

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_1H ^2_1H ^3_1H
 atomic number →

<p>H-1</p> <p>Hydrogen (protium)</p> <p>1p⁺ 0n 1e</p> <p>mass number = 1 (mass of a certain isotope)</p> <p>^1_1H</p> <p>hydrogen-1 (protium)</p>	<p>H-2</p> <p>Deuterium</p> <p>1p⁺ 1n 1e</p> <p>mass number = 2</p> <p>^2_1H</p> <p>hydrogen-2 (deuterium)</p>	<p>H-3</p> <p>Tritium</p> <p>1p⁺ 2n 1e</p> <p>mass number = 3</p> <p>^3_1H</p> <p>hydrogen-3 (tritium)</p>
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mass number (no atomic # given with this format)

^1_1H 1.00794 99.985% Stable	^2_1H 2.0141 0.015% Stable	^3_1H t _{1/2} = 12.32yrs 10 ⁻¹⁵ %
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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

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

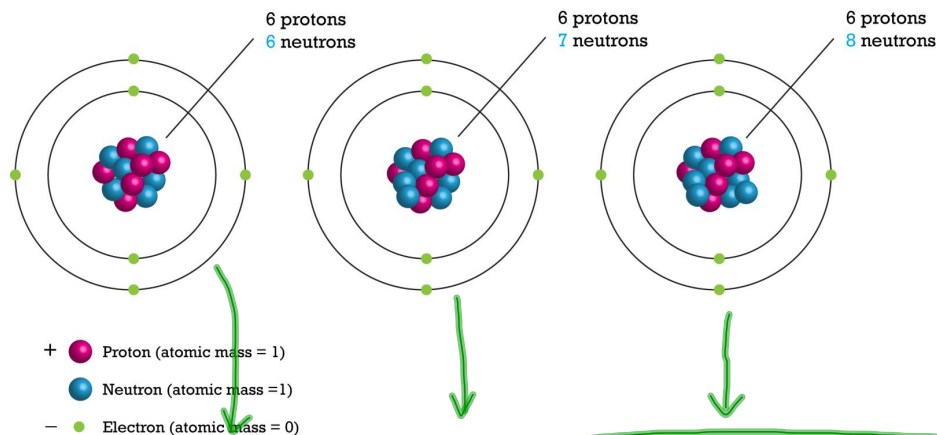
$$= 0.00015(2) = 0.0003$$

$$\text{Average atomic mass} \rightarrow 1.00015 \text{ u}$$

for hydrogen
(What's on periodic table)

Isotopes of Carbon:

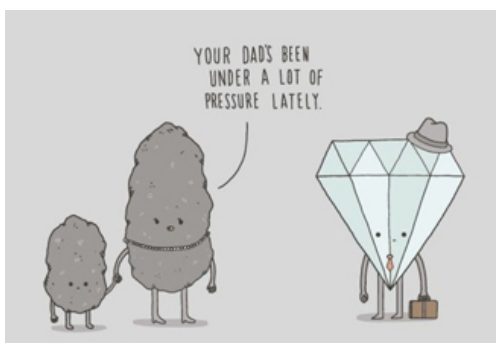
Relative abundances: 98.9%	1.1%	negligible %
↓	↓	↓



Symbol for these isotopes	C-12	C-13	C-14
	${}^1_6\text{C}$	${}^{13}_6\text{C}$	${}^{14}_6\text{C}$

Calculate the average atomic mass for Carbon:

$$\begin{aligned}
 & \text{C-12} \quad \leftarrow \text{mass} \quad : \quad \frac{98.9}{100} (12) = 11.868 \\
 & \text{C-13} \quad \leftarrow \% \text{ for C-13} \quad : \quad \frac{1.1}{100} (13) = 0.143 \\
 & \text{Average atomic mass} = 11.868 + 0.143 = 12.011 \text{ u}
 \end{aligned}$$



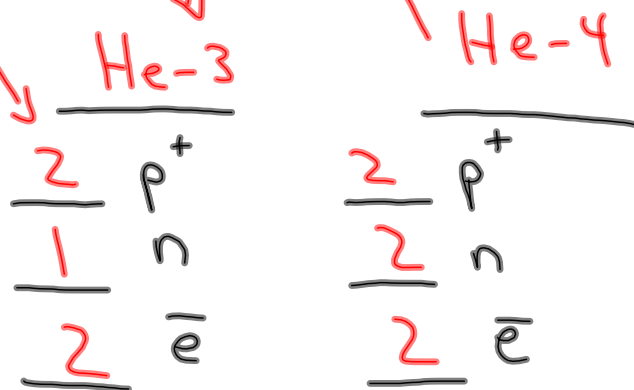
% Abundances

Isotopes of Helium:

Stable Isotopes		Radioactive Isotopes		
0.01%	99.99%			
${}^3_2\text{He}$	${}^4_2\text{He}$	${}^5_2\text{He}$	${}^6_2\text{He}$	${}^8_2\text{He}$
		2×10^{-21} sec.	0.81 sec.	0.12 sec.
Half-life in seconds				

p⁺

atomic # (periodic table)

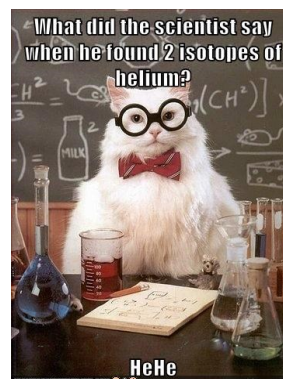


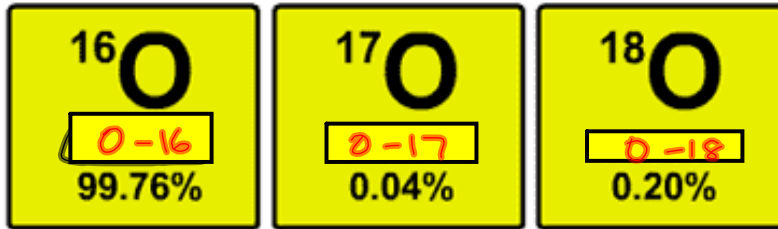
Calculate the atomic mass for Helium:

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

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

$$\boxed{3.9999 \text{ u}}$$





Stable

Stable

Stable

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

Calculate the atomic mass for O.

$$\left. \begin{aligned} \frac{99.76}{100} (16) &= 15.9616 \\ \frac{0.04}{100} (17) &= 0.0068 \\ \frac{0.20}{100} (18) &= 0.036 \end{aligned} \right\} \begin{array}{l} \text{atomic} \\ \text{mass} \\ 16.0044 \text{ u} \end{array}$$

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.

O₂ FACTS

- Less than 200 years ago the earth's atmosphere comprised of 40% Oxygen, although today we breathe 21%
- Every day we breathe 20,000 times
- Research has demonstrated that our vital lung capacity decreases 5% with every decade of life, this lung elasticity means less Oxygen
- Blood is the liquid carrier of Oxygen that fuels all systems, stimulates chemical reactions and cleans itself of waste and toxins
- By mass, Oxygen makes up 90% of the water molecule, water makes up 65% - 75% of the human body
- The brain which makes up 2% of our total mass, and requires 20% of the body's Oxygen

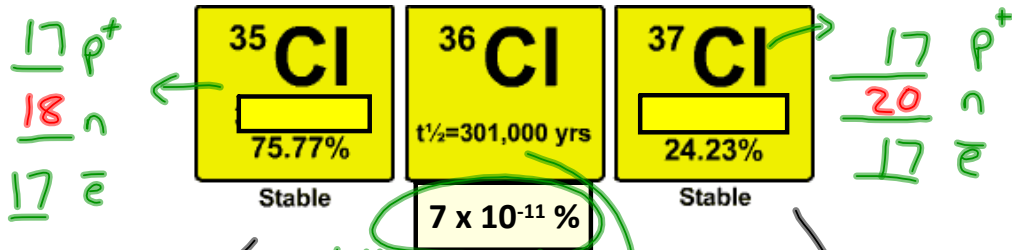
An Oxygen Bar is a kiosk that offers non-medical Oxygen contains 21% Oxygen, the remainder is Nitrogen, Argon and other trace gases. The Oxygen in Oxygen Bars is 90% Oxygen allowing the consumer to breathe 4 to 5 times the normal amount of Oxygen.

Shop FF08, Level 2, Harbourside Shopping Centre, Darling Harbour (Opposite Harbourside)
email: oxygen@o2bar.com.au web: www.o2bar.com.au find us on facebook

Did you know that liquid and solid oxygen are light blue in color?

DID YOU KNOW...

YOUR BRAIN USES 20% OF THE OXYGEN THAT ENTERS YOUR BLOODSTREAM?



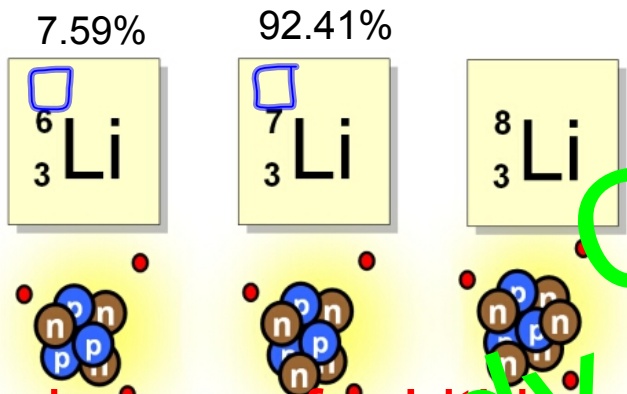
Don't use in calculation
negligible

Derek Derek Derek Derek Derek

Atomic mass:

$$\frac{75.77}{100} \times 35 = 26.5195$$

$$\frac{24.23}{100} \times 37 = 8.9651$$

$$35.4846$$


Atomic mass for Lithium?

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

$$\frac{92.41}{100} (7) = 6.4687$$

$$= 6.9241$$

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?

$$\begin{array}{r} \frac{0.01}{100}(234) = \\ 0.234 \end{array} + \begin{array}{r} \frac{0.71}{100}(235) = \\ 1.6685 \end{array} + \begin{array}{r} \frac{99.28}{100}(238) \\ 236.2864 \end{array}$$

237.9783 u 😊

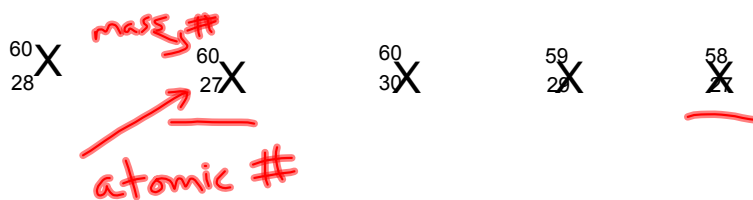
3. Titanium has five common isotopes: Ti-46 (8.0%), Ti-47 (7.8%), Ti-48 (73.4%), Ti-49 (5.5%), Ti-50 (5.3%). What is the average atomic mass of titanium?

$$\begin{array}{l} \text{Ti-46} : \frac{8.0}{100}(46) = 3.68 \\ \text{Ti-47} : \frac{7.8}{100}(47) = 3.666 \\ \text{Ti-48} : \frac{73.4}{100}(48) = 35.232 \\ \text{Ti-49} : \frac{5.5}{100}(49) = 2.695 \\ \text{Ti-50} : \frac{5.3}{100}(50) = 2.65 \end{array}$$

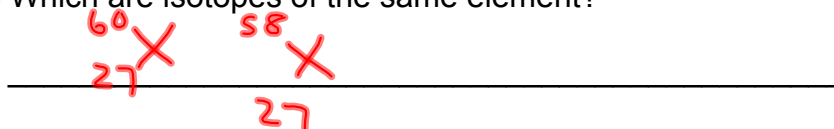
= 47.923 u

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?



b) How many protons do these isotopes have?



c) How many neutrons do these isotopes have?



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
${}_{94}^{239}\text{Pu}$	94	145	94

