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[TP] For an hypothetical class, 75 students weigh 100 lbs, 100 students weigh 150 lbs, 50 students weigh 200 lbs. Roughly (guesstimate), what will the average weight 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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Lecture 2 CH101 A1 (MWF 9 am)

Friday, September 9, 2016

For today ...

- Complete: Air in SCI/109
- Atoms, elements, and isotopes
- Isotopes → atomic weight

Next lecture: Chemist's dozen: The mole. Begin ch3: Naming things; molecular mass spectra

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[Quiz] If all of the air in SCI/109 were condensed to liquid, how many 5-gallon containers would be required to hold the liquid air?
This is just an initial guesstimate (no "wrong" answer!)

20% 1. Much less than 1
20% 2. About 1
20% 3. About 5
20% 4. About 10
20% 5. Much more than 10

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Liquid volume of the air in SCI/109

If all of the air in SCI/109 were condensed to liquid, how many 5 gallon containers would be required to hold the liquid air?

Mass of air ≈ 2400 kg

Liquid air density ≈ 1 g/cm^3

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Liquid volume of the air in SCI/109

If all of the air in SCI/109 were condensed to liquid, how many 5 gallon containers would be required to hold the liquid air?

Mass of air ≈ 2400 kg

Liquid air density ≈ 1 g/cm^3

Volume of liquid air is about 600 gal ≈ 120 5-gallon containers

So, while atoms are small, they take up space

Atoms, elements, and isotopes

Atoms, elements, isotopes

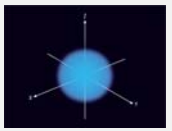
The world is made of atoms.

Atoms come in different kind (elements)

Atoms of a different kind come in different flavors (isotopes)

Atoms

Mostly wispy, nearly empty,
cloud of negative charge (electrons) ≈ 10^{-8} cm diameter



Nucleus: ≈ 10^{-12} cm diameter extraordinarily dense
sphere of positive charge

Positive charge due to protons

Mass ≈ protons + neutral neutrons

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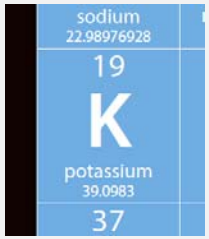
Element identity and atomic number Z



Number of protons = atomic number $Z = 19$

Relative atomic weight = 39.0983

Where does the number 39.0983 come from?

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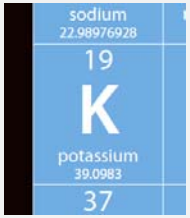
Atoms of an element come in different "flavors"

Atoms with the same number of protons …
but with different numbers of neutrons …
are chemically the same …
but have different masses

We call such different flavors of atoms of an element isotopes

39.0983 u is the average mass of the different kinds of atoms (isotopes) of K that are in a sample of K.



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Atomic mass unit u

1 u defined to be exactly (1/12) mass of 1 atom of ^{12}C

Exactly 12 g of ^{12}C contains $N_A = 6.02214 \times 10^{23}$ atoms

Therefore, mass of one ^{12}C atom is …

$12\ g / N_A = 1.99265 \times 10^{-23}$ g

And so, 1 u = …

(1/12) x 1.99265×10^{-23} g = 1.66054×10^{-24} g

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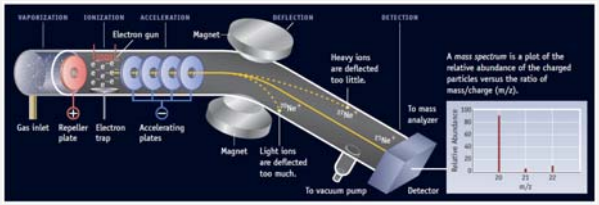
Mass spectrometer "weighs" atoms



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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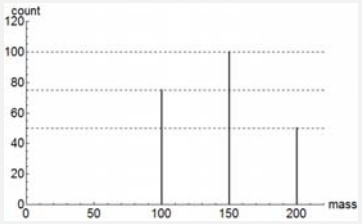
Average mass of CH101 students?

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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