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Mathematics Essay Problems

Country: _____ Name: _____ ID: _____ Score: _____

Instructions:

- Write down your name and country on every page.
- You have 90 minutes to work on this test.
- Write down your detail solutions or working process in English on the space below the question.
- Each problem is worth 3 points, and partial credit may be awarded.
- Use black or blue colour pen or pencil to write your answer.



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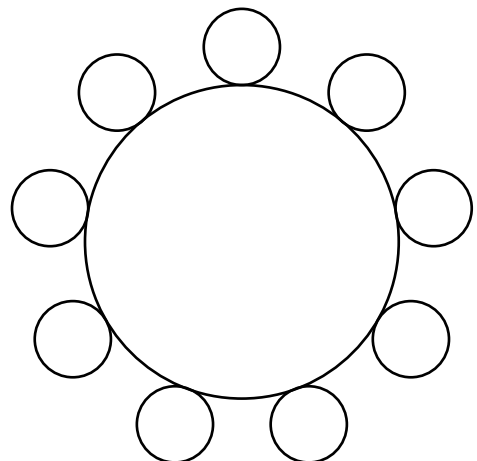
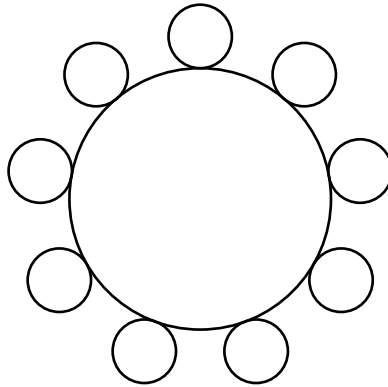
The following table is for jury use only.

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ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

1. Write the numbers 1, 2, 3, ..., 9 on the circumference of a circle in such a way that no two neighboring numbers would give a sum that is divisible by either 3 or 5 or 7.



ANSWER: _____

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

2. Suppose that the sum of n consecutive integers (included positive integers, 0 and negative integers) is 55, find the largest value of n .

ANSWER: _____

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

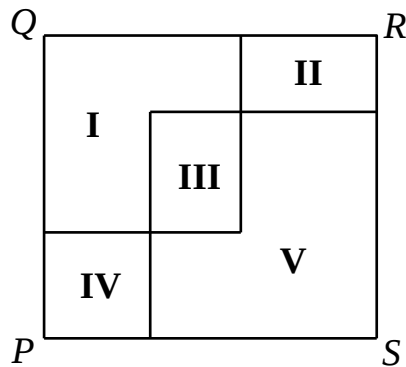
3. Let $\overline{a}$, $\overline{b}$ and c be digits. The product of the three-digit numbers $\overline{abc}$, $\overline{bca}$ and $\overline{cab}$ is a nine-digit number whose first digit is 2 and whose last digit is 9. Find this product.

ANSWER: _____

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

4. The shape of a factory is a rectangle $PQRS$ with $PS = 44$ m and $RS = 40$ m. The factory is divided into 5 rooms, **I**, **II**, **III**, **IV** and **V**, as shown in the figure below. The perimeters of room **II**, **III** and **IV** are equal. If room **I** with **III** form a square, and room **V** with room **III** also form a square, what is the sum of the perimeters of room **I** and **V**, in m?



ANSWER: _____ m

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

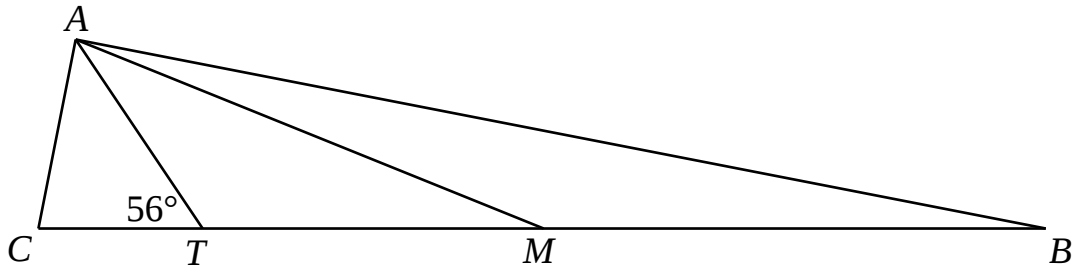
5. The number $\overline{abcab}$ is a multiple of 7, $\overline{abc}$ a multiple of 9 and $\overline{cba}$ a multiple of 4. Find the smallest value for $a \times b \times c$.

ANSWER: _____

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

6. In $\triangle ABC$, point M is the midpoint of BC , $AM = CM$, $\angle ATC = 56^\circ$, and AT bisects $\angle BAC$, as shown in the figure below. What is the size of $\angle AMB$, in degrees?



o

ANSWER: _____

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

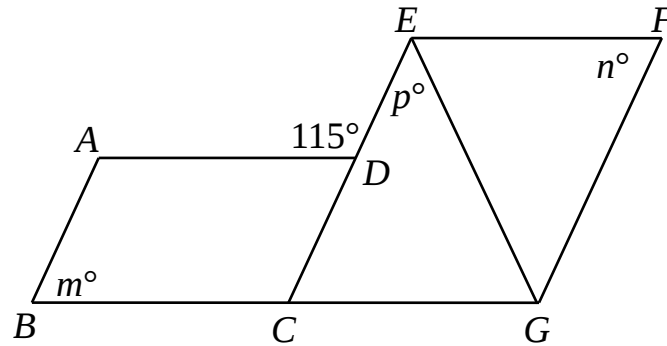
7. A group of students went on a field trip by bus. Each bus held the same number of students, each seat was filled, and everyone had a seat. But on the way, one bus broke down. The students were distributed evenly among the remaining buses, and in each bus 4 students had to stand. On the way home, two more buses broke down, and so they finished the trip with 18 students standing in each bus. How many students were on this trip?

ANSWER: _____ **students**

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

8. In the figure below, $ABCD$ and $CEFG$ are parallelograms so that BCG is a straight line, and $\angle ADE = 115^\circ$. If $EG = FG$, find the values of $m + n + p$.



ANSWER: _____

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

9. How many different four-digit numbers are there with the sum of its digits is 9 such that the digit 0 is not included?

ANSWER: _____ **four-digit numbers**

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

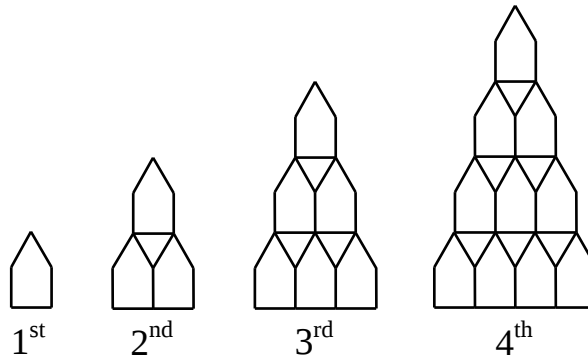
10. Using 6 given colors, you color each side of a cube to a different color, then you write the six numbers on it so that the numbers 6 and 1; 2 and 5; 3 and 4 are facing each other. How many different cubes can you make? (Two cubes are considered to be the same if you can rotate one cube into the position of the other.)

ANSWER: _____

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

11. The diagram below shows a sequence of towers made from toothpicks. How many toothpicks will the 10th tower require?



ANSWER: _____ **toothpicks**

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

12. The two-digit number $\overline{ab}$ and the number $\overline{ab} + 45$ are said to be similar if the sum of the digits of $\overline{ab}$ is the same as the sum of the digits of $\overline{ab} + 45$. For example : 15 and $15 + 45 = 60$ are similar because the sum of the digits of each number is 6. How many pairs of similar numbers are there?

ANSWER: _____ **pairs**

ESSAY PROBLEMS

Country: _____ Name: _____ ID: _____

13. In how many ways can three different numbers be selected from the numbers 1 to 15, so that their sum is a multiple of 4?

ANSWER: _____ **ways**