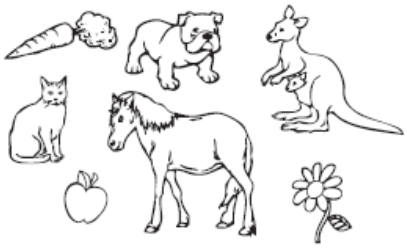
MO MATH
NATIONAL MUSEUM OF MATHEMATICS

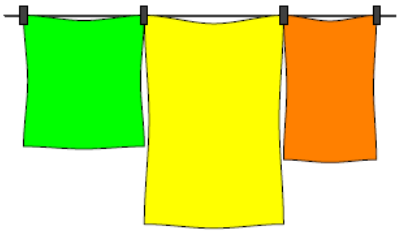
Level 1

1. How many animals are there in the picture below?



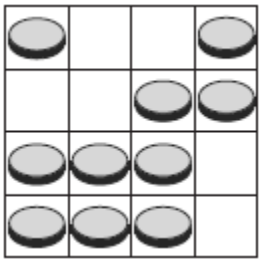
A. 3 B. 4 C. 5 D. 6 E. 7

2. Father hangs the laundry outside on a clothesline. He wants to use as few pins as possible. For 3 towels he needs 4 pins, as shown. How many pins does he need for 9 towels?



A. 9 B. 10 C. 12 D. 16 E. 18

3. There are coins on the board. We want to have 2 coins in each column and 2 coins in each row. How many coins need to be removed?



A. 0 B. 1 C. 2 D. 3 E. 4

Problems selected from Math Kangaroo

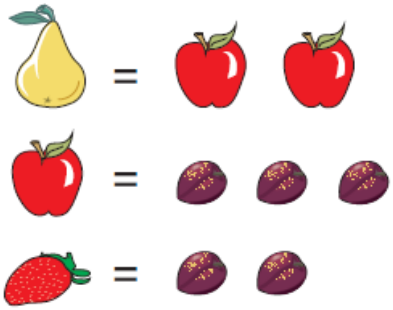
4. Which digits are missing on the right?

A. 3 and 5 B. 4 and 8 C. 2 and 0 D. 6 and 9 E. 7 and 1

5. George has 2 cats of the same weight. What is the weight of one cat if George weighs 30 kilograms?

A. 1 kilogram B. 2 kilograms C. 3 kilograms D. 4 kilograms
E. 5 kilograms

6. In a certain game it is possible to make the following exchanges:



Adam has 6 pears. How many strawberries will Adam have after he trades all his pears for just strawberries?

A. 12 B. 36 C. 18 D. 24 E. 6

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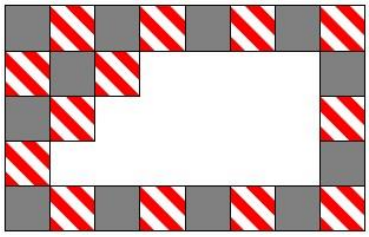
Level 2

1. A regular rectangular pattern on a wall was created with 2 kinds of tiles: grey and striped. Some tiles have fallen off the wall (see the picture). How many grey tiles have fallen off?



A. 9 B. 8 C. 7 D. 6 E. 5

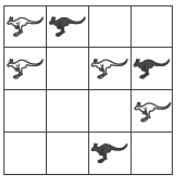
2. Among Nikolay's classmates there are twice as many girls as boys. Which of the following numbers can be equal to the number of all children in this class?

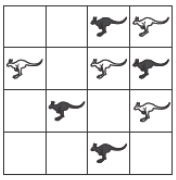
A. 30 B. 20 C. 24 D. 25 E. 29

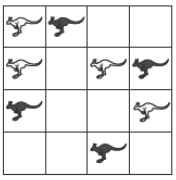
3. Gregory forms two numbers with the digits 1, 2, 3, 4, 5, and 6. Both numbers have three digits, and each digit is used only once. He adds these two numbers. What is the greatest sum Gregory can get?

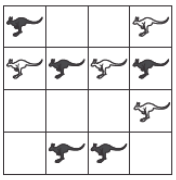
A. 975 B. 999 C. 1083 D. 1173 E. 1221

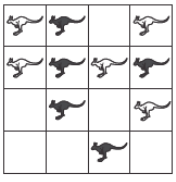
4. In which figure is the number of black kangaroos larger than the number of white kangaroos?

A. 

B. 

C. 

D. 

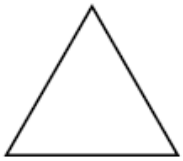
E. 

Problems selected from Math Kangaroo

5. Each time Pinocchio lies, his nose gets 6 cm longer. Each time he tells the truth, his nose gets 2 cm shorter. After his nose was 9 cm long, he told three lies and made two true statements. How long was Pinocchio's nose afterwards?

A. 14 cm B. 15 cm C. 19 cm D. 23 cm E. 31 cm

6. Joining the midpoints of the sides of the triangle in the drawing we obtain a smaller triangle. We repeat this one more time with the smaller triangle. How many triangles of the same size as the smallest resulting triangle fit in the original drawing?



A. 5 B. 8 C. 10 D. 16 E. 32

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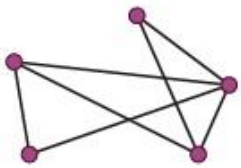
Level 3

1. Sally can put 4 coins in a square made using 4 matches (see picture). At least how many matches will she need in order to make a square containing 16 coins that do not overlap?

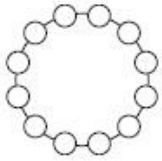
(A) 8 B. 10 C. 12 D. 15 E. 16

2. There are five cities in Wonderland. Each pair of cities is connected by one road, either visible or invisible. On the map of Wonderland, there are only seven visible roads, as shown. Alice has magical glasses: when she looks at the map through these glasses she only sees the roads that are otherwise invisible. How many invisible roads can she see?



A. 9 B. 8 C. 7 (D) 3 E. 2

3. Kanga wants to arrange the twelve numbers from 1 to 12 in a circle in such a way that any neighboring numbers always differ by either 1 or 2. Which of the following pairs of numbers have to be neighbors?



A. 5 and 6 B. 10 and 9 C. 6 and 7 (D) 8 and 10 E. 4 and 3

Problems selected from Math Kangaroo

4. Nathalie wanted to build the same cube as Diana had (Figure 1). However, Nathalie ran out of small cubes and built only a part of the cube, as you can see in Figure 2. How many small cubes must be added to Figure 2 to form Figure 1?

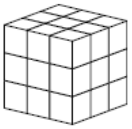


Figure 1

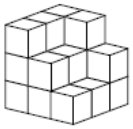
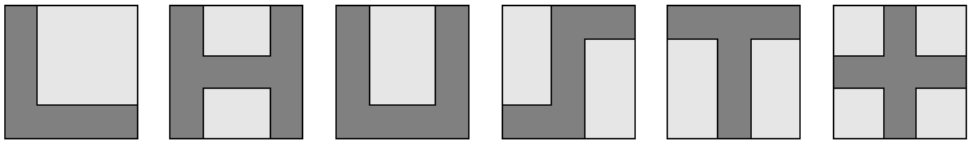


Figure 2

A. 5 B. 6 C. 7 D. 8 E. 9

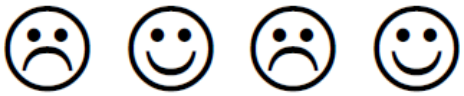
5. Mary shades various shapes on square sheets of paper, as shown.



How many of these shapes have the same perimeter as the sheet of paper itself?

A. 2 B. 3 C. 4 D. 5 E. 6

6. There are four buttons in a row as shown below. Two of them show happy faces, and two of them show sad faces. If we press on a face, its expression turns to the opposite (e.g., a happy face turns into a sad face). In addition to this, the adjacent buttons also change their expressions to the opposite. What is the least number of times you need to press the buttons in order to get all happy faces?



A. 2 B. 3 C. 4 D. 5 E. 6

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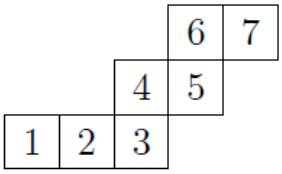
Level 4

1. Mary has a pair of scissors and five cardboard letters. She cuts each letter exactly once (along a straight line) so that it falls apart into as many pieces as possible. Which letter falls apart into the most pieces?

A. O B. F C. S D. H E. M

2. A cube is rolled on a plane so that it turns around its edges. It begins at position 1, and is rolled so that one of its faces touches the plane in positions 2, 3, 4, 5, 6, and 7, in that order, as shown. Which two of these positions were occupied by the same face of the cube?



A. 1 and 7 B. 1 and 6 C. 1 and 5 D. 2 and 7 E. 2 and 6

3. A rope is folded in half, then in half again, and then in half again. Finally the folded rope is cut through, forming several strands. The lengths of two of the strands are 4 m and 9 m. Which of the following could not have been the length of the whole rope?

A. 52 m B. 68 m C. 72 m D. 88 m
E. All the previous are possible

4. In the picture, the big triangle is equilateral and has an area of 9. The lines are parallel to the sides and divide the sides into three equal parts. What is the area of the shaded part?

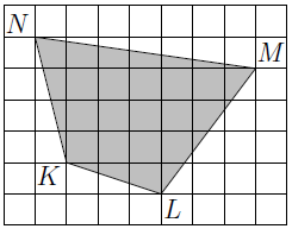
A. 1 B. 4 C. 5 D. 6 E. 7

Problems selected from Math Kangaroo

5. Vasya wrote down several consecutive integers. Which of the following could not be the percentage of odd numbers among them?

A. 40 B. 45 C. 48 D. 50 E. 60

6. The diagram shows a shaded quadrilateral $KLMN$ drawn on a grid. Each cell of the grid has sides of length 2 cm. What is the area of $KLMN$?



A. 96 cm^2 B. 84 cm^2 C. 76 cm^2 D. 88 cm^2 E. 104 cm^2

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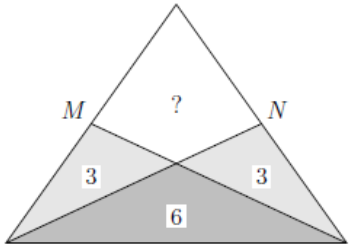
Level 5

1. The diagram shows an isosceles triangle; M and N are the midpoints of the equal sides. The triangle has been divided into four regions by two straight lines. Three of the regions have areas of 3, 3, and 6, as shown. What is the area of the fourth region?



A. 3 B. 4 C. 5 D. 6 E. 7

2. If Adam stands on the table and Mike stands on the floor, then Adam is 80 cm taller than Mike. If Mike stands on the same table and Adam stands on the floor, then Mike is one meter taller than Adam. How high is the table?

A. 20 cm B. 80 cm C. 90 cm D. 100 cm E. 120 cm

3. The last non-zero digit of the number $K = 2^{59} \times 3^4 \times 5^{53}$ is

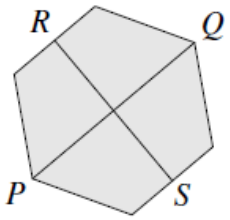
A. 1 B. 2 C. 4 D. 6 E. 9

4. The number 200013 – 2013 is not divisible by

A. 2 B. 3 C. 5 D. 7 E. 11

Problems selected from Math Kangaroo

5. The points P and Q are opposite vertices of a regular hexagon and the points R and S are the midpoints of opposite edges, as shown. The area of the hexagon is 60 cm^2. What is the product of the lengths of PQ and RS?



A. 40 cm^2 B. 50 cm^2 C. 60 cm^2 D. 80 cm^2 E. 100 cm^2

6. How many positive integers are multiples of 2013 and have exactly 2013 divisors (including 1 and the number itself)?

A. 0 B. 1 C. 3 D. 6 E. other answer

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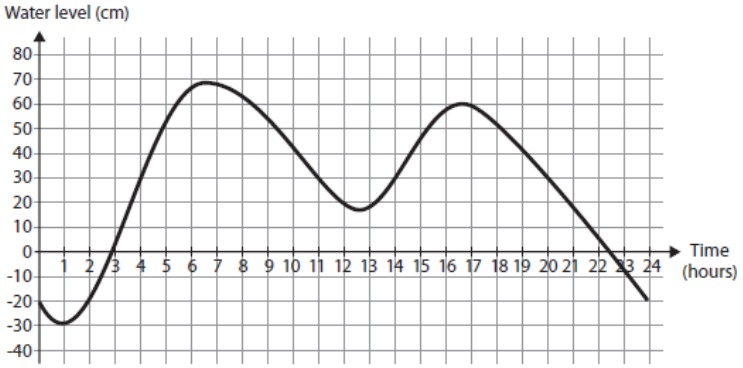
Level 6

1. The water level in a port city rose and fell on a certain day as shown in the figure. For how many hours was the water level above 30 cm on that day?

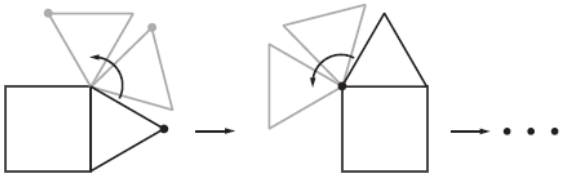


A. 5 B. 6 C. 7 D. 9 E. 13

2. My age is a two-digit integer which is a power of 5, and my cousin's age is a two-digit integer which is a power of 2. The sum of the digits of our ages is an odd number. What is the product of the digits of our ages?

A. 240 B. 2010 C. 60 D. 50 E. 300

3. An equilateral triangle rolls without slipping around a square with side length of 1 (see picture). What is the length of the path that the marked point covers until the triangle and the point reach their starting positions the next time?



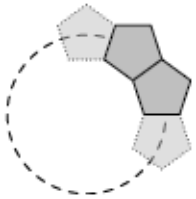
A. 4π B. $(28/3)\pi$ C. 8π D. $(14/3)\pi$ E. $(21/2)\pi$

4. Which of the following numbers is the largest?

A. 2013 B. 2^{0+13} C. 20^{13} D. 201^3 E. 20×13

Problems selected from Math Kangaroo

5. Radu has identical plastic pieces in the shape of a regular pentagon. He glues them edge to edge to complete a circle, as shown in the picture. How many pieces are there in this circle?



A. 8 B. 9 C. 10 D. 12 E. 15

6. How many pairs (x, y) of integers with $x \leq y$ exist such that their product equals 5 times their sum?

A. 4 B. 5 C. 6 D. 7 E. 8