Mountain Out of a Mole of Beans – Sample Data & ANSWER KEY

Part 1

Type of Bean (seed)	Mass of 100 Beans (g)	Average Mass of 1 Bean (g)	Relative Mass of Beans	Calculated Number of Beans in One Relative Mass	Measured Number of Beans in One relative Mass
Great Northern	32.30	0.3230	6.21	19.2	19
Kidney	52.35	0.5235	10.1	19.3	18
Popcorn	14.13	0.1413	2.71	19.2	19
Lentil	5.23	0.0523	1.00	19.2	20

Part 2

Atom	Mass of One Atom (g)	Mass Relative to Hydrogen (*Calculate*)	Atomic Mass (g)	Number of Atoms in a Relative Mass (*Calculate*)
Hydrogen	1.66×10^{-24}	1.00	1.01	6.02×10^{23}
Carbon	2.00×10^{-23}	12.0	12.01	6.00×10^{23}
Iron	9.30×10^{-23}	56.0	55.85	6.02×10^{23}
Aluminum	4.49×10^{-23}	27.0	26.98	6.01×10^{23}
Zinc	1.08×10^{-22}	65.1	65.38	6.02×10^{23}
Lead	3.44×10^{-22}	207	207.2	6.02×10^{23}
Copper	1.05×10^{-22}	63.3	63.55	6.03×10^{23}

Questions – ANSWER KEY

1. What did you find out about the number of beans in one relative mass?

The number of beans in one relative mass is always the same. For the sample data provided, it is 19.2.

2. How do your calculated values of the number of beans in a relative mass compare with the measured values?

The calculated values were all the same. However, due to the inconsistencies in size of the beans (seeds) and incorrectly rounding up or rounding down with the mass on the balance, the measured values were close (and close to the calculated value), but not exactly the same.

3. How is the number of beans in a relative mass affected by the relative mass of the bean?

The number of beans in a relative mass is NOT affected by the relative mass of the bean,

4. Explain why there is always the same number of beans in one relative mass.

Relative mass is the ration of the smallest bean to the largest, so when you find the number of beans in a relative mass, they are in relation or being compared to the same number; therefore, they are the same.

5. Compare the volume of relative mass piles. Were they the same? Why or why not?

The volume of the piles were not the same because the beans were not the same size.

6. Among the elements, hydrogen has the least massive atoms (an atom of hydrogen has an average mass of 1.66×10^{-24}g). This is very small, but remember it is only one atom! What is the relative mass of hydrogen if it is the least massive element?

The relative mass of hydrogen is 1.00 g.

7. How do the atomic masses found on a periodic table compare to the relative masses that you calculated?

They are almost exactly the same with differences of 0.1-0.2 g.

8. What are the atomic masses found on the table, and how are they determined?

The atomic masses are calculated by finding the percentage abundance for each isotope for the elements, multiplying this by the decimal value of these abundances by the individual isotope's atomic mass and then summing all these isotope values.

9. What did you find out about the number of atoms of each element in one atomic mass?

There is the same number of atoms in one atomic mass regardless of the element. These were found to all be close to 6.02×10^{23} atoms.

10. Whose name is given to the number of atoms in the relative mass?

Avogadro's name is given to the number of atoms in the relative mass.

11. One atomic mass unit (amu) is the approximate mass of a proton or a neutron. This mass is equal to 1.66×10^{-24}g. How many atomic mass units are in one gram?

$$(1\ g)\left(\frac{1\ amu}{1.66 \times 10^{-24}}\right) = \mathbf{6.02 \times 10^{23}\ amu}$$

12. If an atom has a mass of 197 amu, find the mass in grams of a mole of these atoms.

(1 mol)(6.02 X 10^{23} atom)(197 amu)(1.66 X 10^{-24}) = ***197 g***

(1 mol) (1 atom) (1 amu)

13. Assume there are 6.2 billion people on the earth and they share a mole of pennies. How many days would it take you to spend your share if you could spend the money at a rate of \$1000 a day?

(1 day)(\$1.00)(6.02 X 10^{23} pennies)(1 mol) = ***9.7 X 10^{8} days/person***

(\$1000)(100 pennies) (1 mol) (6.2 X 10^{9} people)