

A Game in the School Corridor

Happy New Year! I hope you're still enjoying my puzzles and I also hope you'll like my puzzle selection in 2007, my last year as the puzzle editor. I'd like to recognize Lee Zinzow as the only reader who solved all six chess puzzles. I'd also like to recognize six readers who solved all of the 2006 regular puzzles: Mark Evans, Mike Failor, Lee Michelson, Stephen Peeples, Al Spooner, and Philip Silverman. Congratulations to all of you!!

THIS ISSUE'S PUZZLE

A narrow school corridor needs to be filled with 100 square tiles, all placed in one line. The tiles are identical in shape, and could be either black or white. Tile placeholders are clearly marked on the floor.

The job to fill the corridor with tiles of alternating color is given to two students in detention. They decide to play the following game instead: Each player in turn puts either a black or a white tile into an empty square. The game stops when three adjacent squares contain a black, a white, and a black tile in that order and the last player wins. If all the squares are filled without getting a black, a white, and a black tile in that order, then the game is a draw.

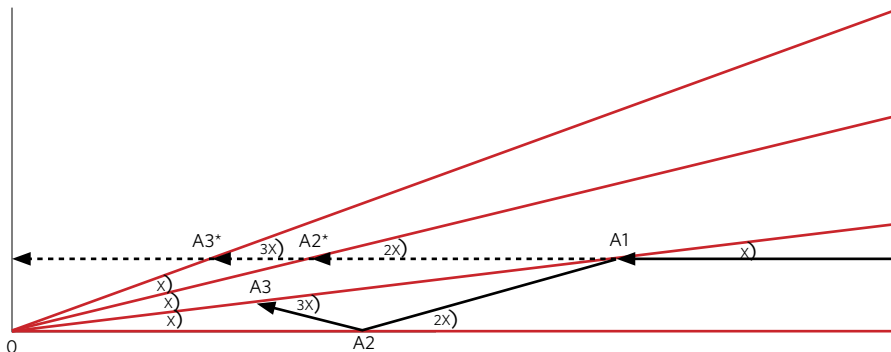
Assuming that there is unlimited supply of tiles of each color, which player can always win?

PREVIOUS ISSUE PUZZLES

Light Travel

A gigantic structure with the shape of a 1-degree angle as shown in the picture is placed on the ground. A photon is sent into the structure parallel to the ground, 2617 meters above it. The structure has a mirror-like surface so that each time the photon hits the structure it bounces off with the degree of incidence equal to the degree of reflection. Assuming that the experiment takes place in an empty space, please answer the following questions:

1. How many times will the photon hit the surface of the structure before it flies off for good?
2. How long will the photon be inside the structure (between the first and last hit)?



Triangle OA2A1 is identical to OA2*A1 (each is isosceles), so $A1A2 = A1A2^*$. Likewise, triangle OA2*A3* is identical to OA2A3 with $A2^*A3^* = A2A3$, and so on.

Solution

1. 179 times. If you're a physics guru, 1 time.
2. Approximately 1 millisecond. If you're a physics guru, 0 seconds.

I first learned about this puzzle, which was stated in a different form, a long time ago. Most people I gave this puzzle to, including Contingencies readers, decided to approach it with the brute-force method. This method works relatively well for answering question 1. but it requires a spreadsheet or advanced trigonometric knowledge to complete question 2. As is the case with many Olympiad-type problems, once you find a neat trick, the solution becomes apparent.

Before I show this trick, I must briefly explain the "if you are a physics guru" part of my answers. When a photon approaches a mirror-like surface, it creates (or adds to) an electromagnetic field and the field begins interacting with the structure's atoms. The photon gets absorbed by an electron in the electron cloud, which fills the empty space between the nucleus and the atom boundary.

Next, the electron takes a quantum leap and re-emits another photon. So in fact, this problem is about a series of photons rather than the original photon that gets eaten immediately upon hitting the structure. If we reword the puzzle so we're inquiring about a number of photons, there should be no questions from physicists.

The picture above shows the essence of the trick. Instead of finding points of

intersection on the photon's way (A1, A2, ...), counting them and calculating corresponding distances, one should create imaginary lines starting from the origin (the vertex of the structure) that create ever increasing angles with the bottom side of the structure.

For example, as you can see from the picture, the second hit occurs at the point of intersection of two lines:

1. Original photon's path parallel to the ground.
2. Line that forms a 2-degree angle with the ground.

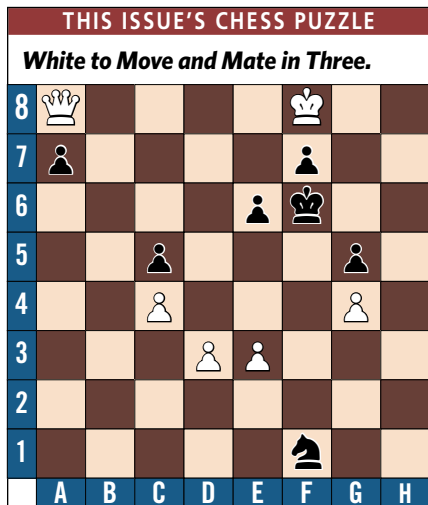
Eventually, the photon's imaginary path will hit the vertical line and go back, hitting the surface at the same points as on the way to the vertical line. There are 90 points at which hits occur. All but one (corresponding to the vertical line) point will be hit twice, so there are a total of $2 * 90 - 1 = 179$ surface hits.

The total distance traveled between the first and the last hit is then $2 * \tan(89^\circ) *$

Solutions may be e-mailed to cont_puzzles@yahoo.com or mailed to **Puzzles, 25 Sparrow Walk, Newtown, Pa. 18940.**

In order to make the solver lists (separately maintained for the regular and chess puzzles), please submit your answers and solutions by **Jan. 31, 2007.** Depending on the response volume, solver lists may contain only the names of people who solved puzzles on the first attempt.

original altitude of 2,617 meters, equaling 299,856 meters. Taking into account the speed of light in an empty space, we obtain the total travel time of 0.001 second.



Chess Puzzle

White to move and mate in three.

Initial position:

White – Ke2, Qh1, Rf4, Be4, Bg1, Nb7, Ne3, pawns c2, d5.

Black – Kd4, Qe8, Ng5, pawn c3.

Solution

- Case A1: 1. Bh2 Qh5; 2. Bf3 Ne4; 3. Re4#
- Case A2: 1. Bh2 Qh5; 2. Bf3 Ke5; 3. Nc4#
- Case B: 1. Bh2 Q- (any other queen move); 2. Qd1 Ke5; 3. Nc4#
- Case C1: 1. Bh2 Qb5; 2. Bd3 Ne4; 3. Qxe4#
- Case C2: 1. Bh2 Qb5; 2. Bd3 Ke5; 3. Ng4#
- Case D: 1. Bh2 Ke5; 2. Rf1 Kd4; 3. Rd1#
- Case E1: 1. Bh2 Nf3; 2. Bf3 Qe4; 3. Re4#
- Case E2: 1. Bh2 Nf3; 2. Bf3 Ke5; 3. Nc4#
- Case E3: 1. Bh2 N- (any other knight move); 2. Qd1 Ke5; 3. Nc4#

Solver lists

Due to an administrative deadline, names of only those people who submitted correct solutions by November 30, 2006, are shown on the lists.

Light Puzzle: Arthur Anderson, Bob Bartholomew, Roger Bovard, Bob Byrne, William Carroll, Tom Dahl, Andrew Dean, Robert Eaton, Mark Evans, Mike Failor, Bill Feldman, Flick Fornia, Christophe Gaboriaud, Steve Gallancy, Nick Gifford, Rui Guo, John Hubenschmidt, Janusz Kawczak, Lee Michelson, Mike Moore, Stephen Peeples, Yan Peng, Harry Ploss, Bill Scott, Lenny Shteyman, Philip Silverman, Sally Smith, Al Spooner, Elnatan Sulimanoff, Tony Torelli, Michael Virga, Mike Weingartner, Matthew Wickwire, Virginia Young

Chess Puzzle: William Carroll, Marc Dreyfuss, Janusz Kawczak, Robert Koch, Krishna Kothoor, Philip Lehpamer, June Meimban, Harry Ploss, Boris Raskin, Edward Scher, Lee Zinzow

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