數趣大地

# MATHGAZINE

LOGOS ACADEMY Dec 2019

## MATH GARDEN

## MAGICAL LOCATIONS ON THE EARTH

Winner's Work
MS1V (2) CHEN Siqi

### PROBLEM

**Can you find a location on earth where you can walk 1 km to the south, 1 km to the east, 1 km to the north, and you will arrive at the starting location?!**

Is it possible? Yes and no. No, because by common sense, only if you travel the same distance in all 4 different directions will your displacement be zero. In the situation mentioned above, you'll need to walk another 1 km to the west.

But why yes? Two things to keep in mind: the location of the four cardinal directions and the fact that the earth is a sphere. North and south are the directions along the earth's surface towards the geographic North and South pole respectively, whereas east and west are the directions perpendicular to north and south. This means that directions are not absolute, but relative to the two poles of earth. So, at the North pole, the northernmost position on earth, no matter which 'direction' you go, you must be moving away from the north pole, hence going towards the south pole, which means heading in the 'southern' direction. At the south pole, you must be going in the 'northern' direction.

Now, let's explain the 2 conditions that the special situation apply.

First, at the North pole.

1. 1 km to the south:
   You stop at a point 1 km away from the North pole.
2. 1 km to the east:
   As east is a direction perpendicular to the north and the earth is a sphere, walking east from the point 1 km away from the North pole does not change your distance from the North pole. This 1 km is like walking on the 'circle' 1 km away from the north pole. So, you stop at another point 1 km away from the North pole.
3. 1 km to the north:
   This means walking 1 km towards the North pole from a point 1 km away from the North pole. Clearly, you're back at the North pole!

The second condition: at some special points slightly more than 1 km away from the South pole.

1. 1 km to the south:
   You walk towards the South pole from a point slightly 1 km away from the South pole and stop at a point very near the South pole. Let's call this point A.
2. 1 km to the east:
   As the east is a direction perpendicular to the south, walking eastwards does not change your distance from the South pole. Also, the earth is a sphere, so if this 1 km completes exactly several revolutions around the earth, you can be back at A. (Why slightly more than 1 km away from the South pole? If it's exactly 1 km, you stop at the South pole, where you cannot do revolutions and can only go 'north'!)
3. 1 km to the north:
   As you are at A, which is 1 km southwards from the starting point, this 1 km to the north brings you back to the starting point.

**Comment by Mr. Chow**

This is an example of non-Euclidean Geometry. In non-Euclidean Geometry, the angle sum of triangle does not equal 180 degrees. That explains the first example, where you walk from the North Pole and go back to the North Pole. The "triangle" formed is greater than 180 degrees.

## INFORMATION

Presented by: π Math Club 數學學會

Advisor:
Mr. Chan Mung Hung Sam
Mr. Chow Ling Hin
Mr. Lee Chung Keung Timothy

Editor:
MS3S Wu Si Yu
MS3A Lee Tsz Yuet
MS2R Lung Cheung Kiu
MS1T Chan Edna

A gift will be given to the first 3 students to solve ALL puzzles correctly. Please contact Mr. Chow @ 7/F, Campus II or Ms. Pang @509, Campus I.
Contributions are welcome!

## DISCOVERING MATH WITH FUN!

Scan this QR code for more math problems explored by students!

# Games of Today

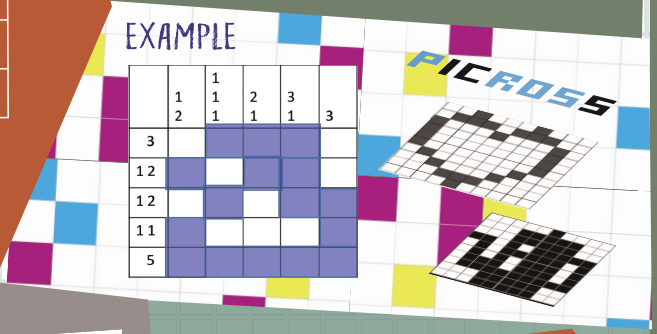
## SUDOKU GAME

| | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 9 | | 3 | | 7 | | 2 | | 8 |
| 1 | 7 | | | 2 | | | 4 | 9 |
| | 5 | 4 | 6 | 8 | 9 | 7 | 3 | |
| | 2 | 1 | | 3 | | 5 | 9 | |
| 4 | 9 | | 8 | 5 | 2 | | 1 | 7 |
| | 3 | 5 | | 6 | | 8 | 2 | |
| | 8 | 9 | 7 | 1 | 3 | 4 | 6 | |
| 3 | 1 | | | 4 | | | 8 | 5 |
| 6 | | 2 | | 9 | | 1 | | 3 |

## PICROSS

| | 1 | 7 | 3 | 3 2 | 4 2 | 4 | 5 4 | 5 4 | 3 | 6 |
|---|---|---|---|---|---|---|---|---|---|---|
| 2 | | | | | | | | | | |
| 4 | | | | | | | | | | |
| 7 | | | | | | | | | | |
| 8 | | | | | | | | | | |
| 10 | | | | | | | | | | |
| 1 1 | | | | | | | | | | |
| 1 2 2 1 | | | | | | | | | | |
| 1 2 2 1 | | | | | | | | | | |
| 1 2 1 | | | | | | | | | | |
| 1 2 1 | | | | | | | | | | |

## EXAMPLE

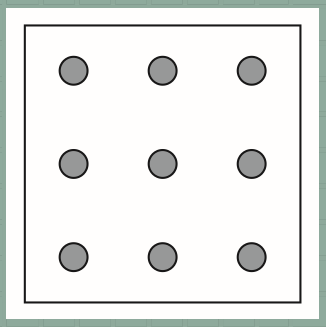



## FIND THE SHAPES

| | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| C | C | F | B | R | R | O | O | M | N | G | H | H | V | L | A | P | W |
| C | D | B | W | Z | D | Y | W | S | D | C | T | G | E | H | Y | R | Q |
| L | D | N | I | H | B | R | U | S | A | O | R | F | N | A | L | V | X |
| K | W | B | Q | Z | Q | F | W | R | P | D | I | N | Q | J | R | D | I |
| D | R | E | H | C | O | S | D | O | E | E | A | Q | E | E | M | T | H |
| I | H | G | T | L | K | C | Q | O | L | O | N | Q | N | J | A | W | E |
| A | O | W | M | G | A | Z | T | U | D | R | G | T | Z | Q | J | I | X |
| M | M | J | X | Q | K | N | E | A | A | V | L | W | A | W | G | T | A |
| O | B | K | X | Y | R | P | W | B | G | R | E | B | I | G | U | L | G |
| N | U | P | D | T | F | B | O | G | M | O | E | R | Q | W | O | I | O |
| D | S | F | B | I | X | B | N | D | J | J | N | S | Y | L | F | N | N |
| E | U | T | V | O | N | U | Y | Z | K | C | I | R | C | L | E | C | N |

Find the words in the puzzle.
Words are hidden ➔ ⬇ and ➘.

## BLOW YOUR MIND!



How can I add just two squares to separate all dots?

## ALPHAMETICS

In the figures below, each distinct letter represents a unique digit such that the arithmetic sum holds.

1.
```
  B E E
-   B B
-------
  6 6 7
```

2.
```
    G O
+   G O
-------
  Z O O
```

3.
```
    N O
  G U N
+   N O
-------
  H U N T
```