

# Estimation : Interesting questions and Back of the envelope calculations

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## 0.1 Avogadro Number: A Mole.

1. How long one has to roll a Aluminium foil to get 1 mole of Aluminium atoms?

**Answer :**

**Step 1.** Required information

Atomic mass of Aluminium = 27. This means 1 mole of Aluminium(Al) atoms weigh 27 grams.

Density of Al = 2.7 grams/cubic centimetre.

Dimensions of household Al foil:

Length = 25 meter(2500cm), Width = 30cm, and Thickness = 14 microns(0.0014cm).

**Step 2.** Volume of Al foil for above dimensions.

Volume = Width x Length x Thickness

= 30 x 0.014 x 2500 cubic centimetre

= 105 cubic centimetre

**Step 3.** Mass of the Al foil = Volume x Density

= 105 x 2.7

= 283.5 grams

**Step 4.** If 27 grams = 1 mole then 283.5 grams = ?

so,  $283.5/27 = 10.5$  moles

**Step 5.** If 283.5 grams = 2500 cm then 27 grams = ?

So,  $(27 \times 2500)/283.5 = 238.09 \text{ cm} \approx 2.4 \text{ metre}$

So, To get 1 mole of Al atoms we have to roll 2.4 meters of Al foil of given dimensions.

2. How much each of 2 SGD, 10 USD, and Rs.50 bills weigh? How many atoms are there in each of the bills (What fraction of a mole?)?
3. How many hair are there on the scalp of average adult human? How big a animal has to be to have 1 mole of hair on his body?
4. How many sheets of A4 size paper collectively has 1 mole of carbon atoms?
5. How big is 1 cubic volume of 1 mole of Styrofoam?
6. How big is a diamond of 1 mole of carbon?

7. How many moles of molecules are there in a dot of white board marker ink?
8. How many moles of electrons does a fully charged phone battery stores?
9. How many litres of iced water one has to drink to reduce 500 calories a day?
10. Why we weigh lightest in the morning after the sleep? Where does this lost mass go?
11. How many moles of ATP molecules does each cell in a human body synthesize? How many ATP molecules are required to run for 1 hour? And how many ATP molecules are required to run at a speed of 60Km/hr?
12. How many moles of water molecules does a human consume in a day? And in his life span?
13. How many leaves per tree are there? Which type of trees will have dense leaves- trees with smaller leaves or trees with bigger leaves?
14. Has humankind printed 1 mole of letters till now? If not then how much more time is required to print 1 mole of letters?
15. For a bacteria E. coli, how big a ball of 1 mole of E. coli will be?
16. How big a packed ball of E. coli will be, so that there are 1 mole of DNA base pairs?
17. How big a ball of E. coli will be to have 1 mole of water?
18. How many memory units does a human being has in his life?