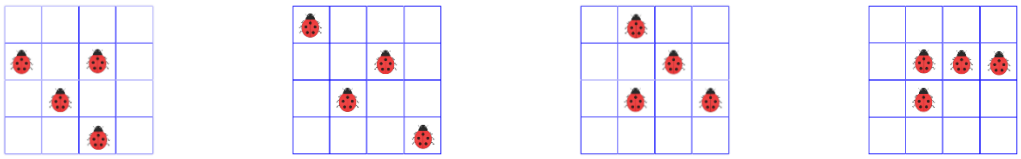
Contexts

Transformations / processes

Grade 1-2 (2018)

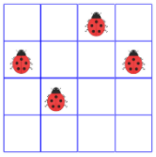
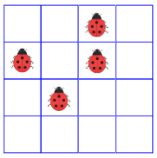
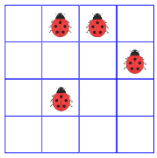
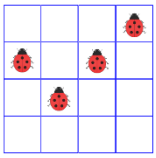
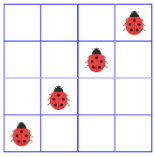
1. There are four ladybugs on a 4×4 board. Two are asleep and do not move.

The other two ladybugs move one square every minute (up, down, left, or right). Here are pictures of the board for the first four minutes:



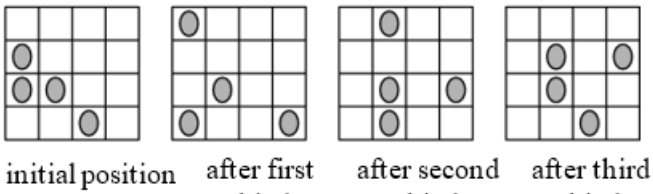
Minute 1 Minute 2 Minute 3 Minute 4

Which of these is a picture of the fifth minute (Minute 5)?

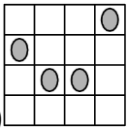
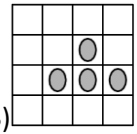
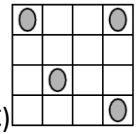
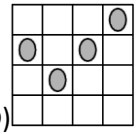
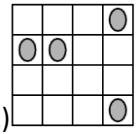
(A)  (B)  (C)  (D)  (E) 

Grade 5-6

30. Four ladybugs sit on different cells of a 4×4 grid. One of them is sleeping and does not move. Each time you whistle, the other three ladybugs move to a free neighbouring cell. They can move up, down, right or left but they are not allowed to go back to the cell they just came from.



Which of the following images might show the result after the fourth whistle?

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

Exchange games

Grade 1-2

Amalia's machine converts one red token into three white tokens and one white token into two red tokens.

Amalia has three red tokens and one white token: ●●●○.

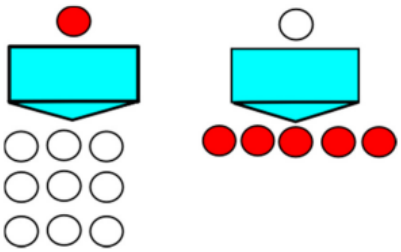
She uses the machine three times to convert three of her tokens.

What is the smallest number of tokens she can end up with?

(A) 7 (B) 6 (C) 8 (D) 5 (E) 9

Grade 3-4

Anja has two machines: one can exchange a red token into 9 white tokens, while the other can exchange a white token into 5 red tokens.



Anja has one white token ○.

What is the fewest number of exchanges after which Anja can have twice as many red tokens as white tokens?

(A) 6 (B) 5 (C) 4 (D) 7 (E) 3

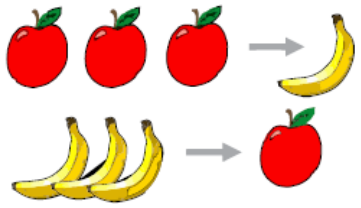
Grades 5-6

Zev has two machines: one exchanges 1 white token into 4 red tokens, while the other exchanges 1 red token into 3 white ones. Zev starts with 4 white tokens. After exactly 11 exchanges, he has 31 tokens. How many of those are red?

(A) 21 (B) 17 (C) 14 (D) 27 (E) 11

Grade 1-2

Every time the witch has 3 apples she turns them in to 1 banana.
Every time she has 3 bananas she turns them into 1 apple.



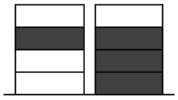
What will she finish with if she starts with 4 apples and 5 bananas?

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

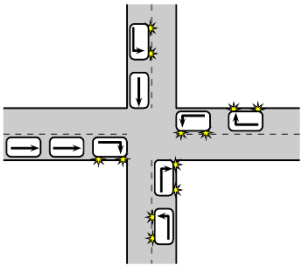
Processes: initial state/final state

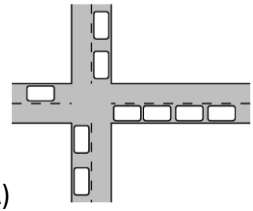
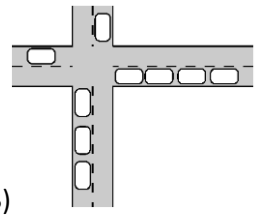
Grade 5-6

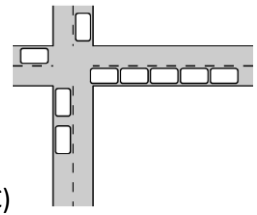
Ronja had four white tokens and Wanja had four dark tokens. They played a game, taking turns to place one token at a time on top of one of the two piles of previously placed tokens.
Ronja started first. Which of the configurations would not be possible to create?

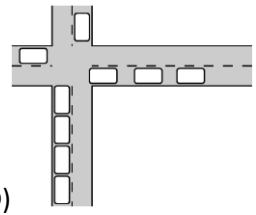
(A)  (B)  (C)  (D)  (E) 

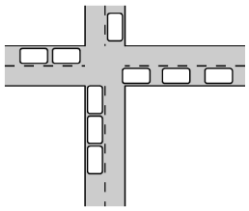
1. Nine cars arrive at a crossroads and drive off as indicated by the arrows.
Which figure shows these cars after leaving the crossroads?



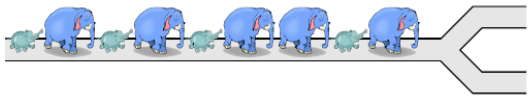
(A)  (B) 

(C) 

(D) 

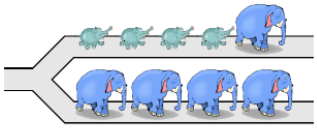
(E) 

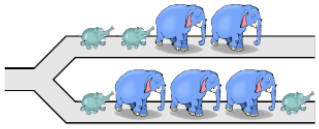
11. Five big elephants and four small ones are walking along a path, as shown.

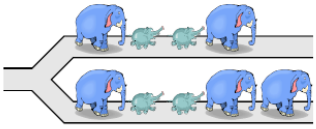


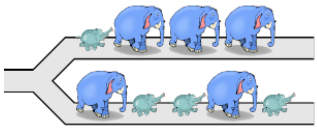
When they reach the junction, each elephant turns either to the left or to the right.

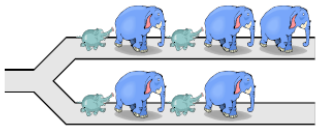
Which of the following *cannot* be the situation after they all pass the junction?

(A) 

(B) 

(C) 

(D) 

(E) 

Processes

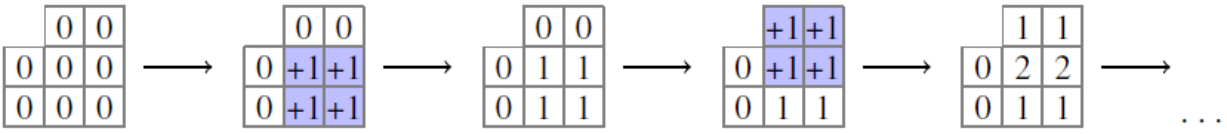
Grade 1-2

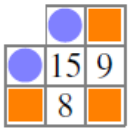
Carl has a shape made up of four squares  .

He places the shape on a grid figure so that it completely covers four of the grid cells.

Every time Carl does this, he increases the number in the four covered cells by 1.

Starting with 0 in every cell of the grid, Carl places his shape several times as shown.



In the end, Carl hid some numbers with stickers: 

What is the sum of the numbers behind the two circles?

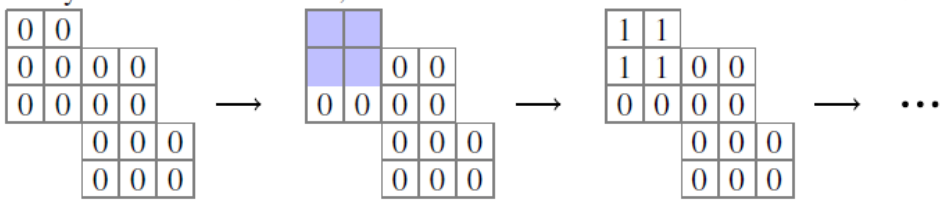
(A) 32 **(B)** 24 **(C)** 23 **(D)** 17 **(E)** 15

Grade 3-4

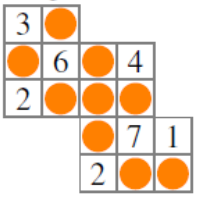
Berta has a shape made up of four glued squares  .

She places the shape on a grid figure so that it completely covers four of the grid cells.

Every time Berta does this, she increases the number in the four covered cells by 1, shown below.



Starting with 0 in every cell of the grid, Berta places her shape several times as described.

In the end, Berta hid some numbers with circle stickers:  .

What is the largest number in her last figure?

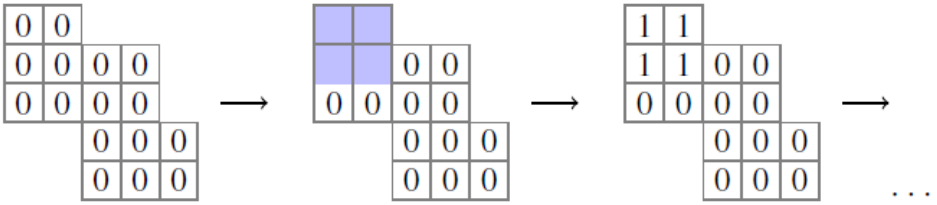
(A) 7 **(B)** 10 **(C)** 8 **(D)** 9 **(E)** 11

Grade 5-6

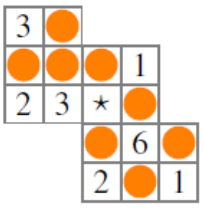
Dale has a shape made up of four squares  .

He places the shape on a grid figure so that it completely covers four of the grid cells.

Every time Dale does this, the number in the four covered cells increases by 1, as shown below



Starting with 0 in every cell of the grid, Dale places his shape several times as described.

In the end, Dale hid some numbers with circle stickers:  .

What number should be in the square marked by $\star$?

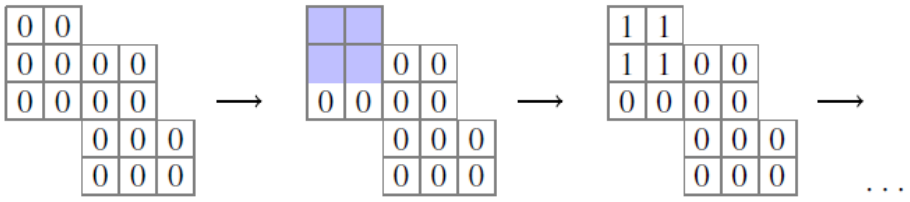
(A) 5 **(B)** 4 **(C)** 10 **(D)** 6 **(E)** 13

Grade 7-8

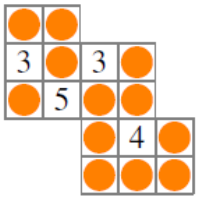
Maxim has a shape made up of four squares  .

He places the shape on a grid figure so that it completely covers four of the grid cells.

Every time Maxim does this, the number in the four covered cells increases by 1, as shown below.



Starting with 0 in every cell of the grid, Maxim places his shape several times as described.

In the end, Maxim hid some numbers with circle stickers:  .

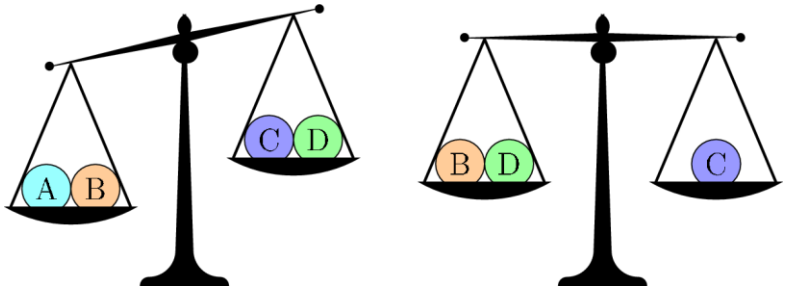
What is the sum of all numbers in the grid if all numbers were visible?

(A) 44 **(B)** 40 **(C)** 38 **(D)** 36 **(E)** 30

Balance/inequalities

Grades 3-4

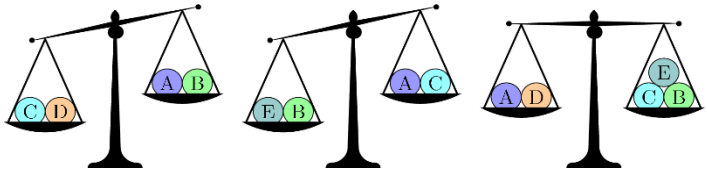
2. Four balls each weigh 10, 20, 30 and 40. Which ball weighs 30?



(A) A (B) B (C) C (D) D (E) it could be A or B

Grades 5-6

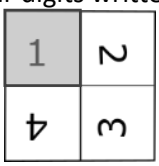
3. Five balls weigh 30 g, 50 g, 50 g, 50 g and 80 g, respectively. Which ball weighs 30 g?
(A) A (B) B (C) C
(D) D (E) E



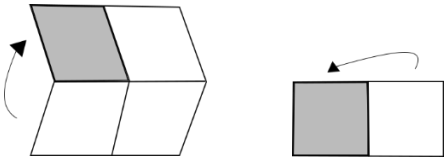
Folding

Grade 1-2

1. Eloise has a square piece of paper with four digits written on it.



She folds the paper in half, and then, in half again, as shown below.



After folding the paper, Eloise gets 

.

In what position will the digit 2 be after having folded the paper?

(A) 2 (B) 2 (C) 2 (D) 2 (E) 2

Grade 3-4

1. Janik has a strip of paper of four cells, with numbers 1,2,3,4 written in them, as shown in the diagram.

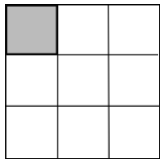
1	2	3	4

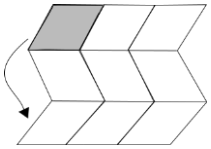
He can fold the strip so that the cells form 4 layers. Among the following options, which cells order – from top to bottom – is not possible to obtain?

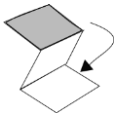
(A) 3,1,2,4 (B) 3,4,2,1 (C) 3,2,1,4 (D) 3,1,4,2 (E) 3,4,1,2

Grade 5-6

1. Vadim has a square piece of paper divided into nine cells. He folds the paper as shown - overlapping horizontally, and then, vertically so that the grey square ends on top.







1	*a*	
		c
	b	

Vadim wants to write the numbers from 1 to 9 into the cells so that, once the paper is folded, the numbers would be in increasing order with number 1 on the top layer.

What numbers should he write instead of a, b and c?

(A) $a = 6, b = 4, c = 8$ (B) $a = 4, b = 6, c = 8$ (C) $a = 5, b = 7, c = 9$

(D) $a = 4, b = 5, c = 7$ (E) $a = 6, b = 4, c = 7$

Transformation

Grades 5-6

4. In the World of Numbers, there are many number-machines, which work in the following way: the machine adds the two beginning digits of the number and replaces them by their sum. For example, beginning with the number 87312 and using six such machines we obtain:

$$87312 \longrightarrow 15312 \longrightarrow 6312 \longrightarrow 912 \longrightarrow 102 \longrightarrow 12 \longrightarrow 3$$

How many such machines should be used in order to get the number $\underbrace{9\ldots9}_{50\ times}$ from the number $\underbrace{9\ldots9}_{100\ times}$?

(A) 50 (B) 60 (C) 100 (D) 80 (E) Not possible to obtain this number

Barnabe transforms the numbers from 1 to 100 by the rule: each number is replaced by the number obtained by adding the original number with the sum of its digits.
Among the newly obtained numbers, how many are even?

(**A**) 49 (**B**) 50 (**C**) 51 (**D**) 45 (**E**) 55

Grades 7-8

22. Amelia transforms the numbers from 1 to 100 by the rule: each number is replaced by the difference of the number and its sum of digits.
How many different numbers will she obtain as a result?

(**A**) 99 (**B**) 10 (**C**) 50 (**D**) 100 (**E**) 11

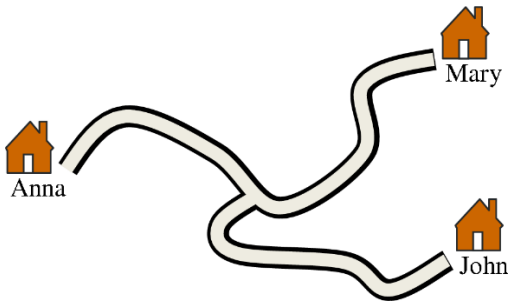
Equations

Grades 1-2

1. The road from Anna's house to Mary's house is 16 km long.

The road from Mary's house to John's house is 20 km long.

The road from the crossroad to Mary's house is 9 km long.



How long is the road from Anna's house to John's house?

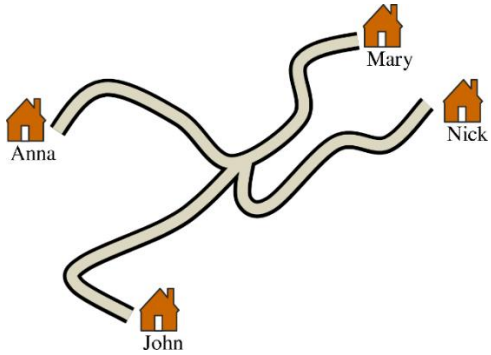
(A) 7 km (B) 9 km (C) 11 km (D) 16 km (E) 18 km

Grades 3-4

5. The distance from Anna's to Mary's house is 16 kilometers along the shown road.

The distance from Mary's to Nick's house is 20 kilometers.

The distance from Nick's to John's house is 19 kilometers.

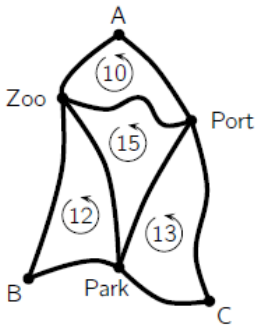


How far is Anna's house from John's?

(A) 15 (B) 16 (C) 18 (D) 19 (E) 20

Grade 5-6

The map shows three bus stations at points A, B and C. A tour from station A to the Zoo and the Port and back to A is 10 km long. A tour from station B to the Park and the Zoo and back to B is 12 km long. A tour from station C to the Port and the Park and back to C is 13 km long. A tour from the Zoo to the Park and the Port and back to the Zoo is 15 km long.



How long is the shortest tour from A to B to C and back to A?

(**A**) 18 km (**B**) 20 km (**C**) 25 km (**D**) 35 km (**E**) 50 km

Configurations

Grade 5-6

27. 201 balls are arranged in a row and are numbered from 1 to 201. Each ball is colored either green or red. Among any ten consecutive balls there are exactly five green balls. Ball number 1 is green. How many red balls are there in the row?

(**A**) 99 (**B**) 100 (**C**) 101 (**D**) 199 (**E**) 200

Grade 7-8

20. 2021 coloured kangaroos are arranged in a row and are numbered from 1 to 2021. Each kangaroo is either red, grey or blue. Amongst any three consecutive kangaroos, there are always kangaroos of all three colours. Bruce guesses the colours of five kangaroos. These are his guesses:
– Kangaroo 2 is grey;
– Kangaroo 20 is blue;
– Kangaroo 202 is red;
– Kangaroo 1002 is blue;
– Kangaroo 2021 is grey.
Only one of his guesses is wrong.
What is the number of the kangaroo whose colour he guessed incorrectly?

(**A**) 2 (**B**) 20 (**C**) 202 (**D**) 1002 (**E**) 2021

Grade 9-10

27. 2021 balls are arranged in a row and are numbered from 1 to 2021.
Each ball is coloured in one of four colours: green, red, yellow or blue.
Among any five consecutive balls there is exactly one red, one yellow and one blue ball.
After any red ball the next ball is yellow. The balls numbered 2, 20 and 202 are green.
What colour is the ball numbered 2021?

(**A**) Green (**B**) Red (**C**) Yellow (**D**) Blue

(**E**) Impossible to determine.