

AMC 12 PRACTICE ARCHIVE

2023

12A and 12B papers + answer keys

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2023 AMC 12A

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Question 1

Not yet answered

Points out of 6

Cities A and B are 45 miles apart. Alicia lives in A and Beth lives in B . Alicia bikes towards B at 18 miles per hour. Leaving at the same time, Beth bikes toward A at 12 miles per hour. How many miles from City A will they be when they meet?

(A) 20 (B) 24 (C) 25 (D) 26 (E) 27

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 2

Not yet answered

Points out of 6

The weight of $\frac{1}{3}$ of a large pizza together with $3\frac{1}{2}$ cups of orange slices is the same as the weight of $\frac{3}{4}$ of a large pizza together with $\frac{1}{2}$ cup of orange slices. A cup of orange slices weighs $\frac{1}{4}$ of a pound. What is the weight, in pounds, of a large pizza?

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

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 3

Not yet answered

Points out of 6

How many positive perfect squares less than 2023 are divisible by 5?

(A) 8 (B) 9 (C) 10 (D) 11 (E) 12

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 4

Not yet answered

Points out of 6

How many digits are in the base-ten representation of $8^5 \cdot 5^{10} \cdot 15^5$?

(A) 14 (B) 15 (C) 16 (D) 17 (E) 18

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 5

Not yet answered

Points out of 6

Janet rolls a standard 6-sided die 4 times and keeps a running total of the numbers she rolls. What is the probability that at some point, her running total will equal 3?

(A) $\frac{2}{9}$ (B) $\frac{49}{216}$ (C) $\frac{25}{108}$ (D) $\frac{17}{72}$ (E) $\frac{13}{54}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 6

Not yet answered

Points out of 6

Points A and B lie on the graph of $y = \log_2 x$. The midpoint of $\overline{AB}$ is $(6, 2)$. What is the positive difference between the x -coordinates of A and B ?

(A) $2\sqrt{11}$ (B) $4\sqrt{3}$ (C) 8 (D) $4\sqrt{5}$ (E) 9

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 7

Not yet answered

Points out of 6

A digital display shows the current date as an 8-digit integer consisting of a 4-digit year, followed by a 2-digit month, followed by a 2-digit date within the month. For example, Arbor Day this year is displayed as 20230428. For how many dates in 2023 will each digit appear an even number of times in the 8-digital display for that date?

(A) 5 (B) 6 (C) 7 (D) 8 (E) 9

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 8

Not yet answered

Points out of 6

Maureen is keeping track of the mean of her quiz scores this semester. If Maureen scores an 11 on the next quiz, her mean will increase by 1. If she scores an 11 on each of the next three quizzes, her mean will increase by 2. What is the mean of her quiz scores currently?

(A) 4 (B) 5 (C) 6 (D) 7 (E) 8

Select one:

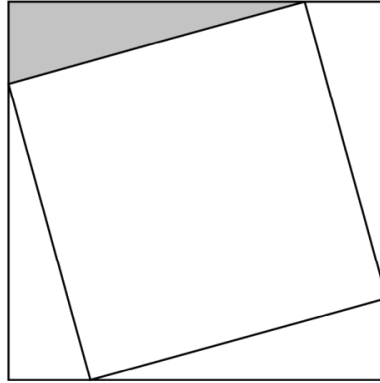
- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 9

Not yet answered

Points out of 6

A square of area 2 is inscribed in a square of area 3, creating four congruent triangles, as shown below. What is the ratio of the shorter leg to the longer leg in the shaded right triangle?



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

Select one:

- ☐ A
☐ B
☐ C
☐ D
☐ E
☐ Leave blank (1.5 points)

Question 10

Not yet answered

Points out of 6

Positive real numbers x and y satisfy $y^3 = x^2$ and $(y - x)^2 = 4y^2$. What is $x + y$?

- (A) 12 (B) 18 (C) 24 (D) 36 (E) 42

Select one:

- ☐ A
☐ B
☐ C
☐ D
☐ E
☐ Leave blank (1.5 points)

Question 11

Not yet answered

Points out of 6

What is the degree measure of the acute angle formed by lines with slopes 2 and $\frac{1}{3}$?

(A) 30 (B) 37.5 (C) 45 (D) 52.5 (E) 60

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 12

Not yet answered

Points out of 6

What is the value of

$$2^3 - 1^3 + 4^3 - 3^3 + 6^3 - 5^3 + \dots + 18^3 - 17^3?$$

(A) 2023 (B) 2679 (C) 2941 (D) 3159 (E) 3235

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 13

Not yet answered

Points out of 6

In a table tennis tournament every participant played every other participant exactly once. Although there were twice as many right-handed players as left-handed players, the number of games won by left-handed players was 40% more than the number of games won by right-handed players. (There were no ties and no ambidextrous players.) What is the total number of games played?

(A) 15 (B) 36 (C) 45 (D) 48 (E) 66

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 14

Not yet answered

Points out of 6

How many complex numbers satisfy the equation $z^5 = \bar{z}$, where $\bar{z}$ is the conjugate of the complex number z ?

(A) 2 (B) 3 (C) 5 (D) 6 (E) 7

Select one:

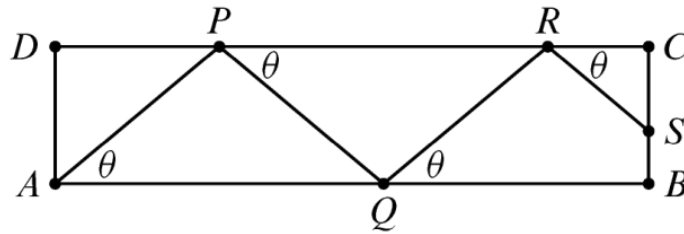
- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 15

Not yet answered

Points out of 6

Usain is walking for exercise by zigzagging across a 100-meter by 30-meter rectangular field, beginning at point A and ending on the segment $\overline{BC}$. He wants to increase the distance walked by zigzagging as shown in the figure below ($APQRS$). What angle θ $\angle PAB = \angle QPC = \angle RQB = \dots$ will produce in a length that is 120 meters? (This figure is not drawn to scale. Do not assume that he zigzag path has exactly four segments as shown; there could be more or fewer.)



- (A) $\arccos \frac{5}{6}$ (B) $\arccos \frac{4}{5}$ (C) $\arccos \frac{3}{10}$
 (D) $\arcsin \frac{4}{5}$ (E) $\arcsin \frac{5}{6}$

Select one:

- ☐ A
☐ B
☐ C
☐ D
☐ E
☐ Leave blank (1.5 points)

Question 16

Not yet answered

Points out of 6

Consider the set of complex numbers z satisfying $|1 + z + z^2| = 4$. The maximum value of the imaginary part of z can be written in the form $\frac{\sqrt{m}}{n}$, where m and n are relatively prime positive integers. What is $m + n$?

- (A) 20 (B) 21 (C) 22 (D) 23 (E) 24

Select one:

- ☐ A
☐ B
☐ C
☐ D
☐ E
☐ Leave blank (1.5 points)

Question 17

Not yet answered

Points out of 6

Flora the frog starts at 0 on the number line and makes a sequence of jumps to the right. In any one jump, independent of previous jumps, Flora leaps a positive integer distance m with probability $\frac{1}{2^m}$.

What is the probability that Flora will eventually land at 10?

- (A) $\frac{5}{512}$ (B) $\frac{45}{1024}$ (C) $\frac{127}{1024}$ (D) $\frac{511}{1024}$ (E) $\frac{1}{2}$

Select one:

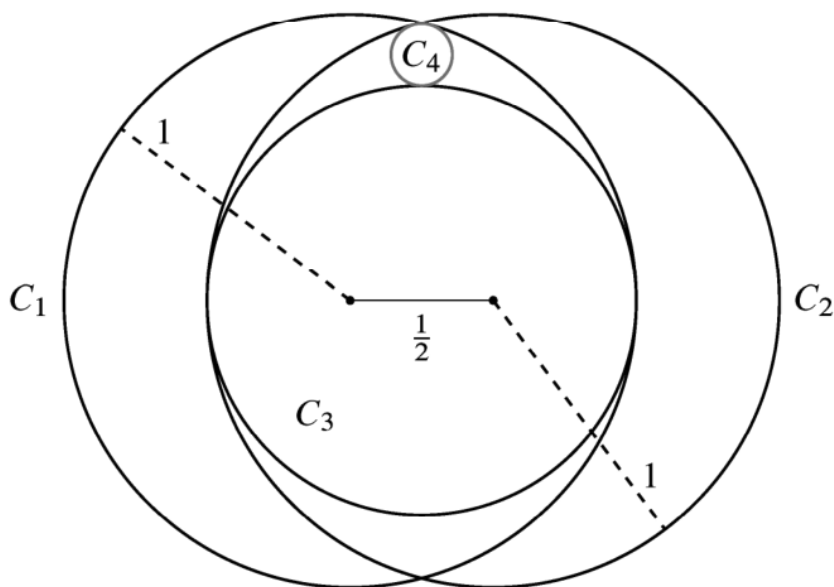
- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 18

Not yet answered

Points out of 6

Circle C_1 and C_2 each have radius 1, and the distance between their centers is $\frac{1}{2}$. Circle C_3 is the largest circle internally tangent to both C_1 and C_2 . Circle C_4 is internally tangent to both C_1 and C_2 and externally tangent to C_3 . What is the radius of C_4 ?



- (A) $\frac{1}{14}$ (B) $\frac{1}{12}$ (C) $\frac{1}{10}$ (D) $\frac{3}{28}$ (E) $\frac{1}{9}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 19

Not yet answered

Points out of 6

What is the product of all solutions to the equation

$$\log_{7x} 2023 \cdot \log_{289x} 2023 = \log_{2023x} 2023 ?$$

- (A) $(\log_{2023} 7 \cdot \log_{2023} 289)^2$ (B) $\log_{2023} 7 \cdot \log_{2023} 289$ (C) 1
(D) $\log_7 2023 \cdot \log_{289} 2023$ (E) $(\log_7 2023 \cdot \log_{289} 2023)^2$

Select one:

- ☐ A
☐ B
☐ C
☐ D
☐ E
☐ Leave blank (1.5 points)

Question 20

Not yet answered

Points out of 6

Rows 1, 2, 3, 4, and 5 of a triangular array of integers are shown below.

			1		
		1		1	
		1		3	
	1		5		1
1		7		11	

Each row after the first row is formed by placing a 1 at each end of the row, and each interior entry is 1 greater than the sum of the two numbers diagonally above it in the previous row. What is the units digits of the sum of the 2023 numbers in the 2023rd row?

- (A) 1 (B) 3 (C) 5 (D) 7 (E) 9

Select one:

- ☐ A
☐ B
☐ C
☐ D
☐ E
☐ Leave blank (1.5 points)

Question 21

Not yet answered

Points out of 6

If A and B are vertices of a polyhedron, define the *distance* $d(A, B)$ to be the minimum number of edges of the polyhedron one must traverse in order to connect A and B . For example, if $\overline{AB}$ is an edge of the polyhedron, then $d(A, B) = 1$, but if $\overline{AC}$ and $\overline{CB}$ are edges and $\overline{AB}$ is not an edge, then $d(A, B) = 2$. Let Q , R , and S be randomly chosen distinct vertices of a regular icosahedron (regular polyhedron made up of 20 equilateral triangles). What is the probability that $d(Q, R) > d(R, S)$?

- (A) $\frac{7}{22}$ (B) $\frac{1}{3}$ (C) $\frac{3}{8}$ (D) $\frac{5}{12}$ (E) $\frac{1}{2}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 22

Not yet answered

Points out of 6

Let f be the unique function defined on the positive integers such that

$$\sum_{d|n} d \cdot f\left(\frac{n}{d}\right) = 1$$

for all positive integers n . What is $f(2023)$?

- (A) -1536 (B) 96 (C) 108 (D) 116 (E) 144

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 23

Not yet answered

Points out of 6

How many ordered pairs of positive real numbers (a, b) satisfy the equation

$$(1 + 2a)(2 + 2b)(2a + b) = 32ab?$$

(A) 0 (B) 1 (C) 2 (D) 3 (E) an infinite number

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 24

Not yet answered

Points out of 6

Let K be the number of sequences $A_1, A_2, \dots, A_n$ such that n is a positive integer less than or equal to 10, each A_i is a subset of $\{1, 2, 3, \dots, 10\}$, and A_{i-1} is a subset of A_i for each i between 2 and n , inclusive. For example, $\{\}$, $\{5, 7\}$, $\{2, 5, 7\}$, $\{2, 5, 7\}$, $\{2, 5, 6, 7, 9\}$ is one such sequence, with $n = 5$. What is the remainder when K is divided by 10?

(A) 1 (B) 3 (C) 5 (D) 7 (E) 9

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 25

Not yet answered

Points out of 6

There is a unique sequence of integers $a_1, a_2, \dots, a_{2023}$ such that

$$\tan 2023x = \frac{a_1 \tan x + a_3 \tan^3 x + a_5 \tan^5 x + \dots + a_{2023} \tan^{2023} x}{1 + a_2 \tan^2 x + a_4 \tan^4 x + \dots + a_{2022} \tan^{2022} x}$$

whenever $\tan 2023x$ is defined. What is a_{2023} ?

(A) -2023 (B) -2022 (C) -1 (D) 1 (E) 2023

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

2023 AMC 12A

Answer key

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



2023 AMC 12B

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Question 1

Not yet answered

Points out of 6

Mrs. Jones is pouring orange juice into four identical glasses for her four sons. She fills the first three glasses completely but runs out of juice when the fourth glass is only $\frac{1}{3}$ full. What fraction of a glass must Mrs. Jones pour from each of the first three glasses into the fourth glass so that all four glasses will have the same amount of juice?

- (A) $\frac{1}{12}$ (B) $\frac{1}{4}$ (C) $\frac{1}{6}$ (D) $\frac{1}{8}$ (E) $\frac{2}{9}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 2

Not yet answered

Points out of 6

Carlos went to a sports store to buy running shoes. Running shoes were on sale, with prices reduced by 20% on every pair of shoes. Carlos also knew that he had to pay a 7.5% sales tax on the discounted price. He had \$43. What is the original (before discount) price of the most expensive shoes he could afford to buy?

- (A) \$46 (B) \$50 (C) \$48 (D) \$47 (E) \$49

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 3

Not yet answered

Points out of 6

A $3 - 4 - 5$ right triangle is inscribed in circle A , and a $5 - 12 - 13$ right triangle is inscribed in circle B . What is the ratio of the area of circle A to the area of circle B ?

- (A) $\frac{9}{25}$ (B) $\frac{1}{9}$ (C) $\frac{1}{5}$ (D) $\frac{25}{169}$ (E) $\frac{4}{25}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 4

Not yet answered

Points out of 6

Jackson's paintbrush makes a narrow strip with a width of 6.5 millimeters. Jackson has enough paint to make a strip 25 meters long. How many square centimeters of paper could Jackson cover with paint?

- (A) 162, 500 (B) 162.5 (C) 1, 625 (D) 1, 625, 000 (E) 16, 250

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 5

Not yet answered

Points out of 6

You are playing a game. A 2×1 rectangle covers two adjacent squares (oriented either horizontally or vertically) of a 3×3 grid of squares, but you are not told which two squares are covered. Your goal is to find at least one square that is covered by the rectangle. A "turn" consists of you guessing a square, after which you are told whether that square is covered by the hidden rectangle. What is the minimum number of turns you need to ensure that at least one of your guessed squares is covered by the rectangle?

(A) 3 (B) 5 (C) 4 (D) 8 (E) 6

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 6

Not yet answered

Points out of 6

When the roots of the polynomial

$$P(x) = (x - 1)^1(x - 2)^2(x - 3)^3 \cdots (x - 10)^{10}$$

are removed from the number line, what remains is the union of 11 disjoint open intervals. On how many of these intervals is $P(x)$ positive?

(A) 3 (B) 7 (C) 6 (D) 4 (E) 5

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 7

Not yet answered

Points out of 6

For how many integers n does the expression

$$\sqrt{\frac{\log(n^2) - (\log n)^2}{\log n - 3}}$$

represent a real number, where $\log$ denotes the base 10 logarithm?

(A) 900 (B) 2 (C) 902 (D) 2 (E) 901

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 8

Not yet answered

Points out of 6

How many nonempty subsets B of $\{0, 1, 2, 3, \dots, 12\}$ have the property that the number of elements in B is equal to the least element of B ? For example, $B = \{4, 6, 8, 11\}$ satisfies the condition.

(A) 256 (B) 136 (C) 108 (D) 144 (E) 156

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 9

Not yet answered

Points out of 6

What is the area of the region in the coordinate plane defined by

$$||x| - 1| + ||y| - 1| \leq 1?$$

- (A) 2 (B) 8 (C) 4 (D) 15 (E) 12

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 10

Not yet answered

Points out of 6

In the xy -plane, a circle of radius 4 with center on the positive x -axis is tangent to the y -axis at the origin, and a circle with radius 10 with center on the positive y -axis is tangent to the x -axis at the origin. What is the slope of the line passing through the two points at which these circles intersect?

- (A) $\frac{2}{7}$ (B) $\frac{3}{7}$ (C) $\frac{2}{\sqrt{29}}$ (D) $\frac{1}{\sqrt{29}}$ (E) $\frac{2}{5}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 11

Not yet answered

Points out of 6

What is the maximum area of an isosceles trapezoid that has legs of length 1 and one base twice as long as the other?

- (A) $\frac{5}{4}$ (B) $\frac{8}{7}$ (C) $\frac{5\sqrt{2}}{4}$ (D) $\frac{3}{2}$ (E) $\frac{3\sqrt{3}}{4}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 12

Not yet answered

Points out of 6

For complex number $u = a + bi$ and $v = c + di$ (where $i = \sqrt{-1}$), define the binary operation

$$u \otimes v = ac + bdi$$

Suppose z is a complex number such that $z \otimes z = z^2 + 40$. What is $|z|$?

- (A) 2 (B) 5 (C) $\sqrt{5}$ (D) $\sqrt{10}$ (E) $5\sqrt{2}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 13

Not yet answered

Points out of 6

A rectangular box $\mathcal{P}$ has distinct edge lengths a , b , and c . The sum of the lengths of all 12 edges of $\mathcal{P}$ is 13, the areas of all 6 faces of $\mathcal{P}$ is $\frac{11}{2}$, and the volume of $\mathcal{P}$ is $\frac{1}{2}$. What is the length of the longest interior diagonal connecting two vertices of $\mathcal{P}$?

- (A) 2 (B) $\frac{3}{8}$ (C) $\frac{9}{8}$ (D) $\frac{9}{4}$ (E) $\frac{3}{2}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 14

Not yet answered

Points out of 6

For how many ordered pairs (a, b) of integers does the polynomial $x^3 + ax^2 + bx + 6$ have 3 distinct integer roots?

- (A) 5 (B) 6 (C) 8 (D) 7 (E) 4

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 15

Not yet answered

Points out of 6

Suppose a , b , and c are positive integers such that

$$\frac{a}{14} + \frac{b}{15} = \frac{c}{210}.$$

Which of the following statements are necessarily true?

- I. If $\gcd(a, 14) = 1$ or $\gcd(b, 15) = 1$ or both, then $\gcd(c, 210) = 1$.
II. If $\gcd(c, 210) = 1$, then $\gcd(a, 14) = 1$ or $\gcd(b, 15) = 1$ or both.
III. $\gcd(c, 210) = 1$ if and only if $\gcd(a, 14) = \gcd(b, 15) = 1$.
(A) I, II, and III (B) I only (C) I and II only
(D) III only (E) II and III only

Select one:

- ☐ A
☐ B
☐ C
☐ D
☐ E
☐ Leave blank (1.5 points)

Question 16

Not yet answered

Points out of 6

In the state of Coinland, coins have values 6, 10, and 15 cents. Suppose x is the value in cents of the most expensive item in Coinland that cannot be purchased using these coins with exact change. What is the sum of the digits of x ?

- (A) 8 (B) 10 (C) 7 (D) 11 (E) 9

Select one:

- ☐ A
☐ B
☐ C
☐ D
☐ E
☐ Leave blank (1.5 points)

Question 17

Not yet answered

Points out of 6

Triangle ABC has side lengths in arithmetic progression, and the smallest side has length 6. If the triangle has an angle of 120° , what is the area of ABC ?

- (A) $12\sqrt{3}$ (B) $8\sqrt{6}$ (C) $14\sqrt{2}$ (D) $20\sqrt{2}$ (E) $15\sqrt{3}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 18

Not yet answered

Points out of 6

Last academic year Yolanda and Zelda took different courses that did not necessarily administer the same number of quizzes during each of the two semesters. Yolanda's average on all the quizzes she took during the first semester was 3 points higher than Zelda's average on all the quizzes she took during the first semester. Yolanda's average on all the quizzes she took during the second semester was 18 points higher than her average for the first semester and was again 3 points higher than Zelda's average on all the quizzes Zelda took during her second semester. Which one of the following statements cannot possibly be true?

- (A) Yolanda's quiz average for the academic year was 22 points higher than Zelda's.
- (B) Zelda's quiz average for the academic year was higher than Yolanda's.
- (C) Yolanda's quiz average for the academic year was 3 points higher than Zelda's.
- (D) Zelda's quiz average for the academic year equaled Yolanda's.
- (E) If Zelda had scored 3 points higher on each quiz she took, then she would have had the same average for the academic year as Yolanda.

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 19

Not yet answered

Points out of 6

Each of 2023 balls is randomly placed into one of 3 bins. Which of the following is closest to the probability that each of the bins will contain an odd number of balls?

- (A) $\frac{2}{3}$ (B) $\frac{3}{10}$ (C) $\frac{1}{2}$ (D) $\frac{1}{3}$ (E) $\frac{1}{4}$

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 20

Not yet answered

Points out of 6

Cyrus the frog jumps 2 units in a direction, then 2 more in another direction. What is the probability that he lands less than 1 unit away from his starting position?

- (A) $\frac{1}{6}$ (B) $\frac{1}{5}$ (C) $\frac{\sqrt{3}}{8}$ (D) $\frac{\arctan \frac{1}{2}}{\pi}$ (E) $\frac{2 \arcsin \frac{1}{4}}{\pi}$

Select one:

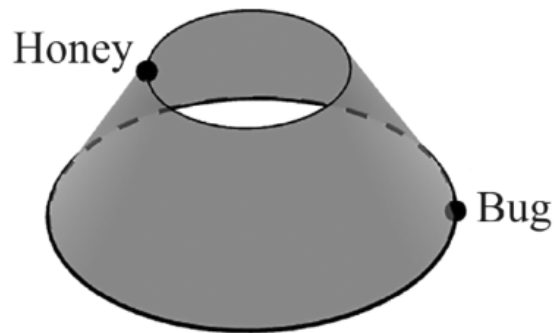
- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 21

Not yet answered

Points out of 6

A lampshade is made in the form of the lateral surface of the frustum of a right circular cone. The height of the frustum is $3\sqrt{3}$ inches, its top diameter is 6 inches, and its bottom diameter is 12 inches. A bug is at the bottom of the lampshade and there is a glob of honey on the top edge of the lampshade at the spot farthest from the bug. The bug wants to crawl to the honey, but it must stay on the surface of the lampshade. What is the length in inches of its shortest path to the honey?



- (A) $6 + 3\pi$ (B) $6 + 6\pi$ (C) $6\sqrt{3}$
 (D) $6\sqrt{5}$ (E) $6\sqrt{3} + \pi$

Select one:

- ☐ A
☐ B
☐ C
☐ D
☐ E
☐ Leave blank (1.5 points)

Question 22

Not yet answered

Points out of 6

A real-valued function f has the property that for all real numbers a and b ,

$$f(a+b) + f(a-b) = 2f(a)f(b).$$

Which one of the following cannot be the value of $f(1)$?

- (A) 0 (B) 1 (C) -1 (D) 2 (E) -2

Select one:

- ☐ A
☐ B
☐ C
☐ D
☐ E
☐ Leave blank (1.5 points)

Question 23

Not yet answered

Points out of 6

When n standard six-sided dice are rolled, the product of the numbers rolled can be any of 936 possible values. What is n ?

(A) 11 (B) 6 (C) 8 (D) 10 (E) 9

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 24

Not yet answered

Points out of 6

Suppose that a , b , c and d are positive integers satisfying all of the following relations.

$$\begin{aligned}abcd &= 2^6 \cdot 3^9 \cdot 5^7 \\ \text{lcm}(a, b) &= 2^3 \cdot 3^2 \cdot 5^3 \\ \text{lcm}(a, c) &= 2^3 \cdot 3^3 \cdot 5^3 \\ \text{lcm}(a, d) &= 2^3 \cdot 3^3 \cdot 5^3 \\ \text{lcm}(b, c) &= 2^1 \cdot 3^3 \cdot 5^2 \\ \text{lcm}(b, d) &= 2^2 \cdot 3^3 \cdot 5^2 \\ \text{lcm}(c, d) &= 2^2 \cdot 3^3 \cdot 5^2\end{aligned}$$

What is $\text{gcd}(a, b, c, d)$?

(A) 30 (B) 45 (C) 3 (D) 15 (E) 6

Select one:

- ☐ A
- ☐ B
- ☐ C
- ☐ D
- ☐ E
- ☐ Leave blank (1.5 points)

Question 25

Not yet answered

Points out of 6

A regular pentagon with area $\sqrt{5} + 1$ is printed on paper and cut out. The five vertices of the pentagon are folded into the center of the pentagon, creating a smaller pentagon. What is the area of the new pentagon?

(A) $4 - \sqrt{5}$ (B) $\sqrt{5} - 1$ (C) $8 - 3\sqrt{5}$

(D) $\frac{\sqrt{5} + 1}{2}$ (E) $\frac{2 + \sqrt{5}}{3}$

Select one:

☐ A

☐ B

☐ C

☐ D

☐ E

☐ Leave blank (1.5 points)

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Answer key

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