COPERNICUS

A TRADITION OF EXCELLENCE

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INSTRUCTIONS

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1. Calculate:

$$2023 \times 2 - 2023 \times 0 + 2023 \times 2 - 2023 \times 3$$

A) 2023
B) 4046
C) 14161
D) 20230

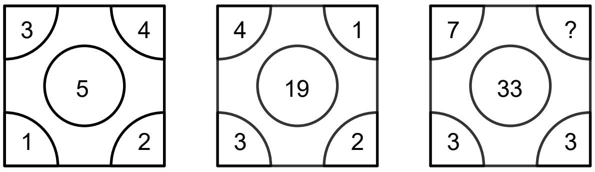
2. The application of the test of the global round of the 4th Copernicus Mathematics Olympiad is being held on July 11, 2023, a Tuesday. Andrew's birthday is 50 days after the application of the test. George is 8 days younger than Andrew. On what day of the week will George's birthday be that year?

A) Monday
B) Tuesday
C) Wednesday
D) Thursday

3. If the number $\overline{14A}$ is prime, then what is the value of the digit A?

A) 1
B) 3
C) 7
D) 9

4. Analyze the images below and find the missing number.



A) 3
B) 9
C) 10
D) 15

5. A soccer player has scored 24 goals in 30 games. If he maintains this average, how many goals will he score in 50 games?

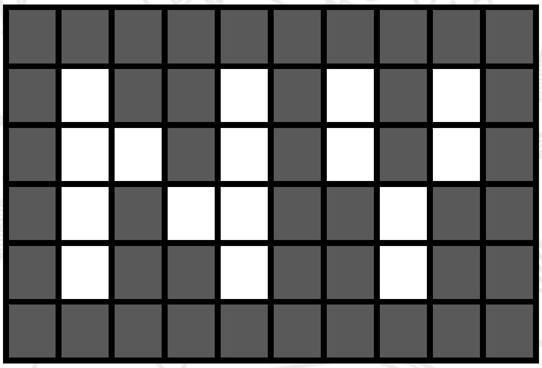
A) 36
B) 40
C) 48
D) 60

6. Find the value of the following expression.

$$\left(2-\frac{8}{10}\right)-\left(\frac{2}{3}-3\frac{1}{5}\right)\div\frac{2}{3}$$

A) $\frac{11}{10}$
B) $\frac{22}{5}$
C) 5
D) 7

7. What fraction of the figure below is shaded?



A) $\frac{4}{15}$

B) $\frac{10}{15}$

C) $\frac{11}{15}$

D) $\frac{13}{15}$

8. Look at the pattern below and find the missing number.

$0 \rightarrow 1$
$1 \rightarrow 0$
$4 \rightarrow 1$
$7 \rightarrow 0$
$49 \rightarrow 2$
$68 \rightarrow 3$
$9840 \rightarrow ?$

A) 2

B) 3

C) 4

D) 5

9. If 1 mile is equivalent to 1.609 kilometers, then 724,050 centimeters are equivalent to how many miles?

A) 4.5

B) 450

C) 4,500

D) 450,000

10. A survey about sports was conducted among the students of a school. In this survey it was found that 120 students play basketball, 140 students play football, 30 students play both basketball and football, and 60 students do not play any of these sports. How many students participated in the survey?

A) 260

B) 290

C) 320

D) 350

11. Find the value of $N + Y + C$.

$$\begin{array}{cccc} & N & Y & C \\ \times & & & 7 \\ \hline 2 & 0 & 2 & 3 \\ \hline \end{array}$$

A) 11

B) 15

C) 19

D) 23

12. How many multiples of 13 are there between 100 and 500?

- **A)** 17
- **B)** 31
- **C)** 38
- **D)** 59

13. Oscar is standing in the middle of a large corridor, in which he can only walk to the right or left, with no obstacle to block his path. Knowing that Oscar has taken 10 steps in random directions, which of the following cannot be the distance, in steps, between his final position and his initial position?

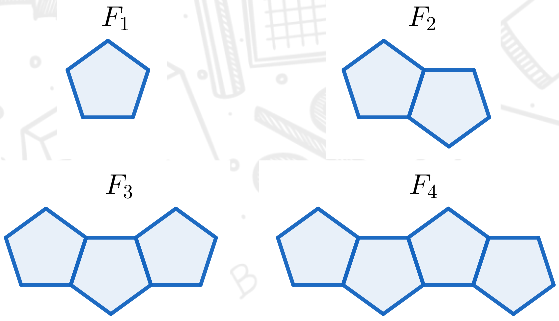
- **A)** 1
- **B)** 2
- **C)** 4
- **D)** 8

14. Find the value of C so that the equality below is true.

$$2 \times C + 3 \times C + 7 = 6 \times 7$$

- **A)** 4
- **B)** 5
- **C)** 6
- **D)** 7

15. If the pattern formed by the plane figures F_1, F_2, F_3 and F_4 continues, how many sides will figure F_5 have? Notice that figure F_2 has 8 sides.



- **A)** 17
- **B)** 18
- **C)** 19
- **D)** 21

16. Consider $a \# b = a \times b + a - b$. For example: $3 \# 2 = 3 \times 2 + 3 - 2 = 7$. So, calculate the value of $(7 \# 4) - (4 \# 7)$.

- **A)** 6
- **B)** 11
- **C)** 22
- **D)** 56

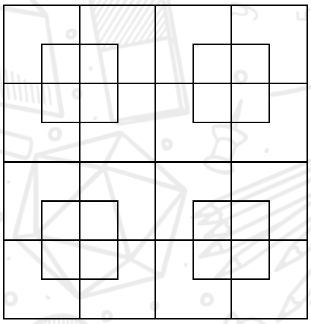
17. Let A, B, C, D, E, and F be natural numbers. It is known that E is greater than B and F, that D is greater than E, and that A is less than D. Based on this, which of the following is a possible relationship between these numbers?

- **A)** $B < A < F < D < E < C$
- **B)** $B < F < E < D < A < C$
- **C)** $B < C < E < A < F < D$
- **D)** $C < B < F < A < E < D$

18. The sum of the digits in the year 2023 is 7. In how many years from now will the sum of the digits of the year have doubled?

- **A)** 7
- **B)** 10
- **C)** 13
- **D)** 16

19. How many squares are there in the picture below?



- **A)** 37
- **B)** 41
- **C)** 50
- **D)** 60

20. George's daughter Mary was born on George's 36th birthday. How old is Mary today, knowing that she is 4 times younger than George?

- **A)** 6
- **B)** 9
- **C)** 12
- **D)** 18

21. Find the next term of the sequence below.

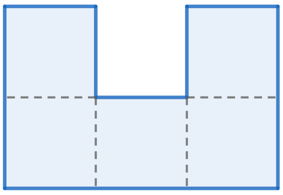
$$1, 1, 3, 5, 9, 17, 31, \ldots$$

Answer: ________________

22. Daniel is playing the "Primes Challenge". In this game, he must speak aloud the natural numbers, in ascending order, starting with 1. However, this game has a peculiar rule: he cannot speak prime numbers and must clap his hands on their turn. If Daniel just clapped his hands for the 25th time, how many multiples of 7 did he utter out loud?

Answer: ________________

23. Alex the astronaut bought a piece of land whose shape is shown in the picture below by the blue lines. He needed exactly 240 meters of fence to go around the entire plot of land. Knowing that the land can be divided into 5 identical squares, as shown by the dashed lines, what is the total area of Alex's land in square meters?



Answer: ________________

24. Beatrice studies at a school where lessons have a standard duration of 45 minutes. If she attends 6 classes a day, 5 days a week, how many hours does Beatrice spend taking classes for 2 weeks?

Answer: ________________

25. Mike wants to write the letters M, A, T, or H in each of the boxes on the grid below so that each column and each row has four different letters. He has already started filling in the grid by writing the letters indicated in the picture. How many different ways can he finish filling in the grid?

M		T	
	A		H

Answer: ________________

Question	Answer
1	A
2	D
3	D
4	B
5	B
6	C
7	C
8	D
9	A
10	B
11	C
12	B
13	A
14	D
15	A
16	A
17	D
18	D
19	C
20	C
21	57
22	12
23	2000
24	45
25	4

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1. Calculate:

$$(4 \times 5 \times 7 \times 0.6) \div (20 \times 28 \times 3)$$

A) 5
B) 0.5
C) 0.05
D) 0.005

2. Two chocolates and three lollipops weigh 150 grams. One chocolate and five lollipops weigh 145 grams. How much do one chocolate and one lollipop weigh, in grams?

A) 50
B) 55
C) 60
D) 65

3. Look at the pattern below and find the missing number.

$0 \rightarrow 1$
$1 \rightarrow 0$
$4 \rightarrow 1$
$7 \rightarrow 0$
$49 \rightarrow 2$
$68 \rightarrow 3$
$9840 \rightarrow ?$

A) 2
B) 3
C) 4
D) 5

4. Beatrice's garden produced more fruit than she needed, so she decided to sell some boxes of fruit. In all, 60 oranges and 75 apples were left over. Being an organized girl, Beatrice has decided that the oranges will be distributed equally among the boxes, just like the apples. Since she wants to sell as many boxes as possible, find the total amount of fruit that should be placed in each box.

A) 15
B) 9
C) 5
D) 4

5. Andrew needs to climb an 8-step ladder. Since he has large legs, he can do this by climbing 1, 2, or 3 steps at a time. How many ways can Andrew get to the top of the ladder?

A) 81
B) 68
C) 31
D) 8

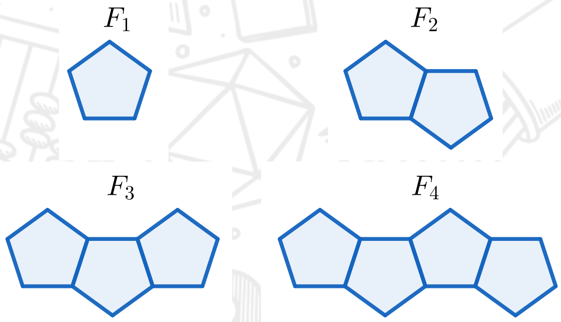
6. Alex the astronaut saved $5 in January, $10 in February, $15 in March, and so on. His goal was to save a total of $765 to buy a new pair of space boots. In which month did Alex reach his goal?

A) January
B) March
C) May
D) July

7. The sum of the digits in the year 2023 is 7. In how many years from now will the sum of the digits of the year have doubled?

A) 7
B) 10
C) 13
D) 16

8. If the pattern formed by the plane figures F_1, F_2, F_3 and F_4 continues, how many sides will figure F_{20} have? Notice that figure F_2 has 8 sides.



A) 62
B) 73
C) 85
D) 100

9. Since it is Sheldon's birthday, his mother gave him a few dollars as a present. He spent $\frac{1}{3}$ of that money buying comic books, spent another \$20 on some candy, and realized that he still had 40% of the initial amount he received. What was the amount given by Sheldon's mother?

A) \$60
B) \$75
C) \$80
D) \$90

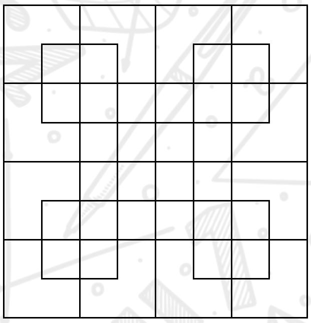
10. A parallelepiped is made up of several identical cubes. The breadth, length and depth of this parallelepiped are 9, 8 and 13 cubes respectively. What is the sum of the digits of the number of visible cubes in this parallelepiped?

A) 12
B) 15
C) 17
D) 18

11. Which of the expressions below does not have the same value as $\frac{21}{8}$?

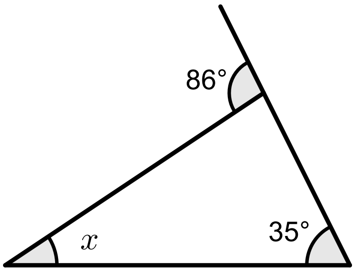
A) $2\frac{5}{8}$
B) $\frac{11}{4}+\frac{10}{4}$
C) $\frac{3}{2}\div\frac{4}{7}$
D) $\frac{21+21}{8+8}$

12. How many squares are there in the picture below?



A) 63
B) 67
C) 71
D) 76

13. Look at the image below, in which one side of the triangle has been lengthened. Based on the information in the image, find the value of x.



A) 45°
B) 51°
C) 86°
D) 121°

14. What percentage of a week equals 21 hours?

A) 0.25%
B) 1.25%
C) 2.5%
D) 12.5%

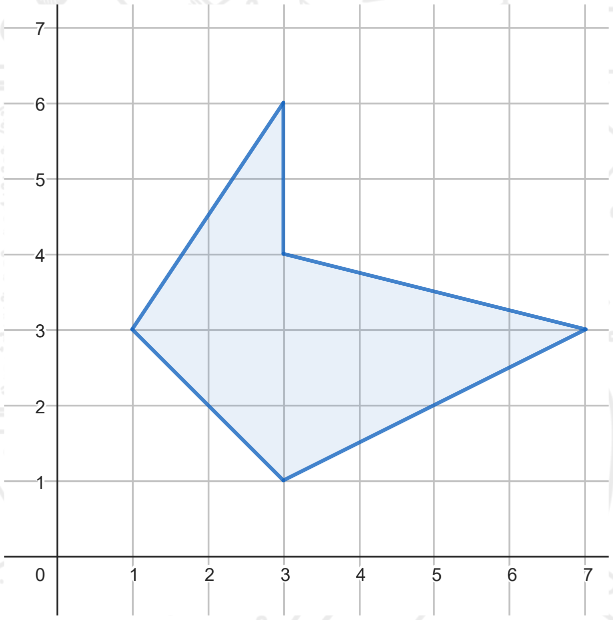
15. The seven-digit number $\overline{56AB359}$ is a multiple of 99. Find the value of $B - A$.

A) 3
B) 4
C) 5
D) 6

16. Daniel is playing the "Primes Challenge". In this game, he must speak aloud the natural numbers, in ascending order, starting with 1. However, this game has a peculiar rule: he cannot speak prime numbers and must clap his hands on their turn. If Daniel just clapped his hands for the 25th time, how many multiples of 7 did he utter out loud?

A) 10
B) 11
C) 12
D) 13

17. What is the area of the polygon below?



A) 11
B) 16
C) 22
D) 27

18. Three men build 5 walls in 2 days. How many men are needed to build 90 walls in 12 days?

A) 9
B) 12
C) 15
D) 24

19. The ratio of girls to boys in a class is $3:2$, respectively. There are 35 students in this class. How many boys are there in this class?

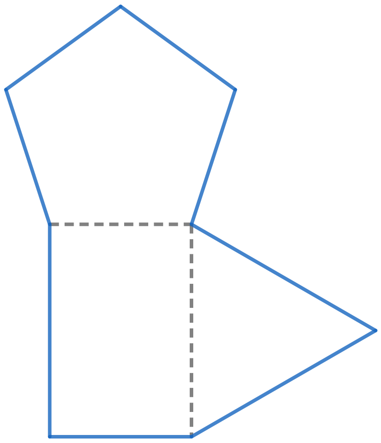
A) 8
B) 14
C) 24
D) 30

20. Mike wants to write the letters M, A, T, or H in each of the boxes on the grid below so that each column and each row has four different letters. He has already started filling in the grid by writing the letters indicated in the picture. How many different ways can he finish filling in the grid?

M		T	
	A		H

A) 1
B) 2
C) 4
D) 8

21. The picture below is made up of a rectangle, an equilateral triangle, and a regular pentagon. Knowing that the perimeter of the figure is 22 meters and that all the measurements of the sides, in meters, are whole numbers, what is the area of the rectangle in square decimeters? Notice that all sides of a regular polygon are the same size.



Answer: ____________

22. Ann will take a test with 25 multiple-choice questions. The scoring of the test works as follows: all students start with 25 bonus points, get 4 points for a correct answer, lose 1 point for an incorrect answer, and get 0 points for an answer left blank. If Ann had a score of 94, how many questions did she leave blank?

Answer: ____________

23. In the diagram below, different letters represent different digits. Therefore, find the value of $N + Y + C$.

$$\begin{array}{cccc} & & N & N \\ & & Y & Y \\ + & & C & C \\ \hline & N & Y & C \\ \hline \end{array}$$

Answer: _______________

24. A horse is tied to the corner of a fence by an 8 meter long rope. The fence is a rectangle, 6 meters by 9 meters, and keeps the horse on the outside. What is the size, in square meters, of the area through which the horse can move? Use $\pi = \frac{22}{7}$.

Answer: _______________

25. Robert forgot to pay a bill, and when he remembered, he found that he would have to pay 7% interest on the original amount. Knowing that Robert paid a total of $8,025, what was the initial amount of his bill?

Answer: _______________

Question	Answer
1	C
2	D
3	D
4	B
5	A
6	C
7	D
8	A
9	B
10	B
11	B
12	C
13	B
14	D
15	D
16	C
17	A
18	A
19	B
20	C
21	800
22	4
23	18
24	154
25	7500

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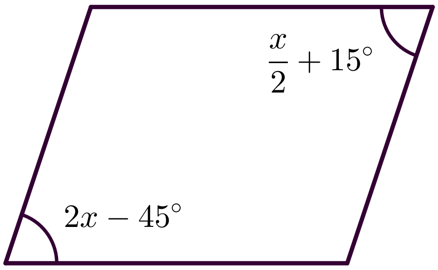
1. Calculate:

$$\frac{2023^4 - 2022^4}{2023^2 + 2022^2}$$

A) 2022
B) 2023
C) 4043
D) 4045

2. In the figure below, two of the internal angles of a parallelogram have been shown. Based on this, find the value of the largest internal angle of this parallelogram.



A) 150°
B) 145°
C) 140°
D) 135°

3. Which of the following is equivalent to $(7\%)^2$?

A) 49%
B) 4.9%
C) 0.49%
D) 0.049%

4. If $x + \frac{1}{x} = 5$, what is the sum of the digits of $x^5 + \frac{1}{x^5}$?

A) 13
B) 14
C) 15
D) 16

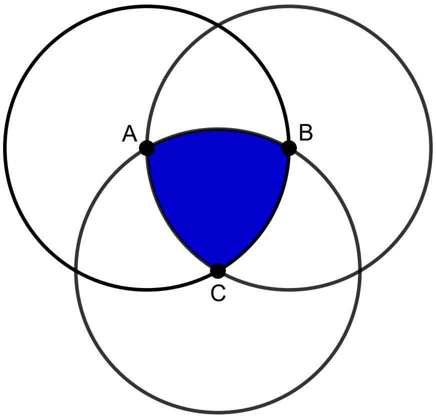
5. Beatrice's garden produced more fruit than she needed, so she decided to sell some boxes of fruit. In all, 60 oranges and 75 apples were left over. Being an organized girl, Beatrice has decided that the oranges will be distributed equally among the boxes, just like the apples. Since she wants to sell as many boxes as possible, find the total amount of fruit that should be placed in each box.

A) 15
B) 9
C) 5
D) 4

6. Alex, the mascot, is having a party and will give the guests bags of 5 candies each. It is known that Alex has 4 different candy flavors at his disposal (chocolate, strawberry, vanilla, and caramel) and that all candies of the same flavor are identical. Therefore, how many different bags can Alex prepare?

A) 1024
B) 120
C) 75
D) 56

7. In the figure below, three identical circles with a diameter of 20 centimeters and centers A, B, and C are arranged so that each circle passes through the center of the other two. What is the area of the blue region in square centimeters? Consider $\pi = 3$ and $\sqrt{3} = 1.7$.



A) 65

B) 130

C) 175

D) 260

8. Let a, b, and c be natural numbers that satisfy the equality below. Find $a + b + c$.

$$a + \frac{1}{b + \frac{1}{c}} = \frac{47}{21}$$

A) 11

B) 12

C) 13

D) 14

9. Andrew needs to climb an 8-step ladder. Since he has large legs, he can do this by climbing 1, 2, or 3 steps at a time. How many ways can Andrew get to the top of the ladder?

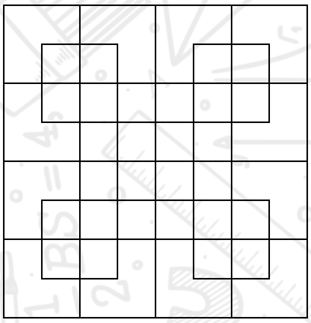
A) 8

B) 31

C) 68

D) 81

10. How many squares are there in the picture below?



A) 63

B) 67

C) 71

D) 76

11. In a group of 500 students, 80 are fluent in Spanish, 150 are fluent in English, and 10 are fluent in both languages. If a student is chosen at random, what is the probability that he or she speaks neither Spanish nor English?

A) 56%

B) 54%

C) 52%

D) 50%

12. The average grade of boys in a class is 5, and the average grade of girls is 8. If the average grade of all the students in this class is 6.2, what is the percentage of boys in the class?

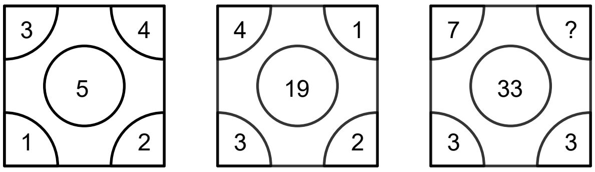
A) 40%
B) 50%
C) 60%
D) 70%

13. Find the value of x.

$$\frac{8x-11}{x+2}=5$$

A) 7
B) 8
C) 11
D) 12

14. Analyze the images below and find the missing number.



A) 3
B) 9
C) 10
D) 15

15. Let m and n be natural numbers. Knowing that $3^m-3^n=1944$, calculate the value of 3^{m-n}.

A) 3
B) 9
C) 27
D) 81

16. Find the value of the expression below.

$$\sqrt[3]{26+15\sqrt{3}}+\sqrt[3]{26-15\sqrt{3}}$$

A) 4
B) 3
C) 2
D) 1

17. Find the value of the sum below, considering that $\lceil x \rceil$ represents the smallest integer not smaller than x. For example: $\lceil 13.05 \rceil = 14$.

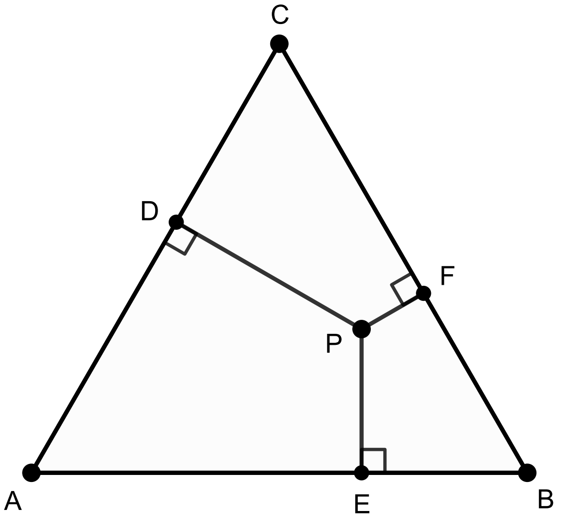
$$\lceil\sqrt{1}\,\rceil+\lceil\sqrt{2}\,\rceil+\lceil\sqrt{3}\,\rceil+\cdots+\lceil\sqrt{99}\,\rceil+\lceil\sqrt{100}\,\rceil$$

A) 500
B) 625
C) 680
D) 715

18. Three vertices of a rectangle are given by the points (2,4), (7,1), and (7,4) on the Cartesian plane. Find the sum of the coordinates of the other vertex of this rectangle.

- **A)** 1
- **B)** 2
- **C)** 3
- **D)** 4

19. In the figure below, triangle ABC is equilateral, $DP = 3$, $EP = 2$, $FP = 1$ and the angles marked are right angles. Find the height of the triangle ABC.



- **A)** 4
- **B)** $4\sqrt{3}$
- **C)** 6
- **D)** $6\sqrt{3}$

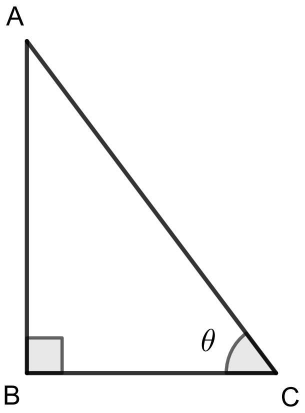
20. Ann will take a test with 25 multiple-choice questions. The scoring of the test works as follows: all students start with 25 bonus points, get 4 points for a correct answer, lose 1 point for an incorrect answer, and get 0 points for an answer left blank. If Ann had a score of 94, how many questions did she leave blank?

- **A)** 1
- **B)** 2
- **C)** 3
- **D)** 4

21. A horse is tied to the corner of a fence by an 8 meter long rope that can slide freely. The fence is a rectangle, 6 meters by 9 meters, and keeps the horse on the outside. What is the size, in square meters, of the area through which the horse can move? Use $\pi = 3$.

Answer: ________________

22. Consider the right triangle ABC below. It is known that the sine of angle θ is equal to $\frac{12}{13}$ and the cosine of that same angle equals the irreducible fraction $\frac{x}{y}$. Find the value of $y - x$.



Answer: ________________

23. Louis and Mary have \$85 together, Mary and Noah have \$103 together, and finally Noah and Louis have \$122 together. How much money do they have in total?

Answer: ________________

24. In the diagram below, different letters represent different digits. Therefore, find the value of $N + Y + C$.

$$\begin{array}{ccc} & N & N \\ & Y & Y \\ + & C & C \\ \hline N & Y & C \\ \hline \end{array}$$

Answer: ________________

25. Knowing that $n! = n \cdot (n-1) \cdot (n-2) \cdot \ldots \cdot 2 \cdot 1$, find the number of zeros at the end of 2023!.

Answer: ________________

Question	**Answer**
1	D
2	B
3	C
4	B
5	B
6	D
7	A
8	A
9	D
10	C
11	A
12	C
13	A
14	B
15	B
16	A
17	D
18	C
19	C
20	D
21	432
22	8
23	155
24	18
25	503

A TRADITION OF EXCELLENCE

WELCOME TO
COPERNICUS

INSTRUCTIONS

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Please read the followings carefully.

1. The exam has 25 multiple choice-questions. Each question weighs 4 points. The maximum score a student can get is 100. There is a penalty of one point for each incorrect answer. So only answer the questions you are sure of.
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Remember that “Hard work beats
talent when talent doesn't work hard”
We wish you the very best luck on the exam.

1. Calculate:

$$\frac{2023^4 - 2022^4}{2023^2 + 2022^2}$$

A) 2022

B) 2023

C) 4043

D) 4045

2. From the information below, find the value of $f(2)$.

$$f\left(f\left(f\left(f\left(f(x)\right)\right)\right)\right) = x + 15$$

A) 1

B) 3

C) 5

D) 7

3. What is the value of the sine of 75°?

A) $\frac{\sqrt{2}+\sqrt{3}}{2}$

B) $\frac{1+\sqrt{2}}{2}$

C) $\frac{\sqrt{3}-1}{2\sqrt{2}}$

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

4. Let m and n be natural numbers. Knowing that $3^m - 3^n = 1944$, calculate the value of 3^{m-n}.

A) 3

B) 9

C) 27

D) 81

5. Alex the astronaut saved \$5 in January, \$10 in February, \$15 in March, and so on. His goal was to save a total of \$765 to buy a new pair of space boots. In which month did Alex reach his goal?

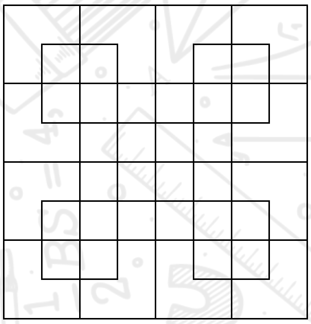
A) January

B) March

C) May

D) July

6. How many squares are there in the picture below?



A) 63

B) 67

C) 71

D) 76

7. Andrew needs to climb an 8-step ladder. Since he has large legs, he can do this by climbing 1, 2, or 3 steps at a time. How many ways can Andrew get to the top of the ladder?

A) 81

B) 68

C) 31

D) 8

8. If $x + \frac{1}{x} = 5$, what is the sum of the digits of $x^5 + \frac{1}{x^5}$?

A) 13
B) 14
C) 15
D) 16

9. The diagonals of a parallelogram measure 14 and 10 centimeters and form an angle of 150°. Calculate the area of this parallelogram in square centimeters.

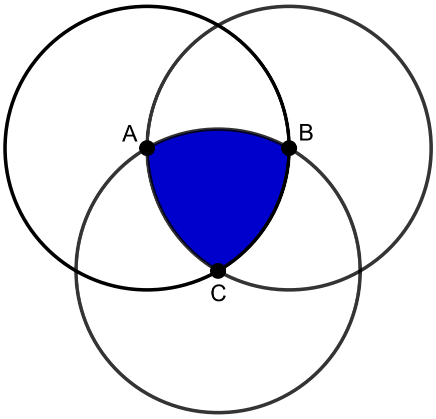
A) 35
B) 70
C) 140
D) 280

10. Find the value of the sum below, considering that $\lceil x \rceil$ represents the smallest integer not smaller than x. For example: $\lceil 13.05 \rceil = 14$.

$$\lceil \sqrt{1} \rceil + \lceil \sqrt{2} \rceil + \lceil \sqrt{3} \rceil + \cdots + \lceil \sqrt{99} \rceil + \lceil \sqrt{100} \rceil$$

A) 500
B) 625
C) 680
D) 715

11. In the figure below, three identical circles with a diameter of 20 centimeters and centers A, B, and C are arranged so that each circle passes through the center of the other two. What is the area of the blue region in square centimeters? Consider $\pi = 3$ and $\sqrt{3} = 1.7$.



A) 65
B) 130
C) 175
D) 260

12. Ann will take a test with 25 multiple-choice questions. The scoring of the test works as follows: all students start with 25 bonus points, get 4 points for a correct answer, lose 1 point for an incorrect answer, and get 0 points for an answer left blank. If Ann had a score of 94, how many questions did she leave blank?

A) 1
B) 2
C) 3
D) 4

13. In the diagram below, different letters represent different digits. Therefore, find the value of $N + Y + C$.

$$\begin{array}{cccc} & & N & N \\ & & Y & Y \\ + & & C & C \\ \hline & N & Y & C \\ \hline \end{array}$$

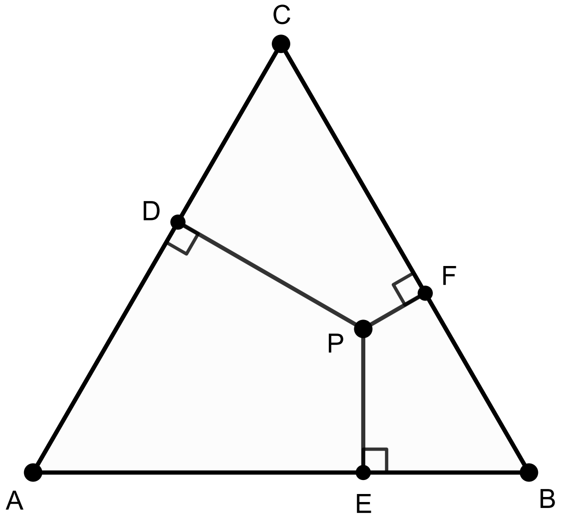
A) 14
B) 16
C) 18
D) 20

14. Determine the number of integer solutions of the equation below.

$$(x^2 - x + 1)^{(2x^2-3x-2)} = 1$$

A) 1
B) 2
C) 3
D) 4

15. In the figure below, triangle ABC is equilateral, $DP = 3$, $EP = 2$, $FP = 1$ and the angles marked are right angles. Find the height of the triangle ABC.



A) 4
B) 6
C) $4\sqrt{3}$
D) $6\sqrt{3}$

16. A certain ice cream shop in New York has 4 flavors of ice cream, which are sold in cups with 5 ice cream scoops. How many ways can you buy a cup of ice cream at this ice cream shop?

A) 14
B) 56
C) 256
D) 1024

17. Find the value of the expression below.

$$\sqrt[3]{26+15\sqrt{3}}+\sqrt[3]{26-15\sqrt{3}}$$

- **A)** 1
- **B)** 2
- **C)** 3
- **D)** 4

18. What is the surface area, in square centimeters, of a sphere that is inscribed in a cube whose diagonal measures 12 centimeters? Use $\pi = 3$.

- **A)** 144
- **B)** 216
- **C)** 432
- **D)** 576

19. Let g be a second-degree function such that $g(1) = 12$, $g(2) = 5$, and $g(3) = 0$. What is the value of $g(4)$?

- **A)** -3
- **B)** 1
- **C)** 3
- **D)** 5

20. Look at the equation below. There are two possible values for $\frac{24y}{x}$. Find the sum of these values.

$$35x^2 + xy - 12y^2 = 0$$

- **A)** 1
- **B)** 2
- **C)** 3
- **D)** 4

21. Knowing that $n! = n \cdot (n-1) \cdot (n-2) \cdot \ldots \cdot 2 \cdot 1$, find the number of zeros at the end of 2023!.

Answer: _______________

22. Four friends will organize a Secret Santa, a game in which they write their names on pieces of paper, put them into an urn, and each participant then randomly removes a piece of paper without telling the others. The fun is in the fact that each person must buy a gift for the friend who is drawn. For the game to work properly, it is necessary that no person draws his or her own name, and the probability of this happening is given by the irreducible fraction $\frac{a}{b}$. So, find the value of $a + b$.

Answer: _______________

23. A horse is tied to the corner of a fence by an 8-meter-long rope that can slide freely. The fence is a rectangle, 6 meters by 9 meters, and keeps the horse on the outside. What is the size, in square meters, of the area through which the horse can move? Use $\pi = 3$.

Answer: _______________

24. Find the largest three-digit number that leaves remainder 1 on division by 3, remainder 2 on division by 4, and remainder 3 on division by 5.

Answer: ______________

25. Let a, b, x, and y be real numbers that satisfy the system of equations below. Accordingly, find the value of $ax^4 + by^4$.

$$\begin{cases} a + b = 24 \\ ax + by = 97 \\ ax^2 + by^2 = 241 \\ ax^3 + by^3 = 823 \end{cases}$$

Answer: ______________

Question	Answer
1	D
2	C
3	D
4	B
5	C
6	C
7	A
8	B
9	A
10	D
11	A
12	D
13	C
14	C
15	B
16	B
17	D
18	A
19	A
20	B
21	503
22	11
23	432
24	958
25	2269

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1. Calculate:

$$\frac{2023^4 - 2022^4}{2023^2 + 2022^2}$$

A) 2022
B) 2023
C) 4043
D) 4045

2. The golden number (φ), or golden ratio, is considered by many to be the most beautiful number in mathematics. This is because it is easily observed in nature, as in Nautilus shells, for example. The expression that defines this ratio is given below. With this, express the value of the sine of 18° as a function of the golden number.

$$\varphi = \frac{1+\sqrt{5}}{2}$$

A) $\frac{1}{2\varphi}$
B) $\frac{1}{\varphi}$
C) φ
D) 2φ

3. Find the sum of the values of x that satisfy the equation below.

$$2^{\log_x(x^2-6x+9)} = 3^{2\,(\log_x \sqrt{x})-1}$$

A) 4
B) 5
C) 6
D) 7

4. With i being the imaginary unit, which of the following is equivalent to $\sqrt{-36}\cdot\sqrt{-25}$?

A) 30
B) -30
C) $30i$
D) $-30i$

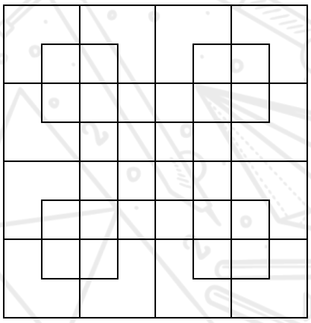
5. Let a, b, c, and d be non-negative integers, with $3^a + 3^b + 3^c + 3^d = 2512$. Find $a+b+c+d$.

A) 12
B) 14
C) 16
D) 18

6. If $x + \frac{1}{x} = 5$, what is the sum of the digits of $x^5 + \frac{1}{x^5}$?

A) 13
B) 14
C) 15
D) 16

7. How many squares are there in the picture below?



- **A)** 63
- **B)** 67
- **C)** 71
- **D)** 76

8. The sum of the odd-order terms of an infinite geometric progression is 8 and the sum of the even-order terms is 4. What is the first term of this progression?

- **A)** 6
- **B)** 7
- **C)** 8
- **D)** 9

9. Find the value of the sum below, considering that $\lceil x \rceil$ represents the smallest integer not smaller than x. For example: $\lceil 13.05 \rceil = 14$.

$$\lceil\sqrt{1}\,\rceil + \lceil\sqrt{2}\,\rceil + \lceil\sqrt{3}\,\rceil + \cdots + \lceil\sqrt{99}\,\rceil + \lceil\sqrt{100}\,\rceil$$

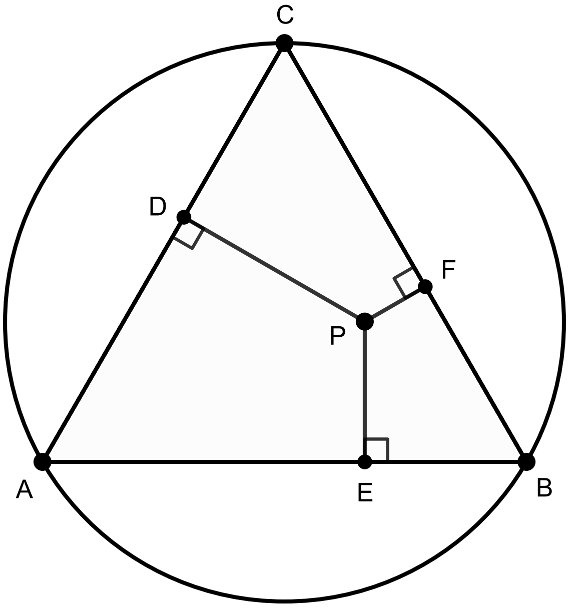
- **A)** 500
- **B)** 625
- **C)** 680
- **D)** 715

10. Find the value of the expression below.

$$\sqrt[3]{26 + 15\sqrt{3}} + \sqrt[3]{26 - 15\sqrt{3}}$$

- **A)** 1
- **B)** 2
- **C)** 3
- **D)** 4

11. In the figure below, triangle ABC is equilateral and is inscribed in a circle of radius 8. Knowing that $FP:EP:DP = 1:2:3$, find the area of triangle DEF.

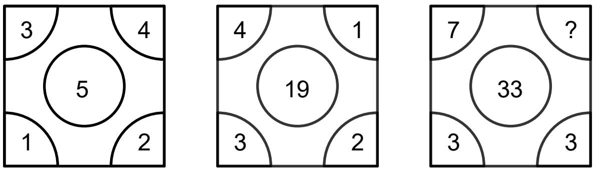


- **A)** $11\sqrt{3}$
- **B)** $9\sqrt{3}$
- **C)** $7\sqrt{3}$
- **D)** $5\sqrt{3}$

12. Let P be a polynomial of integer roots such that $P(0) = 114$. Which of the following numbers cannot be a root of this polynomial?

A) 2
B) 6
C) 19
D) 20

13. Analyze the images below and find the missing number.



A) 3
B) 9
C) 10
D) 15

14. What is the surface area, in square centimeters, of a sphere that is inscribed in a cube whose diagonal measures 12 centimeters? Use $\pi = 3$.

A) 144
B) 216
C) 432
D) 576

15. Find the last two digits of the number below.

$$2023^{2024}$$

A) 11
B) 21
C) 31
D) 41

16. Given below are the first terms of the Fibonacci sequence. Find the remainder of the division of the 2023rd term of this sequence by 8.

$$1, 1, 2, 3, 5, 8, 13, 21, 34, \ldots$$

A) 1
B) 3
C) 5
D) 7

17. Ann and John are playing a game in which they take turns removing, without replacement, balls from a box. This box has 3 green balls and 7 white balls, but it is not possible to see the color of the balls before removing them. The winner is the one who removes the first green ball. If Ann was the first to remove a ball, what is the probability that she will win the game?

A) $\frac{3}{10}$
B) $\frac{1}{2}$
C) $\frac{7}{12}$
D) $\frac{3}{4}$

18. What is the sum of the digits of the coefficient of x^{23} in the expansion of the polynomial below?

$$(1 + x^3 + x^5)^{10}$$

A) 3
B) 5
C) 7
D) 9

19. Look at the equation below. There are two possible values for $\frac{24y}{x}$. Find the sum of these values.

$$35x^2 + xy - 12y^2 = 0$$

A) 1
B) 2
C) 3
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20. A certain ice cream shop in New York has 4 flavors of ice cream, which are sold in cups with 5 ice cream scoops. How many ways can you buy a cup of ice cream at this ice cream shop?

A) 14
B) 56
C) 256
D) 1024

21. Knowing that the polynomial $p(x) = x^3 - 26x^2 + 216x - 576$ has 3 positive real roots, calculate the harmonic mean between these roots.

Answer: ______________

22. Knowing that $n! = n \cdot (n-1) \cdot (n-2) \cdot \ldots \cdot 2 \cdot 1$, find the number of zeros at the end of 2023!.

Answer: ______________

23. Six friends will organize a Secret Santa, a game in which they write their names on pieces of paper, put them into an urn, and each participant then randomly removes a piece of paper without telling the others. The fun is in the fact that each person must buy a gift for the friend who is drawn. For the game to work properly, it is necessary that no person draws his or her own name, and the probability of this happening is given by the irreducible fraction $\frac{a}{b}$. So, find the value of $a + b$.

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