COPERNICUS

A TRADITION OF EXCELLENCE

WELCOME TO COPERNICUS

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1. Calculate the sum:

$$101 + 202 + 303 + 404 + 505$$

A) 999

B) 1500

C) 1515

D) 1551

2. Which one is bigger:

$$X = 123 \times 321$$
$$Y = 100 \times 300$$

A) X

B) Y

C) Equal

D) Impossible to determine

3. Alex started the lesson at $09:15$ and finished at $13:05$. How long did Alex study?

A) 4 hours

B) 4 hours, 10 minutes

C) 3 hours, 50 minutes

D) 3 hours

4. Which answer is correct:

$$
\begin{array}{r}
1\,\square\,7 \\
+\quad 6\,\square \\
\hline
2\,2\,2
\end{array}
$$

A) $167 + 65$

B) $177 + 66$

C) $157 + 65$

D) $156 + 65$

5. What number comes next?

$$2, 5, 10, 17, 26, 37, \ldots$$

A) 38

B) 74

C) 50

D) 65

6. There are 20 trees in the row. Distance between each 2 trees is $2\,m$. What is the distance between the first and the last tree?

A) 38

B) 40

C) 42

D) 24

7. If $X \Delta Y = X + Y$ and $X \odot Y = X \times Y$, what will be $(4\Delta 3)\odot 2$?

A) 14

B) 9

C) 10

D) 16

8. Which day of the week will be 22nd of April, if 22nd of March is Friday?

A) Friday

B) Monday

C) Tuesday

D) Sunday

9. How many different ways you can use to get from A to B? (You can go through each point only once)
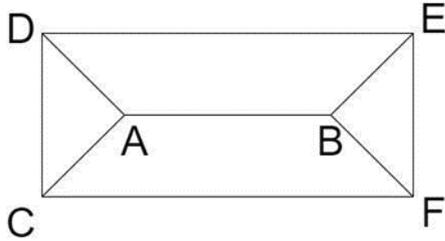
A) 9

B) 8

C) 7

D) 6

10. Two plums weigh one apple and three apples weigh two oranges. How many plums does one orange weigh?

A) 2

B) 3

C) 4

D) 6

11. The sum of the ages of mother, father and son is 66. What will be the sum of their ages after 3 years?

A) 75

B) 69

C) 72

D) 66

12. Find $A + B$, if the sum of numbers in the bottom two circles is equal to the number in the top ring.
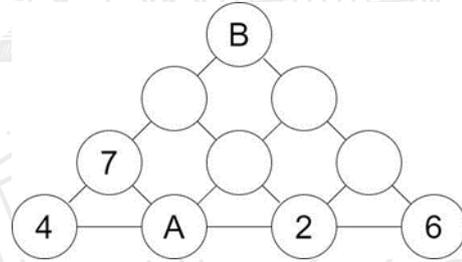
A) 28

B) 19

C) 24

D) 27

13. There are 30 cats in the yard. These include mothers and kittens. Each mother cat has at least 3 kittens. What is the maximum number of mother cats?

A) 10

B) 9

C) 8

D) 7

14. Grandma poured 30 liters of water into five three-liter and four two-liter jars, and the rest into half-liter jars. How many half-liter jars did Grandma use?

A) 12

B) 14

C) 16

D) 18

15. There are four doors and their four keys. How many attempts does it take to figure out which key fits which door? (Each key takes only one door).

A) 6

B) 10

C) 4

D) 16

16. The mother counted and if she gave each child 4 candies, then there would be 3 candies left. And if you give each one 5 candies, then 2 candies will be missing. How many children does the mother have?

A) 3

B) 4

C) 5

D) 6

17. John, Jane, Jimmy and Janet together have 42 balls. John has as many balls as Jane, Jimmy and Janet together. Jane has 5 balls more than Jimmy and 8 balls less than Janet. How many balls does Jane have?

A) 5

B) 6

C) 7

D) 8

18. The figure below is made up of two rows of numbers. Knowing that the pattern used in the first row has been applied the same way in the second row, find the value of A.

2	3	5	9	17
4				A

A) 19

B) 34

C) 49

D) 68

19. Find the value of x.
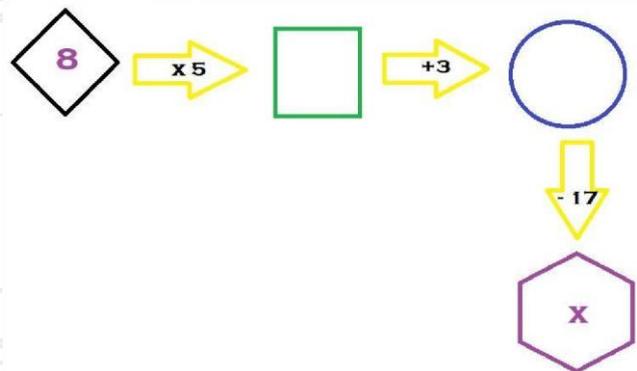
A) 29

B) 43

C) 26

D) 32

20. Area of this square is $64\ cm^2$. Find the length of one side of this square.
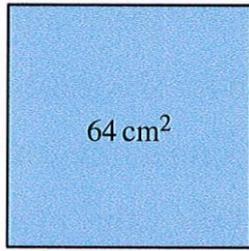
A) 8 cm

B) 12 cm

C) 16 cm

D) 32 cm

21. How many faces does the shape below have?
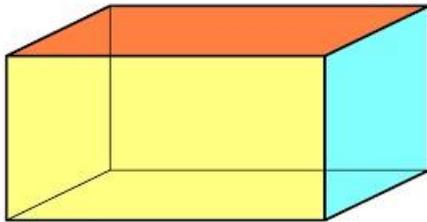
A) 8

B) 6

C) 5

D) 4

22. How many circles will be in pattern 50?

Pattern 1   Pattern 2   Pattern 3   Pattern 4
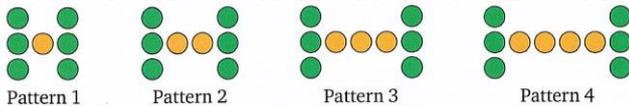
A) 96

B) 69

C) 126

D) 56

23.
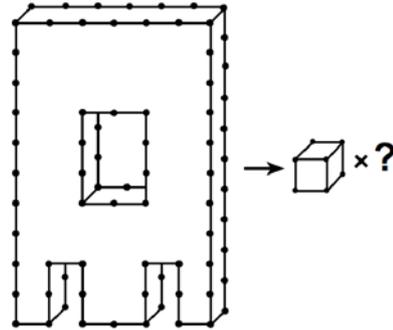
A) 48

B) 50

C) 52

D) 54

24. Find Highest Common Factor of 36 and 48.

A) 144

B) 12

C) 8

D) 6

25. The sum of two numbers is 96. The bigger number is twice as large as the smallest number. Find the biggest number.

A) 18

B) 24

C) 36

D) 64

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

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1. How many times do you have to write the digit 9, when you write the numbers from 1 to 100?

A) 10

B) 11

C) 19

D) 20

2. From number 209827325 delete 4 digits so that you get the smallest number. What will be the product of deleted digits?

A) $9 \cdot 8 \cdot 7 \cdot 3$

B) $9 \cdot 8 \cdot 7 \cdot 5$

C) $9 \cdot 8 \cdot 7 \cdot 2$

D) $9 \cdot 8 \cdot 3 \cdot 5$

3. There are 12 bicycles in the garden, with 2 or 3 wheels. Total number of wheels are 30. How many bicycles are there with 2 wheels?

A) 3

B) 4

C) 6

D) 8

4. $X \Delta Y = X + 2 \cdot Y$ and $X \Omega Y = X \cdot Y$. What will be $(107 \Delta 115) \Omega 6$?

A) 228

B) 2022

C) 1332

D) 80730

5. Calculate:

$$9 + 99 + 999 + 9\,999 + 99\,999 + 999\,999$$

A) 9 999 999

B) 1 888 888

C) 987 654 321

D) 1 111 104

6. Find the perimeter of $ABCDEFGH$ if $AB = 6$, $BC = 9$, and $FG = 2$.

A _____ H
           F   G
           E   D
B _____ C
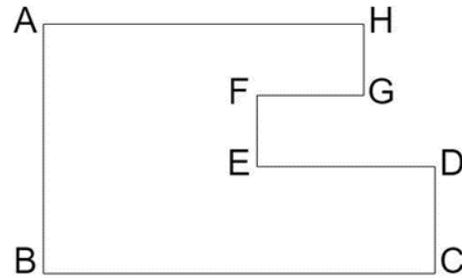
A) 20

B) 24

C) 26

D) 34

7. X is reminder when 2022 is divided by 11 and Y is reminder when 2022 is divided by 9. What will be $X + Y$?

A) 20

B) 2022

C) 4

D) 15

8. One chicken eats 200 g food per day. How many chickens will eat 8 kg of food in 4 days?

A) 10

B) 8

C) 12

D) 6

9. How many three-digit numbers can be written only with even number?

A) 900

B) 450

C) 500

D) 100

10. How many squares exist on the picture?
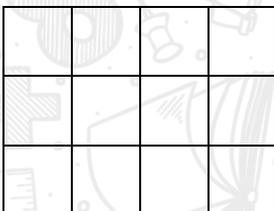
A) 15

B) 20

C) 18

D) 24

11. The length, width and height of the aquarium is 10 cm, 20 cm and 30 cm. What will be water volume if a quarter of the aquarium is filled?

A) 1000

B) 1500

C) 2000

D) 3000

12. How many natural divisors does a product of three distinct prime numbers have?

A) 3

B) 6

C) 8

D) 9

13. Calculate:

$$\left(1-\frac{1}{2}\right)\cdot\left(1-\frac{1}{3}\right)\cdot\left(1-\frac{1}{4}\right)\cdot \ldots \cdot\left(1-\frac{1}{21}\right)\cdot\left(1-\frac{1}{22}\right)$$

A) $\dfrac{1}{2}$

B) $\dfrac{1}{10}$

C) $\dfrac{1}{22}$

D) $\dfrac{1}{2\cdot3\cdot4\cdot\ldots\cdot22}$

14. The perimeter of $ABCD$ rectangle is 43. Calculate the perimeter of $APQR$, if all little rectangles are squares.
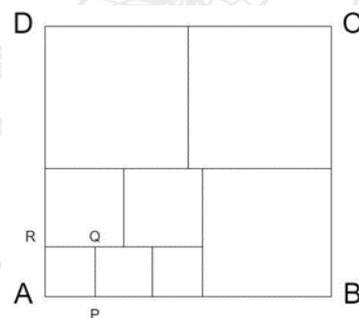
A) 1

B) 2

C) 3

D) 4

15. Speed of the dog is 4600 dm/min, speed of the cat is $8\,m/s$ and speed of the mouse is $27\,km/h$. Which one is faster?

A) Dog

B) Cat

C) Mouse

D) Dog and Cat

16. Alex has 3 pairs of shoes, 4 pants and 5 t-shirts. How many different ways of putting clothes are there?

A) 12

B) 24

C) 30

D) 60

17. Jim thought of a number. Jack multiplied Jim's imaginary number by 4 and then added 15. Jane multiplied Jim's imaginary number by 15 and added 4. What number did Jimmy come up with if Jack and Jane got the same answer?

A) 1

B) 2

C) 3

D) 4

18. The store has 4 plates, 3 cups and 7 spoons (all items are different colors). How many ways can you buy two different items?

A) 14

B) 42

C) 84

D) 91

19. Calculate the sum:

$$1 + 3 + 5 + \cdots + 97 + 99$$

A) 2500

B) 5050

C) 5000

D) 4950

20. The letters in the word MATHEMATICIAN were put in a box. What is the chance of getting letter A?

A) 3 out of 9

B) 3 out of 10

C) 3 out of 13

D) 3 out of 11

21. Alex received a container of fresh eggs. He sold $\frac{1}{3}$ of the eggs in the morning and sold 320 eggs in the afternoon. At the end of the day, he found that $\frac{1}{4}$ of the eggs were not sold. How many eggs did he receive in the beginning?

A) 768

B) 448

C) 1224

D) 549

22. How many numbers are there in the sequence $11, 14, 17, 20, \ldots, 71, 74$?

A) 20

B) 21

C) 22

D) 23

23. To complete the grid below, each of the digits from 1 to 4 must occur exactly once in each row and in each column. What number should replace X?

1		2	
2	3		
			4
			X

A) 1

B) 2

C) 3

D) 4

24. Let the operation $*$ be defined by $a * b = ab - a - b + 2$. If $7 * b = 13$, what is the value of b?

A) 1

B) 2

C) 3

D) 4

25. These steps are made of blocks. How many blocks are needed to make 100th step?

1 step
1 block

2 steps
3 blocks

3 steps
6 blocks

4 steps
10 blocks
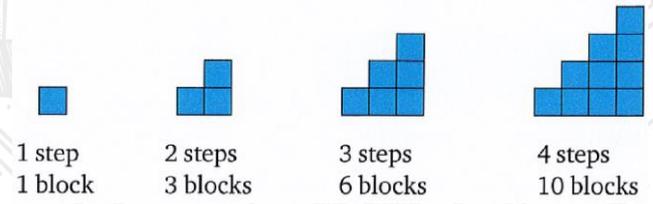
A) 100

B) 250

C) 1010

D) 5050

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

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1. Seven-digit number $62AB427$ is divisible by 99. Find the value of $A + B$.

   A) 7

   B) 5

   C) 6

   D) 4

2. There are 37 numbers on a roulette wheel: 0 and the whole numbers from 1 to 36. What is the chance of getting a perfect square number?

   A) $\dfrac{1}{6}$

   B) $\dfrac{7}{37}$

   C) $\dfrac{6}{37}$

   D) $\dfrac{5}{37}$

3. The square in the figure has side length equal to 2. What is the radius of the small circle? (Circles are touching)
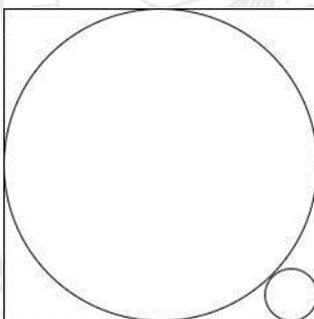
   A) $\sqrt{2} - 1$

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

   C) $\sqrt{2}$

   D) $3 - 2\sqrt{2}$

4. The average of five weights is 13 grams. If a 7-gram weight is added, what is the average of the six weights?

   A) 11

   B) 12

   C) 13

   D) 14

5. The sum of 10 consecutive natural numbers are 195. Find the value of the first one.

   A) 13

   B) 14

   C) 15

   D) 16

6. Every day at school, Alex climbs a flight of 6 stairs. Alex can climb using 1, 2 or 3 steps or a combination of any of them. How many ways can Alex climb the flight of 6 stairs?

   A) 18

   B) 20

   C) 22

   D) 24

7. Find the simplest form of $\dfrac{\left(\sqrt{10}-1\right)^2 - 3}{\sqrt{10}+\sqrt{3}-1}$.

   A) $\sqrt{10} - \sqrt{3} - 1$

   B) $\sqrt{10} + \sqrt{3} - 1$

   C) $\sqrt{7} - 1$

   D) $\sqrt{3} + 1$

8. Inside two parallel lines there are two squares $ABCD$ and $AKLM$. Find the angle $\angle TLK$ if $\angle BCE = 66°$ and $\angle DAM = 118°$.
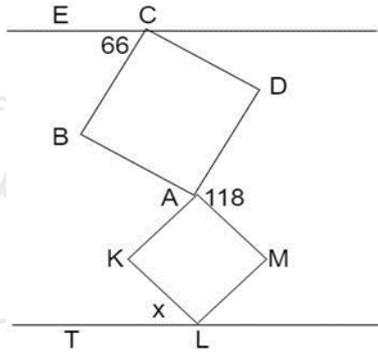
A) 42°

B) 48°

C) 52°

D) 58°

9. If $a_1 + a_2 = 1$, $a_2 + a_3 = 2$, $a_3 + a_4 = 3$, …, $a_{50} + a_{51} = 50$ and $a_{51} + a_1 = 51$, then what is the sum of $a_1, a_2, a_3, …, a_{51}$?

A) 538

B) 1075

C) 663

D) 754

10. If $a^2 + b^2 = 117$ and $ab = 54$, then find the value of $\frac{a+b}{a-b}$.

A) $\frac{3}{5}$

B) 3

C) 5

D) $\frac{5}{3}$

11. In the given figure, $ABCD$ is a quadrilateral. $\angle ADB = 60°$, $\angle BAC = 70°$, $\angle DBC = 30°$ and $\angle ACB = 60°$. Find $\angle DAC$.
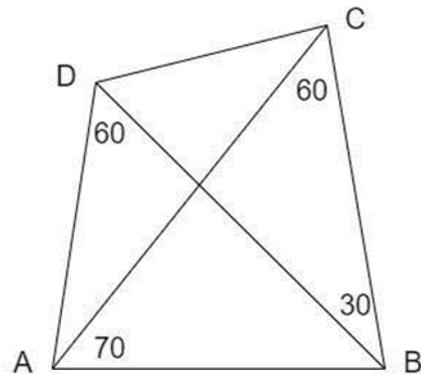
A) 20°

B) 30°

C) 40°

D) 50°

12. If $x + \frac{1}{x} = 4$, find the value of $x^3 + \frac{1}{x^3}$.

A) 8

B) 16

C) 52

D) 64

13. In $ABCD$ quadrilateral, $AB : BC : CD : DA = 2 : 3 : 4 : 5$. The perimeter of ABC is equal to $15\ cm$ and the perimeter of ACD is equal to $27\ cm$. What is the length of CD?

A) 10

B) $\frac{27}{5}$

C) 15

D) 12

14. Solve equation $(x\nabla 5) - 3(x\nabla 7) + 3x = 3\frac{3}{35}$ if $(a\nabla b) = \frac{2a}{b} + 1$.

- **A)** $x = \dfrac{12}{5}$
- **B)** $x = 3$
- **C)** $x = 2$
- **D)** $x = 2.5$

15. If $f(x) = -x^2$ and $g(x) = -4x - 5$, for what positive value of x will be $f(x+2)$ equal to $g(x+2)$?

- **A)** 4.5
- **B)** 2
- **C)** 3
- **D)** 4

16. If a and b are positive natural numbers such that $2022 - ab = 2a(1 + b) + a + 3b + 3$, find the value of $a + b$.

- **A)** 2022
- **B)** 341
- **C)** 337
- **D)** 2021

17. Calculate:

$$\frac{4.5 : \left(47.375 - \left(26\frac{1}{3} - 18 \times 0.75\right) \times 2.4 : 0.88\right)}{17.81 : 1.37 - 23\frac{2}{3} : 1\frac{5}{6}}$$

- **A)** 3
- **B)** 4
- **C)** 3.5
- **D)** 3.6

18. If $f(t) = 3 - |2t + 1|$, find the value of $f(-2) + f(-1) + f(0) + f(1) + f(2)$.

- **A)** 2
- **B)** 3
- **C)** 1
- **D)** 0

19. How many divisors does $2^4 \cdot 3^3 \cdot 4^2$ have?

- **A)** 12
- **B)** 24
- **C)** 24
- **D)** 36

20. Find the length of CD, if AB is a diameter, O is the center of the circle, $\angle CMO = 60°$, $MF = 12$ and $ME = 18$.
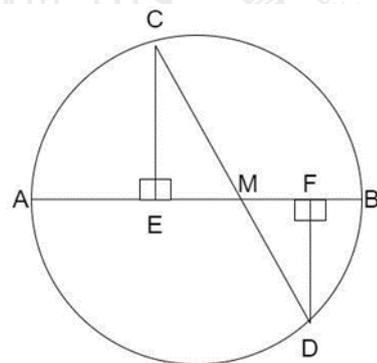
- **A)** 30
- **B)** 60
- **C)** 6
- **D)** 40

21. What is the last digit of 2022^{2022}?

- **A)** 2
- **B)** 4
- **C)** 6
- **D)** 8

22. $ABCD$ is a square, and $MNPQ$ is a rectangle. Find the sum of the perimeters of the colored rectangles, if $AB = 8$, $MN = 2$, and $NP = 14$.
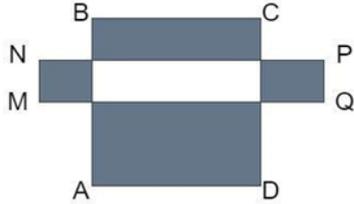
A) 48

B) 52

C) 60

D) 64

23. Which one of the following numbers is equal to $\dfrac{2022^4 - 2021^4}{2022^2 + 2021^2}$?

A) 2043

B) 4043

C) 2021.5

D) $2 \cdot (2022^2 - 2021^2)$

24. Three points A, B, and C have coordinates $(0, 4)$, $(6, 2)$, and $(10, 4)$, respectively. What is the measure of angle $\angle ABC$?

A) $105°$

B) $120°$

C) $135°$

D) $145°$

25. Find the simplest form of $\sqrt{5 - 2\sqrt{6}}$.

A) 0.5

B) $\sqrt{3} - \sqrt{2}$

C) $\sqrt{5} - \sqrt{3}$

D) $\sqrt{5} - \sqrt{2}$

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

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1. How many zeros are there at the end of 720! ?

   A) 150

   B) 162

   C) 178

   D) 184

2. Find the remainder when 2022^{2022} is divided by 11.

   A) 1

   B) 4

   C) 7

   D) 9

3. Calculate the value of the expression below.

$$2 \cdot \frac{\sqrt[3]{8^{n-2} + 7 \cdot 8^{n-3}}}{\sqrt[4]{16^{n-1} - 16^{n-2}}}$$

   A) 2

   B) $\sqrt[12]{5}$

   C) $\sqrt[12]{3}$

   D) $\sqrt[12]{15}$

4. You throw three regular six-sided dice. What is the probability that you will get one odd number and two even numbers?

   A) $\frac{1}{4}$

   B) $\frac{3}{8}$

   C) $\frac{4}{27}$

   D) $\frac{1}{3}$

5. Points A, B, C, D, and E are on a line such that $AB = 3$, $BC = 6$, $CD = 8$, and $DE = 4$. What is the smallest possible value of AE?

   A) 0

   B) 1

   C) 2

   D) 3

6. Find $x + y + z$ if x, y, and z are non-negative integers and

$$\begin{cases} x^3 - y^3 - z^3 = 3xyz \\ x^2 = 2(y + z) \end{cases}.$$

   A) 0

   B) 1

   C) 2

   D) 4

7. There are 20 students in a class. If one new boy joins the class, there will be twice as many boys as girls in the class. What is the product of the number of boys and the number of girls in the class?

   A) 75

   B) 84

   C) 91

   D) 96

8. If a, b, and c are natural numbers, how many solutions does the equation below have?

$$a^3 + b^3 + 4 = c^3$$

   A) 0

   B) 1

   C) 3

   D) Infinite

9. Let x, y, and z be real numbers such that $3x + y = 1$, $3y + z = \frac{1}{2}$, and $3z + x = -\frac{1}{2}$. What is the value of $x + y + z$?

A) 1

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

C) $\frac{1}{3}$

D) $\frac{1}{4}$

10. Which of the following is equal to $\frac{1+\sqrt{2}}{\sqrt{2}-1}$?

A) $1 + \sqrt{2}$

B) $3 + 2\sqrt{2}$

C) $3\sqrt{2}$

D) $2 + 2\sqrt{2}$

11. Given that $4^{63} - 1$ is divisible by 103, find the integer n such that $n^3 - 1$ is divisible by 103 and $46 < n < 103$.

A)   48

B)   56

C)   64

D)   68

12. Let $ABCD$ be a kite with $AB = AD = 3$ and $CB = CD = 7$. A circle ω is inscribed in $ABCD$ (so that ω is tangent to all four sides). Find the largest possible radius of ω.

A) $\frac{19}{10}$

B) 2

C) $\frac{21}{10}$

D) $\frac{11}{5}$

13. Simplify the expression below.

$$(4 + \sqrt{15})(\sqrt{6} - \sqrt{10})\sqrt{4 - \sqrt{15}}$$

A) -2

B) 1

C) $\sqrt{2}$

D) $\sqrt{5}$

14. Find the value of

$$\left(\frac{1}{x-\sqrt{y}} + \frac{1}{x+\sqrt{y}} - \frac{2\sqrt{y}}{x^2-y}\right) \cdot \left(x + \sqrt{y}\right).$$

A)   1

B)   2

C)   3

D)   4

15. Find $x - y$ if

$$\begin{cases} y^2 = x^3 - 3x^2 + 2x \\ x^2 = y^3 - 3y^2 + 2y \end{cases}.$$

A)   0

B)   0 or 1

C)   0 or 2

D)   1 or 2

16. How many ways are there to cover a 4×4 square with only 2×2 and 1×1 squares, if tiles cannot be cut, exceed the boundary of the big square, or overlap?

A)   23

B)   30

C)   35

D)   39

17. Calculate the value of

$$\left(a - \frac{1}{a}\right)\left(\frac{1}{a-1} - \frac{1}{a+1} - 1\right) \cdot \frac{5a}{3-a^2}.$$

A) 2

B) 3

C) 4

D) 5

18. Find the maximal integer value of a, when the roots of the equation below have different signs.

$$(a - 2)x^2 - 3ax + a + 5 = 0$$

A) -2

B) -1

C) 0

D) 1

19. Find the largest integer x such that $x^2 + 57x + 2870$ is a perfect square.

A) 2022

B) 2025

C) 2027

D) 2029

20. The square in the figure has side length equal to 2. What is the radius of the small circle? (circles are touching)
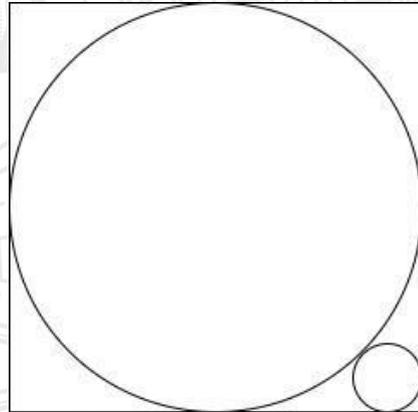
A) $\sqrt{2} - 1$

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

C) $\sqrt{2}$

D) $3 - 2\sqrt{2}$

21. Find the simplest form of $\dfrac{\left(\sqrt{10}-1\right)^2 - 3}{\sqrt{10}+\sqrt{3}-1}$.

A) $\sqrt{10} - \sqrt{3} - 1$

B) $\sqrt{10} + \sqrt{3} - 1$

C) $\sqrt{7} - 1$

D) $\sqrt{3} + 1$

22. $10, 30, 32, 96, 98, 294, 296, ?$
What number should replace the question mark?

A) 888

B) 912

C) 818

D) 298

23. Find the missing number.
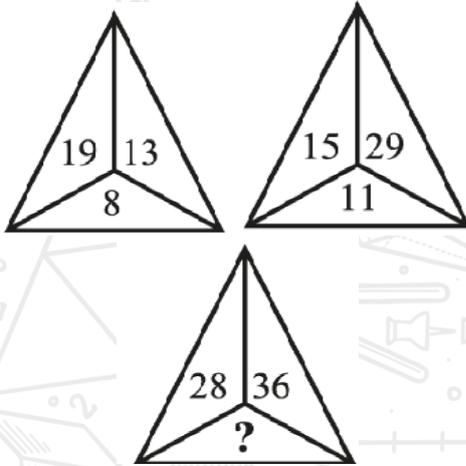
A) 12

B) 14

C) 16

D) 20

24. 473982 is to 1419 as 329684 is to 1418. Therefore, 751694 is to?

A) 1213

B) 1319

C) 1913

D) 2115

25. If $x + \dfrac{1}{x} = 4$, find the value of $x^3 + \dfrac{1}{x^3}$.

A) 8

B) 16

C) 52

D) 64

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

COPERNICOS

A TRADITION OF EXCELLENCE

WELCOME TO COPERNICOS

INSTRUCTIONS

You are about to take Copernicus Exam.

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.

2. Start with the easier questions, you can always come back to the questions you leave.

3. The time allocated for the exam is 60 minutes. You will start when the invigilator tells you to start.

4. You are required to comply with the directions given by the head invigilator before the examination.

5. Those who are taking the exam with a mobile phone MUST make sure that during the examination no one calls.

6. If anything in the examination is unclear, you can contact the invigilator.

7. Where permitted you may use a translation dictionary.

8. Students must not give or receive assistance of any kind during the exam. Any cheating, any attempt to cheat, assisting others to cheat, participating therein, or engaging in such improper conduct is a serious violation and will generally result in disqualifying.

Remember that "Hard work beats talent when talent doesn't work hard"
We wish you the very best luck on the exam.

1. What is the value of
$2020 \cdot 2024 - 2010 \cdot 2034$?

   A)   2022

   B)   1011

   C)   400

   D)   140

2. Calculate the value of
$\dfrac{1}{3} + \dfrac{1}{15} + \dfrac{1}{35} + \dfrac{1}{63} + \dfrac{1}{99} + \dfrac{1}{143}$.

   A) $\dfrac{2011}{2022}$

   B) $\dfrac{1}{2}$

   C) $\dfrac{6}{13}$

   D) $\dfrac{11}{13}$

3. What is the remainder when 2022^{16} is divided by 17?

   A)   1

   B)   2

   C)   15

   D)   16

4. Calculate the value of
$\dfrac{1}{\sqrt{4}+\sqrt{5}} + \dfrac{1}{\sqrt{5}+\sqrt{6}} + \dfrac{1}{\sqrt{6}+\sqrt{7}} + \dfrac{1}{\sqrt{7}+\sqrt{8}}$.

   A) $2(\sqrt{2}-1)$

   B) $\sqrt{8} - \sqrt{4}$

   C) $\sqrt{2}$

   D)   0

5. Find the value of $\dfrac{x}{x^2+y^2} - \dfrac{y(x-y)^2}{x^4-y^4} - \dfrac{1}{x+y}$.

   A) x

   B) $x + y$

   C) $x - y$

   D)   0

6. Calculate the value of
$\sin 40° + \sin 20° - \sin 80°$.

   A)   0

   B) $-\sin 20°$

   C)   0.5

   D) $\sin 20°$

7. Find x if $x + x^2 + x^3 = 258$.

   A)   3

   B)   6

   C)   9

   D)   12

8. Find n, if $n + \lfloor\sqrt{n}\rfloor + \lfloor\sqrt[3]{n}\rfloor = 2022$. Note: $\lfloor x \rfloor$ is the biggest natural number no more than x.

   A)   1964

   B)   1965

   C)   1966

   D)   1967

9. How many triplets of prime numbers are solutions of the equation below?

$$3p^4 - 5q^4 - 4r^2 = 26$$

A) 0

B) 1

C) 2

D) 3

10. Calculate the value of
$$\left(\frac{2a}{a+2} + \frac{2a}{6-3a} + \frac{8a}{a^2-4}\right) : \frac{a-4}{a-2}.$$

A) a

B) $a+2$

C) $\dfrac{a}{a+2}$

D) $\dfrac{4a}{3(a-4)}$

11. Find the value of $a + b - c - d$, if

$$\begin{cases} a+b+c+d = 20 \\ ab + ac + ad + bc + bd + cd = 150 \end{cases}.$$

A) 0

B) 10

C) 12

D) 16

12. If $m = 32!$, which statement is true?

A) $m < 2^{70}$

B) $2^{70} < m < 2^{100}$

C) $2^{100} < m < 2^{130}$

D) $2^{130} < m$

13. Real numbers a and b satisfy the equations $3^a = 81^{b+2}$ and $125^b = 5^{a-3}$. What is the value of ab?

A) -60

B) -12

C) 12

D) 60

14. Students from Mrs. Hein's class are standing in a circle. They are evenly spaced and consecutively numbered starting with 1. The student with number 3 is standing directly across from the student with number 17. How many students are there in Ms. Hein's class?

A) 28

B) 29

C) 30

D) 31

15. Calculate the value of the expression below.

$$\left(\frac{5\sqrt{x}+\sqrt{y}}{\sqrt{x}-5\sqrt{y}} + \frac{5\sqrt{x}-\sqrt{y}}{\sqrt{x}+5\sqrt{y}}\right) \cdot \left(\frac{x\sqrt{y}-25y\sqrt{y}}{x+y}\right)$$

A) $x + y$

B) $5xy$

C) $10\sqrt{y}$

D) $5\left(\sqrt{x}+\sqrt{y}\right)$

16. What is $3a^b + 8a^{-3b}$, if $a^b = 2$?

A) 5

B) 7

C) 8

D) 24

17. Let $f(x,y) = x^3 + 3xy^2$. What is $f(20,12) - f(12,20)$?

A) 2^6

B) 2^7

C) 2^8

D) 2^9

18. The parallelogram $ABCD$ is such that $\angle B < 90°$ and $AB < BC$. Points E and F are chosen on the circumscribed circle ω of triangle ABC so that the tangents to ω at these points pass through point D. If $\angle EDA = \angle FDC$, find angle $\angle ABC$.

A) $30°$

B) $45°$

C) $60°$

D) $90°$

19. Let $f(x,y) = 2 - x^2 - y^2$. What is $f(5,2)$?

A) -27

B) -12

C) -9

D) 0

20. If x and y are real numbers satisfying $x^2 y = 12$ and $xy^2 = 18$, find $x + y$.

A) 3

B) 4

C) 5

D) 6

21. The polynomial $x^4 - bx^2 - 1550x + d$ has 4 real roots. Find the sum of their cubes.

A) 4450

B) 4550

C) 4650

D) 4750

22. Find the only positive root of $x^4 + 4x^3 + 5x^2 = 3$.

A) $\dfrac{\sqrt{5}-1}{2}$

B) $\dfrac{\sqrt{5}}{2}$

C) $\dfrac{\sqrt{5}+1}{2}$

D) $\sqrt{5}$

23. Calculate the value of $(\cos 165° - \cos 105°)^2$.

A) $\dfrac{1}{\sqrt{3}}$

B) $\dfrac{1}{2}$

C) $\dfrac{\sqrt{3}}{2}$

D) 1

24. What number should replace the question mark?

3	8	4	9
2	4	3	6
6	7	8	2
4	2	1	?

A) 6

B) 8

C) 9

D) 4

25. 473982 is to 1419 as 329684 is to 1418. Therefore, 751694 is to what?

A) 1213

B) 1319

C) 1913

D) 2115

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