

Ask a Scientist Springtime Puzzle Party!

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Solutions are on p.3

WARM-UP PUZZLE: TWO COINS

A jewelry box has two drawers. One of the drawers contains a coin that's silver on one side and gold on the other. The other drawer contains a coin that's silver on both sides. You open a drawer and see a coin with a silver face. What is the chance that the hidden face of that coin is also silver?

PUZZLE #1: MILK AND WATER

Consider two cans, the first containing one liter of milk and the second containing one liter of water. Suppose you take one cup of milk out of the first can and pour it into the second can. After mixing you take one cup of the mixture from the second can and pour it back into the first can. Which one of the following statements is true?

- a) There is now more water in the first can than milk in the second can.
 - b) There is now less water in the first can than milk in the second can.
 - c) There is now as much water in the first can as there is milk in the second can.
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PUZZLE #2: DRILLING THROUGH A SPHERE

A ten-inch long cylindrical hole is bored through the center of a sphere so that the axis of the cylinder coincides with the diameter of the sphere. Find the volume of the resulting object. Note: The length of the cylinder is measured after the hole is bored; i.e., you don't count the heights of the two spherical caps (one at each end, which disappear after the drilling) as part of the length of the cylinder. FYI: The volume of a sphere is $\frac{4}{3}$ pi times the cube of the sphere's radius.

PUZZLE #3: CHESS BOARD 1

Imagine a piece of paper with a chess board printed on it. We want to cut the chess board paper into pieces (along the lines!) such that each piece has twice as much squares of one color than of the other color (i.e. twice as much black squares as white squares or twice as much white squares as black squares). Is this possible? Give a proof that shows why it is or isn't possible.

PUZZLE #4: CHESS BOARD 2

Imagine a chess board and 32 dominoes. Each domino covers exactly two adjacent squares on the chessboard, so the 32 dominoes can perfectly cover all 64 squares. Now remove two diagonally opposite corner squares from the chess board: for example, remove the square in the north-west corner and the square in the south-east corner. Is it possible to place the 31 dominoes on the board so that all the remaining 62 squares are covered? Give a proof that shows why it is or isn't possible.

PUZZLE #5: DOLLARS IN ENVELOPES

I'm going to hand you one thousand dollars, in one-dollar bills. Your job is to put those dollar bills into envelopes, in such a manner that no matter what number of dollars I ask you for you'll be able to hand me the appropriate combination of envelopes that total the exact amount asked for. What's the fewest number of envelopes this can be done in, and how much money do you put in each one?

PUZZLE #6: THE LITTLE FLY

Two trains are on the same track a distance 60 miles apart heading towards one another. One train is travelling at 25mph and the other is travelling at 35mph. A fly starting out at the front of one train flies towards the other at a speed of 45mph. Upon reaching the other train, the fly turns around and continues towards the first train...and so on. How many miles does the fly travel before getting squashed in the collision of the two trains? (Assume the fly loses no time in turning around to reverse direction.)

PUZZLE #7: THE DRIED UP CUCUMBERS

On a sunny morning, a greengrocer places 200 kilograms of cucumbers in cases in front of his shop. At that moment, the cucumbers are 99% water. In the afternoon, it turns out that it is the hottest day of the year, and as a result, the cucumbers dry out a little bit. At the end of the day, the greengrocer has not sold a single cucumber, and the cucumbers are now only 98% water. How many kilograms of cucumbers does the greengrocer have left at the end of the day?

SOLUTIONS

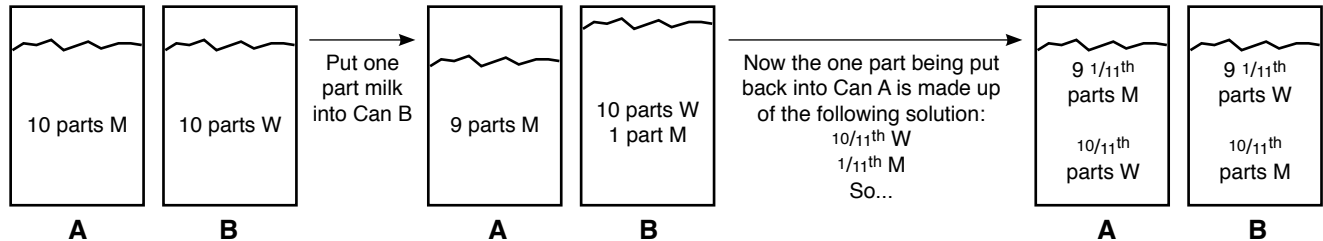
WARM-UP PUZZLE: TWO COINS

The chance is two out of three. There are a total of three opportunities to see a silver face, and two of those have a silver face on the other side.

PUZZLE #1: MILK AND WATER

c) There is now as much water in the first can as there is milk in the second can.

To illustrate, imagine we start with 10 parts of each, and transfer one part back and forth:



PUZZLE #2: DRILLING THROUGH A SPHERE

The volume of the remaining object is same as the volume is for a 10-inch sphere (523.6 cubic inches). Since the problem doesn't give the radius of the sphere or of the cylinder, we can assume that's its solution is independent of this information. So as an exercise, imagine a 10-inch cylinder of zero radius—this would mean that the sphere has a diameter of 10 inches. It just so happens (and can be proven with calculus) that as the cylinder becomes wider, and therefore the sphere's diameter becomes larger, the volume of the remaining object remains constant.

PUZZLE #3: CHESS BOARD 1

Not possible! By definition, the pieces that have twice the number of one color square than the other must contain a total number of squares that's a multiple of three. To cover the entire chess board perfectly, 64 would also have to be a multiple of three, but it's not.

PUZZLE #4: CHESS BOARD 2

Not possible! Each domino covers two squares of opposite color, since only squares of opposite color are adjacent. The two corners that are removed must be the same color, therefore their removal leaves a board that has two more squares of one color than another.

PUZZLE #5: DOLLARS AND ENVELOPES

The fewest possible is ten envelopes. Think about the binary system. In the first nine envelopes, put 1 dollar, 2 dollars, then 4, 8, 16, 32, 64, 128, and 256. If you add all those up, that's 511 dollars, so in the last envelope put 489 dollars.

PUZZLE #6: THE LITTLE FLY

It flies 45 miles before it gets squashed. Since the combined speed of the two trains is 60mph, and they start out 60 miles apart, it takes them one hour to collide. In that one hour, regardless of back-and-forth zig-zagging, the fly has travelled 45 miles.

PUZZLE #7: THE DRIED UP CUCUMBERS

The cucumbers weigh 100kg at the end of the day. In the morning, the 200kg of cucumbers are 99% water. So the non-water part of the cucumbers has a mass of 2kg. At the end of the day, the cucumbers are 98% water. The remaining 2% is still the 2kg of non-water material (which does not change when the water evaporates). If 2% equals 2kg, then 100% equals 100kg. So, the greengrocer has 100kg of cucumbers left at the end of the day.

