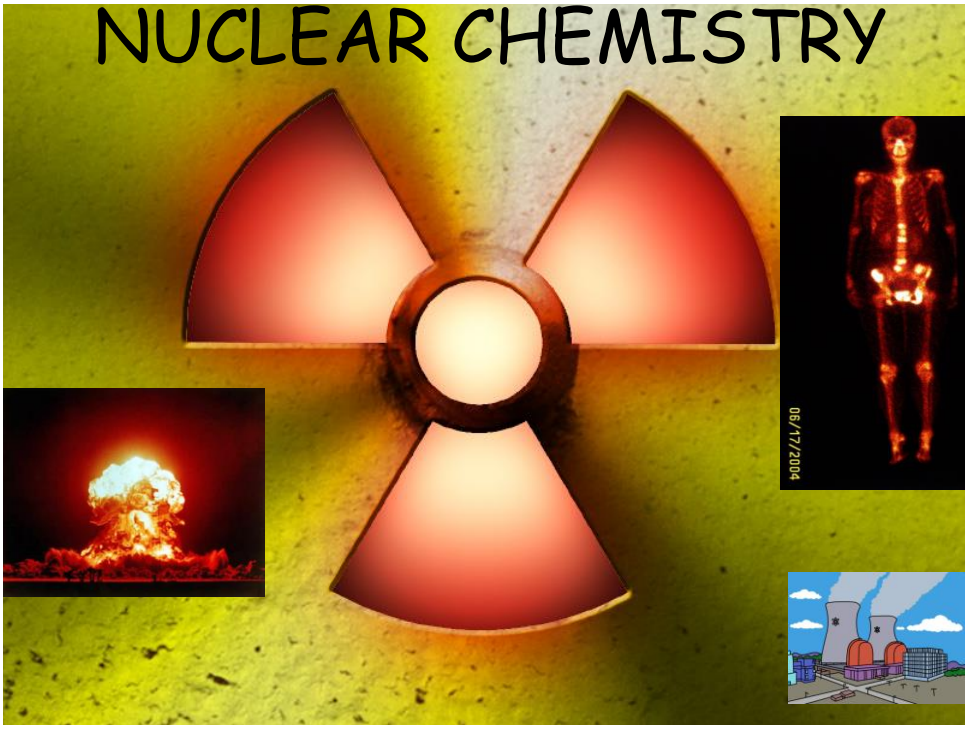
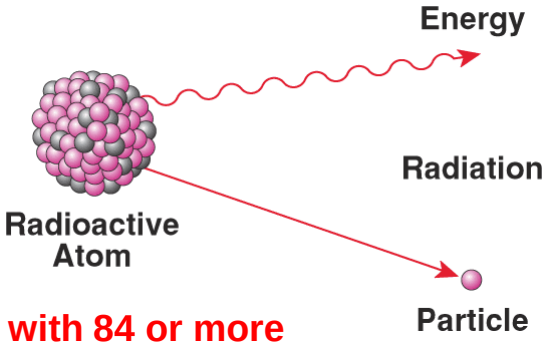


Nuclear and radiation chemistry
(334 chem)

What is nuclear chemistry?

Nuclear chemistry is the study of the structure of **atomic nuclei** and the **changes** they undergo.

What is nuclear chemistry?



Any atom with 84 or more protons is radioactive

Chemical vs. Nuclear Reactions

Chemical Reactions	Nuclear Reactions
1.Occur when bonds are broken.	1. Occur when nuclei emit particles and/or rays.

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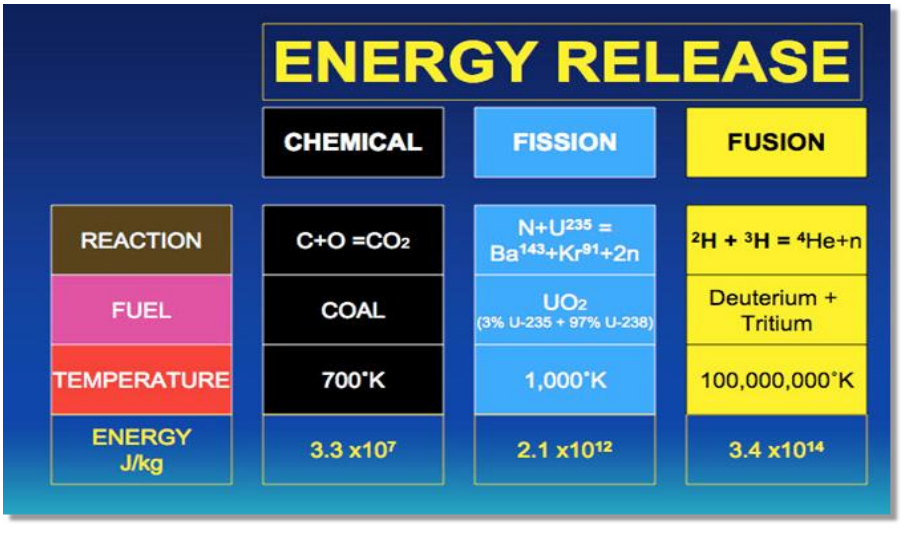
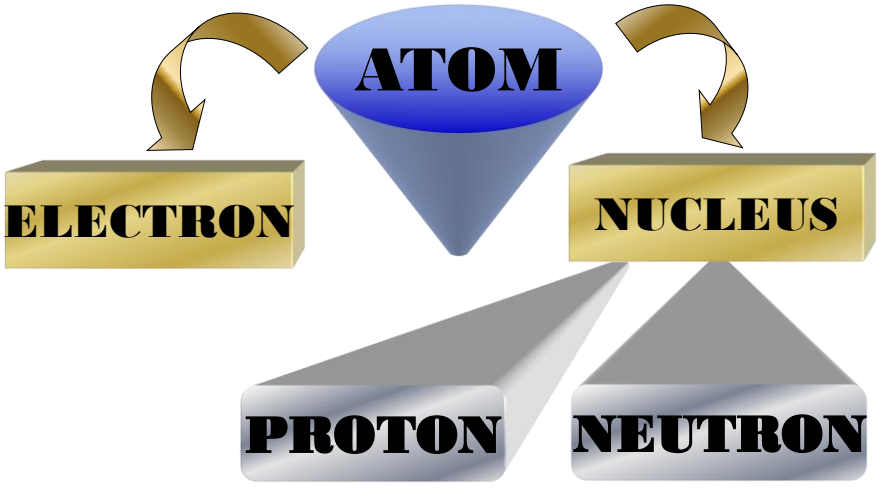
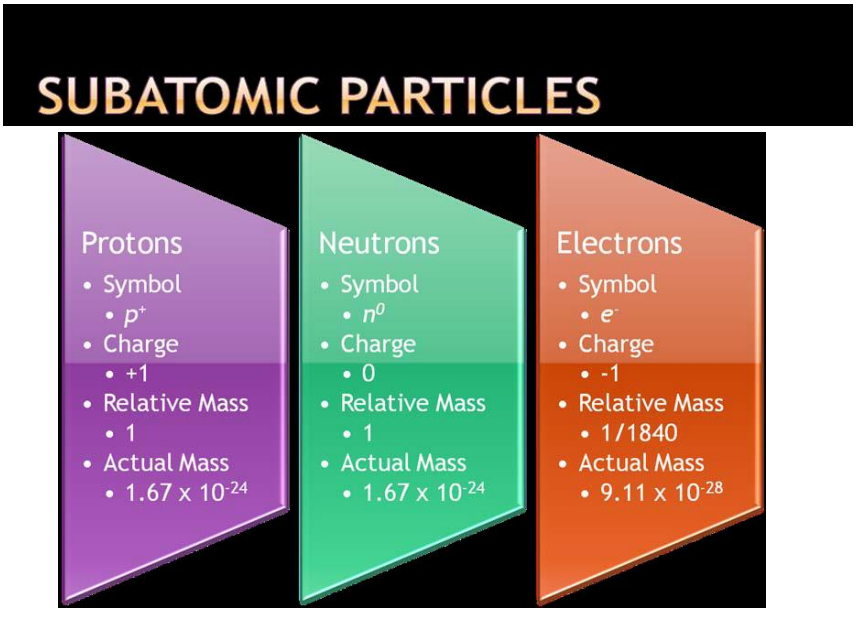
3. Involve only valence electrons.	3. May involve protons, neutrons, and electrons.
4. Associated with small energy changes.	4. Associated with large energy changes.
5. Reaction rate influenced by temperature, particle size, concentration, etc.	5. Reaction rate is not influenced by temperature, particle size, concentration, etc.

Compare the energy relase in chemical reaction and nuclear reaction

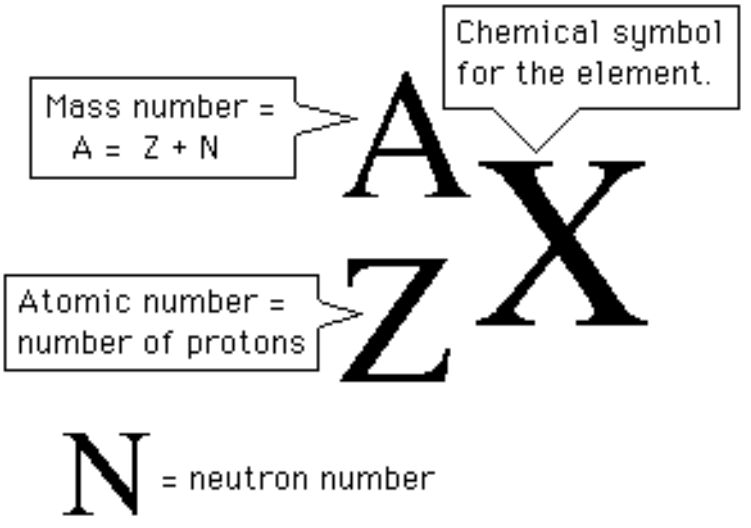


Basic Particles of Atom





Atomic Number and Mass Number



Atomic Number and Mass Number

$^{27}_{13}\mathrm{Al}$

- Total number of nucleons is 27
- Total number of protons is 13
- The number of neutrons is 14

EXERCISE
Complete the table below!

Atomic Number	Mass Number	Proton	Neutron	Electron	Symbol
					$^{18}_{10}Ne$
					$^{108}_{47}Ag$
					$^{119}_{50}Sn$
83	209				$^{209}_{83}Bi$
	137		81		$^{137}_{56}Ba$
	56	26			$^{56}_{26}Fe$
		16	15		$^{31}_{16}S$
			31	28	$^{59}_{28}Ni$

EXERCISE
Complete the table below!

Atomic Number	Mass Number	Proton	Neutron	Electron	Symbol
10	18	10	8	10	$^{18}_{10}Ne$
47	108	47	61	47	$^{108}_{47}Ag$
50	119	50	69	50	$^{119}_{50}Sn$
83	209	83	126	83	$^{209}_{83}Bi$
56	137	56	81	56	$^{137}_{56}Ba$
26	56	26	30	26	$^{56}_{26}Fe$
16	31	16	15	16	$^{31}_{16}S$
28	59	28	31	28	$^{59}_{28}Ni$

What is these??

ISOTOPE

ISOBAR

ISOTONE

ISOELECTRON

ISOTOPE

DEFINITION OF ISOTOPE:

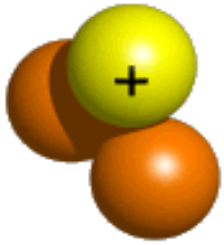
The atoms which have similar atomic number but the mass number is different.

EXAMPLE:

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

$^{12}_{6}C$, $^{13}_{6}C$ and $^{14}_{6}C$

The Nuclei of the Three Isotopes of Hydrogen

Protium	Deuterium	Tritium
		
1 proton	1 proton 1 neutron	1 proton 2 neutrons
$^{1}_{1}H$	$^{2}_{1}H$	$^{3}_{1}H$
Protium	Deuterium	Tritium

ISOBAR

DEFINITION OF ISOBAR:

The atoms which have different atomic number (the element is different) but the mass number is same.

EXAMPLE:

$^{14}_{7}N$ **and** $^{14}_{6}C$

$^{24}_{11}Na$ **and** $^{24}_{12}Mg$

ISOTONE

DEFINITION OF ISOTONE:

The atoms which come from different element, but the amount of neutron is same

Example:

Oxygen $^{16}_{8}O$ (p=8; n=8)

Nitrogen $^{15}_{7}N$ (p=7; n=8)

Carbon $^{14}_{6}C$ (p=6; n=8)

are isotones because of having same no. of neutron (8).

ISOELECTRON

DEFINITION OF ISOELECTRON:

The atoms which come from different element, but the amount of electron is same

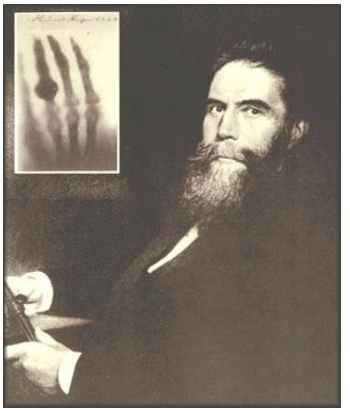
EXAMPLE:

$^{27}_{13}Al^{3+}$, $^{16}_{8}O^{2-}$ and $^{20}_{10}Ne$

p = 13	p = 8	p = 10
n = 14	n = 8	n = 10
e = 10	e = 10	e = 10

Discovery of Radiation

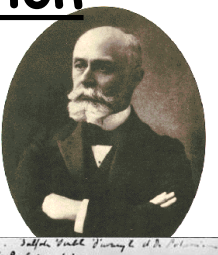
Roentgen (1895)



- Studied fluorescent materials that glowed when hit with a beam of electrons.
- Discovered a mysterious form of radiation was given off even without electron beam. This radiation could pass through paper and other objects but not dense materials (lead, bone).
- Called them X-rays

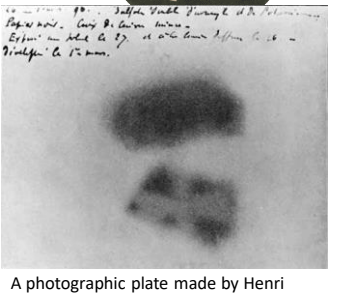
Discovery of Radiation

Becquerel (1896)



He designed an experiment to determine if phosphorescent minerals also gave off X-rays.

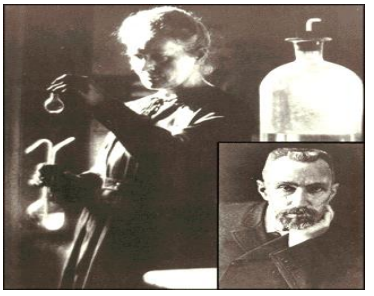
Becquerel discovered that certain minerals were constantly producing energy rays that could penetrate matter. Becquerel determined that all the minerals that produced these rays contained uranium. The rays were produced even though the mineral was not exposed to outside energy. He called them uranic rays because they were emitted from minerals that contained uranium like X-rays.



A photographic plate made by Henri Becquerel shows the effects of exposure to radioactivity. A metal Maltese cross, placed between the plate and radioactive uranium salt, left a clearly visible shadow on the plate.

Discovery of Radiation

Pierre and Marie Curie



Marie Curie broke down these minerals and used an electroscope to detect where the uranic rays were coming from. She discovered the rays were emitted from specific elements. She also discovered new elements by detecting their rays:

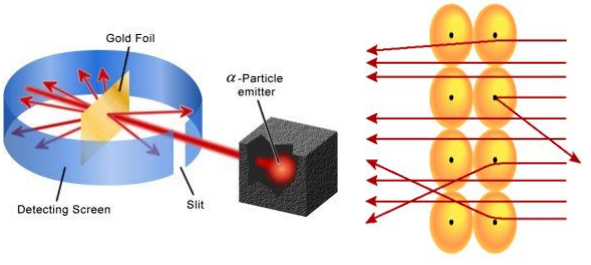
- radium named for its green phosphorescence
- polonium named for her homeland. Because these rays were no longer just a property of uranium, she renamed it radioactivity

Discovery of Radiation

Rutherford

•Studied radioactivity and named types of nuclear radiation.

•Discovered that elements decay into other elements after emitting nuclear radiation. Called it Nuclear Decay.



•Gold foil experiment revealed that the mass of an atom is concentrated in the nucleus (atom is mostly space).

Definition of some terminology in nuclear chemistry

***nuclear reactions**: **reaction that involves a change in an atom's nucleus**

*** Radioactivity**: **Radioactivity is the spontaneous emission of radiation in the form of particles**

***Radioactive decay**: **loss of energy by a nucleus as it emits radiation until it forms a stable atom**

***Radiation is an energy in the form of electro-magnetic waves or particulate matter, traveling in the air."**

***Nucleons: summation of proton and neutron in nucleus of atoms**

***Nuclear binding energy : The energy that must be added to separate the nucleons into its individual (protons and neutrons**