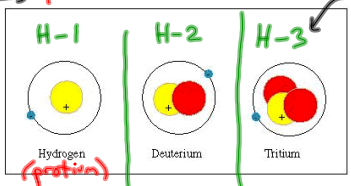
Same atomic number, same # protons and electrons

Isotopes are atoms of the **same element** which have **different numbers of neutrons**, and therefore **different masses**.

Let's look at the isotopes of Hydrogen...

mass number → $^{1}_{1}H$ $^{2}_{1}H$ $^{3}_{1}H$

atomic number →



mass number (no atomic # given with this format)

(protium)

1 p+ 0 n 1 e

1 p+ 1 n 1 e

1 p+ 2 n 1 e

mass number = 1 (mass of a certain isotope)

mass number = 2

mass number = 3

$^{1}_{1}H$ hydrogen-1 (protium)

$^{2}_{1}H$ hydrogen-2 (deuterium)

$^{3}_{1}H$ hydrogen-3 (tritium)

^{1}H	^{2}H	^{3}H
1.00794	2.0141	$t_{1/2}$ = 12.32yrs
99.985%	0.015%	10^{-15} %
Stable	Stable	

negligible

If we have 100 000 atoms of H:

99 985 H-1

15 H-2

per cent = "per 100"

99.985 % H-1

$\frac{99.985}{100}(1) = 0.99985$

0.015 % H-2

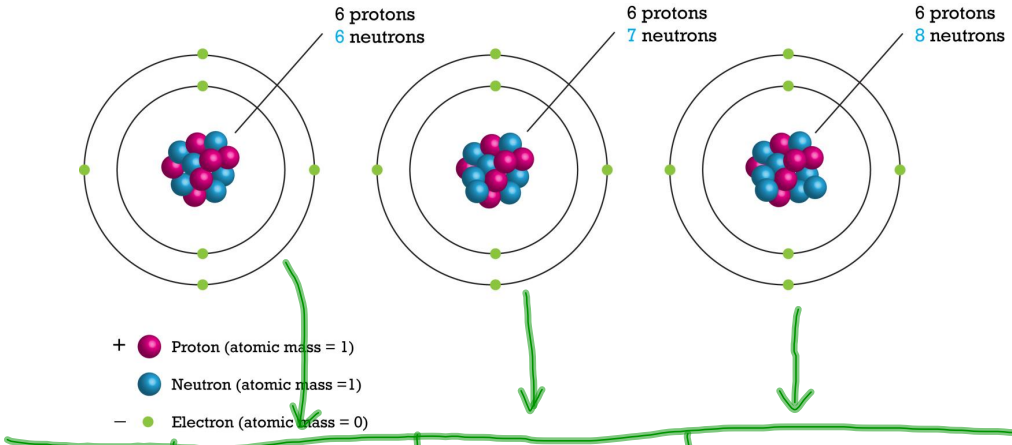
$\frac{0.015}{100}(2) =$ +

$= .00015(2) = 0.0003$

Average atomic mass for hydrogen (What's on periodic table) → 1.00015 u

Isotopes of Carbon:

Relative abundances: 98.9% | 1.1% | negligible %



Symbol for these isotopes	C-12	C-13	C-14
	$^{12}_{6}C$	$^{13}_{6}C$	$^{14}_{6}C$

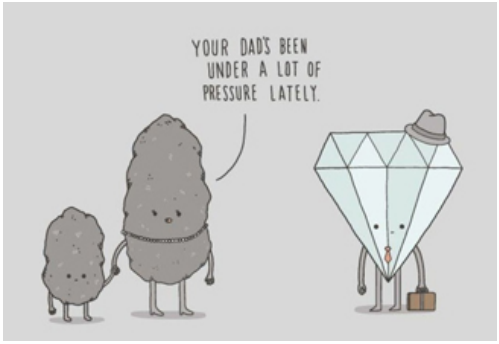
Calculate the average atomic mass for Carbon:

C-12 (mass): $\frac{98.9}{100}(12) = 11.868$ (98.9 = % for C-12)

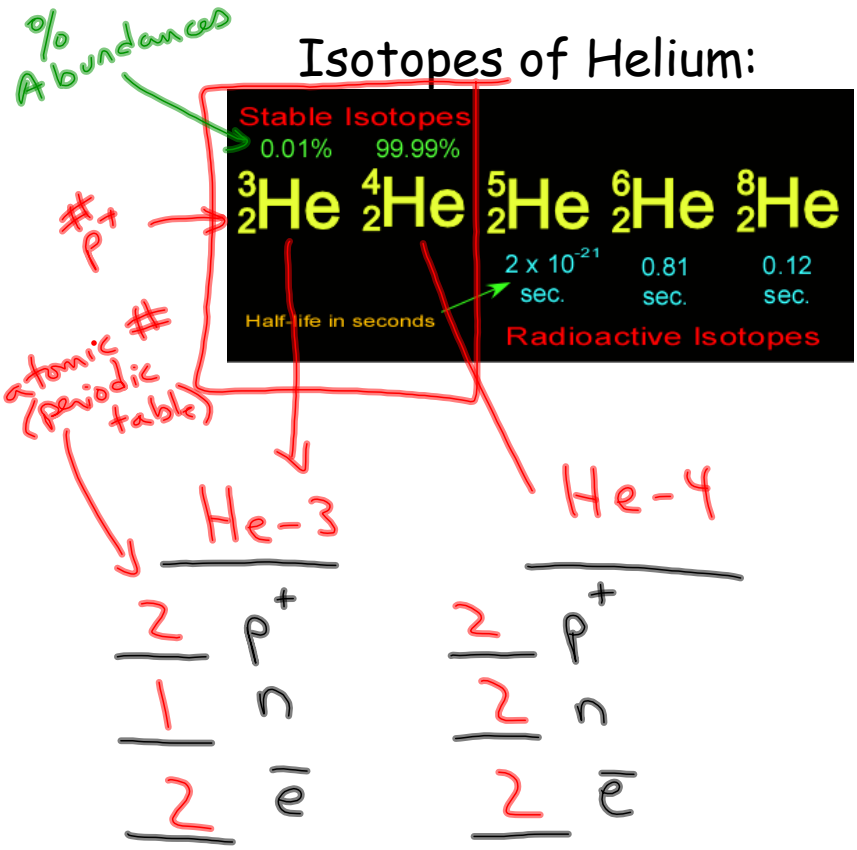
C-13: $\frac{1.1}{100}(13) = 0.143$ (1.1 = % for C-13)

\+

Average atomic mass = 12.011 u



Isotopes of Helium:



He-3

2 p^+

1 n

2 $\bar{e}$

He-4

2 p^+

2 n

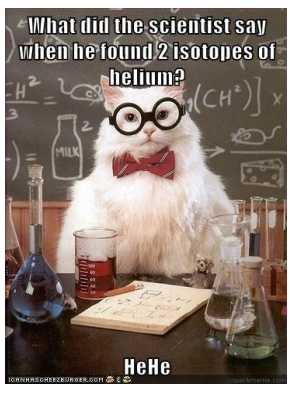
2 $\bar{e}$

Calculate the atomic mass for Helium:

$\frac{0.01}{100}(3) = 0.003$

$\frac{99.99}{100}(4) = 3.9996$

3.9999 u



^{16}O	^{17}O	^{18}O
O-16	O-17	O-18
99.76%	0.04%	0.20%
Stable	Stable	Stable

OR

	$^{16}_{8}O$	$^{17}_{8}O$	$^{18}_{8}O$
protons	8	8	8
neutrons	8	9	10
electrons	8	8	8

Calculate the atomic mass for O.

$\frac{99.76}{100}(16) = 15.9616$

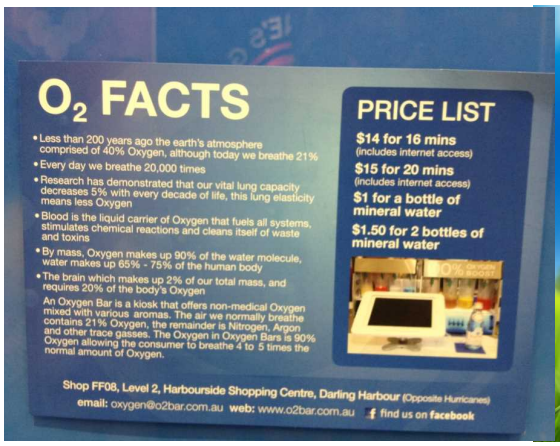
$\frac{0.04}{100}(17) = 0.0068$

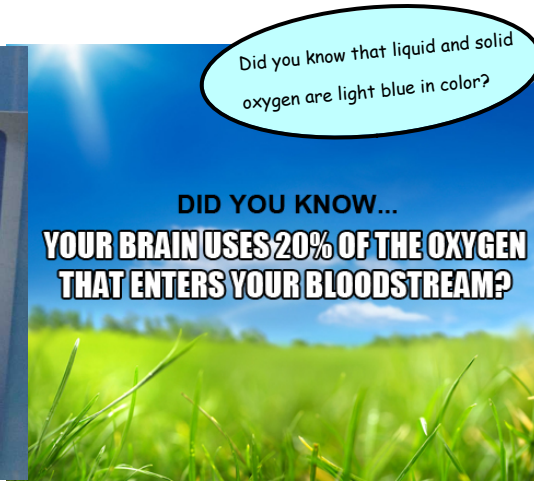
$\frac{0.20}{100}(18) = 0.036$

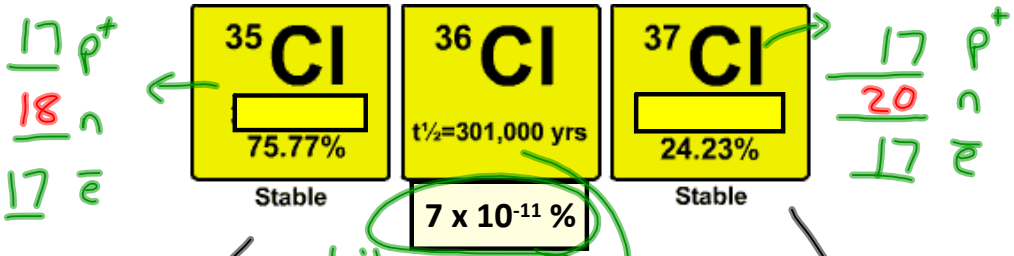
} atomic mass 16.0044u

Almost All Of The Oxygen:Fact

Almost all of the Oxygen in the Earth's atmosphere has been produced by living organisms. Oxygen accounts for 21% of our atmosphere, with Nitrogen making up 78%, and a mixture of other gases composing the remaining 1%. Oxygen only occurs as a minor constituent in the atmospheres of other planets in our Solar System.







don't use in calculation

negligible

Derek Derek Derek Derek Derek Derek Derek Derek

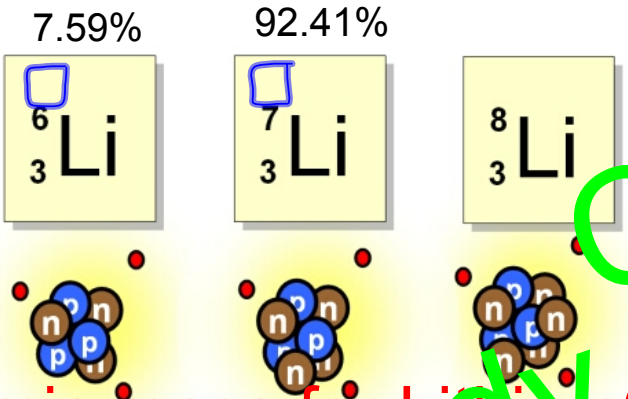
Cl-35 Cl-36 Cl-37

Atomic mass:

75.77 × 35 = 26.5195

24.23 × 37 = 8.9651

35.4846 u



Cody Cody Cody

Atomic mass for Lithium?

$\frac{7.59}{100}(6) = 0.4554$ + $\frac{92.41}{100}(7) =$

$= 6.92410$ u 6.4687

Try:

1. Argon has three naturally occurring isotopes: argon-36, argon-38, and argon-40. Based on Argon's reported atomic mass, which isotope do you think is the most abundant in nature? Explain.

Ar : 39.95 u = atomic mass = average of isotopes

Ar-40 is most abundant because it's so close to the average!

2. Uranium is used in nuclear reactors and is a rare element on earth. Uranium has three common isotopes. If the abundance of U-234 is 0.01%, the abundance of U-235 is 0.71%, and the abundance of U-238 is 99.28%, what is the average atomic mass of uranium?

$\frac{0.01}{100}(234) = 0.234$ +

$\frac{0.71}{100}(235) = 1.6685$ +

$\frac{99.28}{100}(238) = 236.2864$

237.9783 u

3. Titanium has five common isotopes: Ti-46 (8.0%), Ti-47 (7.8%), Ti-48 (73.4%), Ti-49 (5.5%), Ti-50 (5.3%). What is the average atomic mass of titanium?

Ti-46 : $\frac{8.0}{100}(46) = 3.68$

Ti-47 : $\frac{7.8}{100}(47) = 3.666$

Ti-48 : $\frac{73.4}{100}(48) = 35.232$

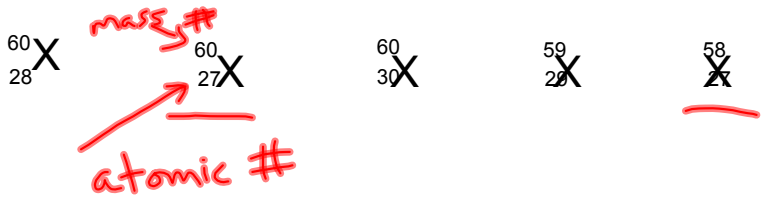
Ti-49 : $\frac{5.5}{100}(49) = 2.695$

Ti-50 = $\frac{5.3}{100}(50) = 2.65$

= 47.923 u

4. Rubidium is a soft, silvery-white metal that has two common isotopes, Rb-85 and Rb-87. If the abundance of Rb-85 is 72.2% and the abundance of Rb-87 is 27.8%, what is the average atomic mass of rubidium?

5. Consider the following fictitious elements. They have been assigned the symbol "X" and identified using atomic notation.



a) Which are isotopes of the same element?

60 27 X and 58 27 X

b) How many protons do these isotopes have?

27

c) How many neutrons do these isotopes have?

33 and 31

6. For each of the following isotopes indicate the number of protons, neutrons and electrons that it has:

	#protons	#neutrons	#electrons
Pb-210	82	128	82
$^{239}_{94}Pu$	94	145	94