

Mathlete Training Centre  
RMO 2024

## Round 1

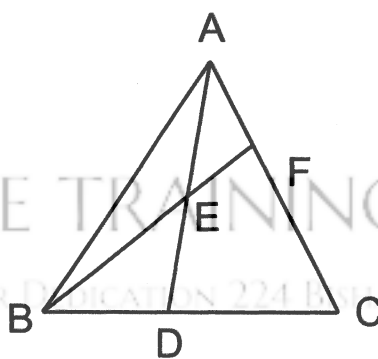
1. Given that  $a_n$  is the remainder of  $7^n \div 11$ , find the value of  $a_1 + a_2 + a_3 + \dots + a_{2024}$ .

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2. Given that  $BD:DC = 3:4$  and  $E$  is the mid-point of  $AD$ , and the sum of the area of  $\triangle AEF$  and  $\triangle EBD$  is 30, find the area of  $\triangle ABC$ .



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3. Student A and Student B set off from points X and Y respectively, moving towards each other simultaneously. If student A increases his speed by 15% and student B increases his speed by 12km/h, they would meet at the same location as if they hadn't increased their speeds. Determine the speed of Student B before they increased their speed.

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4. In the figure below, there are 12 points on the circle. How many distinct triangles can be formed using any 3 points as vertices, considering triangles that are identical upon rotating and flipping as one triangle?



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5. Given that the sum of  $N$  consecutive numbers is 2024, find the maximum value of  $N$ .

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6. Given that  $x$ ,  $y$  and  $z$  are positive integers, if  $x + \frac{y}{z} = 15$  and  $y + \frac{x}{z} = 20$ , find the value of  $\frac{x+y}{z}$ .

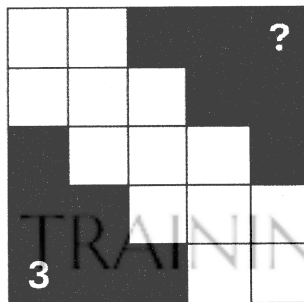
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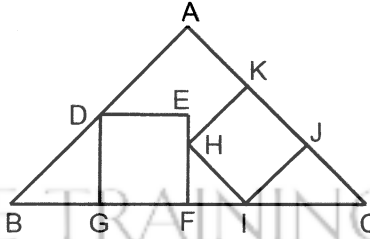
7. Given that  $\frac{1}{2^2-1} + \frac{1}{4^2-1} + \frac{1}{6^2-1} + \dots + \frac{1}{2024^2-1} = A$  where A is in simplified form.

Find the sum of the digits of the numerator and denominator of A.

8. Using only the numbers 1, 2, 3, 4 and 5, fill in the grid below such that each number appears only once in each column and row. Given that the sum of the numbers in the three regions are the same, find the value of ?.



9. In the figure below,  $\triangle ABC$  is an isosceles right-angled triangle and  $F$  is the mid-point of  $BC$ . Given that  $DEFG$  and  $KJIH$  are squares and the area of  $DEFG$  is 126, find the area of  $KJIH$ .



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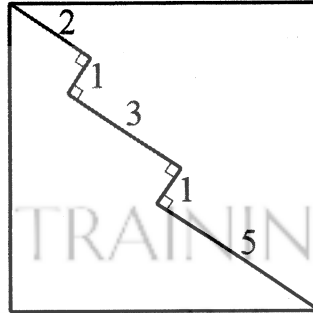
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10.  $\left(\frac{1}{2} + \frac{1}{3} + \frac{1}{4} + \dots + \frac{1}{31}\right) + \left(\frac{2}{3} + \frac{2}{4} + \dots + \frac{2}{31}\right) + \dots + \left(\frac{29}{30} + \frac{29}{31}\right) + \frac{30}{31} =$

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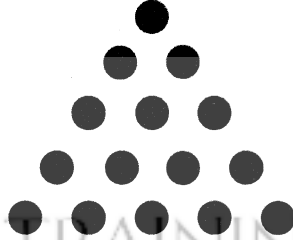
11. In the figure below, a square is depicted with line segments drawn inside, each labelled with its length. Determine the area of this square.



12.  $\frac{[1, 2]}{1 \times 2}, \frac{[1, 2, 3]}{1 \times 2 \times 3}, \dots, \frac{[1, 2, \dots, 100]}{1 \times 2 \times \dots \times 100}$

Given that  $[1, 2]$  represents the LCM of 1 and 2, how many different values are there?

13. How many ways can a straight line pass through any of 3 dots?



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14. In a school band, there are 30 more boys than girls in the year 2023. In 2024, some new members join such that the total number of students is 10% more than in 2023. The number of boys increased by 5% while the number of girls increased by 20%. How many members were there in 2024?

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15. There are 19 cards, labelled 1-19 in a bag. What is the minimum number of cards to take out to ensure that any 2 cards sum to 20?

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16. Allan, Betty and Carl had some marbles. If Allan gave Betty 20 marbles the ratio of Betty's marbles to Allan and Carl's marbles was 2:1. If Allan gave Carl 30 marbles the ratio of Carl's marbles to Betty's and Allan's marbles would be 3:1. Find the amount of marbles they had altogether.

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17. Cups A, B and C contains a mixture of lemon juice and water. The total volume of mixture in each cup is the same. Cup A had a mixture of lemon juice to water of ratio of 2:1. Cup B had a mixture of lemon juice to water of ratio of 4:3 and Cup C had a mixture of lemon juice to water of ratio 7:5. John poured all the mixtures into a glass. What was the ratio of lemon juice to water in the glass?

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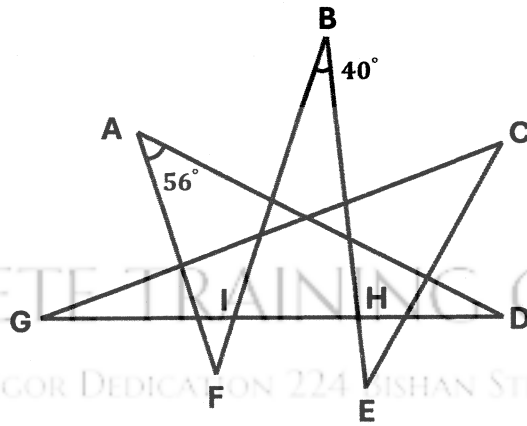
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18. How many digits are there in the number  $816243240 \dots 20162024$ ?

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19. As shown in the figure below, find  $\angle C + \angle D + \angle E + \angle F + \angle G$ .



20. There is a sequence 4, 9, 24, 69, 204, 609,  $x$ ,  $y$ , what is the sum of the  $x$  and  $y$ ?