How many hydrogen atoms are in a can of coke? (Do it in your head.)

Answer: \(3 \times 10^{25}\) atoms of hydrogen in a can of coke

Solution: There are 455 ml in a can of coke, which is about 455 grams since coke is mostly water and water has a density of 1 g/ml. 455 g is about 500g. Water weighs about 18 g/mole which is about 20, so there are 500/20 = about 25 moles of water in a can of coke. Which means there are 50 moles of hydrogen in a can of coke (because water has 2 hydrogens). But Avagadro’s number is about 6 \times 10^{23}, so there are 300 \times 10^{23} or 3 \times 10^{25} atoms of hydrogen in a can of coke.

Pretty amazing huh? Especially since this is really close to the answer you would get with a calculator, and since both the answer you would get with a calculator and in your head are WRONG anyway given the approximations and error in the data given you in the first place.

Deep thought: If you appreciate what I just wrote, you are meant to be an experimental scientist—it a far more profound argument than the simple notion about the value of estimations, it is an appreciation that ALL DATA is uncertain, so why the heck are you using 18 places on your calculator to solve for a wrong answer?

10 Problems to do yourself without a calculator. All of this should be review.

1. Convert the following numbers to/from scientific notation
   a. \(10,045,200 =\)
   b. \(0.00703005 =\)
   c. \(6.022 \times 10^{23} =\)
   d. \(1.055 \times 10^{-34} =\)

2. Complete the following exponent identities/rules
   a. \(10^m \times 10^n =\)
   b. \((10^m)^n =\)
   c. \([(10^m)^n]^0 =\)

3. Solve the following
   a. \((6x10^4)(7x10^5) =\)
   b. \(10^5 + 5x10^3 =\)
   c. \(10^5 + 2.5x10^{-2} =\)
   d. \((5x10^{-6})(9x10^5) =\)

4. Round the following numbers to the specified number of significant figures.
   a. 455, 1 -
   b. 1.59995627, 5 -
   c. 18.01528, 1 -
   d. 978.23, 4 -
   e. 1.04, 1 -
5. Estimate the number of hydrogen atoms in a 16 oz bottle of coke. (Hint, you’ll need to know the volume so google it or go look at a bottle of coke.)

6. Do the following without a calculator.
   a. $3.1416 \div 2 =$
   b. $985.6 \div 1.4 =$
   c. $1123.2 \div 3.6 =$
   d. $763236 \div 6 =$

7. Do with following without a calculator.
   a. $23 \times 91 =$
   b. $6.022 \times 11 =$
   c. $18 \times 55 =$
   d. $3.14 \times 270 =$

8. Simply (write as a number or a single log with no coefficient) the following logarithms
   a. $\log_n(n^{15}) =$
   b. $\ln(e) =$
   c. $\ln(x) + \ln(y) =$
   d. $n \log_b(x) =$

9. Estimate the number of helium atoms in the Sun, assume that the mass of the Sun is $2.0 \times 10^{30}$ kg, the Sun is completely composed of hydrogen and helium, and that the mole ratio of hydrogen to helium is 12:1.

10. Sketch the following functions (a pet peeve of a particular thermodynamics professor). Include both negative and positive values for x.
    a. $y = x$
    b. $y = x^2$
    c. $y = \frac{1}{x}$
    d. $y = \sin(x)$ (indicate where 0’s are located)
    e. $y = \sin^2(x)$