

MATH FIELD DAY 2011 RELAYS

**Relay A**

- A1. Find the number of real solutions of the equation  $3^{x^2} = 9$ .
- A2. Let  $k$  be the number you receive. Find the distance between the points  $(-k, k+1)$  and  $(k-1, 7)$ .
- A3. Let  $k$  be the number you receive. If  $f(x-k) = kx - 13$ , find  $f(0)$ .
- A4. Let  $k$  be the number you receive. Find the area of the square whose perimeter is  $k$ .
- A5. Let  $k$  be the number you receive. How many different prime numbers are factors of  $k$ ?



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**Relay B**

B1. Simplify the expression:  $1 - \frac{1}{1 - \frac{1}{1 - \frac{1}{2}}}$ .

B2. Let  $k$  be the number you receive. Find the number of negative solutions to the equation  $|x - 2| = k + 1$ .

B3. Let  $k$  be the number you receive. Find the integer nearest to  $2\pi - 3k$ .

B4. Let  $k$  be the number you receive. Find the remainder when  $x^3 - 4x^2 + 2$  is divided by  $x - k$ .

B5. Let  $k$  be the number you receive. Find the  $x$ -coordinate of the point where the line  $kx - (k - 1)y = 21$  intersects the  $x$ -axis.



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**Relay C**

C1. How many integers from 1 to 49 are divisible by 2 or 3?

C2. Let  $k$  be the number you receive. If  $4 = \frac{k}{2^{x+1}}$ , find  $x$ .

C3. Let  $k$  be the number you receive. What is the smallest positive integer with  $k + 1$  different prime factors?

C4. Let  $k$  be the number you receive. A right triangle with hypotenuse of length  $k/2$  has a leg of length 12. Find the length of the other leg.

C5. Let  $k$  be the number you receive. Find the positive root of  $x^2 - (k - 1)x - k = 0$ .



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**Relay D**

D1. If a right triangle has a hypotenuse of length 20 and one leg of length 12, find the length of the second leg.

D2. Let  $k$  be the number you receive. If the area of Square A is  $k$  times the area of Square B, what is the ratio of side length of Square A to the side length of Square B?

D3. Let  $k$  be the number you receive from the front and  $n$  be the number you receive from the back. Find  $\frac{x}{y}$  if  $x$  and  $y$  are solutions of the system: 
$$\begin{cases} x + y = k \\ x - y = n \end{cases}$$

D4. Let  $k$  be the number you receive. Find the positive solution of the equation  $x(x + k) = 20$ .

D5. If  $s_0 = 1$  ,  $s_1 = 5$  , and for each positive integer  $k$  ,  $s_{k+1} = s_k - s_{k-1}$  , find  $s_3$ .

