Senior Math League Competition - December 12, 2013

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Question 1:

Reduce the following polynomial:

$$\frac{1}{2}a + \frac{1}{3}b + 2a - 3b - \frac{3}{4}a - \frac{1}{6}b + \frac{3}{4} - \frac{1}{2}$$

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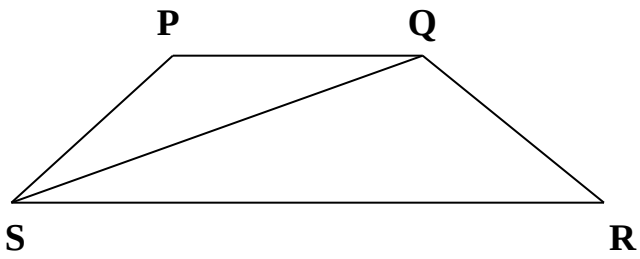
Question 2:

In the figure below, PQRS is a trapezoid with an area of 12 cm ^{2}. RS is twice the length of PQ. What is the area of ΔPQS?



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Question 3:

It takes 852 digits to number the pages of a book consecutively. How many pages are there?

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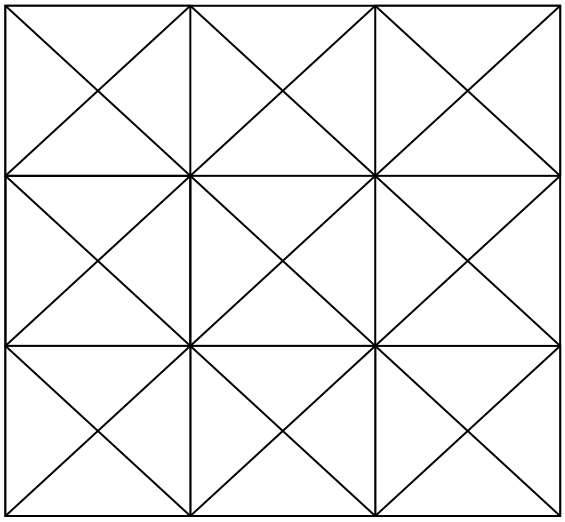
Question 4:

How many squares are there in the figure below?



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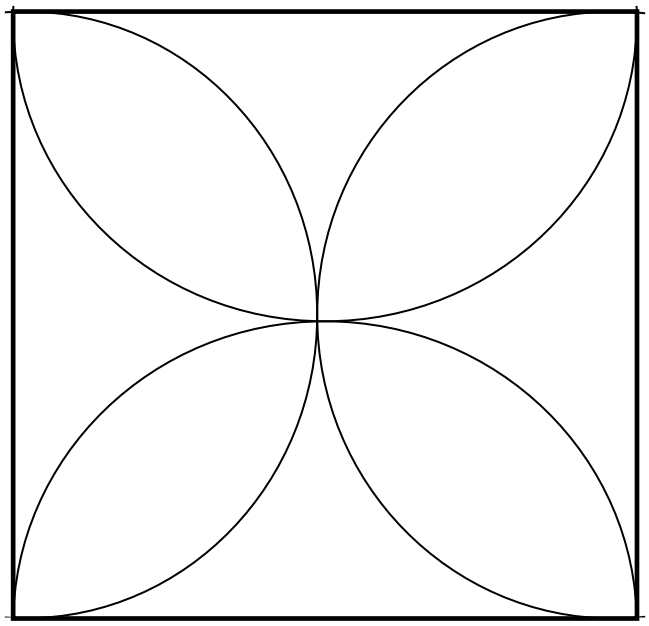
Question 5:

The sides of the square below are 6 cm. The diameters of the four semicircles are equal to the length of each side. Find the area of the shaded leaves. Leave answer in terms of π.



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Question 6:

How many ways are there to arrange the letters in the word BANANA, in which the 3 A`s and the 2 N`s are considered identical?

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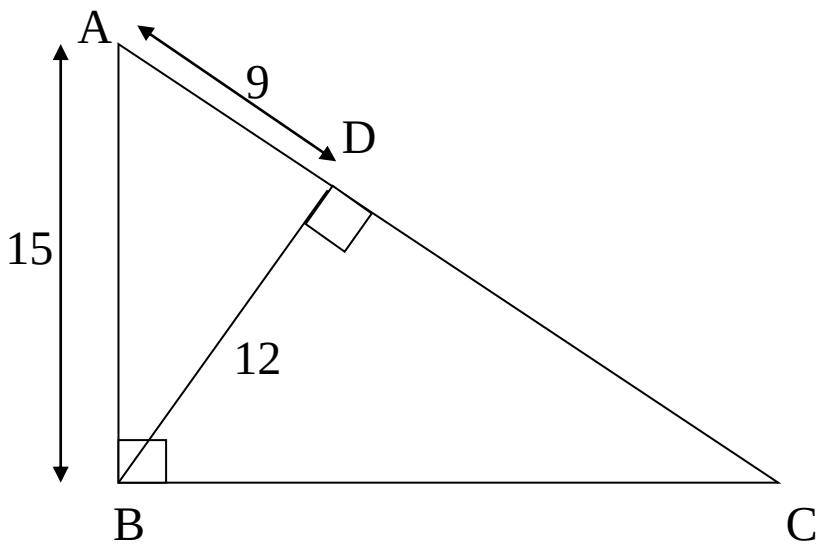
Question 7:

Find the length of BC.



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Question 8:

x is a positive number with the property that $x^2 + \frac{1}{x^2} = 23$. What is the value of $x + \frac{1}{x}$?

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Question 9:

The length of a rectangle can be expressed as x^3y^2 and the area as x^5y^3, where x and y are natural numbers. If the area is 4000 m^2, what is the perimeter of the rectangle?

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Relay 1:

1. The quadratic equation $x^2 + 6x + \mathbf{A} = 0$ has two equal roots.

   Write the value of **A** in the box #1 of the Relay Answer Sheet.

2. Each student in a class of 25 students wrote 2 different tests. It is known that

   - (2 × **A**) students passed the first test.
   - 22 students passed the second test.
   - No students failed both tests.

   B is the number of students who passed both tests.

   Write the value of **B** in Box # 2 of the Relay Answer Sheet.

3. A set of 5 numbers has an average of **B**. If a 6^{th} number is included, then the average is 27. **C** is the value of the 6^{th} number.

   Write the value of **C** in Box # 3 of the Relay Answer Sheet.

4. **D** is the $\mathbf{C}^{th}$ digit of 3/13 .

   Write the value of **D** in Box # 4 of the Relay Answer Sheet.

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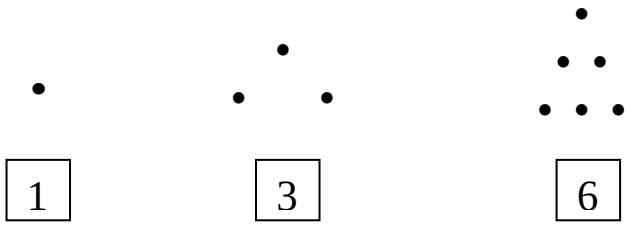
Relay 2:

1. The numbers between 1 and 441 are written on a piece of paper. Mrs. Swaine circles the even numbers with red circles and Mrs. Wilson circles the multiples of 5 with blue circles. **A** is how many numbers are circled with only one color?

   Write the value of **A** in Box # 1 of the Relay Answer Sheet.

2. Numbers such as 1, 3 and 6 are sometimes referred to as triangular numbers, because the value of the number can be represented by a triangular shape as shown below.



   A is the sum of the first **B** triangular numbers.

   Write the value of **B** in Box # 2 of the Relay Answer Sheet.

3. The prime factorization of (54 × **B**) can be written as $a^x \cdot b^y \cdot c^z$. **C** is the sum of *a, b, c, x, y, z.* (Note: a, b, c, x, y, and z are not necessarily different)

   Write the value of **C** in Box # 3 of the Relay Answer Sheet.

4. **D** is the last digit of ($2^{\mathbf{C}} \times 2^{13}$) (2^C is 2 to the power of **C**).

   Write the value of **D** in Box # 4 of the Relay Answer Sheet.

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Relay 3:

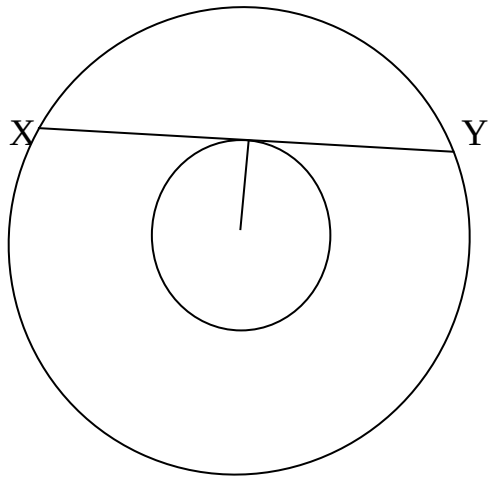
1. The product of the digits of the number 165 is 30. **A** is how many **other** three-digit numbers that have 30 as the product of their digits?

   Write the value of **A** in Box # 1 of the Relay Answer Sheet.

2. $x^2 - \mathbf{B}x + \mathbf{A} = 0$

   Write the value of **B** in Box # 2 of the Relay Answer Sheet.

3. Two circles have the same center. The larger circle has a radius of 20. The smaller circle has a radius of **B**. **C** is the length of the XY (which is perpendicular to the radius of the smaller circle).



   Write the value of **C** in Box # 3 of the Relay Answer Sheet.

4. **D** is the sum of the first **C** terms of the following sequence:

   1, -2, 3, -4, 5, 1, -2, 3, -4, 5, 1, -2, 3, -4, 5, 1, -2, 3, -4, 5, ….

   Write the value of **D** in Box # 4 of the Relay Answer Sheet.

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Relay # 1 - Answers

A	**9**
B	**15**
C	**87**
D	**0**

Relay # 1 - Answer Sheet

TEAM #_____ School: _____

A	
B	
C	
D	

Regular points (max. 5) +	**Bonus Points (max. 6) =**	**Total Points**

Proctors Initials: _____

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Relay # 2 - Answers

A	**220**
B	**10**
C	**16**
D	**2**

Relay # 2 - Answer Sheet

TEAM #_____ School: _____

A	
B	
C	
D	

Regular points (max. 5) +	**Bonus Points (max. 10) =**	**Total Points**

Proctors Initials: _____

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Relay # 3 - Answers

A	**11**
B	**12**
C	**32**
D	**17**

Relay # 3 - Answer Sheet

TEAM #_____ School: _____

A	
B	
C	
D	

Regular points (max. 5) +	**Bonus Points (max. 10) =**	**Total Points**

Proctors Initials: _____

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Answers

1. $\frac{7}{4}a - \frac{17}{6}b + \frac{1}{4}$.
2. 4
3. 320
4. 31
5. $18\pi - 36$
6. 60
7. 20
8. 5
9. 440

Masters Individual 1. 13/2g