[TP] Which of the following contains the smallest number of atoms?

25% 1. 187 g of liquid mercury, Hg
25% 2. 1400 u of uranium, U
25% 3. 6×10^{24} atoms of sodium, Na
25% 4. 2 mol of hydrogen gas, H_2

Lecture 4 CH101 A1 (MWF 9:05 am)

Wednesday, September 12, 2017

For today ...

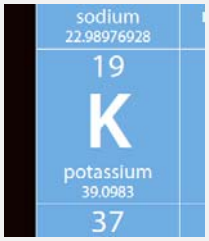
- Complete: Isotopes → atomic weight
- Chemist's dozen: The mole

Next lecture: Begin ch3: Naming things. Molecular mass spectra; mass spectra of compounds with Br (or Cl); light; infrared (IR) spectra

Average mass of an atom of K

Two isotopes: K-39 and K-41

How many protons and how many neutrons in each?



Average mass of an atom of K

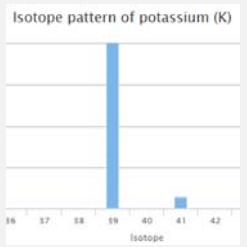
Two isotopes: K-39 and K-41

K-39 peak at 38.9637 u, height 933

K-41 peak at 40.9618 u, height 67

Write and then evaluate the expression whose value is the average mass in u of an atom of K.

f_{39} 38.9637 u + f_{41} 40.9618 u = 39.098 u



Average mass of an atom of K

Two isotopes: K-39 and K-41

K-39 peak at 38.9637 u, height 933

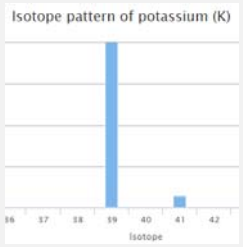
K-41 peak at 40.9618 u, height 67

The average mass in g of an atom of K is ...

$$= 39.098\ \text{u} \times \left(\frac{1}{12} \times 12\ \text{g} \times \frac{1}{N_\text{A}}\right)/\text{u}$$

$$= 39.098\ \text{g} / N_\text{A}$$

$$= 6.4923 \times 10^{-23}\ \text{g}$$



Average mass of any atom

The average mass of an atom of K is 39.098 g/N_A

The average mass of an atom of Br is 79.904 g/N_A

The average mass of an atom of H is 1.008 g/N_A

The average mass of any atom in g/N_A is the number given on the periodic table.

Molar mass of any element

Molar mass is the mass of N_A "average" atoms of an element.

The average mass of an atom of K is 39.098 g/N_A

The molar mass of K is $N_\text{A} \times$ (39.098 g/N_A) = 39.098 g

The molar mass of Br is 79.904 g

The molar mass of H is 1.008 g

The molar mass of any element in g is the number given on the periodic table.

Atomic weight = magnitude of average mass

The atomic weight of K is 39.098 (no units!)

The atomic weight of Br is 79.904

The atomic weight of H is 1.008

The atomic weight of an element is the number given on the periodic table.

[TP] The periodic table indicates that "C" has a mass of 12.011. Which of the following statements is true?

0% 1. All carbon atoms have mass 12.011 g
0% 2. All carbon atoms have mass 12.011 u
0% 3. No carbon atoms have mass 12.011 g
0% 4. No carbon atoms have mass 12.011 u
0% 5. (1) and (2) are correct
0% 6. (3) and (4) are correct
0% 7. None of the above

[Quiz] The molar mass of Cl is 35.453 g. ^{37}Cl has a natural abundance of 24.24%. Which of the following statements is true?

0% 1. The mass of one atom of naturally occurring Cl is 35.453 g divided by Avogadro's number
0% 2. The mass of one atom of naturally occurring Cl cannot be 35.453 g divided by Avogadro's number.
0% 3. Neither of the statements is true.

Terms to distinguish

Relative atomic mass, A_r: ratio of mass of an isotope relative to mass of 1/12 of the mass of one ^{12}C atom.

A_r of ^{13}C is 13.00335 (unitless)

Atomic mass unit, u: 1/12 of the mass of one ^{12}C atom

1 u = (1/12) × (12 g) / N_A = g / N_A = 1.66054×10^{-24} g

Atomic weight: average of relative atomic masses of the isotopes of an element

Atomic weight of C is 12.01 (unitless)

Molar mass, M: Mass in grams numerically equal to atomic weight; that is, the mass in grams of N_A "average atoms" of an element

Molar mass of C is 12.01 g

Chemist's dozen: mole → counting by weighing

Mole: Count by weighing

The mass in g of 1 mol of any element is called its molar mass

Number of particles in 1 mol is $N_A = 6.022140857 \times 10^{23}$

Each of these amounts contains the same number of atoms

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