

Senior 1

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):

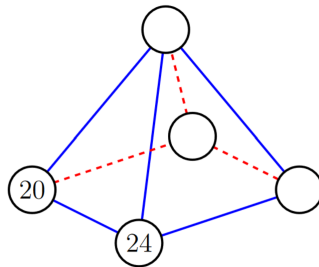
How many positive two-digit integers are there such that the product of both digits is a positive square number?

- A: 9
- B: 13
- C: 15
- D: 17
- E: 18

Question 2 (MC):

On each corner of the pyramid below, Emily writes a positive integer such that the sum of numbers touching each of the five faces is the same. She already wrote 20 and 24 on two neighbouring corners as shown below. What will the sum of all numbers be when she is done?

- A: 101
- B: 132
- C: 145
- D: 146
- E: More information required



Question 3 (MC):

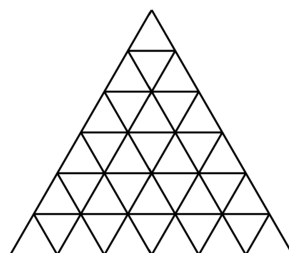
Two parents, aged 50 and 46 respectively, have three kids, aged 12, 13 and 15. What age will the oldest child be when the sum of the ages of the parents is twice the sum of the ages of the children?

- A: 17
- B: 19
- C: 20
- D: 21
- E: 24

Question 4 (MC):

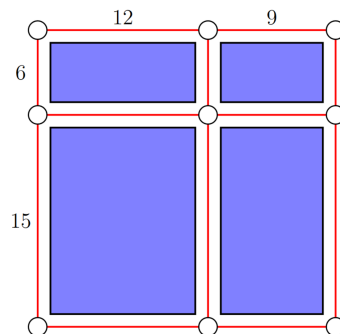
In the following diagram, at least how many triangles would we need to colour red so that each uncoloured triangle shares an edge with a red triangle?

- A: 9
- B: 10
- C: 12
- D: 15
- E: 21



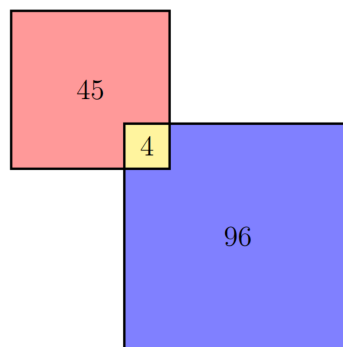
Question 5 (NUM):

The MO-Headquarters consist of four rectangular buildings as illustrated below in blue. There is a street food vendor at each corner marked with a circle. Jana wants to visit them all in a single trip. She can start and end where she wants and walk along the red lines. How far does she have to walk at least?



Question 6 (NUM):

Ruhi has a garden formed by two overlapping squares, as shown in the picture below. She grows red flowers in the red region of area 45, yellow flowers in the yellow region of area 4 and blue flowers in the blue region of area 96. If the yellow region is a square, what is the perimeter of Ruhi's garden?



Question 7 (NUM):

Mathys has 20 different flavours of candy in his jar and each flavour occurs 20 times. One by one, he will randomly take out a piece of candy and eat it. At least how many pieces of candy does Mathys need to eat in order to be certain that he either ate 20 candies of the same flavour or tasted each flavour at least once?

Question 8 (NUM):

What is the largest number such that any pair of consecutive digits within it form a two-digit square number?

Question 9 (T/F):

Two positive integers a, b are called friends if either $a = 3b + 2$ or $b = 3a + 2$. Which of these propositions are true?

- A: An odd and an even number can be friends.
- B: There is a number that is friends with two numbers.
- C: Two prime numbers can be friends.
- D: There are two numbers that are friends and both divisible by 5.

Question 10 (T/F):

A mailman wants to deliver the mail on a circular road with 42 houses. For this he starts at a house and then moves clockwise, always skipping exactly n houses before stopping at the next house. For which values of n does he visit every house?

- A: 23
- B: 24
- C: 25
- D: 26

Senior 2

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):

Five people all make a statement about how many of them are liars:

- Elisabeth: "Two of us are liars!"
- Guy: "Three of us are liars!"
- Karin: "Four of us are liars!"
- Ignazio: "Three of us are liars!"
- Viola: "All of us are liars!"

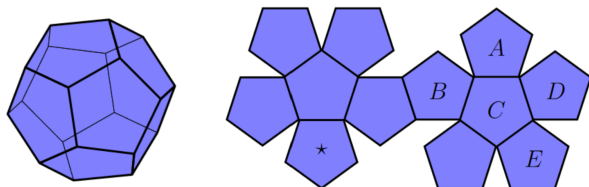
How many of them are liars?

- A: 2
- B: 3
- C: 4
- D: 5
- E: More information required

Question 12 (MC):

A dodecahedron is a solid with 12 pentagonal faces, as shown on the left. If the shape on the right is folded into a dodecahedron, what face will end up directly opposite the face marked with a star?

- A: A
- B: B
- C: C
- D: D
- E: E



Question 13 (MC):

Let $x > 0$ be a real number with $x + \frac{1}{x} = 3$. What is the value of $x^4 + \frac{1}{x^4}$?

- A: 47
- B: 52
- C: 77
- D: 81
- E: More information required

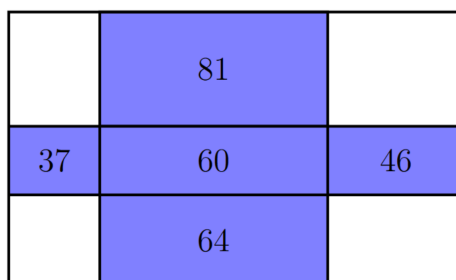
Question 14 (MC):

Paul has written down finitely many different rational numbers on the blackboard. He notices that the product of any two different numbers on the board is also on the board. At most how many numbers could be on the board?

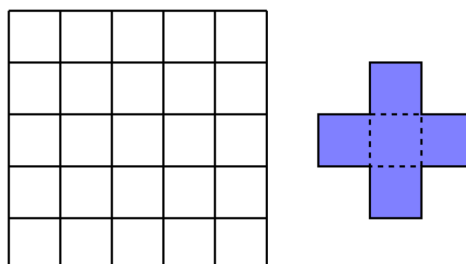
- A: 2
- B: 3
- C: 4
- D: 5
- E: More than 5

Question 15 (NUM):

Each of the small blue rectangles below is labelled with its perimeter. What is the perimeter of the large outer rectangle?

**Question 16 (NUM):**

A Swiss cross is the shape made out of 5 squares illustrated below. At most how many squares of the 5×5 grid below can you colour red, such that any Swiss cross formed by the grid lines contains at most 1 red square?

**Question 17 (NUM):**

Bora and Jonah together with their 4 other friends, want to sit around a round table with 6 different chairs. If Bora and Jonah do not want to sit next to each other, how many possible seating plans are there?

Question 18 (NUM):

What is the smallest positive integer that has different remainders when divided by each of 1, 2, 3, 4, 5?

Question 19 (T/F):

Viviane has an 8-minute and an 11-minute hourglass. If the sand in both hourglasses is currently settled, which of the following numbers of minutes can Viviane measure exactly, starting from now?

- A: 12
- B: 14
- C: 16
- D: 21

Question 20 (T/F):

Which statements are true about the infinite sequence $7, 77, 777, \dots$?

- A: The sequence contains a number divisible by 9.
- B: The sequence contains two numbers whose difference is divisible by 101.
- C: The sequence contains a square number.
- D: The sequence contains exactly one prime number.

Senior 3

MC:	+20 for the correct answer,	-5 for a wrong answer,	0 for unanswered
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NUM:	+20 for the correct answer,	0 for wrong or unanswered	

Question 21 (MC):

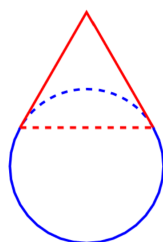
Among the numbers $1^1, 2^2, 3^3, \dots, 2024^{2024}$, how many are square numbers?

- A: 1012
- B: 1013
- C: 1034
- D: 1056
- E: 2023

Question 22 (MC):

Tobias drew a raindrop consisting of a circle of radius 1 and an equilateral triangle, such that two of the sides of the triangle are tangent to the circle. What is the area of his raindrop?

- A: $\pi + \sqrt{3}$
- B: $\pi + \frac{2\sqrt{3}}{3}$
- C: $\frac{\pi}{3} + \sqrt{3}$
- D: $\frac{\pi}{3} + 2\sqrt{3}$
- E: $\frac{2\pi}{3} + \sqrt{3}$



Question 23 (MC):

Out of the five people Anaëlle, Bibin, Chengjie, David, Elia, two have conspired to steal all cookies from the cookie jar. One person is the thief who has stolen the cookies and the second person is the accomplice, who has helped the thief and thus is also guilty. Only the three innocent people are guaranteed to tell the truth. Here is what they say:

- Anaëlle: “Bibin and David are not the thief”
- Bibin: “Chengjie is not the thief and David is not the accomplice”
- Chengjie: “Anaëlle and Elia are not the thief”
- David: “Chengjie and Elia are not the accomplice”
- Elia: “Anaëlle is not the accomplice”

Who is the thief?

- A: Anaëlle
- B: Bibin
- C: Chengjie
- D: David
- E: Elia

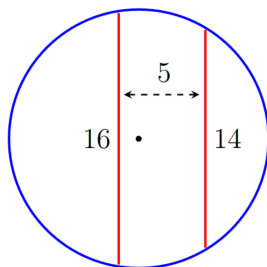
Question 24 (MC):

Let a, b, c be positive integers such that $a + b, b + c, c + a$ are distinct perfect squares. What is the smallest possible value of $a + b + c$?

- A: 7
- B: 14
- C: 25
- D: 55
- E: 77

Question 25 (NUM):

A circle has radius r . Two parallel chords inside the circle have lengths 14 and 16 and are separated by a distance of 5. What is the value of r^2 ?



Question 26 (NUM):

What is the largest integer n such that $n^2 + 2n - 2024$ is a square?

Question 27 (NUM):

How many 10 digit numbers, whose digits are all 1 or 2, are divisible by 3?

Question 28 (NUM):

What is the smallest positive integer that contains each of the digits 1, 2, 3, 4 and is divisible by each of the numbers 1, 2, 3, 4?

Question 29 (T/F):

There are 5 circles in the plane. Which of the following are possible?

- A: Every circle is tangent to exactly two other circles.
- B: Every circle is tangent to exactly three other circles.
- C: Every circle is tangent to a different number of other circles.
- D: Every pair of circles has exactly one common tangent circle.

Question 30 (T/F):

We colour all positive integers from 1 up to 100 in either red, green or blue. Which of the following statements are necessarily true?

- A: There are two numbers with the same colour and difference divisible by 33.
- B: There are two numbers with the same colour whose ratio is either 1 : 2 or 1 : 3.
- C: There are 4 square numbers with the same colour.
- D: There are three numbers with the same colour that add to 100.