MC:	+12 for the correct answer,	−3 for a wrong answer,	0 for unanswered
T/F:	+3 for each correct answer,	−3 for each wrong answer,	0 for unanswered
NUM:	+12 for the correct answer,	0 for wrong or unanswered	

Question 1 (MC):

In a park, there are three round ponds. The shores of the ponds are partitioned into six segments in total, as depicted in the picture. Johann starts at point A and wants to walk along each of the six segments exactly once. How many different walks are possible?

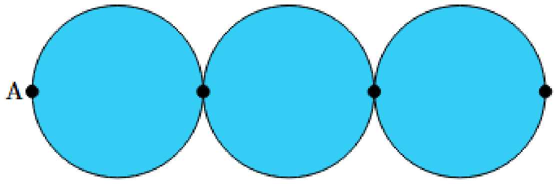
A: 4

B: 6

C: 8

D: 10

E: 12



Question 2 (MC):

Jana creates a burger which has four layers between the buns: patty, cheese, salad and a tomato slice. How many ways are there to arrange the four layers if the cheese has to be somewhere (not necessarily directly) above the patty?

A: 3

B: 6

C: 8

D: 12

E: 16

Question 3 (MC):

Take an arbitrary triangle, which is divided by its medians into some regions. If the triangle has an area of 1, how big can the grey area be at most? (A median is a line connecting one vertex of a triangle with the midpoint of the opposite side.)

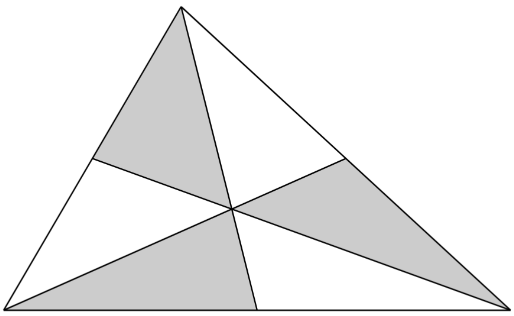
A: $\frac{1}{3}$

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

C: $\frac{3}{5}$

D: $\frac{2}{3}$

E: $\frac{3}{4}$



Question 4 (MC):

In a 2×2 grid Annalena writes down the numbers $1, 2, 3, 4$ in the four cells. For both rows, she calculates the product of the two numbers in that row. Then she does the same for the two columns and the diagonal from top left to bottom right. She then sums up the five values and gets the number k. Which of the following isn't a possible value for k?

A: 23

B: 25

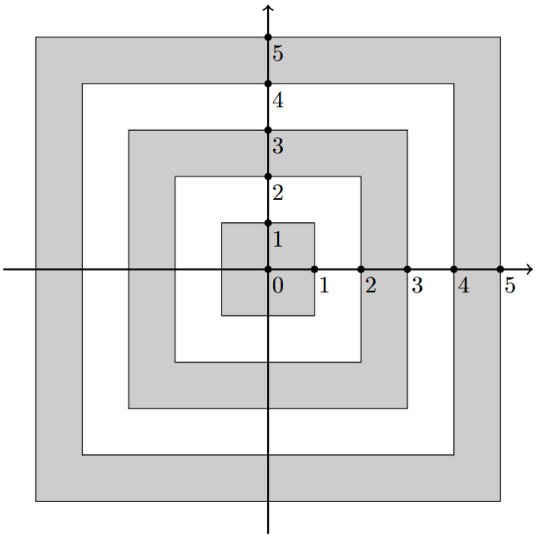
C: 27

D: 29

E: 31

Question 5 (NUM):

All of the quadrilaterals in the picture below are squares. How big is the grey area?



Question 6 (NUM):

What is the smallest value that the following expression can take on, over all integers $x \geq 42$?

$$\frac{2023}{1+\frac{1}{x}} + \frac{2023}{1+x}$$

Question 7 (NUM):

Anaëlle, Bibin, Clemens, David and Emily each got a paper with a number between 1 and 50. Their numbers are consecutive in some order. When comparing the numbers, they discover the following:

- Anaëlle: "My number is a prime number".
- Bibin: "Hey, mine too!".
- Clemens: "My number is right between Anaëlle's and Bibin's numbers, and it is divisible by 9".
- David: "My number is by 3 larger than Clemens' number".

What is Emily's number?

Question 8 (NUM):

The tap of Marco's bathtub is broken. Luckily, Marco has three buckets which measure 4, 5 and 16 litres respectively which he can use to fill the tub. What is the minimal number of times Marco has to fill up a bucket at the fountain to fill his tub with exactly 119 litres if he is not allowed to throw away any leftover water?

Question 9 (T/F):

Six people participated in a chess tournament, where everyone played against everyone else exactly once. The winner of each match got 2 points and the loser got 0 points. In a draw, both players got 1 point. On the final scoreboard, there are five consecutive people with $2, 3, 4, 5$ and 6 points respectively. How many points could the remaining person have?

A: 0

B: 1

C: 8

D: 9

Question 10 (T/F):

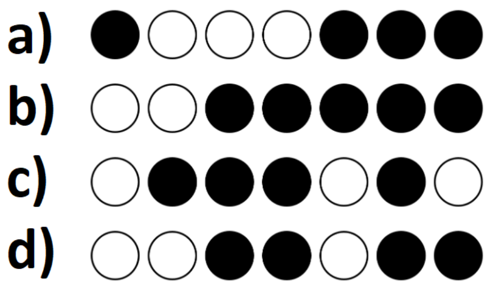
Valentin arranges 7 coins in a line, black on one side and white on the other. All the coins are black side up at the beginning. A move consists of Valentin picking a coin and flipping it and all the coins on its left. After precisely three moves, which of the following configurations are possible?

A: a)

B: b)

C: c)

D: d)



MC:	+16 for the correct answer,	–4 for a wrong answer,	0 for unanswered
T/F:	+4 for each correct answer,	–4 for each wrong answer,	0 for unanswered
NUM:	+16 for the correct answer,	0 for wrong or unanswered	

Question 11 (MC):

The number 1 is written on the blackboard. Matthew changes the number step by step. In each step he either multiplies it by 3 or he subtracts 1. What is the minimum number of steps needed to reach the number 2023?

A: 10

B: 11

C: 12

D: 13

E: 14

Question 12 (MC):

In a big room there are many tables with the shape of an isosceles trapezoid. One of the two bigger angles is 99°. Viviane wants to put together some of the tables along their two shortest sides, so that the tables form a closed ring. How many tables does she need?

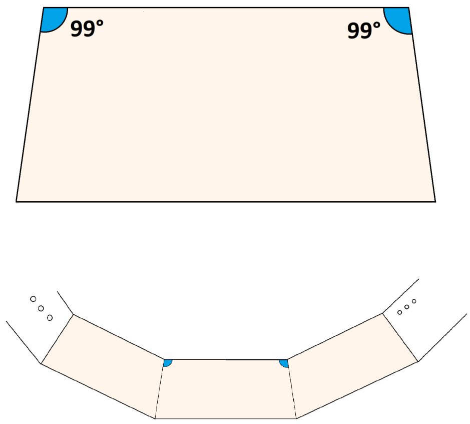
A: 15

B: 18

C: 20

D: 24

E: 25



Question 13 (MC):

Let ω_1 be a circle of centre A and radius 2. Let B be a point on ω_1. Let ω_2 be a circle of centre B and radius 2. Let C be one of the intersections of both circles. Define D and E as the sketch presents. What is the area of triangle CDE?

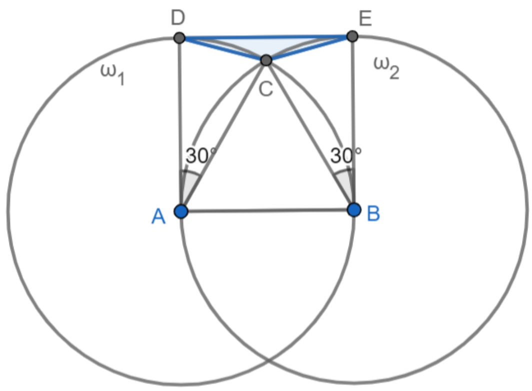
A: $\pi - 3$

B: $2 - \sqrt{3}$

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

D: $\frac{1}{2}$

E: $\frac{\pi}{2} - \sqrt{3}$



Question 14 (MC):

How many times during a day (24 hours) are the minute hand and the hour hand of a clock opposite from each other?

A: 20

B: 22

C: 23

D: 24

E: 25

Question 15 (NUM):

Patrick forgot his 4-digit password, but he remembers the following properties:

- The two digit number formed by the first two digits, and the one formed by the last two digits are square numbers.
- The second and third digits are both prime numbers, and together they also form a two-digit prime number.

What is Patrick's password?

Question 16 (NUM):

In the following 6 boxes, the numbers 1 to 6 appear exactly once. What is the smallest possible value of the expression?

$$60 \cdot \left(\frac{\square}{\square} + \frac{\square}{\square} + \frac{\square}{\square}\right)$$

Question 17 (NUM):

On a blackboard there is a four-digit number. The digits are strictly decreasing when read from left to right and the middle two digits are each strictly smaller than the average of their neighbouring digits. What is the largest possible number on the blackboard?

Question 18 (NUM):

In a 4×4 grid, Henning wrote a number on each cell. Then, he observed that the sum of numbers in each column, in each row and in both main diagonals are the same. Call this number the magic sum. Unfortunately, Tanish was naughty and decided to erase some of the numbers, which leads to the displayed square. What is the magic sum?

7	27	29	
17		11	
9	21	19	
			25

Question 19 (T/F):

There are 10 distinct lines given in the two-dimensional plane. How many intersection points can there be in total?

A: 0

B: 1

C: 3

D: 45

Question 20 (T/F):

In a circle there are 2023 people. Each person is either a truth-teller or a liar. Each person in the circle says: "Both of my neighbours are liars!". Which of the following could be the number of truth-tellers?

A: 674

B: 675

C: 1011

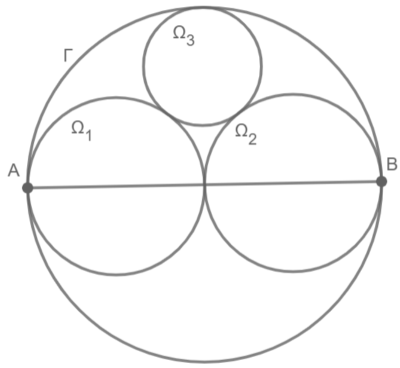
D: 1012

Senior 3

MC:	$+20$ for the correct answer,	-5 for a wrong answer,	0 for unanswered
T/F:	$+5$ for each correct answer,	-5 for each wrong answer,	0 for unanswered
NUM:	$+20$ for the correct answer,	0 for wrong or unanswered	

Question 21 (MC):

Given a circle Γ of radius 6 and AB be a diameter. Consider two small circles Ω_1 and Ω_2 of radius 3 such that A belongs to Ω_1, and B to Ω_2. All 3 circles are pairwise tangent. Let Ω_3 be tangent to all 3 other circles. What is the radius of Ω_3?



A: $\frac{\pi}{2}$

B: 2

C: $\frac{\sqrt{3}+1}{2}$

D: $6-\sqrt{41}$

E: 1

Question 22 (MC):

We fill each cell of a 10×10 table with $+1$ or -1. What's the biggest possible number k such that there are exactly k rows with strictly positive sum and k columns with strictly negative sum?

A: 5

B: 6

C: 7

D: 8

E: 9

Question 23 (MC):

Consider the 25 two-digit numbers which only contain the digits $1, 2, 3, 4$ and 5. Noah wants to place some of them along the boundary of a circle, such that the last digit of each number is equal to the first digit of the next number in clockwise direction. If he cannot use the same number twice, how many numbers can Noah place at most?

A: 19

B: 20

C: 21

D: 24

E: 25

Question 24 (MC):

Let Γ be a circle of radius 1 consider three circles of radius r which are tangent to Γ and also pairwise tangent. What is r?

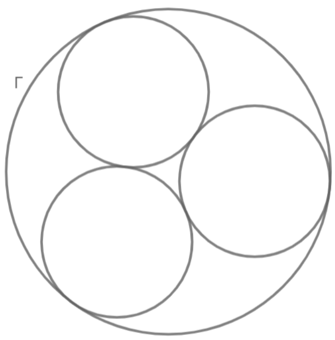
A: $\frac{\sqrt{3}}{2+\sqrt{3}}$

B: $\frac{2}{7}$

C: $\frac{\pi}{8}$

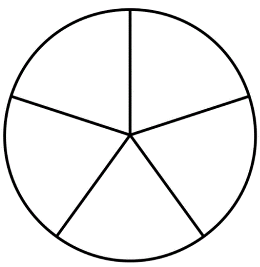
D: $\frac{\sqrt{3}}{3}$

E: $\frac{2}{5}$



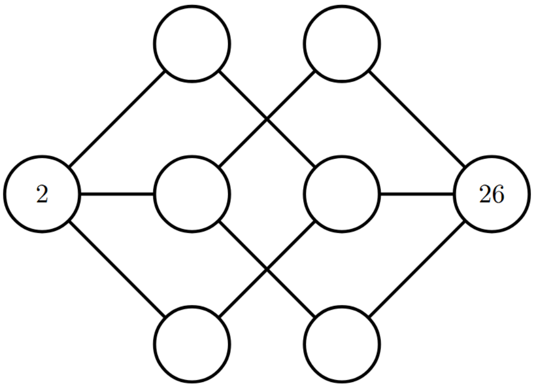
Question 25 (NUM):

A circle is divided into 5 sections. How many ways are there to colour the sections using three different colours such that no two adjacent sections are of the same colour?



Question 26 (NUM):

On a paper there are 8 circles, some of them are connected (see picture below). Two circles already contain the numbers 2 and 26. Nicole writes a number in each of the six remaining circles such that in the end, all numbers she wrote are the average of the numbers in the neighbouring circles. (Two circles are neighbouring if they are connected by a segment). What is the sum of all the eight numbers?



Question 27 (NUM):

How many three-digit numbers are divisible by their leftmost digit?

Question 28 (NUM):

There are 1000 suspicious people standing in a line. One of them has hidden a diamond in their pocket and all 1000 people know who. The police will ask everyone: "How many people are standing between you and the person with the diamond?". Luckily, the police knows that at least k people will answer truthfully. What is the minimal number of k needed in order for the police to find the diamond with certainty?

Question 29 (T/F):

Julia wrote down the number 6 on her blackboard. She can now repeatedly replace the current number n either with n^2 or $n-4$. Which numbers can she eventually arrive at?

A: 32

B: -2022

C: 500

D: 2022

Question 30 (T/F):

We call a natural number n *amazing* if it has at least 4 different divisors and if the sum of its four largest divisors is exactly equal to $2n$. Which of the following statements is true about amazing numbers?

A: There exist less than 100 amazing numbers.

B: All amazing numbers are divisible by 3.

C: There exists an amazing number ending with the two digits 12.

D: There exists an amazing number ending with the two digits 22.