

The JETS Challenge

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Challenge 55 – The Avogadro’s Number Challenge

Problem:

Assume Avogadro’s number (6.02×10^{23}) of snowflakes with an average dimension in all three directions of 1 mm, were to fall uniformly across the northern half of the United States (total U.S. area = 9,629,047 sq km) during a winter season with no melting.

How thick (meters) is the total snow layer?

Solution:

6.02×10^{23} snowflakes

$r = .5 \text{ mm} = .0005 \text{ m} = .0000005 \text{ km}$

$\frac{1}{2}$ U.S. area = $\frac{1}{2} (9,629,047 \text{ km}^2) = 4,814,523.5 \text{ km}^2$

$$v = \frac{4}{3} \pi r^3$$

$$\text{Volume} = 4,814,523.5 \text{ km}^2 \cdot x \text{ km} = \frac{4}{3} \pi (5 \times 10^{-7} \text{ km})^3 \cdot (6.02 \times 10^{23})$$

$$x \text{ km} = \frac{\frac{4}{3} \pi (5 \times 10^{-7} \text{ km})^3 \cdot (6.02 \times 10^{23})}{4,814,523.5 \text{ km}^2}$$

$$= \frac{315,206.46291 \text{ km}^3}{4,814,523.5 \text{ km}^2}$$

$$x = .06546991 \text{ km}$$

$$= 65.5 \text{ m}$$

x km