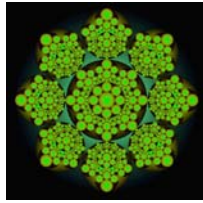


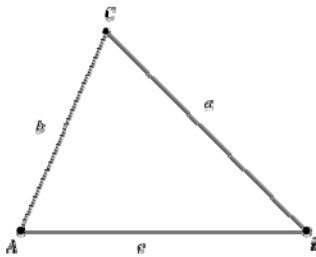
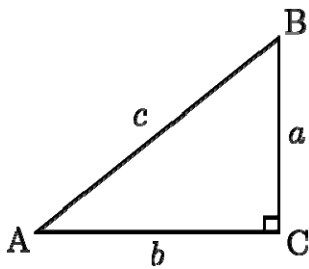
Kinawa Mathematical Circle



PUZZLES

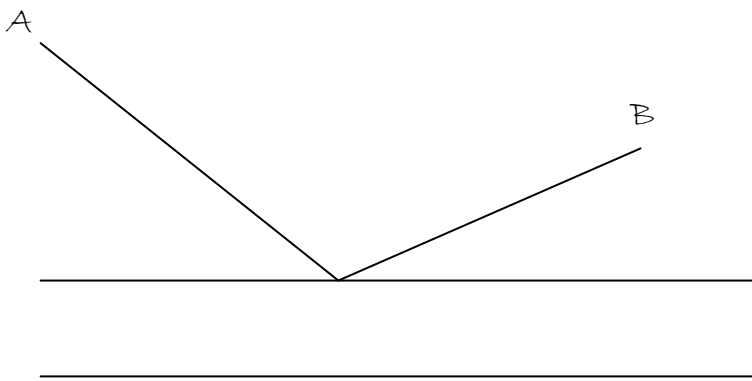
Geometry

Three principles:

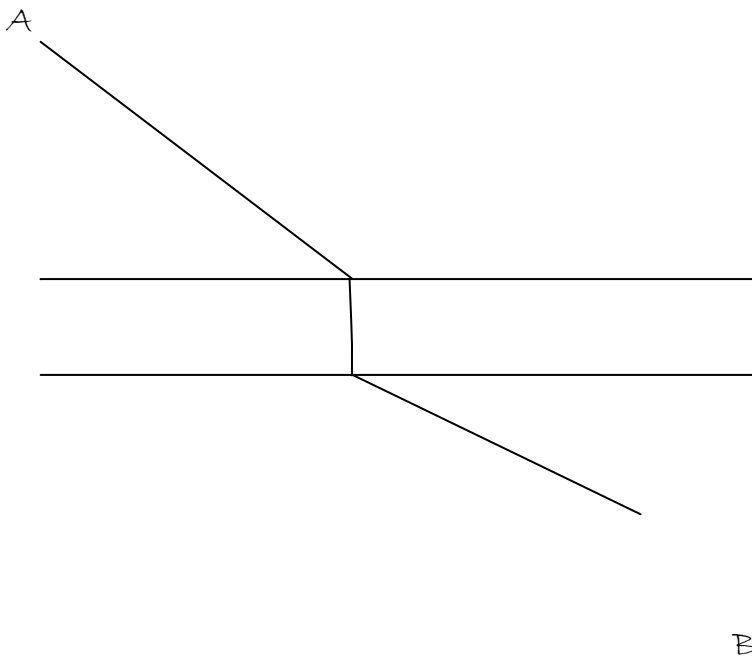


- (A) In a right triangle the side c is longer than a or b .
- (B) In any triangle the sum of lengths of any two sides is larger than the third side.
- (C) The shortest way between two points is a straight line.

Puzzle 1. A road needs to be build to provide an access to the river for two villages and also, using the same road, to connect the two villages with each other. The villages are located on the same side of the river. How to build the road to make it the shortest and this way to minimize the cost of construction and the travel time?



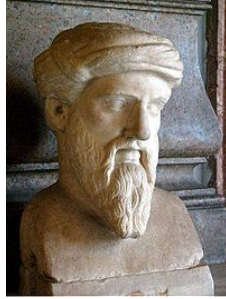
Puzzle 2. A road and a bridge need to be build to provide an access to the river for two villages and also, using the same road and bridge, to connect the two villages with each other. The villages are located on the opposite sides of the river. The construction of the bridge is very expensive so that the bridge has to be the shortest possible, perpendicular to the river. How to build the road to make it the shortest and this way to minimize the cost of construction and the travel time?



Puzzle 3. In a rectangular room with dimensions $30' \times 12' \times 12'$, a spider is located in the middle of one $12' \times 12'$ wall one foot away from the ceiling. A fly is in the middle of the opposite wall one foot away from the floor. If the fly remains stationary, what is the shortest total distance (i.e., the *geodesic*) the spider must crawl along the walls, ceiling, and floor in order to capture the fly?

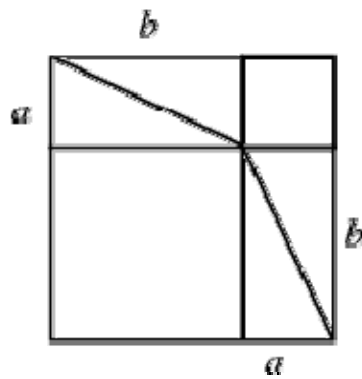
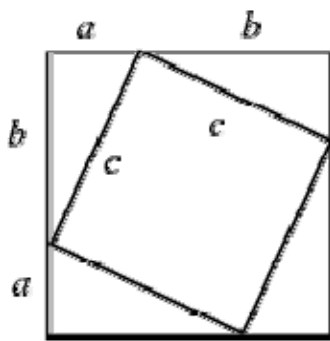
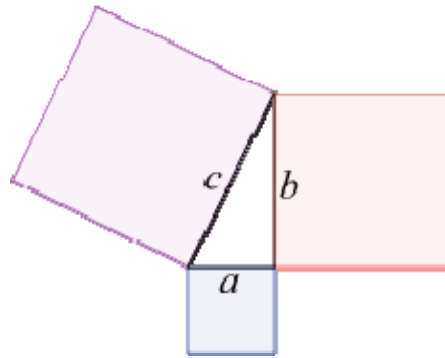
<http://mathworld.wolfram.com/SpiderandFlyProblem.html>

Pythagoras (Πυθαγόρας)

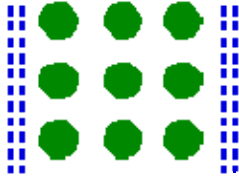


The Pythagorean Theorem
In a right triangle

$$a^2 + b^2 = c^2$$



Puzzle 4. Place nine dots in a square pattern:

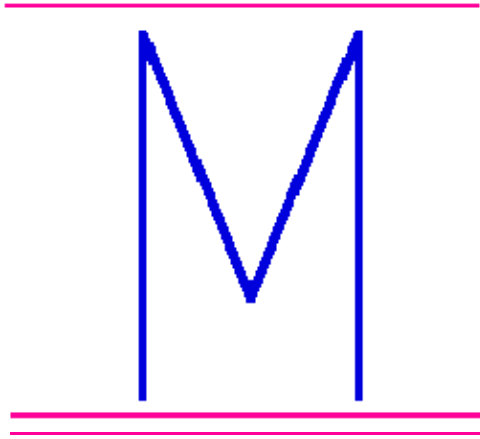


Can you connect all dots with only four straight lines?

Puzzle 5. A gardener laying out a bed of roses finds that she can plant 7 rosebushes so that they form 6 straight lines with 3 rosebushes in each line. Can you?

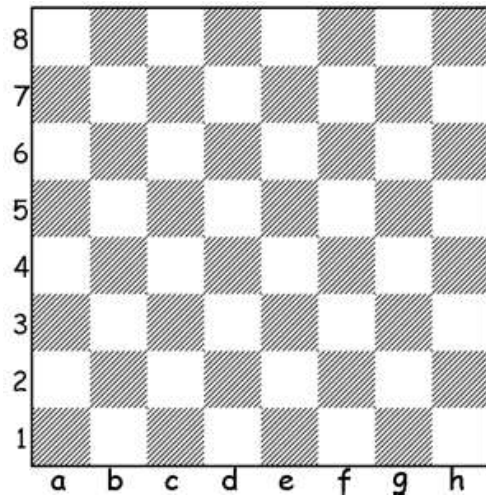
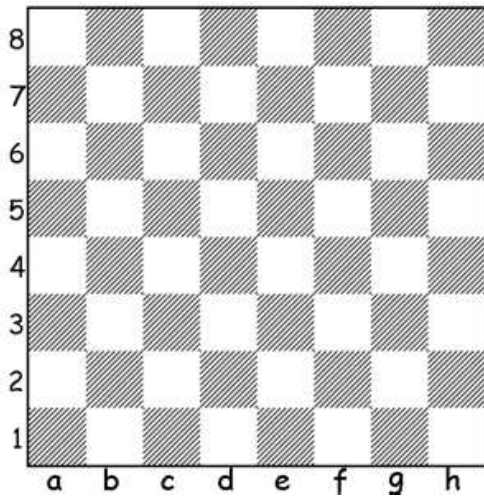
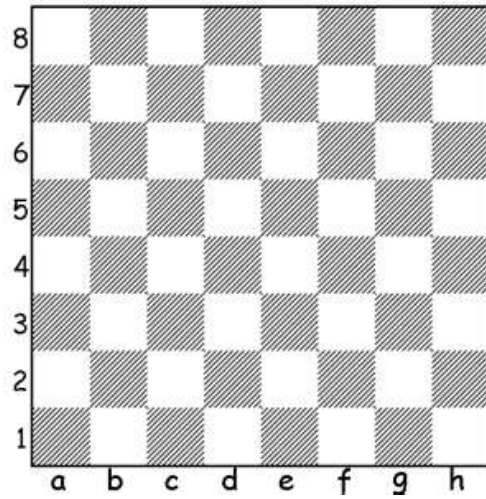
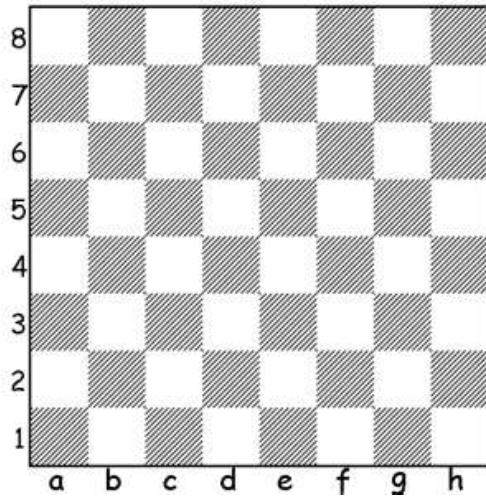


Puzzle 6. [M-puzzle] Can you construct nine triangles by drawing three straight lines through a capital M?



Chess and Chessboard Puzzles

Puzzle 1. Place 8 queens on a chessboard so that none of them is checked.



Puzzle 2. On a 9 by 9 chessboard white pawns are placed on white squares and black pawns on black squares. Can the pawns be switched, so that black all pawns will end up on white squares and all white pawns on black squares?

Puzzle 3. Nobody knows if because of white having the first move, they have a winning strategy regardless of how well black play or perhaps black have a winning strategy so that having the first move is a disadvantage.

If white can choose to make one or two moves first and then the game goes on as usual (one move at a time), then there is a strategy for white to at least have a draw in the game. Prove it!

Transportation Problems

Puzzle 1. A shepherd with a goat, cabbage, and wolf needs to cross a river in a small boat. He can take only one item in one trip. Goat and wolf or goat and cabbage cannot be left alone. Help the shepherd make the crossing.

Puzzle 2. Open the Excel worksheet "Transportation Puzzle".

Equations

Puzzle 1. A brick weighs as much as 1 lb and half of a brick. What's the weight of the brick?

Puzzle 2.

Diophantus
"Father of algebra"
c. 250 C.E.

The "Silver Age" of Alexandria, also known as the Later Alexandrian Age, was about 250 - 350 C.E. Diophantus, a Greek algebraist of this era, was thought to belong to this time period, but there is some uncertainty to the exact time frame of his life. Little is known of his personal life except for an algebraic puzzle rhyme determining his age from *Anthologia Palatina* which is a collection of problems dating from the 5th and 6th centuries.

"Here lies Diophantus." The wonder behold- Through art algebraic, the stone tells how old: "God gave him his boyhood one-sixth of his life, One-twelfth more as youth while whiskers grew rife; And then yet one-seventh eve marriage begun; In five years there came a bouncing new son. Alas, the dear child of master and sage Met fate at just half his dad's final age. Four years yet his studies gave solace from grief; Then leaving scenes earthly he, too found relief."

Can you solve the puzzle?