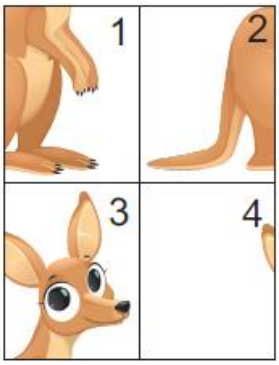
MO MATH
NATIONAL MUSEUM OF MATHEMATICS

Level 1

1. Nelly arranged the 4 pieces to make a picture of a kangaroo. How are the pieces arranged?



(A.)

4	3
2	1

B.

3	4
2	1

C.

2	1
4	3

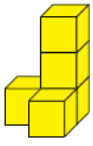
D.

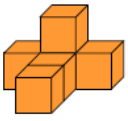
4	3
1	2

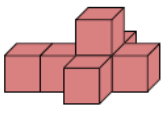
E.

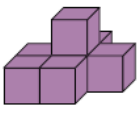
3	4
1	2

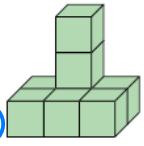
2. Five shapes are made by gluing cubes together face to face. Which shape uses the most cubes?

A. 

B. 

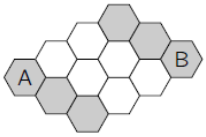
C. 

D. 

(E.) 

Problems selected from Math Kangaroo

3. Mark the Bee can walk only on gray cells. In how many ways can you color exactly two white cells gray so that Mark can walk from A to B?

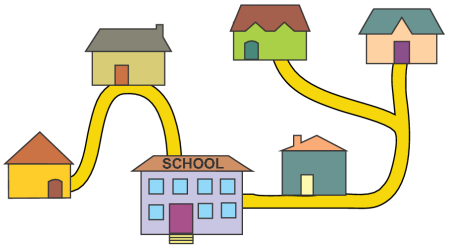


A. 3 B. 4 C. 5 D. 6 E. 7

4. The pink tower is taller than the red tower but shorter than the green tower. The silver tower is taller than the green tower. Which tower is the tallest?

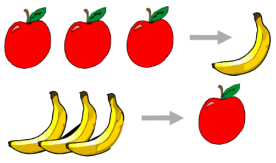
A. pink tower B. green tower C. red tower D. silver tower
E. we don't know

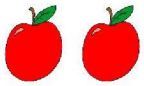
5. The picture shows the five houses of five friends and their school. The school is the largest building in the picture. To go to school, Doris and Ali walk past Leo's house. Eva walks past Chloe's house. Which is Eva's house?



A.  B.  C.  D.  E. 

6. Every time the witch has 3 apples, she turns them into 1 banana. Every time she has 3 bananas, she turns them into 1 apple. What will she end up with if she starts with 4 apples and 5 bananas?



A.  B.  C.  D.  E. 

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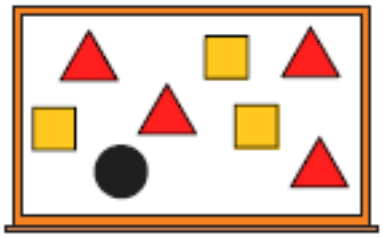
Level 2

1. Elli draws the big square (shown in the picture) with chalk on the pavement. She starts at the square marked with the number 1 and begins jumping. Each time she jumps, she always jumps to a number that is 3 more than the number she is standing on. What is the largest number Elli can jump to?

1	5	8	11
4	7	10	14
24	23	13	18
21	19	16	20

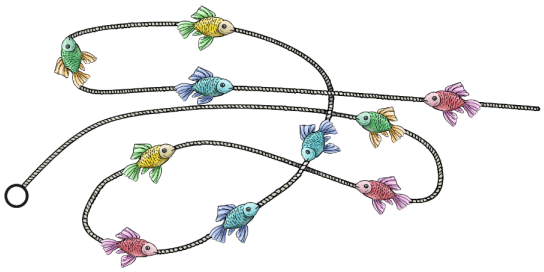
A. 11 B. 14 C. 18 D. 19 E. 24

2. The teacher writes the numbers from 1 to 8 on the board. The teacher then covers the numbers with triangles, squares, and a circle. If you add the four numbers covered by the triangles, the sum is 10. If you add the three numbers covered by the squares, the sum is 20. Which number is covered by the circle?



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

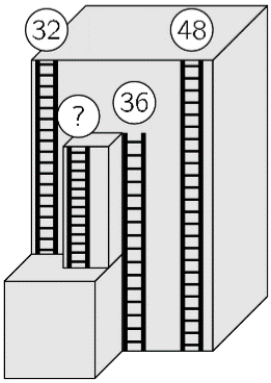
3. How many fish will have their heads pointing towards the ring when we straighten the line?



A. 3 B. 5 C. 6 D. 7 E. 8

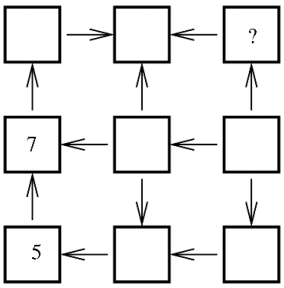
Problems selected from Math Kangaroo

4. On a tall building there are 4 fire escape ladders, as shown. The heights of 3 ladders are at their tops. What is the height of the shortest ladder?



A. 12 B. 14 C. 16
D. 20 E. 22

5. Elena wants to write the numbers from 1 to 9 in the squares shown. The arrows always point from a smaller number to a larger one. She has already written 5 and 7. Which number should she write instead of the question mark?



A. 2 B. 3 C. 4 D. 6 E. 8

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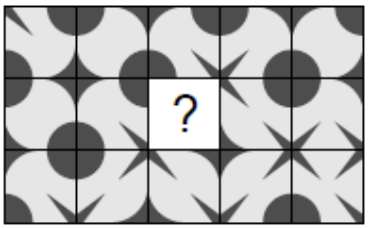
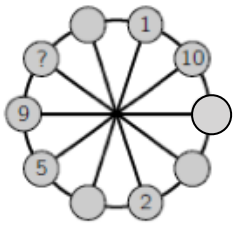
Level 3

1. Which piece completes the pattern?



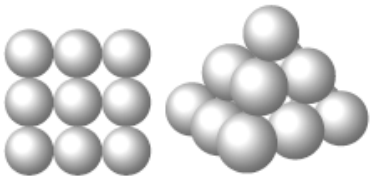
A.  B.  C.  D.  (E.) 

2. The numbers from 1 to 10 have to be placed in the small circles, one in each circle. Numbers in any two neighboring circles must have the same sum as the numbers in the two diametrically opposite circles. Some of the numbers are already placed. What number should be placed in the circle with the question mark?



(A) 3 B. 4 C. 6 D. 7 E. 8

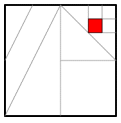
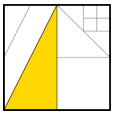
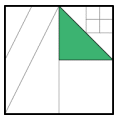
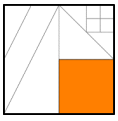
3. Don builds a pyramid using balls. The square base consists of 3 × 3 balls. The middle layer has 2 × 2 balls, and there is one ball at the top. Any two balls that touch each other are glued at their contact point. How many glued contact points are there?



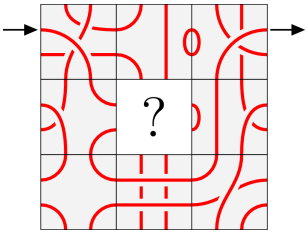
A. 20 B. 24 C. 28 D. 32 (E.) 36

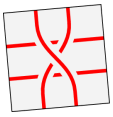
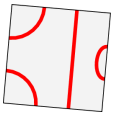
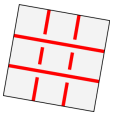
Problems selected from Math Kangaroo

4. There is a square with line segments drawn inside it. The line segments are drawn either from the vertices or the midpoints of other line segments. We colored $\frac{1}{8}$ of the large square. Which one is our coloring?

A.  B.  C.  D.  E. 

5. Rosa wants to start at the arrow, follow the line, and get out at the other arrow. Which piece, if placed in the middle, cannot produce this? Note: The piece can be rotated.



A.  B.  C.  D.  E. 

6. 10 elves and trolls each were given a token with a different number from 1 to 10 written on it. They were each asked what number was on their token and all answered with a number from 1 to 10. The sum of the answers was 36. Each troll told a lie and each elf told the truth. What is the smallest number of trolls there could be in the group?

A. 1 B. 3 C. 4 D. 5 E. 7

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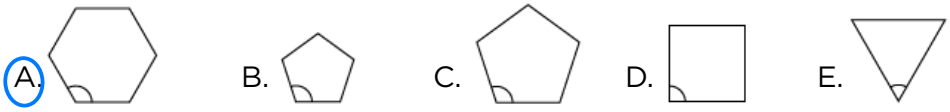
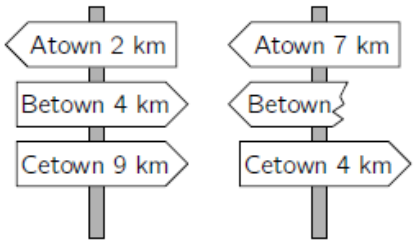
Level 4

1. In which of the regular polygons below is the marked angle the largest?

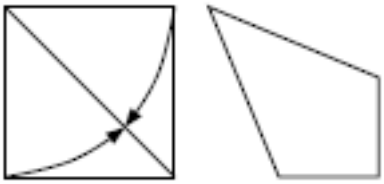


2. The shortest path from Atown to Cetown runs through Betown. The two signposts shown are set up along this path. What distance was written on the broken sign?



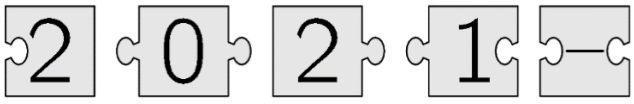
A. 1 km B. 3 km C. 4 km D. 5 km E. 9 km

3. Zaida took a square piece of paper and folded two of its sides to the diagonal, as shown, to obtain a quadrilateral. What is the size of the largest angle of the quadrilateral?



A. 112.5° B. 120° C. 125° D. 135° E. 150°

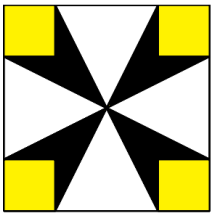
4. When the five pieces shown fit together correctly, the result is a rectangle with a calculation written on it. What is the result of this calculation?



A. -100 B. -8 C. -1 D. 199 E. 208

Problems selected from Math Kangaroo

5. The area of the large square is $16cm^2$ and the area of each small square is $1cm^2$. What is the total area of the black flower?



A. $3cm^2$ B. $\frac{7}{2}cm^2$ C. $4cm^2$ D. $\frac{11}{2}cm^2$ E. $6cm^2$

6. 2021 colored kangaroos are arranged in a row and are numbered from 1 to 2021. Each kangaroo is colored red, gray, or blue. Among any three consecutive kangaroos, there are always kangaroos of all three colors. Bruce guesses the colors of five kangaroos. These are his guesses: Kangaroo 2 is gray; Kangaroo 20 is blue; Kangaroo 202 is red; Kangaroo 1002 is blue; Kangaroo 2021 is gray. Only one of his guesses is wrong. What is the number of the kangaroo whose color he guessed incorrectly?

A. 2 B. 20 C. 202 D. 1002 E. 2021

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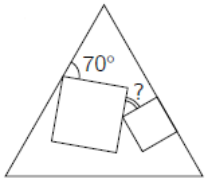
Level 5

1. When Cosmo wears his new shirt properly as shown on the left, the horizontal stripes form seven closed rings around his waist. This morning he buttoned his shirt incorrectly, as shown on the right. How many closed rings were there around Cosmo's waist this morning?

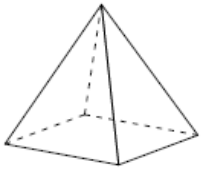
(A) 0 B. 1 C. 2 D. 3 E. 4

2. Two squares of different size are drawn inside an equilateral triangle. One side of one of these squares lies on one of the sides of the triangle, as shown. What is the size of the angle marked by the question mark?



A. 25° B. 30° C. 35° D. 45° (E.) 50°

3. Kanga labeled the vertices of the square-based pyramid using 1, 2, 3, 4, and 5 once each. For each face Kanga calculated the sum of the numbers on its vertices. Four of these sums are 7, 8, 9, and 10. What is the sum of the numbers at the vertices of the fifth face?



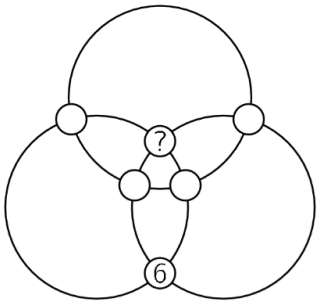
A. 11 B. 12 (C.) 13 D. 14 E.15

Problems selected from Math Kangaroo

4. Each year, the third Thursday in March is named Kangaroo Day. The dates of Kangaroo Day for the next few years are shown below, with one error. Which date is wrong?

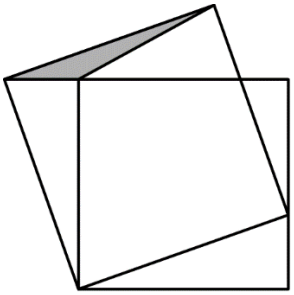
A. March 17, 2022 B. March 16, 2023 C. March 14, 2024
D. March 20, 2025 E. March 19, 2026

5. The numbers from 1 to 6 are placed in the circles at the intersections of three rings. The position of number 6 is shown. The sums of the numbers on each ring are the same. What number is placed in the circle with the question mark?



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

6. The smaller square in the picture has an area of 16 and the gray triangle has an area of 1. What is the area of the larger square?



A. 17 B. 18 C. 19 D. 20 E.21

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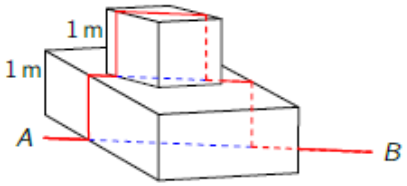
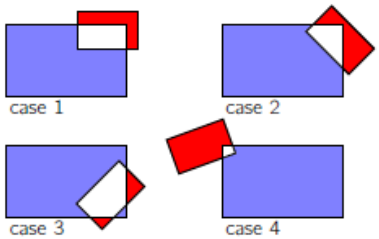
Level 6

1. An ant walked every day on a straight horizontal path from A to B, which are 5 m apart. One day humans placed two strange obstacles of height 1 m each on the path. Now the ant walks along or above the same straight line except that it has to climb up and down vertically over both the obstacles, as shown in the picture. How long is the ant's path now?



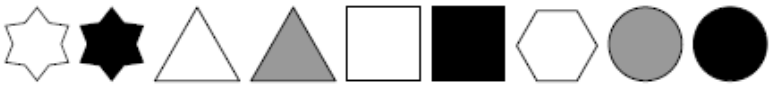
A. $7m$ (B) $9m$ C. $5+4\sqrt{2}m$ D. $9-2\sqrt{2}m$
E. The length depends on the angles at which the obstacles are situated along the path.

2. A blue rectangle and a red rectangle are overlapping. The figure shows 4 different such cases. We denote by B the area of the part of the blue rectangle that is not common to the two rectangles, and we denote by R the area of the red rectangle that is not common to the two rectangles. Which of the following statements is true about the quantity B – R?



A. In case 1 the quantity B – R is larger than in the other cases.
B. In case 2 the quantity B – R is larger than in the other cases.
C. In case 3 the quantity B – R is larger than in the other cases.
D. In case 4 the quantity B – R is larger than in the other cases.
(E) The quantity B – R is the same in all cases.

3. Adam and Britt try to find out which of the following figures is Carl's favorite.

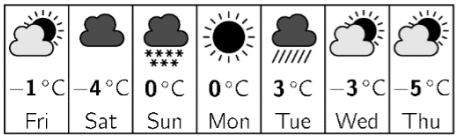


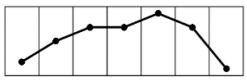
Adam knows that Carl has told Britt its shape. Britt knows that Carl has told Adam its color. Then the following conversation takes place. Adam: "I don't know Carl's favorite figure and I know that Britt doesn't know it either." Britt: "At first I didn't know Carl's favorite figure, but now I do." Adam: "Now I know it too." Which figure is Carl's favorite?

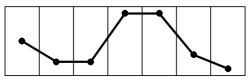
A.  B.  (C)  D.  E. 

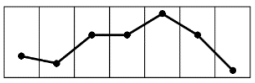
Problems selected from Math Kangaroo

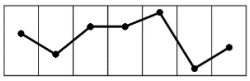
4. Paula's weather app shows a diagram of the predicted weather and maximum temperatures for the next seven days, as shown. Which of the following represents the corresponding graph of maximum temperatures?

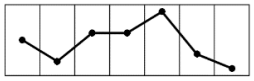


A. 

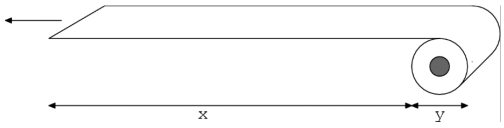
B. 

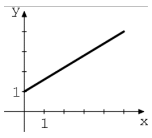
C. 

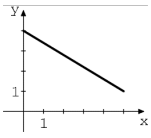
D. 

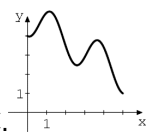
(E.) 

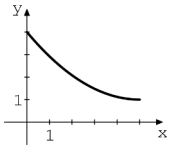
5. A naughty puppy grabs the end of a roll of toilet paper and walks away at a constant speed. Which of the functions below best describes the thickness y of the roll as a function of the unrolled part x?

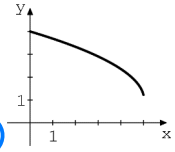


A. 

B. 

C. 

D. 

(E.) 

6. A certain game is won when one player gets 3 points ahead. Two players A and B are playing the game and at a particular point, A is 1 point ahead. Each player has an equal probability of winning each point. What is the probability that A wins the game?

A. $\frac{1}{2}$ (B.) $\frac{2}{3}$ C. $\frac{3}{4}$ D. $\frac{4}{5}$ E. $\frac{5}{6}$