NEXT-TIME QUESTION

Most of us know that when a sheet of paper is folded in half three times, the thickness of the wad of paper is $2 \times 2 \times 2$ or 2^3 or 8 times the thickness of a single sheet. The thickness of a typical sheet of thin paper is about 7×10^{-5} m.

If you could fold a sheet of paper in half 51 times, the height of the resulting "pile of paper" would

a) be about 1 kilometer.

b) reach the Moon.

c) reach the Sun.

Hewitt Drew it!

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a) be about 1 kilometer.   b) reach the Moon.   c) reach the Sun.

Answer: c, reach the Sun

The "pile of paper" would reach from the Earth to the Sun!

Calculation: For 51 foldings we must multiply the thickness of the paper by $2^{51} = 2.3 \times 10^{15}$.

$(7 \times 10^{-5}\text{ m})(2.3 \times 10^{15}) = 1.6 \times 10^{11}$ m.

Approximation: Every ten doublings multiples the thickness by a factor of $2^{10} = 1024 \sim 10^3$. Fifty doublings will multiply the thickness by $2^{50} = (2^{10})^5 = (10^3)^5 = 10^{15}$. Fifty-one doublings multiplies the thickness by a factor of approximately 2×10^{15}. When this is multiplied by the thickness of one sheet the resulting thickness of the pile of paper is 1.4×10^{11} m. (The distance from the Earth to the Sun is 1.5×10^{11} m.)

Question: If the original sheet of paper had an area of 600 cm^2 (roughly the area of a sheet of notebook paper) and if the resulting pile of paper was a square in cross section, what would be the width of the pile of paper?

Answer: The volume of the original sheet is $(6 \times 10^{-2}\text{ m}^2)(7 \times 10^{-5}\text{ m}) = 4.2 \times 10^{-6}\text{ m}^3$. If we assume that the volume is conserved in this redistribution of paper, then the cross-section area of a column reaching the Sun is $4.2 \times 10^{-6}\text{ m}^3/1.6 \times 10^{11}$ m or $2.6 \times 10^{-17}\text{ m}^2$. The edge of a square of this area is 5.1×10^{-9} m. This is roughly 50 times the diameter of the hydrogen atom.

thanx to Al Bartlett

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