Chemistry 6A F2007

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Monday

12/3/07

Exam 3: Friday 12/7/07 (here in lecture)

What will be covered on the exam?

- •Chapter 6: 6.9-6.15
- •Chapter 7: All
- •Chapter 8: All
- •Chapter 9: 9.1 - 9.9
- •Any thing from lab as well

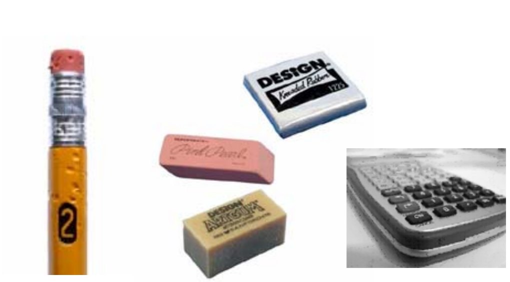
What do I need to bring?

Bring a Pencil, Eraser, Calculator and scamtron form 882

YOU NEED TO KNOW YOUR LAB SECTION NUMBER!

What do I need to bring?

Scantron form 882
100 question jobby-doo



chewing optional…

Chapter 10: *Radioactivity and Nuclear Processes*

LEARNING OBJECTIVES

After completing this chapter, you should be able to:

1. Describe and characterize the common forms of radiation.
2. Write balanced equations for nuclear reactions.
3. Solve radioactive half-life problems.
4. Describe the influence of radiation on health.
5. Describe and compare the units used to measure radiation.
6. Describe uses of radioisotopes.
7. Understand the concept of induced nuclear reactions.
8. Describe nuclear fission and fusion reactions.

Radiation vs. Radioactivity

What is the difference between radiation and radioactivity?

Radiation is energy in transit, either particulate or electromagnetic in nature

Radioactivity is the characteristic of various materials to emit ionizing radiation.

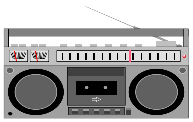
Ionization is the removal of electrons from an atom.

High energy radiation when interacting with matter can stimulate the ejection of electrons.

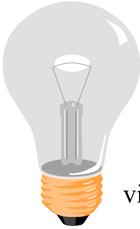
Is all radiation harmful? NO!

Non-Ionizing Radiation does not have enough energy to remove electrons from atoms.

Examples of non-ionizing radiation are:



Radio waves



visible light

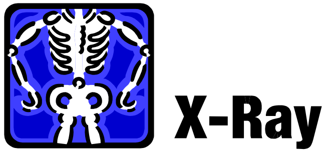
micro waves

Ionizing Electromagnetic Radiation:

These photons do have enough energy to remove electrons from atoms

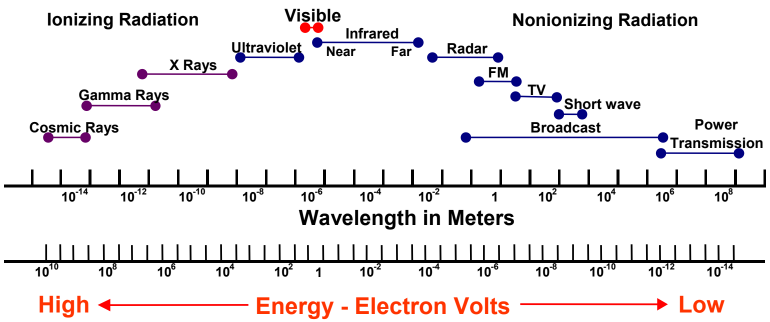
Examples:

X-rays



Gamma rays (cosmic rays)

Electromagnetic Spectrum



Solar radiation wavelength

Visible light – 400 to 760 nm

Ultraviolet radiation (UV) > 400 nm (sunburn)

Infrared radiation < 760 nm (heat)

UV radiation

Stimulates melanin (dark pigment) that absorbs UV protecting cells

Health Effects

out of every 2 to 3 million non-malignant skin cancers, there are ~130,000 malignant melanomas (~ 5 %)

Sunburn

acute cell injury causing inflammatory response (erythema)

Accelerates aging process

RADIOACTIVE NUCLEI

In 1896 Henri Becquerel, a French physicist, discovered that uranium compounds emitted rays that could fog photographic plates wrapped in lightproof paper.

Research showed that the penetrating rays originate from changes that occur in the nuclei of some atoms.

Radioactive nuclei are nuclei that undergo spontaneous changes and emit energy in the form of radiation.

The emission of radiation by radioactive nuclei is often called **radioactive decay.**

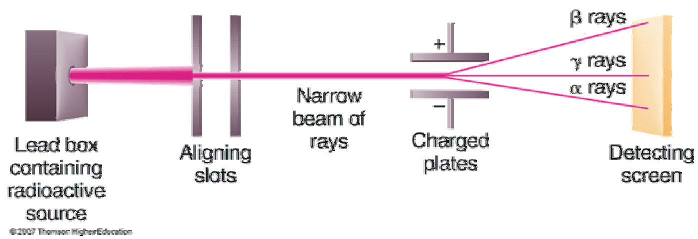
Historical Perspective:

1895 - Wilhem Conrad Roentgen discovered X-rays and in 1901 he received the first Nobel Prize for physics.

1903 - Marie Curie and Pierre Curie, along with Henri Becquerel were awarded the Nobel Prize in physics for their contributions to understanding radioactivity, including the properties of uranium.

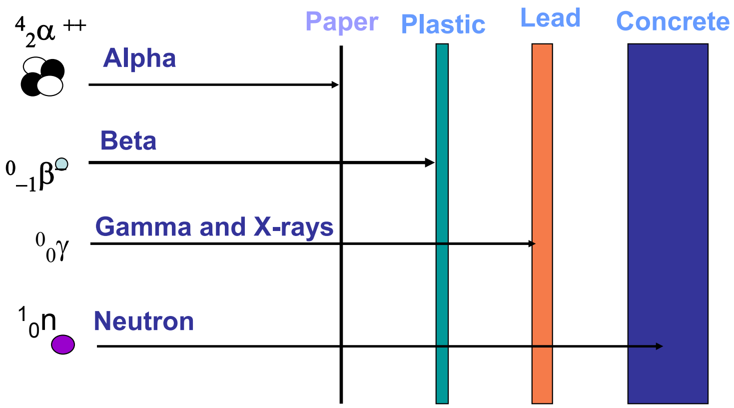
1942 - Enrico Fermi and others started the first sustained nuclear chain reaction in a laboratory beneath the University of Chicago football stadium.

Radiation emitted by uranium or by other radioactive elements, can be separated into three types by an electrical or magnetic field.



•Particles deflected downward towards the negative plate must be positive.
•Particles deflected upward towards the positive plate must be negative.
•Particles that are unaffected by the plates must be neutral.

Types of Radiation



ALPHA RADIATION

Alpha radiation consists of a stream of particles called alpha particles. Alpha particles are helium-4 nuclei: two protons and two neutrons, He^{2+}.

BETA RADIATION

Beta radiation consists of a stream of beta particles (electrons). They are created in the nucleus of radioactive atoms when a neutron is converted into a proton and an electron.

GAMMA RADIATION

Gamma radiation consists of high energy photons similar to X rays, but with a higher energy.

NEUTRON RADIATION

Neutron radiation consists of a stream of high energy neutrons emitted from the nuclei of radioactive nuclei.

POSITRON RADIATION

Positron radiation consists of a stream of positrons (e^+ electrons with a positive charge).
Positrons are created in the nucleus of radioactive atoms when a proton is converted into a neutron and a positron.

ELECTRON CAPTURE

While electron capture does not emit a stream of particles, it is a mode of decay for some unstable nuclei in which an electron from outside the nucleus is drawn into the nucleus, where it combines with a proton to form a neutron.

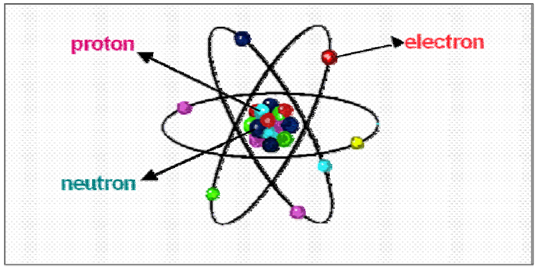
CHARACTERISTICS OF NUCLEAR RADIATION

TABLE 10.1 Characteristics of nuclear radiation

Type of radiation	Symbols	Mass number	Charge	Composition
Alpha	$^4_2\alpha$ (α, ^4_2He, He^{2+})	4	+2	Helium nuclei, 2 protons + 2 neutrons
Beta	$^{\ 0}_{-1}\beta$ (β, β^-, $^{\ 0}_{-1}e$, e^-)	0	−1	Electrons produced in nucleus and ejected
Gamma	γ ($^0_0\gamma$)	0	0	Electromagnetic radiation
Neutron	^1_0n (n)	1	0	Neutrons
Positron	$^0_1\beta$ (β^+, ^0_1e, e^+)	0	+1	Positive electrons

Atoms

The building blocks of all matter.
Made up of protons and neutrons and electrons.



Most all atoms are very stable
Some however, may have too much energy thus making them unstable. (radioactive)

NUCLEAR REACTIONS and PROCESSES:

In a chemical reaction, the atoms on both sides of the equation are not changed:

reactant elements = product elements

In nuclear reactions, specific isotopes of an element may behave differently.

An element may change into another isotope of itself or into a completely different element entirely!

$$^{A}_{Z}X \rightarrow {}^{A^*}_{Z}X \text{ or } {}^{A}_{Z}Y$$

EXAMPLES OF NUCLEAR REACTIONS

Example 1: Bromine-84 decays by emitting a beta particle. What is the symbol for the daughter produced?

Recall for isotopes: $^{A}_{Z}X$

X = the element
A = mass number
Z = atomic number

35 protons, 49 neutrons

$$^{84}_{35}Br \longrightarrow {}^{0}_{-1}\beta + {}^{84}_{36}Kr$$

When a beta particle is lost $\left({}^{0}_{-1}\beta\right)$ the daughter must have a mass number of 84 and an atomic number of 36.

$$^{84}_{35}Br \longrightarrow {}^{0}_{-1}\beta + {}^{84}_{36}Kr$$

Notice that overall mass and the number of protons are the same on each side of the arrow…

$$84 = 84 + 0$$
$$35 = -1 + 36$$

Just as in a chemical process, mass must be balanced in a nuclear process.