2017 INTERNATIONAL TEENAGERS MATHEMATICS OLYMPIAD (ITMO) DAVAO CITY, PHILIPPINES

08-12 NOVEMBER 2017

ORGANIZED BY: MATHEMATICS TRAINERS' GUILD, PHILIPPINES
WWW.MTGPHIL.ORG

KEY STAGE 2 - TEAM CONTEST

TIME LIMIT: 60 MINUTES

INFORMATION:

- You are allowed 60 minutes for this paper, consisting of 10 questions printed on separate sheets. For questions 1, 3, 5, 7 and 9, only numerical answers are required. For questions 2, 4, 6, 8 and 10, full solutions are required.
- Each question is worth 40 points. For odd-numbered questions, no partial credits are given. There are no penalties for incorrect answers, but you must not give more than the number of answers being asked for. For questions asking for several answers, full credit will only be given if all correct answers are found. For even-numbered questions, partial credits may be awarded.
- Diagrams shown may not be drawn to scale.

INSTRUCTIONS:

- Write down your team's name in the space provided on every question sheet.
- Enter your answers in the space provided after individual questions on the question paper.
- During the first 10 minutes, the four team members examine the first 8 questions together, and then altogether discuss them. Then they distribute the questions among themselves, with each team member is allotted at least 1 question.
- During the next 35 minutes, the four team members write down the solutions of their allotted problems on the respective question sheets, with no further communication /discussion among themselves.
- During the last 25 minutes, the four team members work together to write down the solutions of the last 2 questions on the respective questions sheets.
- You may not use instruments such as protractors, calculators and electronic devices.
- At the end of the contest, you must hand in the envelope containing all question sheets and all scratch papers.

TEAM:	SCORE:

FOR JURIES USE ONLY

No.	1	2	3	4	5	6	7	8	9	10	Total	Sign by Jury
Score												
Score												

supported by:

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Team：_____ Score：_____

1. Let each of the letters *D, A, V, O, M, T, H* and *S* represent a distinct digit from 0 to 9 so that $\overline{DAVAO}$ and $\overline{MATHS}$ are 5-digit numbers and it satisfies:

$$\begin{array}{cccccc} & D & A & V & A & O \\ + & D & A & V & A & O \\ \hline & M & A & T & H & S \end{array}$$

Find the sum of all possible values for *T*.

Answer: _____

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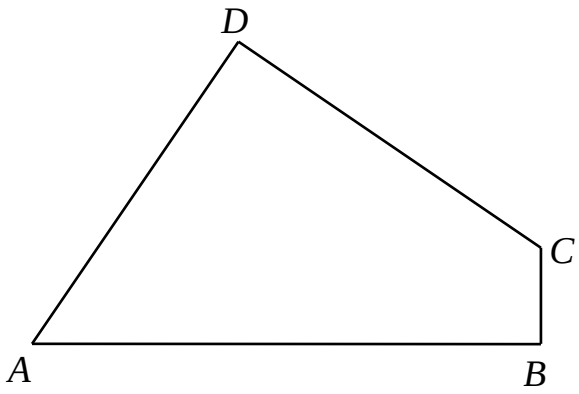
2. The figure below shows a quadrilateral $ABCD$ so that $\angle ADC = \angle ABC = 90°$ and $AD = DC$. If the area of the quadrilateral $ABCD$ is 196 cm^2, find the distance from D to AB, in cm.



Answer: _____ cm

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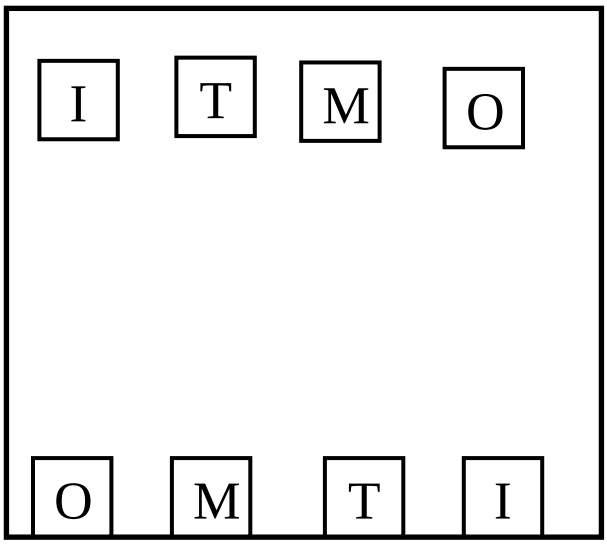
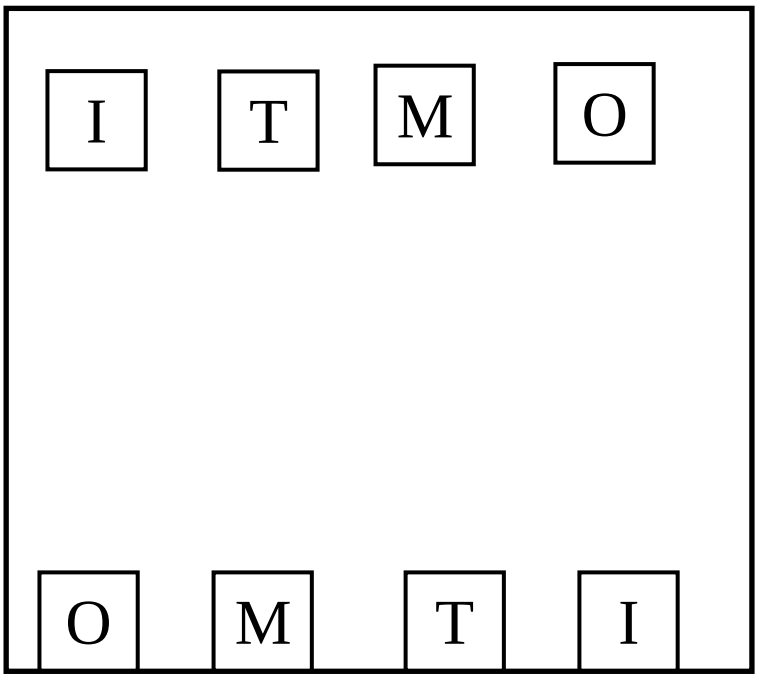
3. Connect each letter in the box on the top with the same letter on the bottom with paths not crossing over one another, nor paths not going outside the border .



Answer:



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4. Fill in each $\square$ with digit from the set {1, 2, 3, 4, 5, 6, 7, 8, 9} with no repetition into the following math operation:

$$\frac{1}{\square}+\frac{1}{\square+\frac{1}{\square}}+\frac{1}{\square+\frac{1}{\square+\frac{1}{\square}}}=\frac{M}{N}$$, where M and N are relatively prime.

Find greatest possible value of $M-N$.

Answer: _____

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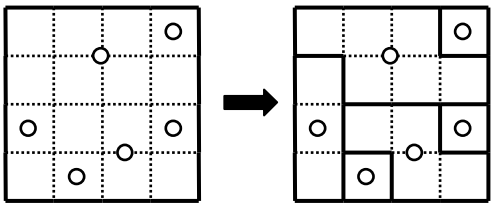
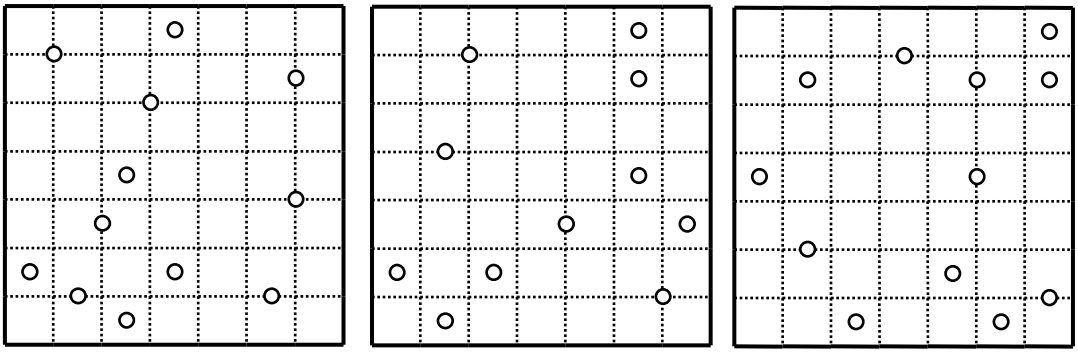
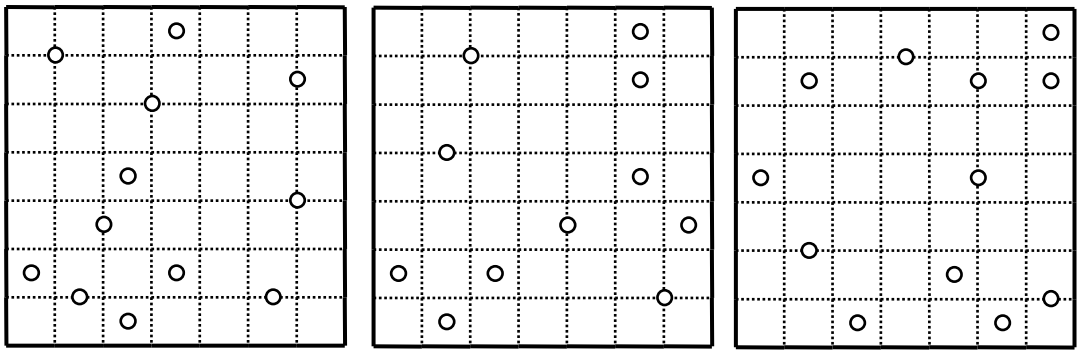
5. Form edges along the dotted lines to create shapes so that each circle is the symmetry center (each shape when rotated 180 degrees along the circle, the shape appears identical) of the enclosed area. An example is shown below. Complete the three challenges below.



Challenge:



Answer:



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6. There are three 3-digit numbers $\overline{ABC}$, $\overline{BCD}$ and $\overline{CDE}$, where each different letter represents a different digit, so that $\overline{ABC}+\overline{BCD}+\overline{CDE}=2017$. Find the difference between the largest and smallest possible value of $\overline{ABCDE}$.

Answer: _____

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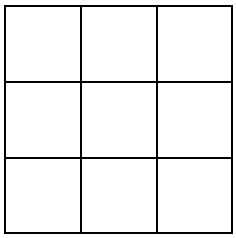
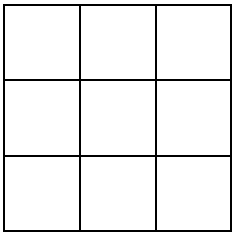
7. Andy wants to put some tokens (can put 0 token) on each of the unit squares of a 3×3 board, so that in any 2×2 subboard, the sum of the number of tokens is a prime number and all of those prime numbers are different. What is the least possible number of tokens that Andy should put on the board? Show one example.



Answer: _____ tokens,



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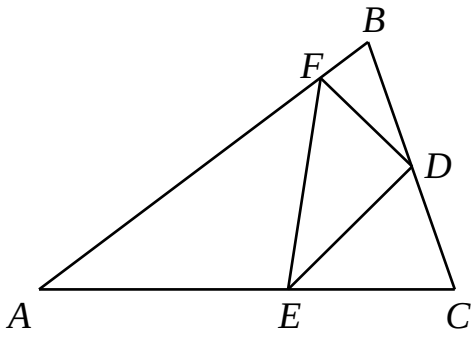
8. The figure shows a triangle ABC. D is the midpoint of BC and E lies on AC such that $AE : EC = 3 : 2$. If F is a point of AB such that the area of triangle DEF is three times the area of triangle BDF, find the ratio of $AF : FB$.



Answer: _____

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9. Use each of the digits 1, 2, 3, 4, 5, 6, 7, 8 and 9 once to form a 2-digit number, a 3-digit number and a 4-digit number, respectively, so that when the first two numbers are multiplied together, the result would be the third number. For example, $12 \times 483 = 5796$.
Aside from the example given above, list down all possible combinations.

Answer:

	×	=	,	×	=	,
	×	=	,	×	=	,
	×	=	,	×	=	,
	×	=	,	×	=	,
	×	=	,	×	=	,
	×	=	,	×	=	,
	×	=	,	×	=	,
	×	=	,	×	=	,
	×	=	,	×	=	,

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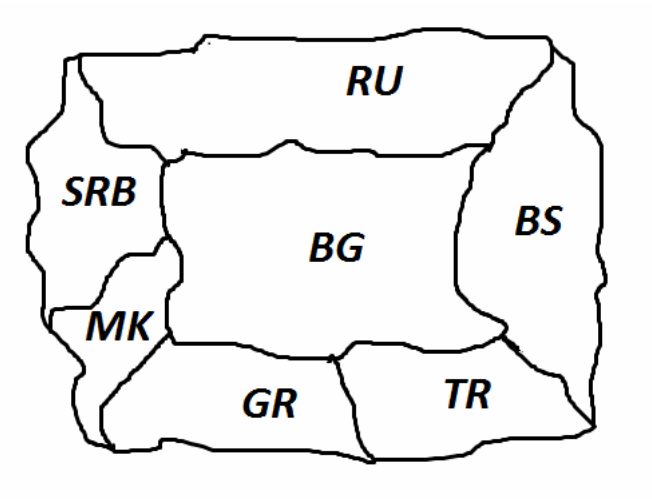
10. The picture shows a part of the Balkan peninsula. In how many ways can we color each region with one of 4 colors, so that every 2 neighboring regions are colored with different colors?



Answer: _____ ways