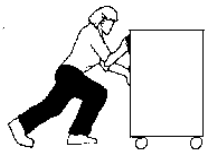
I WHAT IS ENERGY?:



A. Energy:

1. The ability to do work.

2. Work is done when a force causes an object to move.

in the direction of the force.

3. When one object does work on another, energy is transferred from the 1st object to the 2nd object.

B. Kinetic Energy:

1. The energy of motion.

2. All moving objects have kinetic energy.

3. Kinetic energy depends on mass and speed

a) The faster something is moving, the more kinetic energy it has.

b) The bigger the mass of a moving object, the greater its kinetic energy.

C. Potential Energy:

1. This is stored energy due to

a) position of the object.

b) composition of the object.

D. Mechanical Energy:

1. Both potential energy & kinetic energy are kinds of mechanical energy.

E. Kinetic vs Potential:

1. When the pendulum is going up....

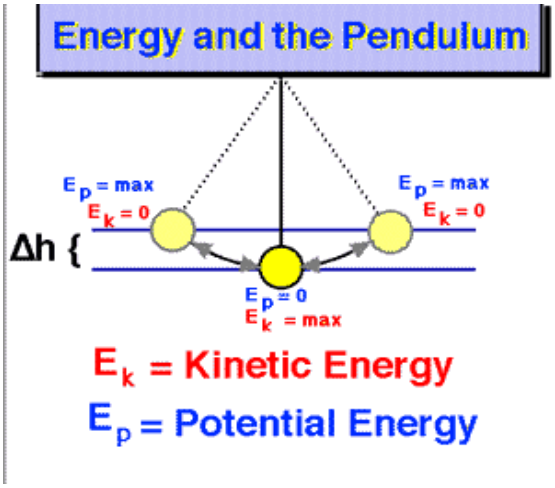
   Potential energy is increasing

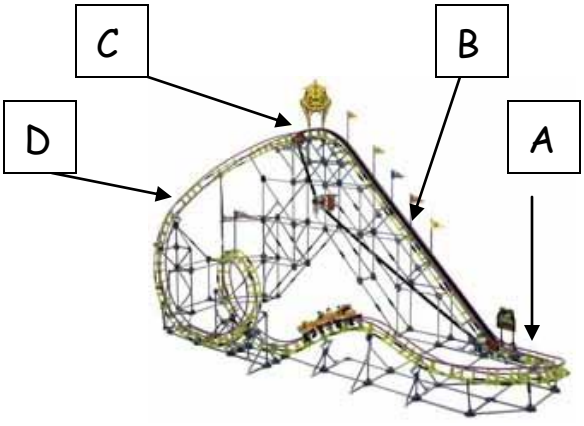
   Kinetic energy is decreasing

2. When the pendulum is going down

   Potential energy is decreasing

   Kinetic energy is increasing





When the roller coaster car is at..

A: P.E. = 0, K.E. = 0

B: P.E. increasing

C: P.E. at maximum

D: K.E. at maximum

F. Other Forms of Energy:

sound	heat	chemical
light	electrical	nuclear

II ENERGY CONVERSIONS:

A. Candle:

chemical energy to light & heat

B. Light bulb :

Electrical energy to light & heat

C. Blender:

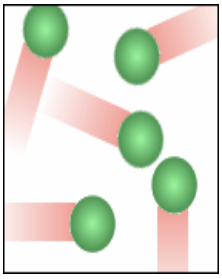
electrical energy to kinetic & sound

D. *Law of Conservation of Energy*: Energy cannot be created or destroyed but it can change forms

III TEMPERATURE:

A. What is it?

1. Temperature is the measure of the average kinetic energy of the particles in an object.



2. All matter is made up of atoms or molecules that are always moving, they have kinetic energy.

3. The more kinetic energy the particles of an object have, the higher the temperature of the object.

B. Average Kinetic Energy:

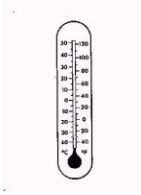
1. Particles in an object move at different speeds.

2. The average kinetic energy of all the particles is the object's temperature.

3. Temperature depends on the average kinetic energy, NOT how much of it you have.

4. There is more tea in the tea kettle, but the temperature of the tea in the cup is the same as the temperature in the kettle.

C. Measuring Temperature:



1. When objects are heated, their particles move faster and spread out.

2. Thermal expansion is the increase in volume of a substance because of an increase in temperature.

3. Thermometers use the *liquids* alcohol or mercury because they expand by constant amounts.

4. Temperature Scales:

a) *Fahrenheit* – Freezing: 32° F Boiling: 212° F

b) *Celsius* - Freezing: 0°C Boiling:100°C

c) *Kelvin** - Freezing: 273° Boiling: 373°

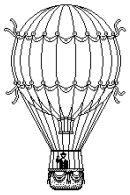
* 0^0 K is Absolute zero (-459^0F), all molecular motion stops. This is not possible, but we have been close.

D. Thermal Expansion:

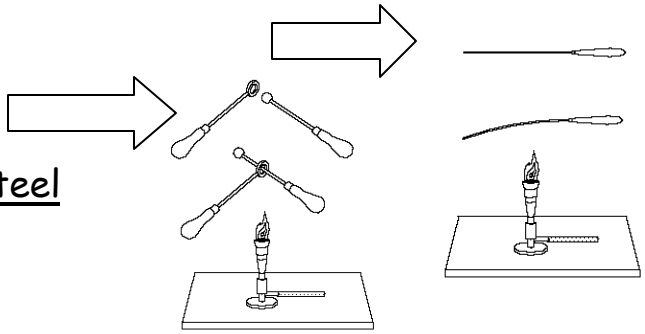
1. In *solids*:

a) Expansion joints on bridges.

b) Cracks in sidewalks



c) Bimetal strip



found in thermostats have brass and steel

d) Ball and ring demo

2. In *gases*: a) hot air balloons.

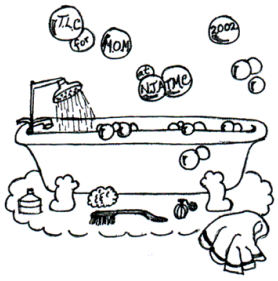
IV HEAT:

A. Thermal energy:

1. The TOTAL kinetic energy of the particles in the object.

2. Measured in joules.

3. The amount of thermal energy depends on two things:



a) the temperature of the object.

b) the mass of the object.

4. A bathtub full of 80^0 water has more thermal energy than a cup of 80^0 water.

c) Type of substance

V HEAT TRANSFER:

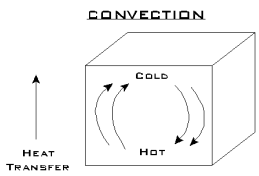
A. Conduction:

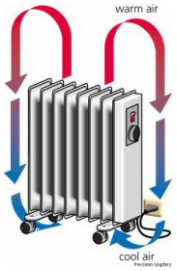
1. The transfer of thermal energy from one substance to another through direct contact.
2. It can also occur within a substance, like a spoon
3. Energy is transferred when particles collide.
4. *Conductors:* transfer heat energy very well.
   a) Metals are good conductors of heat.
5. *Insulators:* do not conduct heat energy well.
   a) Examples: glass plastic cloth

B. Convection:

1. The transfer of heat energy by the movement of a liquid or a gas.
2. The molecules move from one place to another.
3. When you boil water in a pot, the …….
   a) water on the bottom gets hot by means of conduction (touching heating element).
   b) water becomes less dense & rises
   c) at the surface, the water begins to cool
   d) the cooler water is more dense & sinks.

4. The *circular motion* of liquids or gases due to these density differences is called a convection current.





5. Convection heats your room…

   a) warm air is less dense so it rises

   b) cool air is more dense so it sinks.

6. Large scale convection currents:

   a) ocean currents

   b) wind patterns (land and sea breezes)

C. Radiation:

1. The transfer of energy by electromagnetic waves such as….

   light and heat (infrared) waves.

2. It occurs without matter.

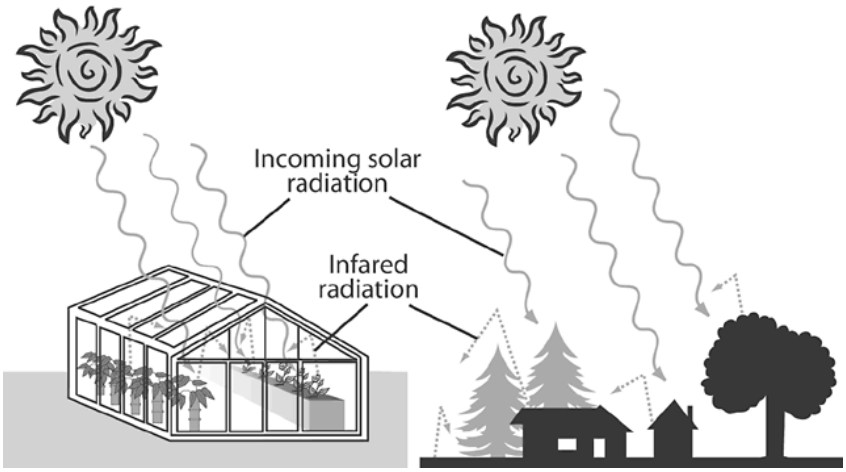
3. *Greenhouse Effect*:

   a) Visible light passes through glass and gets absorbed.

   b) Then it turns into heat energy. (Infrared energy)

   c) Heat is trapped by the glass.

   d) Our atmosphere also traps heat energy……with its water vapor, CO_2 and methane



4. Shiny surfaces reflect radiation.

   a) Example: aluminum foil

D. Thermos: What type of heat transfer does each feature stop?

1) Airtight stopper: convection

2) Foam insulation: conduction

3) Trapped air space: convection&conduction

4) *Shiny* stainless steel bottle: radiation

5) Plastic cap: conduction& convection

6) Plastic outside: conduction

7) Stainless steel *vacuum* bottle:convection &conduction

VII HEAT AND CHANGES OF STATE:

A. States of Matter:

1. The state of a substance depends on:

   a) the speed of its particles

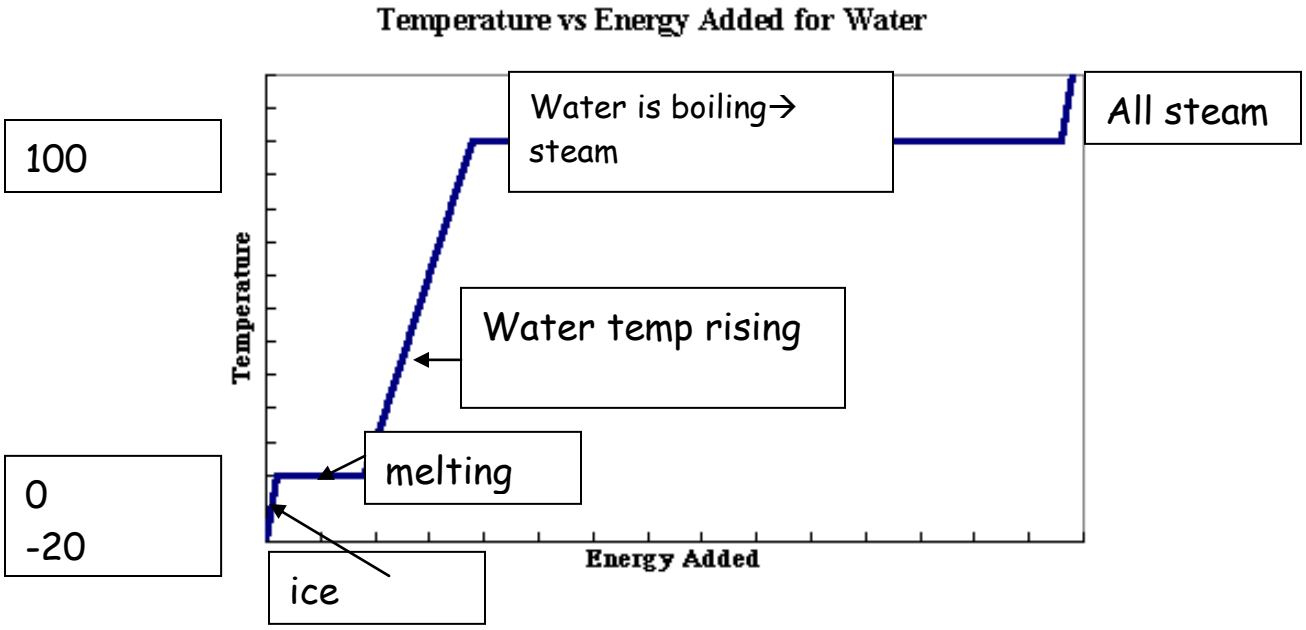
   b) the attraction between them

   c) the pressure around them.

2. A gas has more thermal energy than a solid.

3. It takes force to break the attraction between particles.

B. Changes of State Graph:



1. As the ice is heated, its temperature goes from -25°C to 0°C

2. As the ice melts, the temperature remains at 0°C

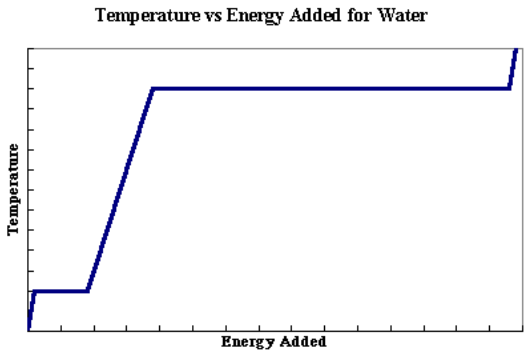
3. The temperature of the ice remains the same until all of the ice becomes liquid water.

4. The water's temperature then increases from 0°C to 100°C

5. At 100°C the water begins to change to steam

6. When all the water becomes steam, the temperature rises.

C. Heat of Fusion:



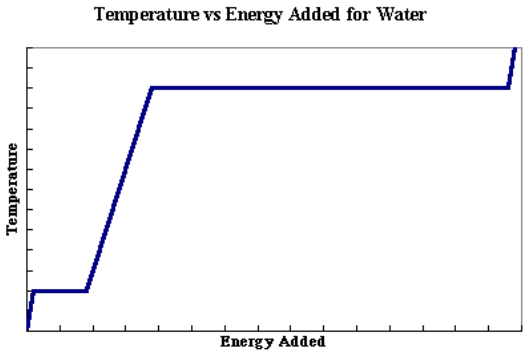
1. The energy needed to break the forces of a solid so it melts.
2. It takes 334 Joules of energy to melt one gram of ice.

3. 1 gram of ice 0^0C | 334 J → / ← 334 J | 1 gram of water 0^0C

4. All the energy goes into breaking the forces. The temperature does NOT go up.

D. Heat of Vaporization:

1. The energy needed to break the forces of a liquid so it can evaporate.
2. At 100^0C one gram of water absorbs 2260 joules of energy to become a gas



3. 1 gram of water 100^0C | 2260 J → / ← 2260 J | 1 gram of steam 100^0C

4. All the energy (2260 J) goes into breaking the forces. The temperature does NOT go up

I RADIOACTIVITY:

A. Nuclear Radiation:

1. High-energy particles and rays that are emitted by the nuclei of some atoms.

2. Radioactivity: the process by which some nuclei give off nuclear radiation.

3. All elements above the atomic number of 83 are radioactive.

B. Radioactive or Stable?

1. Stable atoms: Number of protons = Number of neutrons

7
N
14. 00

⇐ Atomic number Protons: 7

⇐ Atomic mass Neutrons: 7

2. Radioactive Atoms (Unstable)

a) More neutrons than protons (if atomic mass is large)

85
At
210

85 protons

125 neutrons

92
U
238

92 protons

146neutrons

C. Isotopes: (see pages 321-323 for more info)

1. Atoms of the same element They have the same atomic number and a different atomic mass .

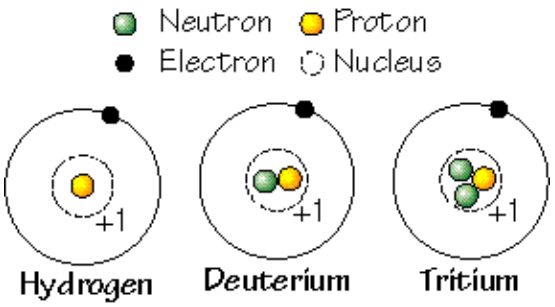
2. Example:

1
H
1

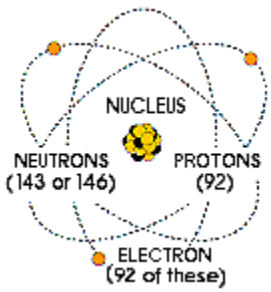
1
H
2

1
H
3

Hydrogen Deuterium Tritium



3. Many large isotopes are radioactive.



4. Naming isotopes:

a) Write the **symbol** of the element

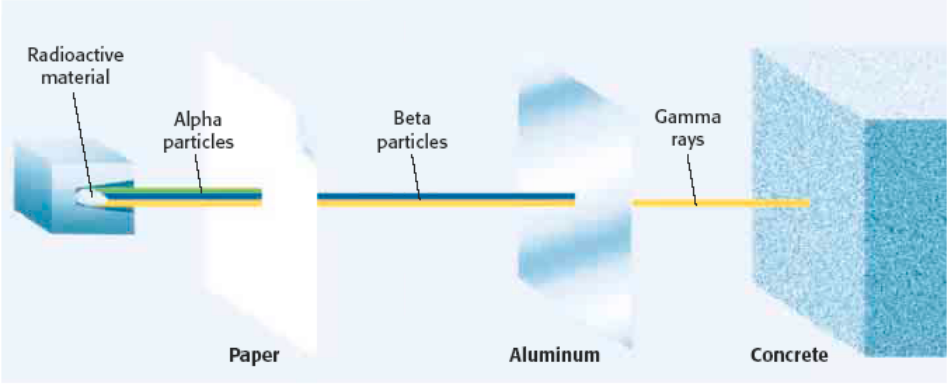
followed by a hyphen and the atomic mass

b) U-238 U-235

III PENETRATING POWER OF RADIATION:

A. Three types of radiation:

1. Alpha particles can be stopped with paper or clothing
2. Beta particles can be stopped with aluminum foil.
3. Gamma rays can be stopped with 3 meters of concrete.



▲ **Alpha particles** have a greater charge and mass than beta particles and gamma rays do. Alpha particles travel about 7 cm through air and are stopped by paper or clothing.

▲ **Beta particles** have a 1− or 1+ charge and almost no mass. They are more penetrating than alpha particles. Beta particles travel about 1 m through air but are stopped by 3 mm of aluminum.

▲ **Gamma rays** have no charge or mass and are the most penetrating. They are blocked by very dense, thick materials, such as a few centimeters of lead or a few meters of concrete.

B. Damage to Living Matter:

1. Radiation damages cells and causes burns.
2. Radiation sickness causes the following symptoms:

   a) fatigue loss of appetite hair loss

   b) Also destruction of blood cells and death

3. Exposure to radiation can also increase the risk of cancer.
4. Radon testing in your home:

   a) Radioactive radon-222 forms from decay of uranium.

   b) It is a gas and can get into your house.

IV USES OF RADIOACTIVITY:

A. Medicine:

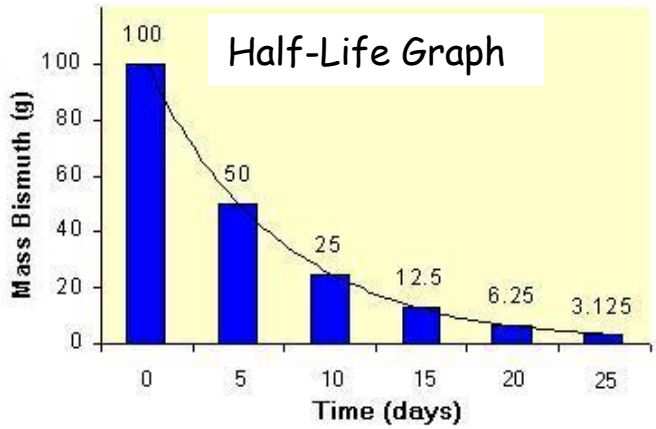
1. Tracers are injected and detectors follow them through the body.

2. Can treat illnesses including cancer

3. Can sterilize healthcare products.

B. Industry:

1. Can detect defects in structures.



C. Geiger Counter:

1. clicks when there is radiation.

D. Radioactive Dating:

1. Radioactive decay occurs at a steady rate.

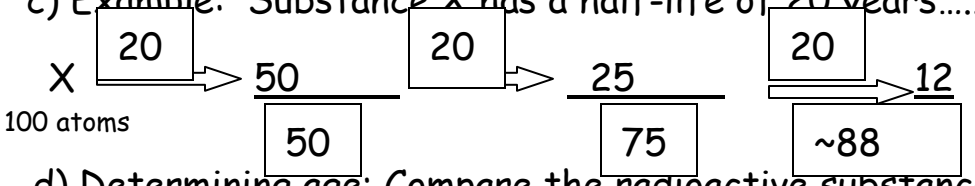
2. Decay is constant, it never speeds up or slows down.

3. Half-life:

a) The time it takes for 1/2 of the radioactive substance to decay.

b) Half-lives range in time from milliseconds to billions of years.

c) Example: Substance X has a half-life of 20 years.....



d) Determining age: Compare the radioactive substance with what it decays into.

e) Atomic "Clocks":

Carbon- 14: 5730 years (good up to 50,000 years)

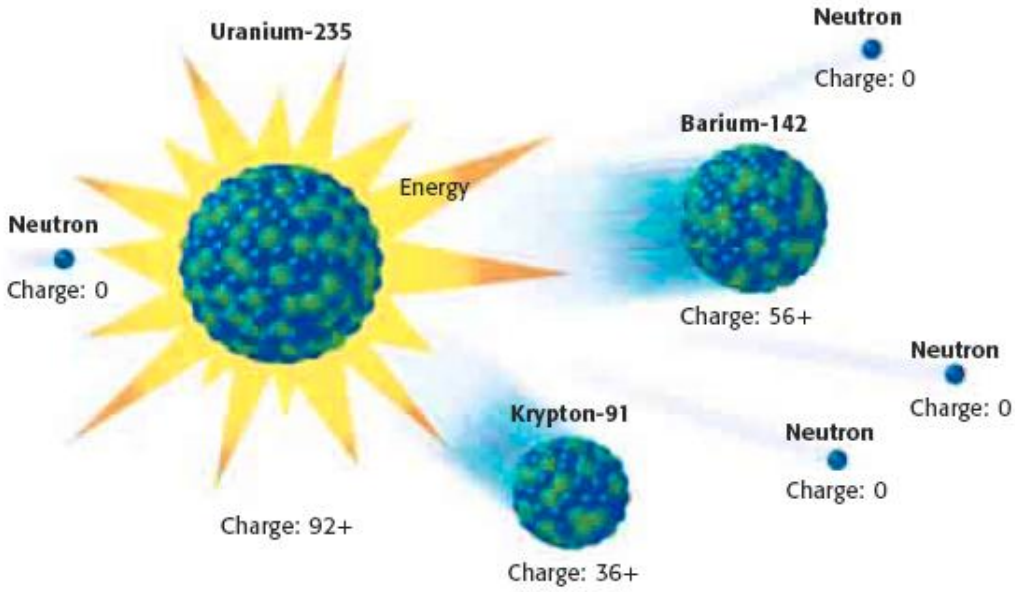
Potassium-40 1-28 billion years (most commonly used)

Uranium-238: 4-5 billion (determined Earth's age)

V NUCLEAR FISSION:

A. What is it?

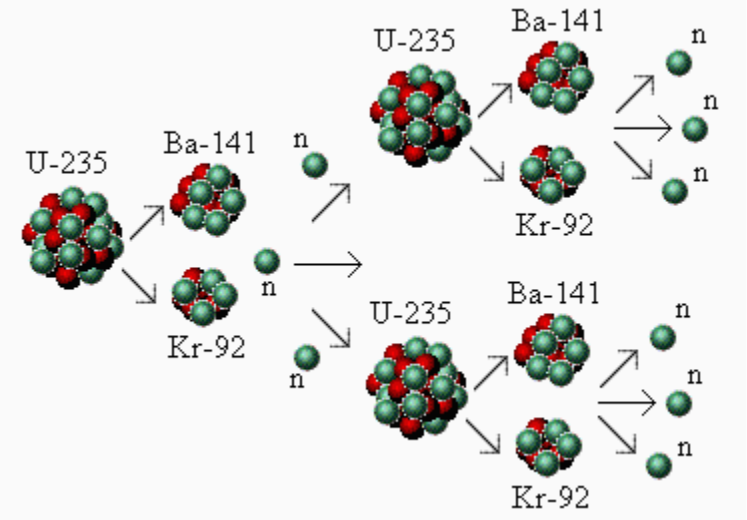
1. When a large nucleus splits into 2 small nuclei and releases energy.
2. Some uranium atoms split naturally, others can be forced to split by hitting the nucleus with a neutron



3. When U-235 splits you get the following:
   a) 2 new elements (Krypton 91 Barium 142)
   b) 3 neutrons
   c) Radiation (alpha beta gama)
   d) Less mass…it is converted into energy
4. One fuel pellet of uranium, can release as much energy as the chemical change of burning 1000 (1 ton) kg of coal.

B. Nuclear Chain Reactions:

1. A continous series of nuclear fission reactions.



2. Controlled chain reaction:

   a) Uranium is split within a nuclear reactor.

   b) Neutrons can be used to control the reaction (speed up or slow down).

3. Uncontrolled chain reaction:

   a) Large amounts of amounts are given off very quickly.

   b) An atomic bomb.

C. Advantages and Disadvantages of Nuclear Fission:

1. Advantages of nuclear fission:

   a) No air pollution

   b) Costs a little to run.

   c) Saves on fossil fuels.

2. Disadvantages of nuclear fission:

   a) Waste is radioactive no place to store it. (Yucca Mountain)

   b) Costs a lot to build. Safety measures

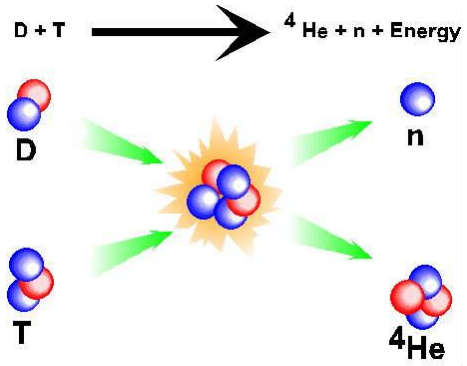
   c) Possible accidents, that might release radiation.

VI NUCLEAR FUSION:

A. What is it?

1. When 2 or more nuclei that have small masses, combine , or fuse to form a larger nucleus

$H_1^2 + H_1^3 \Rightarrow$ He + energy



2. Advantages of fusion:

   a) No air pollution. No nuclear waste or radiation.

   b) Save on fossil fuels.

   c) Unlimited fuel , because the fuel is hydrogen which is found in water

3. Disadvantages:

   a) Needed temperatures are too high.(25,000,000 °F)

   b) Not possible to do yet.