The Scottish Mathematical Council

MATHEMATICAL CHALLENGE 2007–2008

Entries must be the unaided efforts of individual pupils. Solutions must include explanations.

Answers without explanation will be given no credit.

CURRENT AND RECENT SPONSORS OF MATHEMATICAL CHALLENGE ARE

The Edinburgh Mathematical Society, Professor L E Fraenkel,

**The London Mathematical Society and The Scottish International Education Trust.**

Senior Division: Problems 2

S1. A cyclist and a runner start off simultaneously around a racetrack each going at a constant speed in the same direction. The cyclist completes one lap and then catches up with the runner. Instantly the cyclist turns around and heads back at the same speed to the starting point where he meets the runner who has just finished his first lap. Find the ratio of their speeds.

S2. Mahti has cut some regular pentagons out of card and is joining them together in a ring. How many pentagons will there be when the ring is complete?
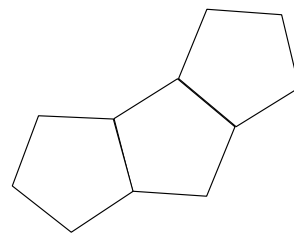
She then decides to join the pentagons with squares which have the same edge length and wants to make a ring as before. Is it possible? If so, determine how many pentagons and squares make up the ring and if not, explain why.
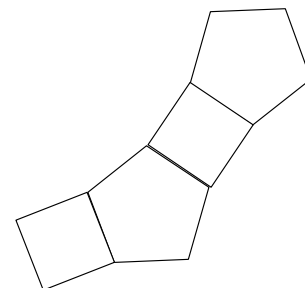
S3. In the diagram, each question mark represents one of six consecutive whole numbers. The sum of the numbers in the triangle is 39, the sum of those in the square is 46 and the sum of those in the circle is 85. What are the six numbers?
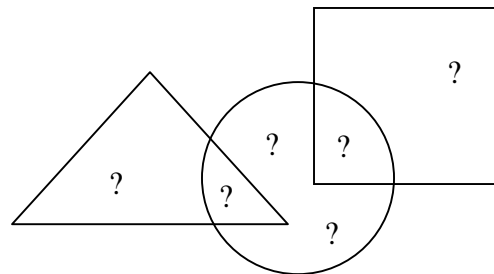
S4. The triangle ABC is inscribed in a circle of radius 1. Show that the length of the side AB is given by $2 \sin c°$, where $c°$ is the size of the interior angle of the triangle at C.

S5. The number 3025 has the peculiar property that, if you split it into two parts as 30 and 25 then $(30 + 25)^2 = 3025$. Find all 4-digit numbers with this property.

END OF PROBLEM SET 2