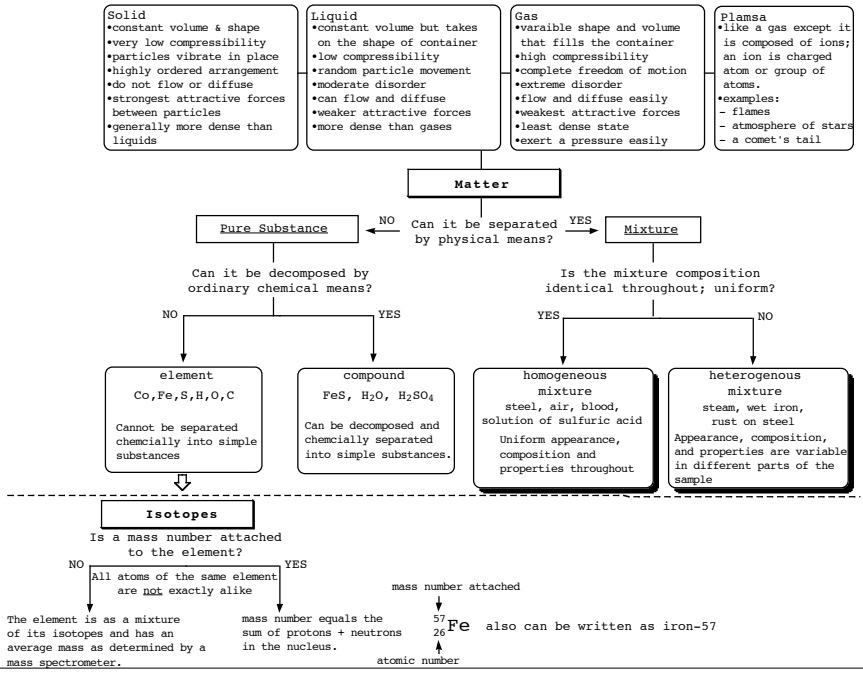
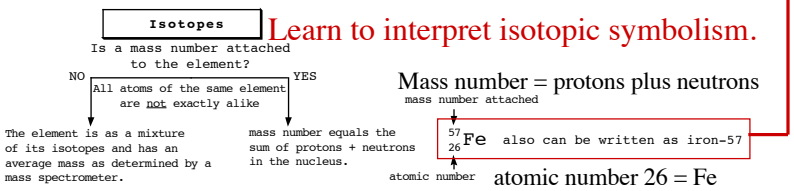
Elements - elements are pure homogeneous forms of matter



Isotopic Symbolism

$^{57}_{26}\mathrm{Fe}$ iron-57

A. Know the how to draw correct isotopic symbols.
B. Know how to interpret the meaning of each symbolic part.
C. All isotopes (istopic symbols) are given a mass number.



Learn to interpret isotopic symbolism.

Mass number = protons plus neutrons

atomic number 26 = Fe

26 protons = 26 electrons for atoms

How many protons and neutrons are in the nucleus of iron-57?

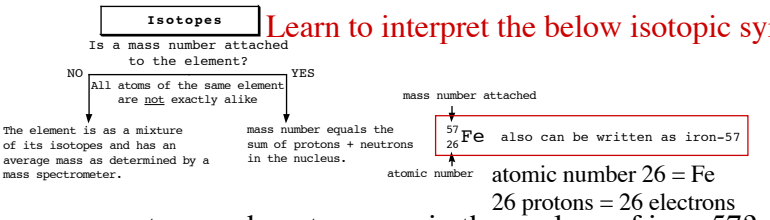
mass number minus atomic number equals number of neutrons

(57 - 26) = 31 neutrons

Elements are made from atoms having the same atomic number, protons

Are all atoms of one particular atom the same or are they mixtures?

1) All atom nuclei for an element have the same number of protons.
2) Every atom in an element has the same number of protons & electrons
3) However, elements are mixtures of their isotopes
4) Isotopes are same atom but can have a different **mass number**
5) **Mass number equals the total number of protons and neutrons in the nucleus for an atom.**
6) Mixtures of isotopes for a given element can be physically separated by use of a mass spectrometer



Learn to interpret the below isotopic symbolism.

atomic number 26 = Fe

26 protons = 26 electrons

How many protons and neutrons are in the nucleus of iron-57?

mass number minus atomic number equals number of neutrons

(57 - 26) = 31 neutrons

HO 34

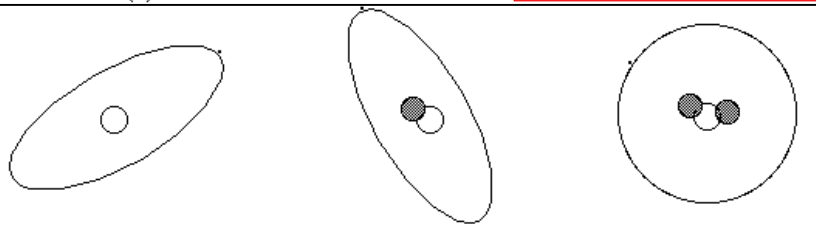
Isotopes of Hydrogen & Nuclear Fusion
Dr.Gergens - Mesa College

neutron (n) mass ≅ 1 amu (atomic mass unit)

proton (p) mass = 1 amu

electron (e) mass = 1/2000 amu

KNOW for each subatomic particle:
- **its mass**
- **its properties**
- **its location about the atom**



hydrogen, H	deuterium, D	tritium, T
hydrogen-1	hydrogen-2	hydrogen-3
most stable form	stable form	least stable form
most abundant	but twice as heavy as H	radioactive
99% naturally occurring	1% naturally occurring	synthetically made

Let's break it down:

- calculating the number of neutrons, protons and electrons
- drawing isotopic symbols

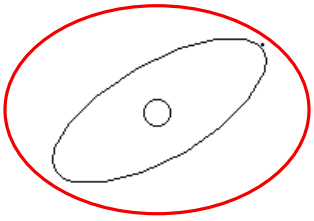
HO 34

Isotopes of Hydrogen & Nuclear Fusion
Dr.Gergens - Mesa College

neutron (n) mass ≅ 1 amu (atomic mass unit)

proton (p) mass = 1 amu

electron (e) mass = 1/2000 amu



hydrogen, H

hydrogen-1

most stable form

most abundant

99% naturally occurring

Draw Isotopic Symbolism

mass number on top

$^{1}_{1}H$

atomic number on bottom

For the illustration,
Calculate the number of
neutrons, protons & electron
using the legend above

n = zero

p = one (physical identity)

e = one (chemical reactivity)

atoms have equal numbers

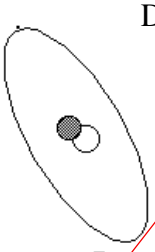
HO 34

Isotopes of Hydrogen & Nuclear Fusion
Dr.Gergens - Mesa College

neutron (n) mass ≅ 1 amu (atomic mass unit)

proton (p) mass = 1 amu

electron (e) mass = 1/2000 amu



deuterium, D

hydrogen-2

stable form

but twice as heavy as H

1% naturally occurring

Draw Isotopic Symbolism

mass number on top

$^{2}_{1}H$

atomic number on bottom

Calculate the number of
neutrons, protons & electrons

n = one

p = one (physical identity)

e = one (chemical reactivity)

Isotopes of Hydrogen & Nuclear Fusion
Dr.Gergens - Mesa College

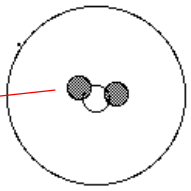
neutron (n) mass ≅ 1 amu (atomic mass unit)
proton (p) mass = 1 amu
electron (e) mass = 1/2000 amu

Draw Isotopic Symbolism

mass number on top

$^{3}_{1}H$

atomic number on bottom



tritium, T
hydrogen-3
least stable form
radioactive
synthetically made

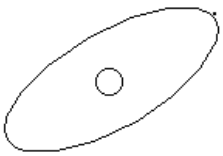
Calculate the number of neutrons, protons & electrons

n = two
p = one (physical identity)
e = one (chemical reactivity)

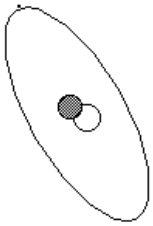
Average Atomic Mass

atomic mass is an average mass of naturally occurring isotopes

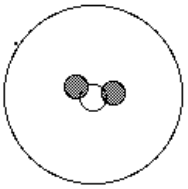
neutron (n) mass ≅ 1 amu (atomic mass unit)
proton (p) mass = 1 amu
electron (e) mass = 1/2000 amu



hydrogen, H
hydrogen-1
most stable form
most abundant
99% naturally occurring



deuterium, D
hydrogen-2
stable form
but twice as heavy as H
1% naturally occurring

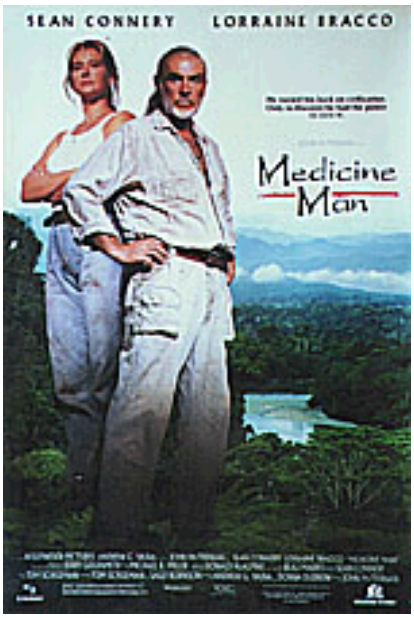


tritium, T
hydrogen-3
least stable form
radioactive
synthetically made

99% (1amu) + 1%(2amu) = 1.01 amu

Average Atomic Mass for H

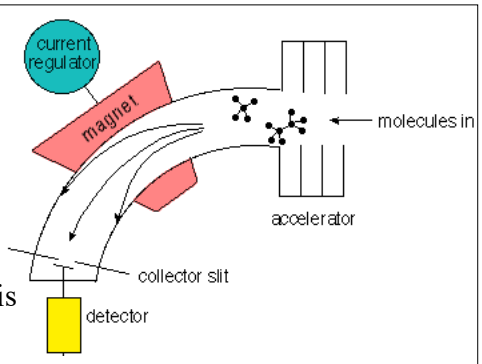
The separation of the isotopes of chlorine as seen in the movie “medicine man”



In the movie the separation of chlorine isotopes
were accomplished by the use of a mass spectrometer

Got’s to save that rain forest
Go Sean go!!!

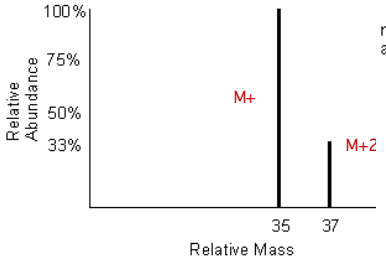
The Mass Spectrometer

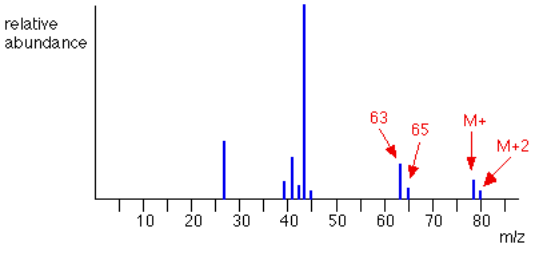


The element chlorine is a mixture of two isotopes in a 3 to 1 ratio which gives a mass spectrum that is

a finger print for the isotopes of chlorine-35 & chlorine-37

simplified mass spectrum of 2-chloropropane - CH_3CHCH_3 (Cl)





Average Atomic Mass 75% (35amu) + 25%(37amu) = 35.5 amu Cl

Average Atomic Mass

atomic mass is an average mass of naturally occurring isotopes

Draw Isotopic Symbolisms for chlorine-35 & chlorine-37

Mass number equals neutrons plus protons

$^{35}_{17}Cl$ $^{37}_{17}Cl$

$^{35}_{17}Cl$	$^{37}_{17}Cl$
n = 18	n = 20
p = 17 (physical identity)	p = 17 (physical identity)
e = 17 (chemical reactivity)	e = 17 (chemical reactivity)

atoms have equal numbers

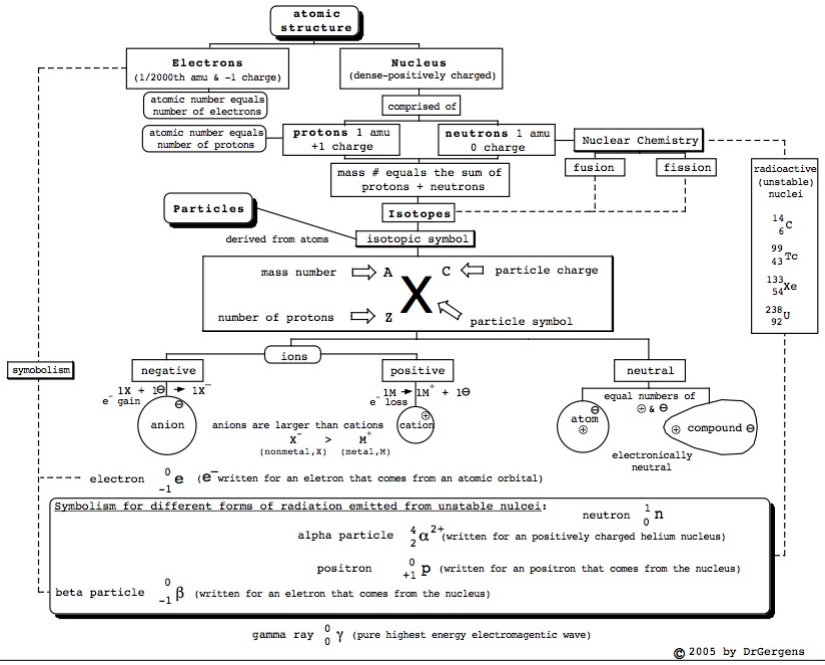
atoms have equal numbers

Natural terrestrial abundance of chlorine-35 & chlorine-37 is 75% and 25%, respectively

average atomic mass as shown on the periodic table

Average Atomic Mass 75% (35amu) + 25%(37amu) = 35.5 amu Cl

Atomic Structure, Isotopic Symbolism & Nuclear Handout



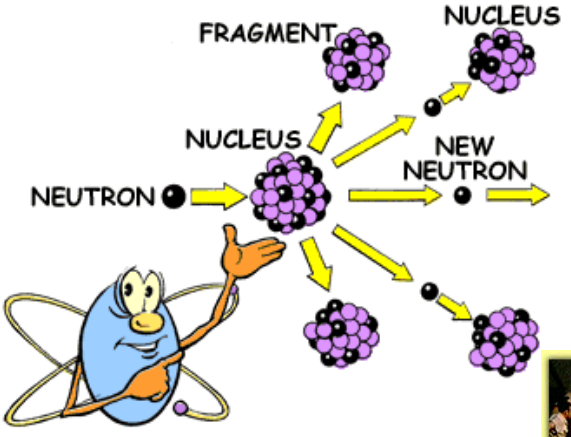
So elements can be physically separated by a mass spectrometer, but can atoms in elements be chemically changed or altered?

Yes, elements can be chemically changed in a **nuclear reaction**, either by

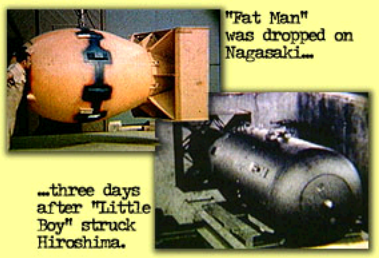
1) fission (a large atom fizzles down into smaller atoms)

2) fusion (to fuse atoms together into large atoms)

Nuclear Fission



The first man-made nuclear explosion, in the New Mexico desert. July 16, 1945.



"Fat Man" was dropped on Nagasaki...

...three days after "Little Boy" struck Hiroshima.

Hmm…what could I do with this?

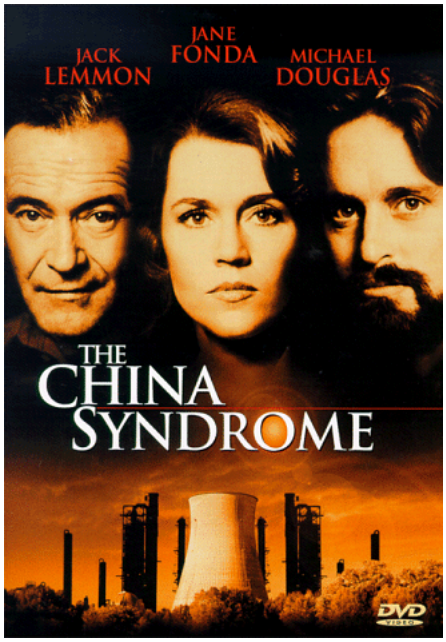
The Atomic Age: From fission to fallout

http://www.cnn.com/SPECIALS/cold.war/experience/the.bomb/history.science/

Nuclear fission at its best

or Worst

2011 tsunami, following a 9.0 magnitude quake, triggered the world's worst nuclear disaster in a generation



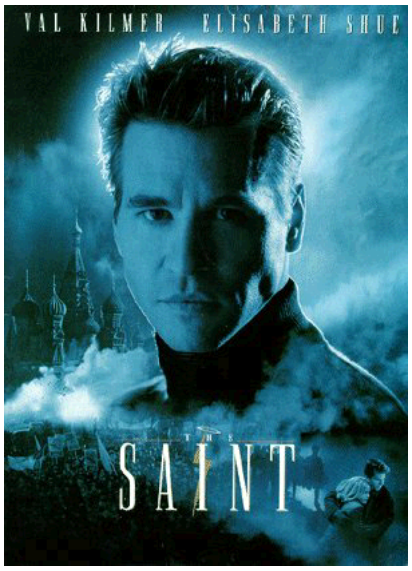
http://history.sandiego.edu/gen/filmnotes/chinasyndrome.html

Nuclear Chemistry at its best???

Cold Fusion???? (pure fantasy)

The science of producing the power of the sun at room temperature is pure fantasy….

...however women pursuing careers in science is not fantasy



The Nobel Prize in Chemistry

Marie Curie - Facts

Marie Curie, née Sklodowska

Born: 7 November 1867, Warsaw, Russian Empire (now Poland)

Died: 4 July 1934, Sallanches, France

Affiliation at the time of the award: Sorbonne University, Paris, France

Prize motivation: "in recognition of her services to the advancement of chemistry by the discovery of the elements radium and polonium, by the isolation of radium and the study of the nature and compounds of this remarkable element"

Field: nuclear chemistry

The Nobel Prize in Chemistry

The Nobel Prize in Chemistry 2009

→ Ada E. Yonath

"for studies of the structure and function of the ribosome"

The Nobel Prize in Chemistry 1964

→ Dorothy Crowfoot Hodgkin

"for her determinations by X-ray techniques of the structures of important biochemical substances"

The Nobel Prize in Chemistry 1935

→ Irène Joliot-Curie

"in recognition of their synthesis of new radioactive elements"

The Nobel Prize in Chemistry 1911

→ Marie Curie, née Sklodowska

"in recognition of her services to the advancement of chemistry by the discovery of the elements radium and polonium, by the isolation of radium and the study of the nature and compounds of this remarkable element"

Ada E. Yonath - Facts

Photo: U. Montan

Ada E. Yonath

Born: 22 June 1939, Jerusalem, British Mandate of Palestine (now Israel)

Affiliation at the time of the award: Weizmann Institute of Science, Rehovot, Israel

Prize motivation: "for studies of the structure and function of the ribosome"

Field: biochemistry, structural chemistry

Dorothy Crowfoot Hodgkin - Facts

Dorothy Crowfoot Hodgkin

Born: 12 May 1910, Cairo, Egypt

Died: 29 July 1994, Shipston-on-Stour, United Kingdom

Affiliation at the time of the award: University of Oxford, Royal Society, Oxford, United Kingdom

Prize motivation: "for her determinations by X-ray techniques of the structures of important biochemical substances"

Field: biochemistry, structural

The Nobel Prize in Chemistry 1935

Frédéric Joliot
Prize share: 1/2

Irène Joliot-Curie
Prize share: 1/2

The Nobel Prize in Chemistry 1935 was awarded jointly to Frédéric Joliot and Irène Joliot-Curie *"in recognition of their synthesis of new radioactive elements"*

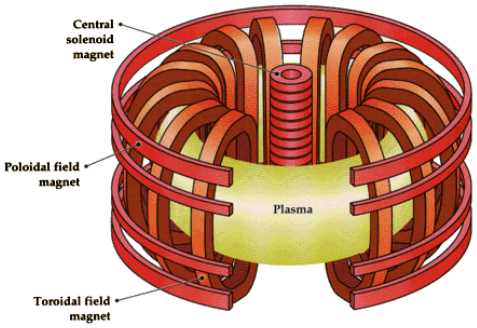
Nuclear Chemistry at its best

HOT Fusion

The science of producing the power of the sun in San Diego is a reality

The Tokamak Reactor at General Atomics

http://fusion.gat.com/



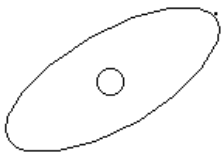
Nuclear fission in San Diego will being with three isotopes of hydrogen.

Isotopes of Hydrogen & Nuclear Fusion
Dr.Gergens - Mesa College

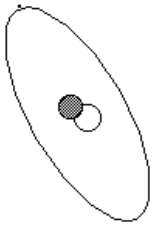
neutron (n) mass ≅ 1 amu (atomic mass unit)

proton (p) mass = 1 amu

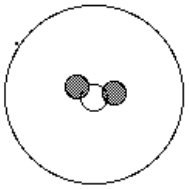
electron (e) mass = 1/2000 amu



hydrogen, H
hydrogen-1
most stable form
most abundant
99% naturally occurring

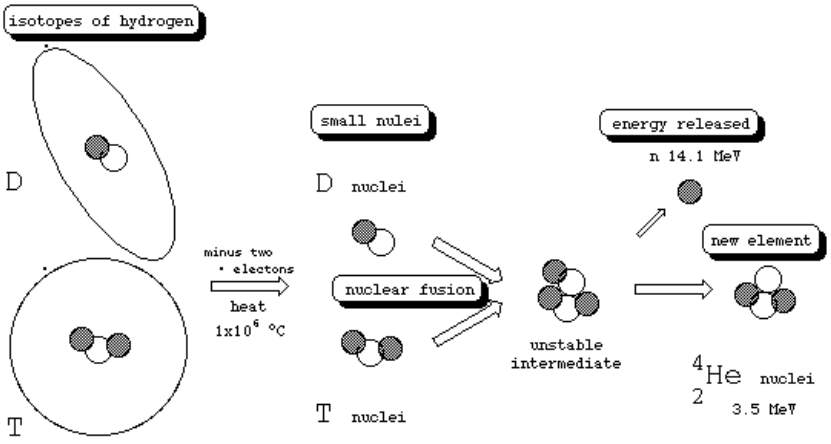


deuterium, D
hydrogen-2
stable form
but twice as heavy as H
1% naturally occurring



tritium, T
hydrogen-3
least stable form
radioactive
synthetically made

Nuclear fusion is the combining of small nuclei into a large one.

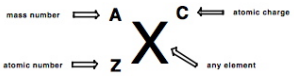


Nuclear fission is the reverse process of nulear fusion

Radiation - Know the three types of radiation and their characteristics

NUCLEAR CHEMISTRY

Dr. Gergens - Mesa College



Number of protons = Z Number of neutrons = A - Z

3 Types of Radiation

Name and Symbol	Identity	Charge	Mass (amu)	Penetration
Alpha (α)	Helium nucleus	2+	4	Low
Beta (β)	Electron	1-	1/1820	Medium
Gamma (γ)	Radiant energy	0	0	High

Radiation - Know the characteristics of radioactive isotopes

Characteristics of Radioactive Isotopes

Binding energy - the energy that holds the protons, neutrons, and other particles together in the nucleus.

List the four factors responsible for nuclear stability

1.	Nuclear stability correlates with the ratio of neutrons to protons in the isotope. A ratio of 1:1 is preferred
2.	Nuclei with large numbers of protons (Z = 84 or greater) tend to be unstable.
3.	Isotopes containing the "magic numbers" 2, 8, 20, 50, 82 or 126 protons or neutrons are stable.
4.	Isotopes with even numbers of protons or neutrons are generally more stable than those with odd numbers.

Nuclear Reaction - Know the process for balancing nuclear reactions

$^{210}_{84}Po \longrightarrow {}^{4}_{2}\alpha + {}^{206}_{82}Pb$

$^{40}_{20}Ca \longrightarrow {}^{0}_{-1}\beta + {}^{40}_{21}Sc$

$^{235}_{92}U \longrightarrow {}^{4}_{2}\alpha + {}^{231}_{90}Th$

$^{222}_{86}Rn \longrightarrow {}^{4}_{2}\alpha + {}^{218}_{84}Po$

$^{238}_{92}U \longrightarrow {}^{0}_{-1}\beta + {}^{238}_{93}Np$

$^{247}_{97}Bk \longrightarrow {}^{4}_{2}\alpha + {}^{243}_{95}Am$

A. In each of the above reactions, the reaction arrow means "goes to"

B. The reactants are on the left, and the products are on the right

C. Total mass (mass numbers) of reactants must be equal to the total mass (mass numbers) of the products

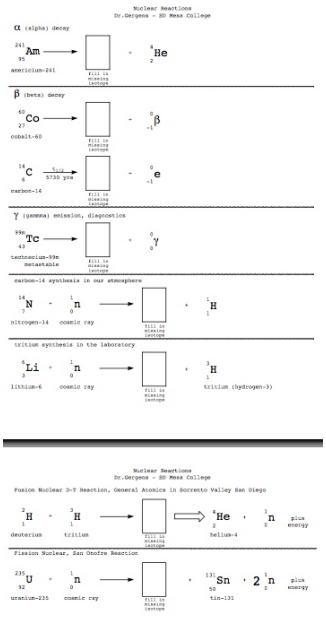
210 = 4 + 206

reactant(s) $^{210}_{84}Po$ **goes to** $^{4}_{2}\alpha + {}^{206}_{82}Pb$ **product(s)**

84 = 2 + 82

D. Total protons (atomic numbers) of reactants must be equal to the total protons (atomic numbers) of the products

Nuclear Reactions - Complete the handout and check your answers



Mass Spectrometer