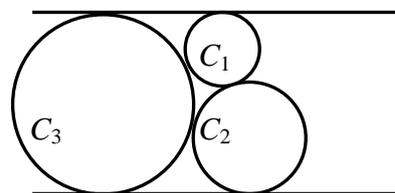


1. A pedestrian started walking from  $A$  to  $B$ . At the same time a biker started cycling from  $B$  to  $A$ . When the biker met the pedestrian, he immediately picked him up, turned round and took him to  $B$  and then, without any delay went to  $A$ . As a result, the biker spent two and a half times longer cycling than if he had gone directly from  $B$  to  $A$ . If the pedestrian had not got a lift, how many times longer would he have spent going from  $A$  to  $B$ ?

2. Is it possible to number the eight vertices of a cube from 1 to 8 in such a way that the value of the sum of the two ends of each edge is different from that of any other edge?

3. Find all possible pairs of positive integers whose sum and product add to 2011.

4. Three circles  $C_1$ ,  $C_2$ ,  $C_3$  are mutually touching and are also touching two parallel lines as shown. If the circles  $C_1$  and  $C_2$  have radii  $s$  and  $t$ , find the radius of  $C_3$ .



5. Solve the system of equations:

$$x^2 + x - 1 = y$$

$$y^2 + y - 1 = z$$

$$z^2 + z - 1 = x$$

6. A point  $P$  is chosen on the circumcircle of the triangle  $ABC$ . Perpendiculars are dropped from  $P$  to the points  $D$ ,  $E$  and  $F$  on sides  $BC$ ,  $CA$  and  $AB$  respectively. Prove that the points  $D$ ,  $E$  and  $F$  lie on a straight line.

7. The notation  $|x|$  is defined as follows:

$$|x| = x \quad \text{if } x \geq 0$$

$$|x| = -x \quad \text{if } x < 0$$

Find the area enclosed by the polygon whose equation is  $||x| - 2| + ||y| - 2| = 4$ .

8. Write the expression  $\frac{1}{\sqrt{2011 + \sqrt{2011^2 - 1}}}$  in the form  $\sqrt{a} - \sqrt{b}$  where  $a, b$  are integers.

**Deadline for receipt of solutions: 30<sup>th</sup> December 2011**

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