Great Ideas in Physics/Physics Dept. / Dr. Lankar Name: _____

Lab1 Conservation of mass/energy E = mc2 or Einstein 's big idea

Part1: watch the movie *Antoine Lavoisier and the conservation of mass* from PBS/Nova and *Lisa Meitner and the fission of the atom*
http://www.youtube.com/watch?v=SQJJYoYvbvk

Antoine Lavoisier built an experiment that shows the conservation of mass and produces hydrogen gas H_2 :

H_2O + Fe -> FeO (IRON OXYDE) + H_2

In his experiment, iron is mixed with water vapor to produce H_2 and iron oxyde.
What is the other name for iron oxyde ? _____
Lavoisier carefully showed that mass of reactants = mass of products.

He also showed that you can produce water H_20 by mixing hydrogen H_2 and _____.
The same principle is used in a hydrogen fuel. You get energy by combining H_2 and O_2 because the binding energy involved in H_20 is less than in H_2 and O_2. Why do you think people belief in a hydrogen economy ?

Hint: think waste product and energy independence. Compared to an economy based on oil.

He also used electricity (using a static electricity generator newly developed) to perform the opposite reaction:
energy (electric) + H2 + O2 = water.

How do you think we produce H_2 today ?

So why using hydrogen fuel is not very efficient ?

Why some people hated Lavoisier ?

What happen to him ?

(see http://bastille-day.com/biography/Marat-Biography)
Who was Jean Paul Marat.

Lavoisier is considered as the father or Modern Chemistry. He said:
rien de se cree, rien de se perd, tout se tansforme. That means :

part2: introduction to Nuclear Physics

Mass/Energy is conserved during any chemical or nuclear reaction. During a nuclear reaction some of the mass involved can become pure energy in form of radiation like gamma rays. The transformation is described by a simple equation $E = mc^2$ where c is the speed of light ($3\ 10^8$ m/s), E is the energy in

joules and m is the mass in kg.

In nuclear Physics elements noted are noted ${}^{A}_{Z}E$. A is the of nucleons (protons + neutrons). A is also called the mass number. Z is the number of protons ot atomic number. Z is the ID of the elements. Carbon 12 and Carbon 14 are called carbon because they have 6 protons. So Z =6. So what is the difference between carbon 12 and its isotope carbon 14?

How many neutrons Carbon 14 has ? _____

Consider the radioactive decay of Uranium 238 = Thorium 234 + alpha particle (helium)/

$$^{238}_{92}U = {}^{234}_{90}Th + {}^{4}_{2}He$$

Note that the number of protons (subscript number) is conserved (conservation of charge) as well as the number of nucleons (superscript number = neutrons+protons). This is the conservation of number. The decay is spontaneous because the binding between the constituents of the uranium is not as strong as in thorium and helium. In the process, uranium loses some mass to energy. The binding energy in elements increases with the number of nucleons up to iron then it decreases. The strong nuclear force is at work.

Radium 226 decays into radon 222 and an alpha particle. Use the periodic table to write this equation: http://www.ptable.com/

_____

Write the nuclear equation for the decay of uranium 234 into thorium 230 and an alpha particle.

_____

Write the nuclear equation for the decay of radium 226 to radon 222 and an alpha particle

_____

It is possible to shoot alpha particles at an element to cause a nuclear reaction. Rutherford bombarded nitrogen 14 with alpha and got a new element :

$$^{4}_{2}He + {}^{14}_{7}N = {}^{1}_{1}H + {}^{A}_{Z}X$$

Find this new elements using the conservation of mass and the conservation of charges. (use the periodic table).

_____

In 1932 Irene Curie (daughter of Marie) and her husband showed that beryllium 9 bombarded with alpha particles were emitting carbon 12 and a unknown particle:

$$^{4}_{2}He + ^{9}_{4}Be = ^{12}_{6}C + ^{A}_{Z}X$$

What was this new particle ? (remember Z is for the charge) _____

Energy/mass is always conserved. For example When an electron collides with its " evil twin" the anti electron or positron they annihilate each other. Matter and anti matter annihilate and produce energy. The matter becomes pure energy = gamma rays.

$$^{0}_{-1}e + ^{0}_{+1}e = \gamma rays$$

Compute the energy of the gamma rays if the mass of electrons and anti electrons is 9.11 10^{-31} kg
Use the formula E = m c^2 with m the total mass (electron + positron).

E = _____ J

convert the energy to eV (unit used in nuclear Physics). 1 eV = 1.6 10^{-19} J

E = _____ eV Then convert to MeV E = _____ MeV (1 MeV = 1,000,000 eV)

The mass of a proton is 1.67 10^{-27} kg
Find the energy equivalent of the proton's mass in joules/ E = _____ J

convert this value to eV / E = _____eV

Find the lowest energy of a gamma ray that could produce a proton-antiproton pair.
E = _____ eV

part3: problems = complete the nuclear equations

1)

$$^{14}_{6}C = ? + ^{0}_{-1}e$$

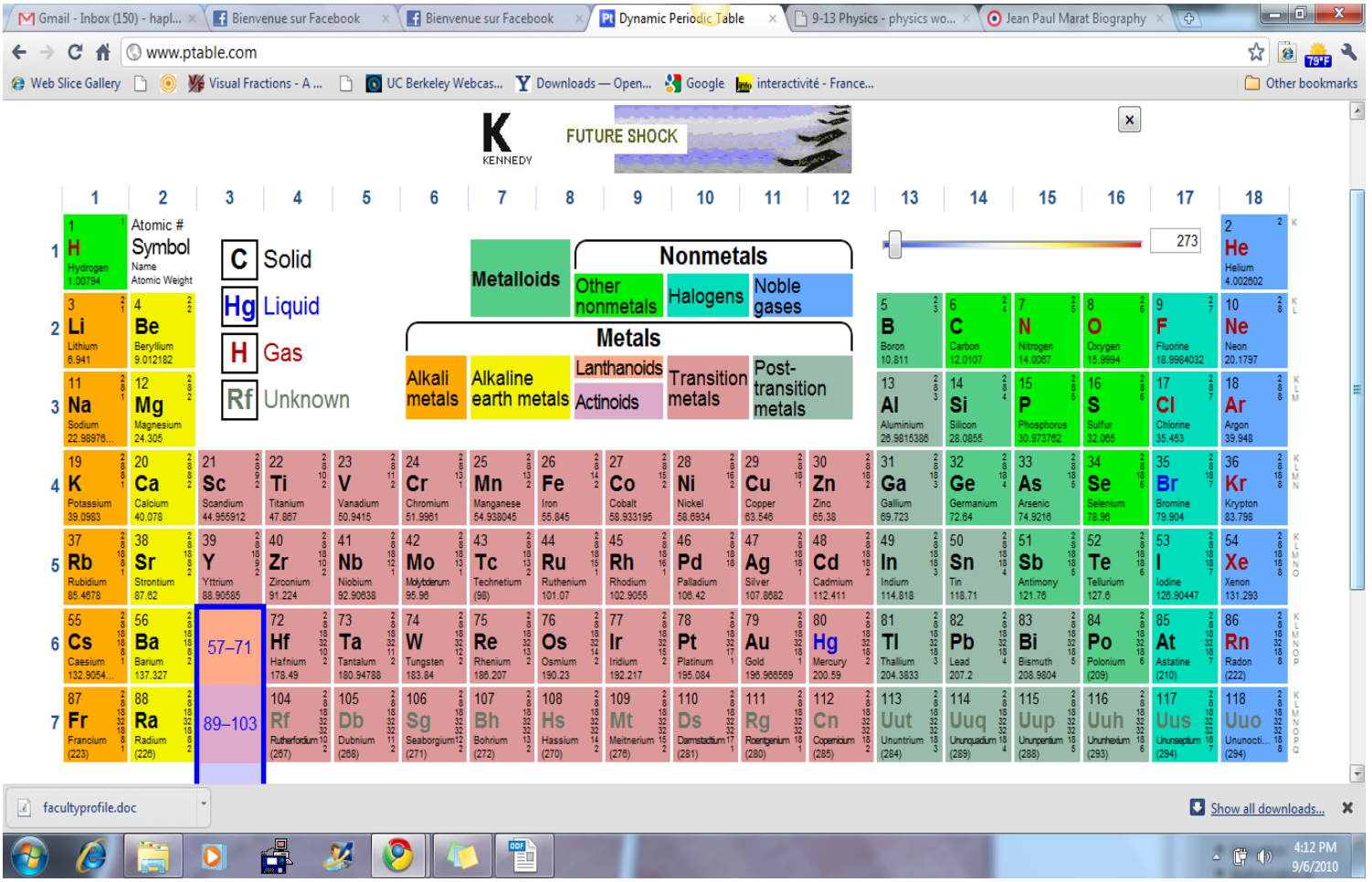
2)A radioactive polonium isotope $^{214}_{84}$Po, undergoes alpha decay and becomes lead. Write the nuclear reaction.

3)Complete the nuclear equation:

$$^{30}_{15}P = ? + ^{0}_{+1}e$$

4)alpha particles are bombarded at nitrogen:

$$^{14}_{7}N + ^{4}_{2}He = ?$$


Gmail - Inbox (150) - hapl...
Bienvenue sur Facebook
Bienvenue sur Facebook
Dynamic Periodic Table
9-13 Physics - physics wo...
Jean Paul Marat Biography
www.ptable.com
Web Slice Gallery
Visual Fractions - A ...
UC Berkeley Webcas...
Downloads — Open...
Google
interactivité - France...
Other bookmarks
KENNEDY
FUTURE SHOCK
Atomic #
Symbol
Name
Atomic Weight
C Solid
Hg Liquid
H Gas
Rf Unknown
Metalloids
Nonmetals
Other nonmetals
Halogens
Noble gases
Metals
Alkali metals
Alkaline earth metals
Lanthanoids
Actinoids
Transition metals
Post-transition metals
273
57–71
89–103
facultyprofile.doc
Show all downloads...
4:12 PM
9/6/2010