Chemistry 6A F2007

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Monday

12/10/07

Exams will be returned in lab, I will have scores posted as soon as I get them form your instructors.

Check out in lab will be held this week only.

If you fail to check out, you will be assessed a fine and have a hold placed on your records.

You last labs are due on the last day of the lab. Any labs turned in late will receive a ZERO score.

Final Exam: Friday 12/21/07 8-10 am (here in lecture)

What will be covered on the exam?

Chapter 1 through 10

The format will be multiple choice.

Many of the questions will be the same as those on your exams!

You can redo the OWL exercises by going into the past due assignments for practice.

TABLE 10.6 Examples of medically useful radioisotopes

Isotope	Emission	Half-life	Applications
$^{3}_{1}H$	beta	12.3 years	To measure water content of body
$^{32}_{15}P$	beta	14.3 days	Detection of tumors, treatment of a form of leukemia
$^{51}_{24}Cr$	gamma	27.8 days	Diagnosis: size and shape of spleen, gastrointestinal disorders
$^{59}_{26}Fe$	beta	45.1 days	Diagnosis: anemia, bone marrow function
$^{60}_{27}Co$	beta, gamma	5.3 years	Therapy: cancer treatment
$^{67}_{31}Ga$	gamma	78.1 hours	Diagnosis: various tumors
$^{75}_{34}Se$	beta	120.4 days	Diagnosis: pancreatic scan
$^{81}_{36}Kr$	gamma	2.1×10^{5} years	Diagnosis: lung ventilation scan
$^{85}_{38}Sr$	gamma	64 days	Diagnosis: bone scan
$^{99}_{43}Tc$	gamma	6 hours	Diagnosis: brain, liver, kidney, bone, and heart muscle scans
$^{123}_{53}I$	gamma	13.3 hours	Diagnosis: thyroid cancer
$^{131}_{53}I$	beta, gamma	8.1 days	Diagnosis and treatment: thyroid cancer
$^{197}_{80}Hg$	gamma	65 hours	Diagnosis: kidney scan

Maintaining a critical distance helps to avoid over exposure.

Distance involves the use of the **inverse square law of radiation:**

The intensity of radiation is inversely proportional to the square of the distance from the source of the radiation.

$$I_x = I_y \times \frac{d_y^2}{d_x^2}$$

As the distance away increases (x) the intensity of radiation decreases. I_y and d_y are the measured intensities at a distance d_y.

A radiation source is emitting at 100 mrads per hour at a distance of 3 ft.

How far must one stay back to minimize exposure to 50 μrads per hour?

$$I_x = I_y \times \frac{d_y^2}{d_x^2} \rightarrow \frac{I_x}{I_y} = \frac{d_y^2}{d_x^2} \rightarrow d_x^2 = \frac{I_y \times d_y^2}{I_x}$$

$$d_x = \sqrt{\frac{I_y \times d_y^2}{I_x}} \rightarrow d_x = \sqrt{\frac{100\text{mrad} \times (3\text{ft})^2}{50\mu\text{rad} \times \frac{1\text{mrad}}{10^3\mu\text{rad}}}}$$

d_x =134 feet! *Stay back Jack!*

INDUCED NUCLEAR REACTIONS

Induced nuclear reactions are processes that take place when nuclei are bombarded with subatomic particles such as *alpha* particles or *neutrons*.

$$^{14}_{7}N + ^{1}_{0}n \longrightarrow ^{14}_{6}C + ^{1}_{1}p$$

An example of an induced nuclear reaction is the one that produces radioactive carbon-14 in the atmosphere.

This process takes place when a nitrogen-14 atom is struck by a cosmic ray neutron.

Induced nuclear reactions have been used to produce all of the elements in the periodic table with atomic numbers greater than 92.

Transuranium Elements

In 1940, the first of the transuranium elements—elements with a Z > 92—was synthesized by bombarding uranium-238 nuclei with neutrons

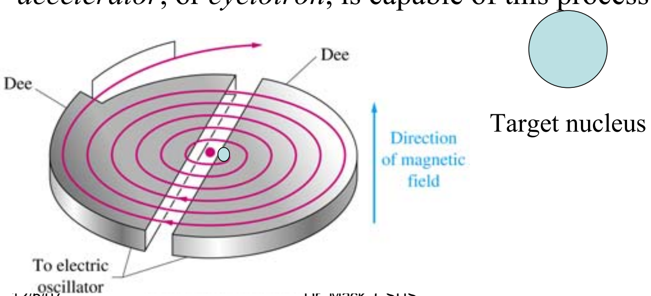
$$^{238}_{92}U + ^{0}_{1}n \rightarrow ^{238}_{93}U$$

$$^{239}_{92}U \rightarrow ^{0}_{-1}e + ^{239}_{93}Np$$

$$^{239}_{93}Np \rightarrow ^{0}_{-1}e + ^{239}_{94}Pu$$

Transuranium Elements

Considerable energy must be imparted to a positive ion in order for it to overcome repulsion by a positively charged nucleus. A machine, called a *charged-particle accelerator*, or *cyclotron*, is capable of this process



Fission vs. Fusion

Heavy nuclei (Uranium) release energy when they **split (Nuclear Fission)**

The **product nuclei** mass is **less** than the sum of the parent nuclei.

Light nuclei (hydrogen, helium) release energy when they **fuse (Nuclear Fusion)**

The **product nuclei** mass is **less** than the sum of the parent nuclei.

Where does the mass go?
Correct, ENERGY!

$$E = \Delta m \times c^2$$

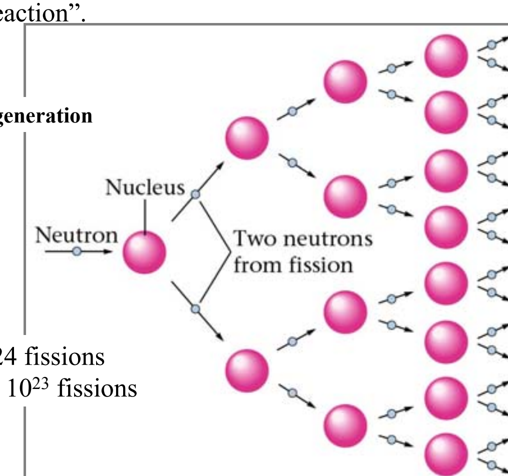
What is Nuclear Fusion?

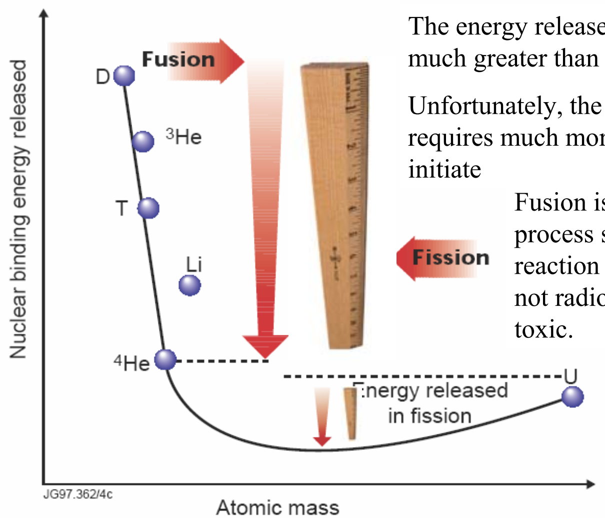
- ***Nuclear Fusion*** is the energy-producing process taking place in the core of the Sun and stars
- The core temperature of the ***Sun*** is about 15 million °C. At these temperatures ***hydrogen*** nuclei fuse to give ***Helium and Energy***.

The release of the additional neutrons in the fission process produces a "chain reaction".

 # fissions double every generation

10 generations = 1024 fissions
80 generations = 6×10^{23} fissions



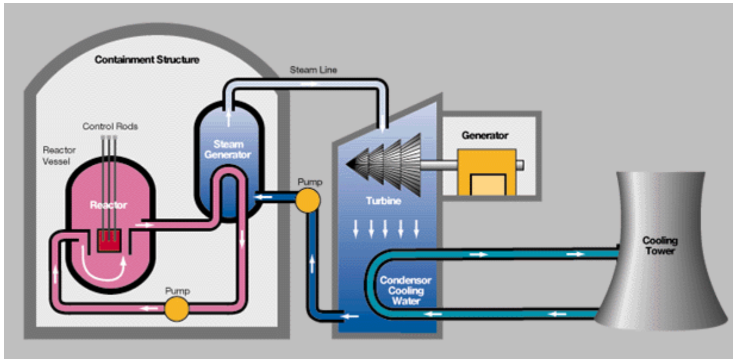


The energy release from fusion is much greater than that of fission.

Unfortunately, the fusion process requires much more energy to initiate

Fusion is a "cleaner" process since the reaction products are not radioactive or toxic.

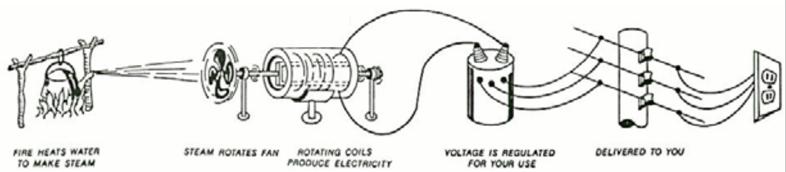
Pressurized Water Reactor



- The PWR has 3 separate cooling systems.
- Only 1 should have radioactivity, the Reactor Coolant System

The reactor makes steam.

The power is transferred to your home where….



The steam drives a turbine that produces electricity

You can play video games or recharge your cell phone…