



## MONTGOMERY COUNTY MATHEMATICS LEAGUE

**Individual for Contest # 4**

**(No Calculators)**

**2015-2016**

Time: 10 minutes

1. The angles of a triangle are in the ratio 3 : 4 : 5. Find the numerical value of the ratio of the sine of the smallest angle to the sine of the next smallest angle.
2. Runners A and B run a race from point P to point Q and back again. B starts out running at 9 miles per hour and A at 12 miles per hour. As B is running towards point Q he meets A, who is already returning to point P. As soon as they meet, B increases his speed, and the race ends up a tie. By how much did B increase his speed?



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3. When the polynomial  $f(x)$  is divided by  $x - a$ , the quotient is  $Q(x)$  and the remainder is  $R$ . When  $f(x)$  is divided by  $3(x - a)$ , the quotient is  $g \cdot Q(x)$  and the remainder is  $h \cdot R$  where  $g$  and  $h$  (as well as  $a$  and  $R$ ) are constants. Find the ordered pair  $(g, h)$ .
4. Point A is a vertex of a cube with unit side, and point G is the vertex of the cube which is farthest from A. Points B, C, and D are the three vertices connected to A by the edges of the cube. The plane determined by points B, C, and D intersects line AG in H. Find the ratio AH : HG.



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5. If the reciprocal of  $(x + y)$  is equal to the sum of the reciprocal of  $x$  and the reciprocal of  $y$ , find all possible numerical values of  $x/y$ . (include complex numbers as possible answers)
6. The median of a triangle is equal in length to the geometric mean of the lengths of the sides which include it. If these two sides 7 and 10, find the length of the side of the triangle to which the median is drawn.