbf{(E) } 15$

Solution

Problem 18

Johann has 64 fair coins. He flips all the coins. Any coin that lands on tails is tossed again. Coins that land on tails on the second toss are tossed a third time. What is the expected number of coins that are now heads?

$\textbf{(A) } 32 \qquad\textbf{(B) } 40 \qquad\textbf{(C) } 48 \qquad\textbf{(D) } 56 \qquad\textbf{(E) } 64$

Solution

Problem 19

In $\triangle{ABC}$, $\angle{C} = 90^{\circ}$ and $AB = 12$. Squares $ABXY$ and $ACWZ$ are constructed outside of the triangle. The points X, Y, Z, and W lie on a circle. What is the perimeter of the triangle?

$\textbf{(A)}\; 12+9\sqrt{3} \qquad\textbf{(B)}\; 18+6\sqrt{3} \qquad\textbf{(C)}\; 12+12\sqrt{2} \qquad\textbf{(D)}\; 30 \qquad\textbf{(E)}\; 32$

Solution

Problem 20

Erin the ant starts at a given corner of a cube and crawls along exactly 7 edges in such a way that she visits every corner exactly once and then finds that she is unable to return along an edge to her starting point. How many paths are there meeting these conditions?

$\textbf{(A) }6\qquad\textbf{(B) }9\qquad\textbf{(C) }12\qquad\textbf{(D) }18\qquad\textbf{(E) }24$

Solution

Problem 21

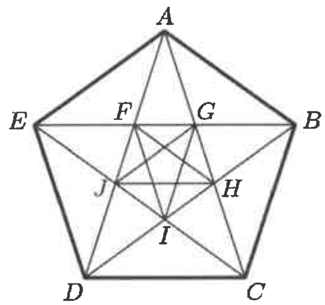
Cozy the Cat and Dash the Dog are going up a staircase with a certain number of steps. However, instead of walking up the steps one at a time, both Cozy and Dash jump. Cozy goes two steps up with each jump (though if necessary, he will just jump the last step). Dash goes five steps up with each jump (though if necessary, he will just jump the last steps if there are fewer than 5 steps left). Suppose Dash takes 19 fewer jumps than Cozy to reach the top of the staircase. Let S denote the sum of all possible numbers of steps this staircase can have. What is the sum of the digits of S?

$\textbf{(A) }9\qquad\textbf{(B) }11\qquad\textbf{(C) }12\qquad\textbf{(D) }13\qquad\textbf{(E) }15$

Solution

Problem 22

In the figure shown below, $ABCDE$ is a regular pentagon and $AG=1$. What is $FG + JH + CD$?



$\textbf{(A) }3\qquad\textbf{(B) }12-4\sqrt5\qquad\textbf{(C) }\dfrac{5+2\sqrt5}{3}\qquad\textbf{(D) }1+\sqrt5\qquad\textbf{(E) }\dfrac{11+11\sqrt5}{10}$

Solution

Problem 23

Let n be a positive integer greater than 4 such that the decimal representation of $n!$ ends in k zeros and the decimal representation of $(2n)!$ ends in $3k$ zeros. Let s denote the sum of the four least possible values of n. What is the sum of the digits of s?

$\textbf{(A) }7\qquad\textbf{(B) }8\qquad\textbf{(C) }9\qquad\textbf{(D) }10\qquad\textbf{(E) }11$

Solution

Problem 24

Aaron the ant walks on the coordinate plane according to the following rules. He starts at the origin $p_0=(0,0)$ facing to the east and walks one unit, arriving at $p_1=(1,0)$. For $n=1,2,3,\dots$, right after arriving at the point p_n, if Aaron can turn 90° left and walk one unit to an unvisited point p_{n+1}, he does that. Otherwise, he walks one unit straight ahead to reach p_{n+1}. Thus the sequence of points continues $p_2=(1,1), p_3=(0,1), p_4=(-1,1), p_5=(-1,0)$, and so on in a counterclockwise spiral pattern. What is p_{2015}?

$\textbf{(A) }(-22,-13)\qquad\textbf{(B) }(-13,-22)\qquad\textbf{(C) }(-13,22)\qquad\textbf{(D) }(13,-22)\qquad\textbf{(E) }(22,-13)$

Solution

Problem 25

A rectangular box measures $a \times b \times c$, where $a, b,$ and c are integers and $1\leq a\leq b\leq c$. The volume and surface area of the box are numerically equal. How many ordered triples (a,b,c) are possible?

$\textbf{(A) }4\qquad\textbf{(B) }10\qquad\textbf{(C) }12\qquad\textbf{(D) }21\qquad\textbf{(E) }26$

Solution

See also

2015 AMC 10B (Problems • Answer Key • Resources)	
Preceded by 2015 AMC 10A Problems	Followed by 2016 AMC 10A Problems
1 • 2 • 3 • 4 • 5 • 6 • 7 • 8 • 9 • 10 • 11 • 12 • 13 • 14 • 15 • 16 • 17 • 18 • 19 • 20 • 21 • 22 • 23 • 24 • 25	
All AMC 10 Problems and Solutions	

- AMC 10
- AMC 10 Problems and Solutions
- 2015 AMC 10B
- Mathematics competition resources

2015 AMC 10B Answer Key

1. C
2. B
3. A
4. C
5. B
6. E
7. A
8. E
9. B
10. C
11. B
12. A
13. E
14. D
15. B
16. C
17. B
18. D
19. C
20. A
21. D
22. D
23. B
24. D
25. B