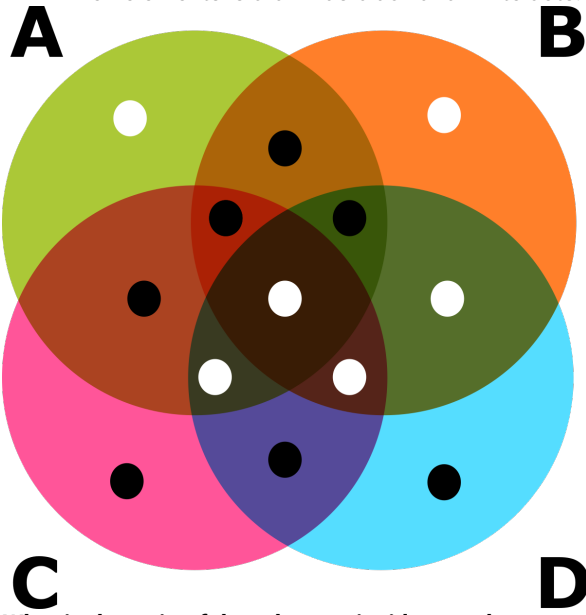


1. The following diagram shows four sets A, B, C, and D. Their elements is drawn as black and white dots.



What is the ratio of dots that are inside exactly two sets compared to all dots?

- A) 4 : 13
 B) 6 : 13
 C) 8 : 13
 D) 9 : 13

(Correct +3, Wrong 0, Blank 0)

2. A wire in a shape of a circle is cut in half each of the same length. The two parts is then bent to make two new circles.

If we do the process described above n times, what is the ratio between the total area of the circles at the end, compared to the initial circle?

- A) 1 : 2
 B) 1 : n^2
 C) 1 : 2^n
 D) 1 : n

(Correct +3, Wrong 0, Blank 0)

3. How many ways can we arrange the letters of KOMODOMATH such that every two O's are separated by at least two letters?

For instance, OMDOMATHOK is okay, while OKMATHDOOM is not okay.

- A) $15 \cdot 7!$
 B) $10 \cdot 7!$
 C) $2 \cdot 7!$
 D) $60 \cdot 7!$

(Correct +3, Wrong 0, Blank 0)

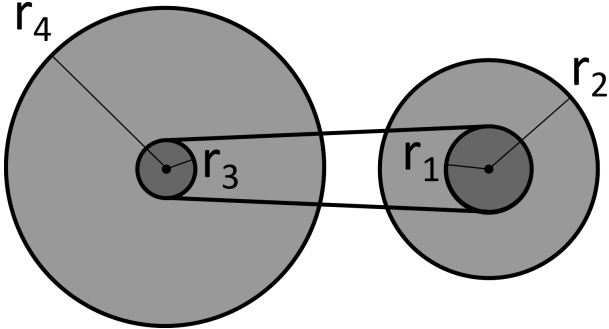
4. A subset S of $\{1, 2, 3, 4, 5\}$ is called *special* if $|S| \in S$ (here the notation $|S|$ means the number of elements in the set S).

How many special subsets of $\{1, 2, 3, 4, 5\}$ are there?

- A) 1
 B) 4
 C) 16
 D) 64

(Correct +3, Wrong 0, Blank 0)

5. Two gears with the same center rotates with the same rotation speed ω . Therefore given the same amount of time, the two will rotate the same amount of rotation. Two gears connected with chain rotates with different rotation speed ω , but if we multiply each rotation speeds with their respective radii r . We'll get the same result for both gears. In other words $\omega \cdot r$ for two gears connected with a chain is the same.



Consider the gear set above. It's known that If gear r_2 rotates 30 times a minute and gear r_4 rotates 15 times a minute.

Which of the following ratio of radii is possible for the combination above?

- A) $r_1 : r_2 : r_3 : r_4 = 3 : 4 : 1 : 8$
- B) $r_1 : r_2 : r_3 : r_4 = 3 : 4 : 2 : 6$
- C) $r_1 : r_2 : r_3 : r_4 = 3 : 4 : 2 : 8$
- D) $r_1 : r_2 : r_3 : r_4 = 2 : 4 : 1 : 6$

(Correct +3, Wrong 0, Blank 0)

6. The cubic equation $x^3 + kx + k^2 = 0$ has a real solution x , where the real number k is a constant. Which of the following statements is guaranteed to be true?

- A) $k \geq \frac{1}{2}$
- B) $0 \leq k \leq \frac{x}{2}$
- C) $x \leq \frac{1}{4}$
- D) $x \leq k$

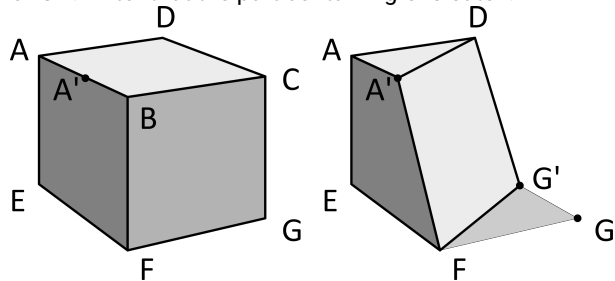
(Correct +3, Wrong 0, Blank 0)

7. If $x^3 - 1 \geq 4x > 0$ then the minimum value of $\frac{x(x-1)(x+1)}{3x+1}$ is ____.

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

(Correct +3, Wrong 0, Blank 0)

8. A cake in the shape of a cube ABCD.EFGH is cut. The cut starts from the line A'D straight to the line FG' as shown, where A' is exactly in the midpoint of AB and G' is the midpoint of GH. After that the part containing C is eaten.

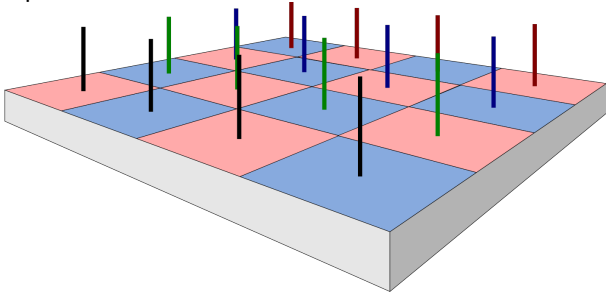


What is the proportion of the cake left compared to the whole cake before cutting?

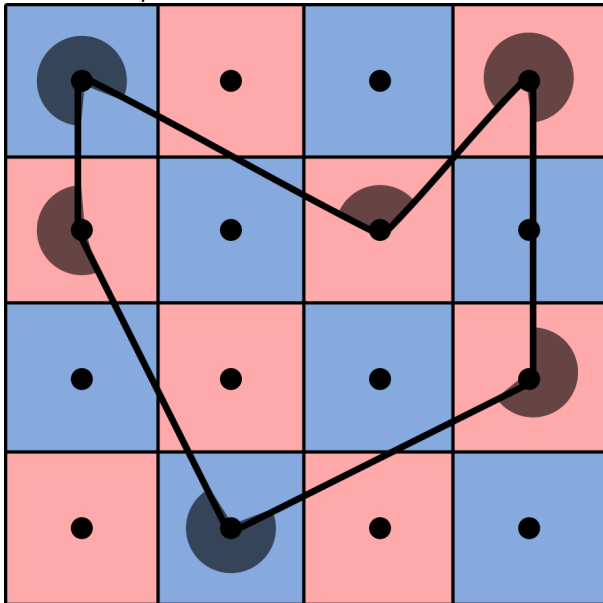
- A) $\frac{1}{2}$
- B) $\frac{7}{9}$
- C) $\frac{3}{5}$
- D) $\frac{5}{8}$

(Correct +3, Wrong 0, Blank 0)

9. A checkerboard consists of 4×4 unit square. Sixteen pegs are fixed on the board, each in the center of all the squares.



Then, a rubber band is inserted into the pegs in such a way to form the shape as shown below.



What is the sum of all the external angles of the shape as shown above?

- A) 1440
 B) 1600
 C) 1820
 D) 1120
 (Correct +3, Wrong 0, Blank 0)

10. Seven people, namely A, B, C, D, E, F, G are seated in a line at random.

What is the probability that A sits to the left of B (not necessarily next to each other) and C sits next to D?

- A) $\frac{5}{12}$
 B) $\frac{1}{6}$
 C) $\frac{1}{7}$
 D) $\frac{2}{7}$
 (Correct +3, Wrong 0, Blank 0)

11. Adam is a rabbit breeder. In the beginning he had 80 white rabbits and 20 black rabbits.

It is known that among the babies of white rabbits, 60% are white and 40% are black. Meanwhile, among the babies of black rabbit, 20% white and 80% are black.

What is the percentage of Adam's black rabbit a very long time after he start breeding the rabbits?

- A) 67%
 B) 25%
 C) 33%
 D) 80%
 (Correct +3, Wrong 0, Blank 0)

12. Andy, Ben, and Charles is playing a card game. The cards consists of nine cards with digit 1 to 9, and divided into three groups of different colors as shown. Each player takes three cards randomly from three different card group Then the player calculate the sum of the number in the card and the winner is the one with the most sum. It's known that Andy got card 2, Ben got card 5, and Charlie got card 8. What is the probability that Andy beats Charlie in the game?



- A) $\frac{1}{8}$
 B) $\frac{1}{4}$
 C) $\frac{3}{8}$
 D) $\frac{1}{2}$
 (Correct +3, Wrong 0, Blank 0)

13. The following is a formula used to calculate the length of an object moving very fast. In the formula, v is the object's speed, c is a constant, l is the object's length when it's at rest, and l' is object's length when it's moving with speed v .

$$l' = l\sqrt{1 - \frac{v^2}{c^2}}$$

Which of the following formula is equivalent to the above formula?

- A) $v = c\left(1 - \frac{l'^2}{l^2}\right)$
 B) $v = c\left(1 - \frac{l'^2}{l^2}\right)^2$
 C) $v = 1 - \frac{cl'^2}{l^2}$
 D) $v = c\sqrt{1 - \frac{l'^2}{l^2}}$

(Correct +3, Wrong 0, Blank 0)

14. In a party, two people shake hands once if and only if they already knew each other before the party. Otherwise they don't shake hands.

Which of the following is impossible?

- A) Someone shakes hands with everyone else.
 B) Everyone does the same number of handshakes.
 C) Everyone does a different number of handshakes.
 D) Someone doesn't shake hands at all.

(Correct +3, Wrong 0, Blank 0)

15. Let $n \geq 6$. Among the exam scores of n students, both the average and the standard deviation have the same value which is 1. The scale of the score is 0 to 4.

From this information alone, the correct conclusion is ____.

- A) All students have the same scores.
 B) The greatest score is at least \sqrt{n} .
 C) The majority of the scores lie in the interval $\left[1 - \frac{1}{\sqrt{n}}, 1 + \frac{1}{\sqrt{n}}\right]$.
 D) There is at least one student whose score is 0 or at least 2.
 (Correct +3, Wrong 0, Blank 0)

16. In the following report "Tax Expenses" is calculated as a percentage compared to "Income before taxes".

Komodo Company Income Statement

September, 2021

Net sales	5,800,000
Cost of sales	2,550,000
Gross profit	<u>3,250,000</u>
Operating Expenses	600,000
Operating Income	<u>2,650,000</u>
Gain (Loss)	(900,000)
Other Income	250,000
Income before taxes	<u>2,000,000</u>
Tax expenses	500,000
Net Income	<u><u>1,500,000</u></u>

What would "Net Income" be if "other income" is increased three times, and the percentage of "Tax expenses" is doubled?

- A) \$1.750.000
 B) \$1.500.000
 C) \$2.000.000
 D) \$1.250.000

(Correct +3, Wrong 0, Blank 0)

17. How many functions $f : \{1, 2, 3, 4\} \rightarrow \{1, 2, 3, 4\}$ satisfy $f(f(x)) = f(x)$ for every $x \in \{1, 2, 3, 4\}$?

- A) 39
- B) 42
- C) 41
- D) 40

(Correct +3, Wrong 0, Blank 0)

18. If $a > b > 1 > c$ then the greatest among three numbers $a + bc, b + ca, c + ab$ is _____.

- A) $a + bc = b + ca = c + ab$
- B) $b + ca$
- C) $c + ab$
- D) $a + bc$

(Correct +3, Wrong 0, Blank 0)

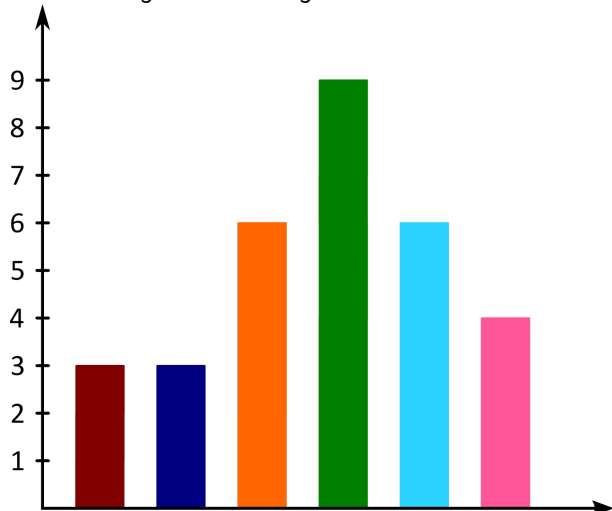
19. A sequence of integers a_1, a_2, \dots, a_{10} satisfies $a_{n-1} \leq a_n \leq a_{n-1} + 1$ for every $n \in \{2, 3, \dots, 10\}$.

If $a_1 = 1$, how many such sequences are possible?

- A) 512
- B) 4096
- C) 2048
- D) 1024

(Correct +3, Wrong 0, Blank 0)

20. Below is the chart of marks students get in mathematics exam. The marks is a multiple of 10, so a student can get 100, 40, 70 etc. And also the difference between marks on the neighboring bar in the graph is 10 and its increasing from left to right.



If the median and the average of the classroom mark is the same, what is the maximum mark in the classroom?

- A) 100
- B) 70
- C) 80
- D) 90

(Correct +3, Wrong 0, Blank 0)

21. A positive integer is called a palindrome if its value does not change when we reverse the order of the digits. For example, 2002 is a palindrome, while 2022 is not. **The number of four digit palindromes that are divisible by 7 is ____.** (Write your answer only un numbers.)
(Correct +4, Wrong 0, Blank 0)

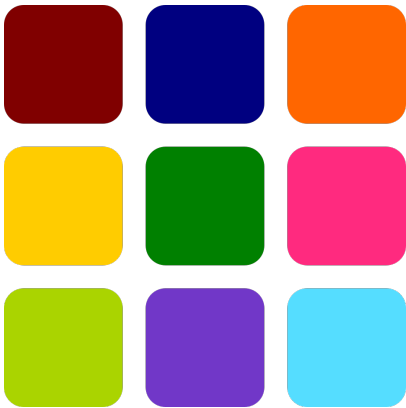
22. The password of Harry's phone consists of three digits. The second digit is twice that of the first digit. If we read the digits as three-digit number we get a number that is divisible by 5 and 32. **What is the sum of all the digits?** (Write your answer only in numbers.)
(Correct +4, Wrong 0, Blank 0)

23. How many subsets $S \subseteq \{1, 2, 3, 4, 5, 6\}$ are there, such that $\{1, 2\} \not\subseteq S$ and $\{2, 3\} \not\subseteq S$?
Note: $A \not\subseteq B$ means the set A is NOT a subset of B . Write your answer only in numbers.
(Correct +4, Wrong 0, Blank 0)

24. A positive integer is divisible by 2022 but not divisible by 3033. **How many such integers are less than 1,000,000?** (Write your answer only in numbers.)
(Correct +4, Wrong 0, Blank 0)

25. Let $f(n)$ be the sum of the remainders when the numbers $1, 2, 3, 4, 5, 6, 7, 8, 9$ are divided by n . For example,
 $f(4) = 1 + 2 + 3 + 0 + 1 + 2 + 3 + 0 + 1 = 13$.
 Find the number of $n \in \{2, 3, 4, 5, \dots, 100\}$ such that $f(n)$ is even. (Write your answer only in numbers.)
 (Correct +4, Wrong 0, Blank 0)

26. The following are cards arranged in a 3 by 3 table. Each card contains a number from 1 to 9. Also the number on each card is different from each other.



The following four conditions is known.

1. The sum of numbers in the first row is 6.
 2. The sum of numbers in the second row is 15
 3. The sum of the numbers in the first column is 12
 4. The sum of the numbers in the second column is 15
- What is the number in the bottom right card?** (Write your answer only in numbers.)

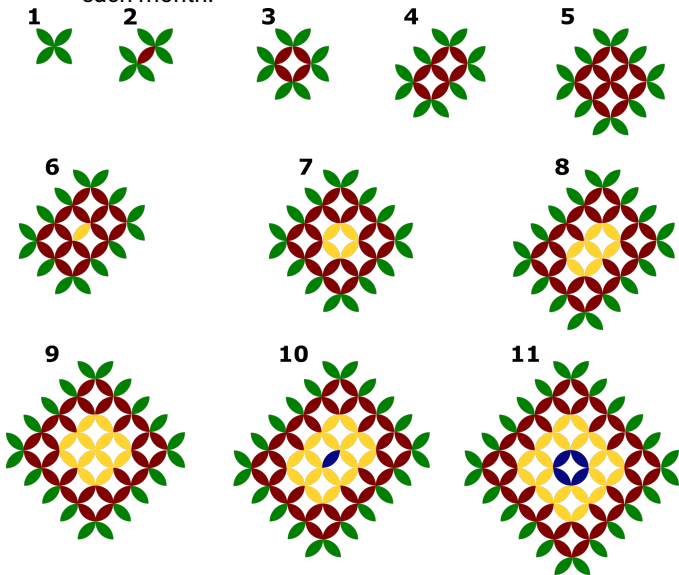
(Correct +4, Wrong 0, Blank 0)

27. Given $p^2q = 2p + 3q + pq$ with p and q prime numbers.

Find the number of possible values for p . (Write your answer only in numbers.)

(Correct +4, Wrong 0, Blank 0)

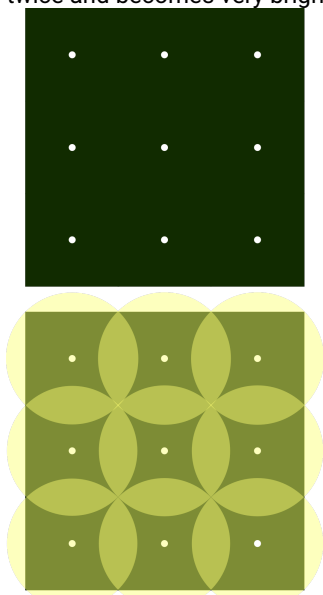
28. The following shows a growth of a plant at the end of each month.



Assuming that each new color coming up in the plant is different than that already present, how many colors will the plant have at the end of its 2nd year? (Write your answer only in numbers.)

(Correct +4, Wrong 0, Blank 0)

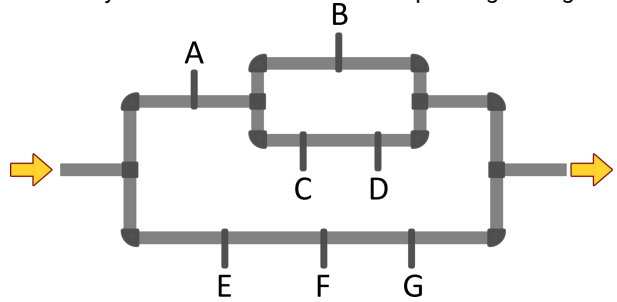
29. A neighborhood park has width of 30 meters and length of 30 meters. Nine lamps are installed in a specific place as shown in the first picture. The nine lamps can light its surrounding area up to $5\sqrt{2}$ meters away from the lamp as shown in the second picture. Therefore some areas are lit twice and becomes very bright.



How large is all the very bright areas inside the park in meter squared? (Use $\pi = 3.14$, and Write your answer only in numbers)

(Correct +4, Wrong 0, Blank 0)

30. The following shows a configuration of pipes where water current enters from the left and exits to the right. In the system there are seven valve, A, B, C, D, E, F, and G. Every valve only let certain amount of water passing through.



In the system, all valves are identical, that is they all have the same maximum water allowed to pass through. Also, the maximum amount water coming out of the system is 30 liter per minute.

Given a lot of water coming from the left, how many liter water passing through the valve G in one minute? (Write your answer only in numbers.)

(Correct +4, Wrong 0, Blank 0)

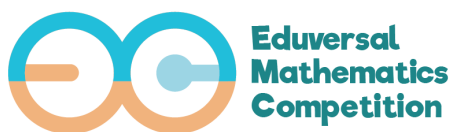
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Answer Keys

No	Key	Code
1	A	KMF/1998/9SKTK
2	C	KMF/2026/WY4MF
3	B	KMF/1919/GZ5BR
4	C	KMF/1974/OUILM
5	D	KMF/2018/VRGIT
6	C	KMF/1970/CSDZG
7	C	KMF/1971/SQQ9H
8	A	KMF/1959/26HZJ
9	A	KMF/1994/TPFWJ
10	C	KMF/1921/NVM13
11	A	KMF/2012/5G9PM
12	B	KMF/1949/QAWGF
13	D	KMF/1981/V8JET
14	C	KMF/1923/6IXW4
15	D	KMF/1922/GW00U
16	D	KMF/1986/VIO2G
17	C	KMF/1972/6JFHA
18	C	KMF/1916/U8ORO
19	A	KMF/1973/D17TS
20	D	KMF/2019/GH7KY