[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

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Lecture 3 CH101 A1 (MWF 9 am)
Monday, September 12, 2016

For today …

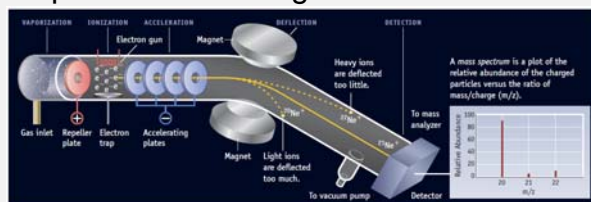- Complete isotopes → atomic weight
- Chemist's dozen: The mole

Next lecture: Begin ch3: Naming things; molecular mass spectra

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Mass spectrometer "weighs" atoms

Strip away an electron, accelerate positive ions, and then deflect them in a magnetic field.
Less deflection, heavier mass
Neon has three "isotopes": ^{20}Ne, ^{21}Ne, and ^{22}Ne
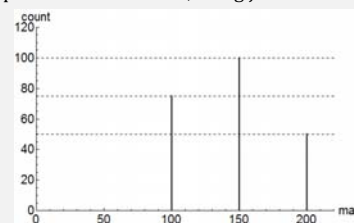Relative peak heights → isotopic abundance

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Average mass of CH101 students?

75 students weigh 100 lbs

100 students weigh 150 lbs

50 students weigh 200 lbs

Sketch the "mass spectrum" of the class, using just counts for the vertical axis

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Slide 9

[TP] For our hypothetical class, 75 students weigh 100 lbs, 100 students weigh 150 lbs, 50 students weigh 200 lbs. Based on your "mass spectrum" sketch, roughly (guesstimate), what will the average be?

25%   1.   Less than 100
25%   2.   Between 100 and 150
25%   3.   Between 150 and 200
25%   4.   Greater than 200

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Slide 10

Average mass of CH101 students?

75 students weigh 100 lbs

100 students weigh 150 lbs

50 students weigh 200 lbs

What is the expression for the fraction of students with mass 150 lbs, f_{150}?

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Slide 11

Average mass of CH101 students?

75 students weigh 100 lbs

100 students weigh 150 lbs

50 students weigh 200 lbs

In terms of f_{100}, f_{150}, and f_{200}, write the expression that evaluates to the exact average.

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Slide 12

Average mass of CH101 students?

75 students weigh 100 lbs

100 students weigh 150 lbs

50 students weigh 200 lbs

total mass = 75 × 100 lbs + 100 × 150 lbs + 50 × 200 lbs

average mass = total mass / (75 + 100 + 50)

= total mass / 225

= (75/225) × 100 lbs + (100/225) × 150 lbs + (50/225) × 200 lbs

= f_{100} × 100 lbs + f_{150} × 150 lbs + f_{150} × 200 lbs

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[TP] For our hypothetical class, average weight of a CH101 student is 144 lbs. Which of the following statements is true for this class?

33%   1.   The weight of each student is 144 lbs
33%   2.   No student weighs 144 lbs
33%   3.   Neither of the statements is true.

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Average mass of an atom of K

Two isotopes: K-39 and K-41
How many protons and how many neutrons in each?

sodium
22.98976928
19
K
potassium
39.0983
37

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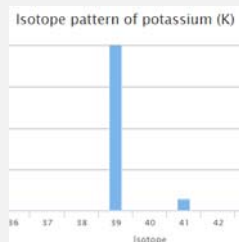
Average mass of an atom of K

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.

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

Isotope pattern of potassium (K)

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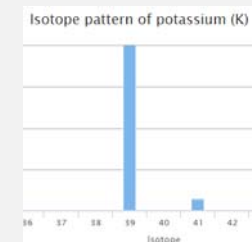

Average mass of an atom of K

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

$$= 39.098\ u$$
$$= 39.098 \times (1/12) \times 12\ g \times (1/N_A)$$
$$= 39.098\ g\ /\ N_A$$
$$= 6.4923 \times 10^{-23}\ g$$

Isotope pattern of potassium (K)

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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.

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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 $N_A \times (39.098\ \text{g}/N_A) = 39.098$ 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.

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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.

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[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?

33%   1.   The mass of one atom of naturally occurring Cl is 35.453 g divided by Avogadro's number

33%   2.   The mass of one atom of naturally occurring Cl cannot be 35.453 g divided by Avogadro's number.

33%   3.   Neither of the statements is true.

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