

MA Θ Competition Team HW Set 15

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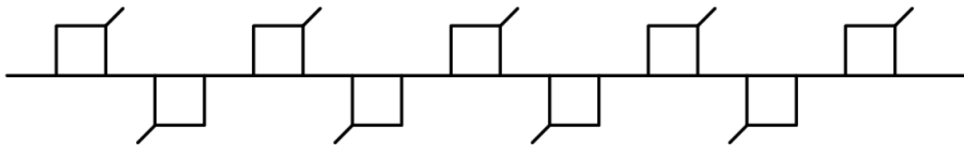
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Problem 1. State the definition of a rigid transformation.

Problem 2. For how many of the following types of quadrilaterals does there exist a point in the plane of a quadrilateral that is equidistant from all four vertices of the quadrilateral?

1. A square
2. A rectangle that is not a square
3. A rhombus that is not a square
4. A parallelogram that is not a rectangle or a rhombus
5. An isosceles trapezoid that is not a parallelogram

Problem 3. The figure below shows line ℓ with a regular, infinite, recurring pattern of squares and line segments.

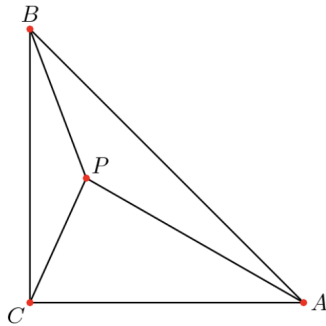


How many of the following four kinds of rigid motion transformations of the plane in which this figure is drawn, other than the identity transformation, will transform this figure into itself?

1. some rotation around a point of line ℓ
2. some translation in the direction parallel to line ℓ
3. the reflection across line ℓ
4. some reflection across a line perpendicular to line ℓ

Problem 4. Jiwu is throwing a very elastic baseball to Anders, who is 50 meters away from him. The baseball bounces off the ground at some point in its trajectory and reaches Anders's hand. Given that Jiwu is 1.80 meters tall, and Anders is 1.85 meters tall, and both throw/receive the ball at head level, what is the minimum path length of the ball's motion?

Problem 5. Isosceles $\triangle ABC$ has a right angle at C . Point P is inside $\triangle ABC$, such that $PA = 11$, $PB = 7$, and $PC = 6$. Legs \overline{AC} and \overline{BC} have length $s = \sqrt{a + b\sqrt{2}}$, where a and b are positive integers. What is $a + b$?



Problem 6. The point $P(a, b)$ in the xy -plane is first rotated counterclockwise by 90° around the point $(1, 5)$ and then reflected about the line $y = -x$. The image of P after these two transformations is at $(-6, 3)$. What is $b - a$?

Problem 7. A laser is placed at the point $(3, 5)$. The laser beam travels in a straight line. Minjoo wants the beam to hit and bounce off the y -axis, then hit and bounce off the x -axis, then hit the point $(7, 5)$. What is the total distance the beam will travel along this path?