



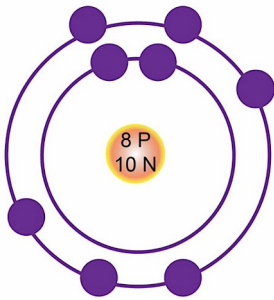
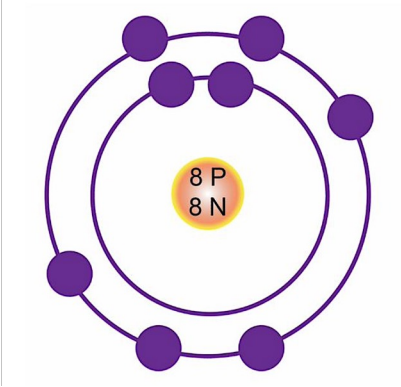
The Isotope or 'same place'



Fredrick Soddy first worked and published papers with Ernest Rutherford between 1900-1902. Through these studies, they found anomalous behaviours in radioactive atoms as they decayed. During these years and the following decades, Soddy was ably assisted by two gifted female scientists; Ruth Pirret and Ada Hitchens from the University of Glasgow. In 1913, Soddy described the process where an element could have more than one atomic mass. He named these isotopes - meaning 'the same place' - because these took the same place on the periodic table. This name had been suggested to him by another influential female scientist - Margaret Todd.



The number of protons of an atom is the atomic number of that atom. Oxygen has 8 protons. Only the element of oxygen has 8 protons; that is the atomic number of oxygen. The atomic mass of oxygen is 16, meaning that there are 8 neutrons + 8 protons. Electrons are not counted in atomic mass.

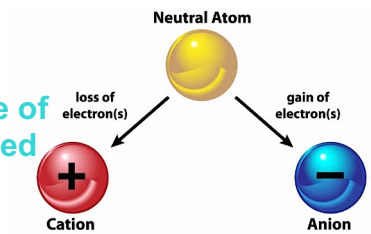


¹⁸O Isotope

An element can change the atomic mass when it loses or gains a neutron. It still has the same number of protons as it had before, so the element remains unchanged. These same elements with differing atomic mass are called isotopes. Here is an isotope of oxygen with an atomic mass of 18.

The electrons in an atom are on different energy levels or shells. The electrons in the furthest level from the nucleus have the most energy.

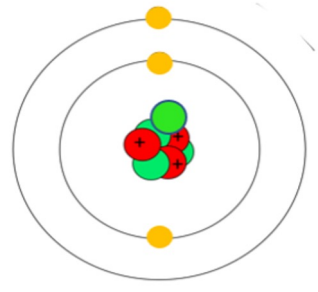
When an atom loses or gains an electron, the overall charge of that atom is no longer balanced. The atom becomes attracted to other atoms. We call that type of atom an ion.





Practice

- An atom has three particles; protons, neutrons and electrons. Protons have a positive charge, neutrons are neutral, and electrons have a negative charge.
- A) Which particles make up the atomic mass of the atom? B) Draw a ring around the electron in this diagram that has the least charge.



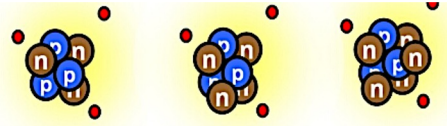
A) _____

- Which of the three particles gives us:- i) the atomic number of an element? ii) what else does that number generally indicate if this element is not an ion, and why?

23
Na
 sodium
 11

- Here are three isotopes of lithium; lithium 6, lithium 7 and lithium 8. The element in the periodic table is lithium 7. Explain why the other two isotopes occur.

6 Li lithium 3	7 Li lithium 3	8 Li lithium 3
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- Complete the nuclear number notation below with the information provided:-

¹²
C
 6

¹¹
B
 -

⁻
Li
 3

40
Ar
 18

Protons =
 Neutrons =
 Electrons =

Protons =
 Neutrons =
 Electrons =

Protons =
 Neutrons =
 Electrons =

Protons =
 Neutrons =
 Electrons =



Calculation using the periodic table

1		2		3										4										5										6										7										0
7 Li lithium 3		9 Be beryllium 4		11 B boron 5										12 C carbon 6										14 N nitrogen 7										16 O oxygen 8										19 F fluorine 9										4 He helium 2
23 Na sodium 11		24 Mg magnesium 12		27 Al aluminium 13										28 Si silicon 14										31 P phosphorus 15										32 S sulfur 16										35.5 Cl chlorine 17										40 Ar argon 18
39 K potassium 19		40 Ca calcium 20		45 Sc scandium 21		48 Ti titanium 22		51 V vanadium 23		52 Cr chromium 24		55 Mn manganese 25		56 Fe iron 26		59 Co cobalt 27		59 Ni nickel 28		63.5 Cu copper 29		65 Zn zinc 30		70 Ga gallium 31		73 Ge germanium 32		75 As arsenic 33		79 Se selenium 34		80 Br bromine 35		84 Kr krypton 36																				
85 Rb rubidium 37		88 Sr strontium 38		89 Y yttrium 39		91 Zr zirconium 40		93 Nb niobium 41		96 Mo molybdenum 42		98 Tc technetium 43		101 Ru ruthenium 44		103 Rh rhodium 45		106 Pd palladium 46		108 Ag silver 47		112 Cd cadmium 48		115 In indium 49		119 Sn tin 50		122 Sb antimony 51		128 Te tellurium 52		127 I iodine 53		131 Xe xenon 54																				
133 Cs caesium 55		137 Ba barium 56		139 La* lanthanum 57		178 Hf hafnium 72		181 Ta tantalum 73		184 W tungsten 74		186 Re rhenium 75		190 Os osmium 76		192 Ir iridium 77		195 Pt platinum 78		197 Au gold 79		201 Hg mercury 80		204 Tl thallium 81		207 Pb lead 82		209 Bi bismuth 83		[209] Po polonium 84		[210] At astatine 85		[222] Rn radon 86																				
[223] Fr francium 87		[227] Ac* actinium 89		[227] Ac* actinium 89		[261] Rf rutherfordium 104		[262] Db dubnium 105		[264] Sg seaborgium 106		[264] Bh bohrium 107		[277] Hs hassium 108		[268] Mt meitnerium 109		[271] Ds darmstadtium 110		[272] Rg roentgenium 111		[285] Cn copernicium 112		[286] Nh nihonium 113		[289] Fl flerovium 114		[289] Mc moscovium 114		[293] Lv livermorium 116		[294] Ts tennessine 117		[294] Og oganesson 118																				

Key

Relative atomic mass
Atomic symbol
Name
Atomic (proton) number

1 H hydrogen 1

To make our calculations easier for these lessons, round the atomic mass number up to the nearest whole number; i.e., in lithium (Li) atomic number = 3, atomic mass = 7

5. Complete the information in the table.

Atom	Isotope
${}^7_3\text{Li}$ Protons = <input type="text" value="3"/> Neutrons = <input type="text" value="4"/> Electrons = <input type="text" value="3"/>	${}^6_3\text{Li}$ Protons = <input type="text"/> Neutrons = <input type="text"/> Electrons = <input type="text"/>
${}^{12}_6\text{C}$ Protons = <input type="text"/> Neutrons = <input type="text"/> Electrons = <input type="text"/>	${}^{13}_6\text{C}$ Protons = <input type="text"/> Neutrons = <input type="text"/> Electrons = <input type="text"/>
${}^{24}_{12}\text{Mg}$ Protons = <input type="text" value="12"/> Neutrons = <input type="text" value="12"/> Electrons = <input type="text"/>	${}^{26}_{12}\text{Mg}$ Protons = <input type="text"/> Neutrons = <input type="text"/> Electrons = <input type="text"/>

6. Complete the data for these ions

Ion
Li^+ Protons = <input type="text"/> Neutrons = <input type="text"/> Electrons = <input type="text"/>
Cu^{2+} Protons = <input type="text"/> Neutrons = <input type="text"/> Electrons = <input type="text"/>
Al^{3+} Protons = <input type="text"/> Neutrons = <input type="text"/> Electrons = <input type="text"/>