<u>Unit Two</u>: Chapters 3 & 22

Calculations in Scientific Notation

In my calculator

- Use the __________________ button to represent "x 10"

Multiplication

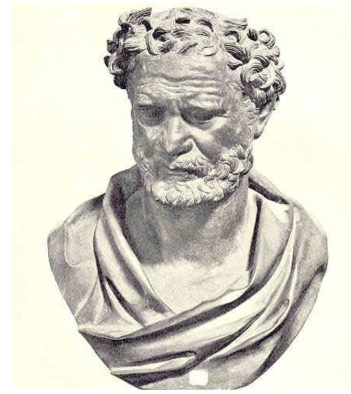
- Coefficients are ________________________ and exponents are ________________________.
- Use _____________________________ in the calculator.
- Round to the ____.
- Ex.

Division

- Coefficients are ________________________ and exponents are ________________________.
- Use _____________________________ in the calculator.
- Round to the ____.
- Ex.

Atomic Theory

Democritus

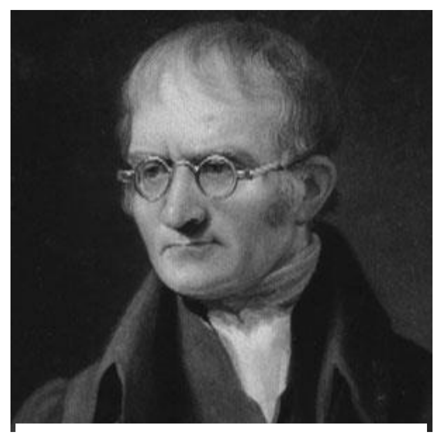


http://d1jqu7g1y74ds1.cloudfront.net/wp-content/uploads/2009/12/Democritus.jpg

- Ancient Greek philosopher
- "Laughing philosopher"
- ____
    - All matter is composed of ____________________________

      ____.
        - He called these particles _________________.

John Dalton



http://www.johndalton.org/wp-content/uploads/2012/09/john-dalton.jpg

- English chemist
- Gathered evidence favoring ____________________

  particle theory of matter
- Provided an explanation for three already existing laws:
    - 1. Law of ____
    - 2. Law of ____
    - 3. Law of ____

Law of Conservation of Mass

- States that:
  - ____

    ____

    ____

    ____

Law of Definite Proportions

- States that:
  - ____

    ____

    ____

    ____

Law of Multiple Proportions

- States that:
  - ____

    ____

    ____

    ____

- $C + O_2$ yields:
  - __________ or
  - __________
- If we have 1.0 g of C, then we have
  - 1.33 g of O_2 combining with carbon to form CO
  - 2.66 g of O_2 combining with carbon to form CO_2
- The ratio of oxygen (mass) between the two compounds is then ___________

Dalton's Atomic Theory

- 1. All matter is composed of ____

  ____.
  - An ________________ is an extremely small particle of matter that retains its identity during ____.
- 2. Atoms of a given ____________________are identical in ______________, ______________, and ____; atoms of _________________________________ differ in _____________, ______________, and ____.
  - An ___________________ is a type of matter composed of only one kind of atom.
- 3. Atoms cannot be ____.

- 4. Atoms of ______________________ elements combine in ____________________ whole-number ratios to form chemical ____________________________.
    - ____________________________ are two or more different elements that are chemically combined.
- 5. In chemical reactions, atoms are ____ ____.

Modern Atomic Theory

- Revised Dalton's Atomic Theory
    - Today, we know that ____ ____.
        - But, the ____ still holds true for chemical reactions.
    - Scientists have also come to know that a given element can have ______________ ____.
        - Referred to as "______________________"

Discovery of the Electron

- ____
- 1897
- Discovers the electron through his

  ___________________________________ experiment

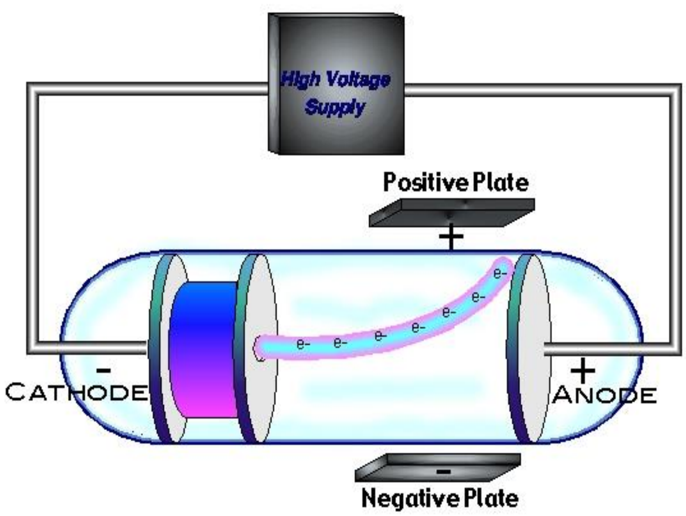
  - __________________________ charged particles
- 1909: ____

  performed experiments confirming the

  ______________________ charge of an ___________________.
- ______________ of an electron: 9.109×10^{-31} kg
- ______________ of an electron: -1.60218×10^{-19} C

http://www.phy.cam.ac.uk/history/electron/jj_c1890.jp

http://www.biography.com/imported/images/Biography/Images/Profiles/M/Robert-Millikan-9408867-1-402.jpg



http://1.bp.blogspot.com/_dWu3ZL-yN-k/TK02gUAHLVI/AAAAAAAAAEU/4myi2BhxEyU/s1600/cathode2.jpg

http://profmokeur.ca/chimie/imchim/athomson.gif

Gold Foil Experiment

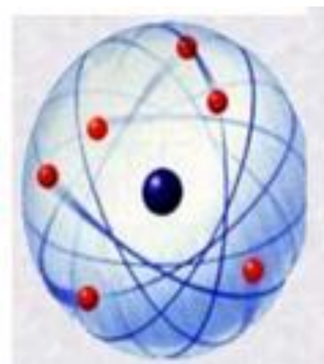
http://upload.wikimedia.org/wikipedia/commons/5/5c/Ernest_Rutherford_cropped.jpg

- 1911, ____
- Discovered that the atom was ________________________

  ____
  - Concluded that there must be a very ____________

    ______________ bundle of _____________ with a __________________ electric

    charge at the ____.
    - Called this the "__________________________"

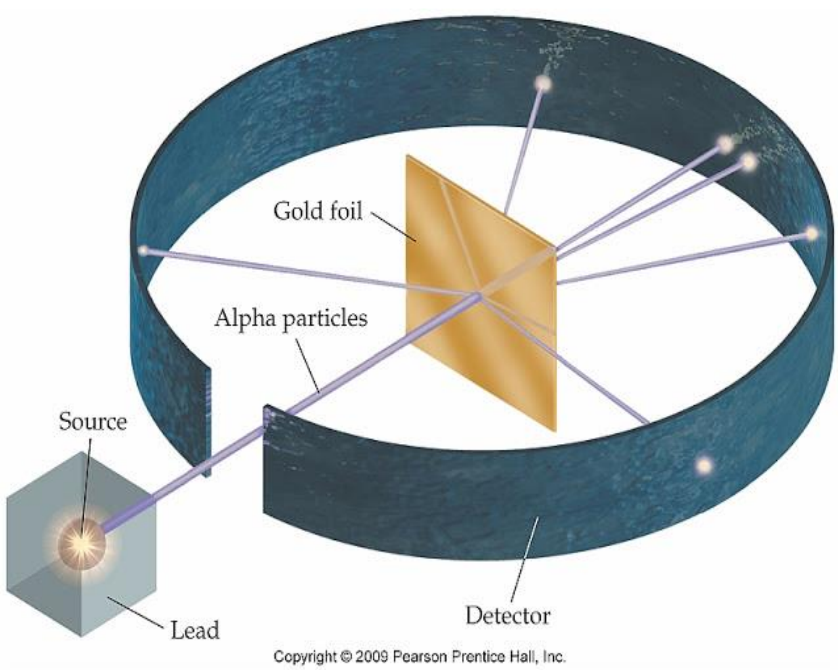


http://www.google.com/imgres?imgurl=&imgrefurl=http%3A%2F%2F www.docstoc.com%2Fdocs%2F2197377%2FHistory-of-the-Atom-Timeline&h=0&w=0&sz=1&tbnid=6_F6asBgf4IveM&tbnh=194&tbnw=259&zoom=1&docid=nnSswWer_bWpqM&ei=WItBUurXCOab2wXmnIHwCw&ved=0CAEQsCU

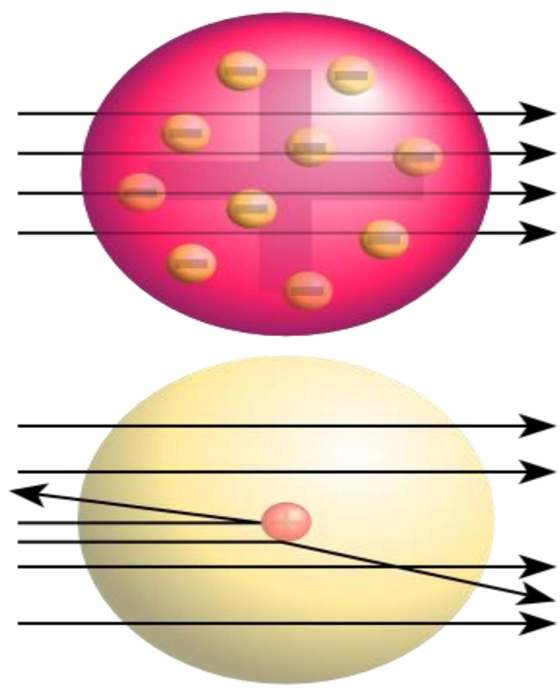
- Suggested that the ___________________ were surrounding the

  ____, though he

  couldn't explain what kept them in motion.



http://4.bp.blogspot.com/-yKZFPeJa9-c/T9ge9EOrByI/AAAAAAAAAG8/bd2w618SJPI/s640/gold+foil+diagram.jpg



http://upload.wikimedia.org/wikipedia/commons/thumb/c/c3/Rutherford_gold_foil_experiment_results.svg/302px-Rutherford_gold_foil_experiment_results.svg.png

Discovery of the Proton

- ____
- 1919
- Discovered that the _______________________ nuclei (__________________), form when alpha particles strike some of the lighter elements.
    - __________________: a nuclear particle having a ______________________ charge equal to that of the ____________________ and a mass more than 1800 times that of the electron.
- __________________ of a proton: 1.673 x 10^{-27} kg
- Protons in a ________________ give the ________________ its ___________________ charge
- __________________ of a proton : +1.60218 x 10^{-19} C

Discovery of the Neutron


http://www.nobelprize.org/nobel_prizes/physics/laureates/1935/chadwick.jpg

- ____
- 1932
- Discovers a _________________ particle located in the _________________ of an atom with a _____________________ almost identical to a ____________________.
    - He called this particle a "_____________________"

- ________________ of a neutron: 1.675 x 10^{-27} kg

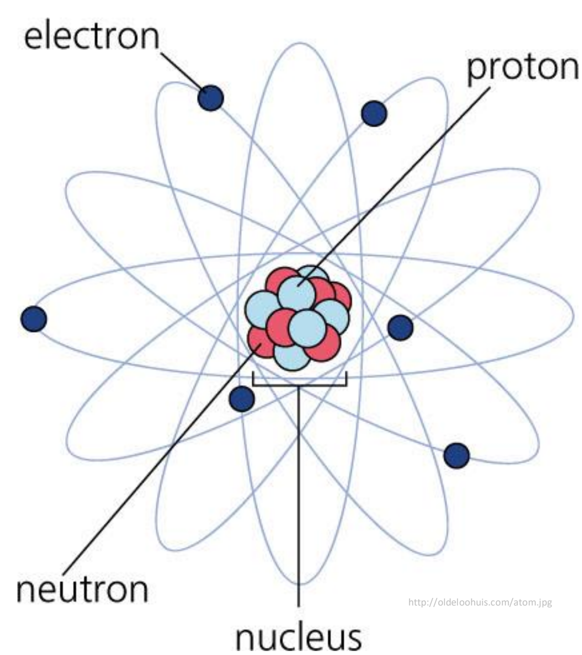
- ________________ of a neutron: 0 C

Summary

Particle	Discovered By	Year	Mass (kg)	Charge (C)	Location
Electron			9.109 x 10^{-31}	-1.60218 x 10^{-19}	
Proton			1.673 x 10^{-27}	+1.60218 x 10^{-19}	
Neutron			1.675 x 10^{-27}	0	

Atomic Structure

Parts of an Atom

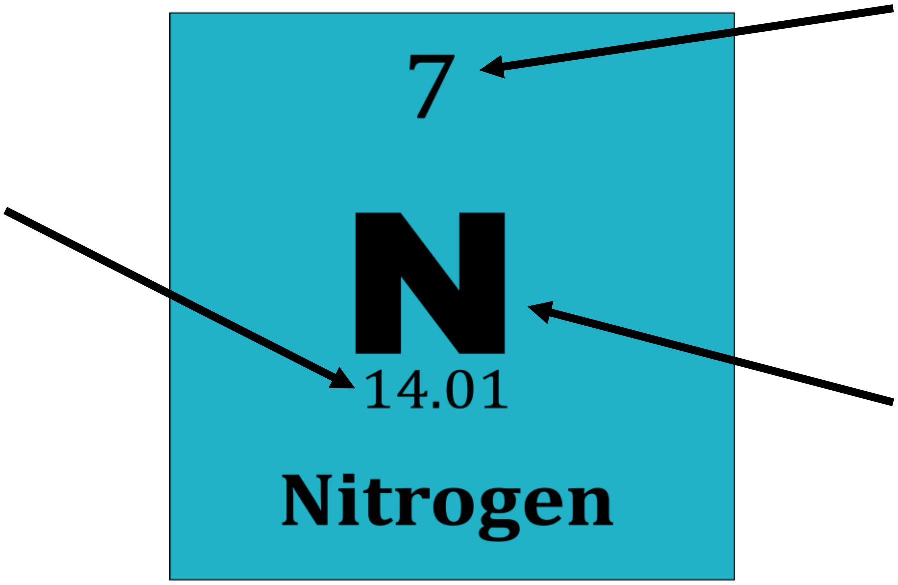


- Protons (p^+)
  - ________________ charge
  - Located in the ______________________
- Neutrons (n^0)
  - ______________ charge
  - Located in the _____________________

- Electrons (e^-)
  - ______________ charge
  - Located ____

    ____

Periodic Table



- **Atomic Number (Z)**
  - The number of ________________ in the nucleus of each atom of that element.
  - Atoms of the same element have ____

    ____.
  - This number ____.
  - # ______________________ = # ______________________

- **Mass Number (A)**
  - The number of ______________________________ in the nucleus of an atom.
  - Whole number rounded from the _____________________________________

    ____.

Atomic Mass

- ______________________________________
  - Mass of only ________________________________, but there can be

    ___________ than one isotope of a given element so we need to take the

    ____________________________________ (which is still measured in amu).
- ______________________________________
  - The weighted _________________ of the atomic masses of the _____________

    ___________________ isotopes of an element
  - Measured in ____________ or "_____________________________________."
    - One ________________ is exactly the mass of 1/12 of a carbon-12 atom

Isotopes

- Isotopes of an element have the ____

  ____.
  - Results in ________________________________

- Identified by specifying their ______________________________

  - **Ex.** Nitrogen – 14 and Nitrogen – 15

$$ {}^{14}_{7}\mathrm{N} \qquad {}^{15}_{7}\mathrm{N} $$

Calculating Average Atomic Mass

- Nitrogen – 14
  - _________% natural abundance
  - Mass: 14.0030740048 amu

- Nitrogen – 15
  - _________% natural abundance
  - Mass: 15.0001088982 amu

Average Atomic Mass: Nitrogen

= (Abundance x Mass) + (Abundance x Mass)
= (0.9963 x 14.0030740048 amu) + (0.0037 x 15.0001088982 amu)
= (13.95126263 amu) + (0.055500403 amu)
= 14.00676303 amu
= 14.01 amu

Neutrons

- How do we determine the number of neutrons?

$$ {}^{14}_{7}\mathrm{N} \qquad {}^{15}_{7}\mathrm{N} $$

- Subtract the ____.

- Nitrogen – 14 has ____________ neutrons

- Nitrogen – 15 has ___________ neutrons

Element	Average Atomic Mass	Atomic #	Mass #	Protons (p^+)	Electrons (e^-)	Neutrons (n^0)	Nuclear Symbol ($^{A}_{Z}X$)
1. potassium							
2.	32.06						
3.		30					
4.		53					
5.			23				
6.				47			
7.					38		
8.						30	
9. Vanadium							
10.		9					
11. Copper							
12.			84				

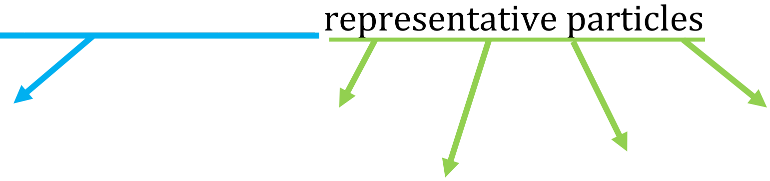
Introduction to the Mole

Specified Numbers

- 1 dozen = ________ items
- In order to count the number of ___________________________ in a substance,

  chemists also use a specified number.

  - It is a unit called the _____________________________________.
- 1 mol = __________________________ representative particles



Representative Particles

- _______________: elements are made up of atoms
  - Ex. He is made up of He atoms
- ________________: diatomic molecules and covalent compounds are made up of

  molecules

  - Ex. H_2O is made up of H_2O molecules

- ____________: atoms or groups of atoms with a charge
    - Ex. K^{1+}, Ca^{2+}, N^{3-}, CO_3^{2-}
- __________________: ionic compounds are made up of formula units
    - Ex. $CaCl_2$ is made up of $CaCl_2$ formula units

Recap!

http://www.bulldog.u-net.com/avogadro/imgs/avogad.gif

- A mole of any substance contains ____________ of representative particles, or ________ representative particles.

Mass of a Mole of an Element

- Mass of a single atom called the __________________________ can be expressed in ____.
- The __________________ of an element expressed in ______________ is the _______________________ of the element.
    - ____________________________________
- Ex. Molar Mass of Nitrogen =
    - 14.01 amu = ________________________________
    - Molar mass of Nitrogen= 14.01 ________________ or 14.01 __________

Calculating the Molar Mass

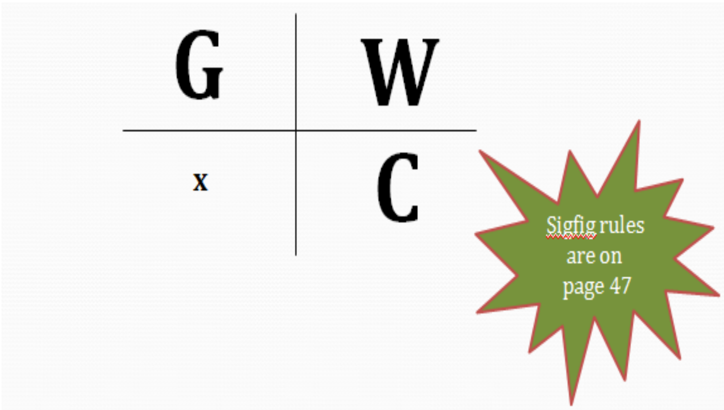
- Platinum (Pt)
  - ____________________________
- Strontium (Sr)
  - ____________________________
- Bromine (Br)
  - ____________________________
- Lead (Pb)
  - ____________________________
- Thorium (Th)
  - ____________________________
- Cadmium (Cd)
  - ____________________________

Recap!

- What is the molar mass of an element?
  - ____
- How do we find the molar mass?
  - ____

    ____
- How is the molar mass expressed?
  - ____

Factor-Label Method



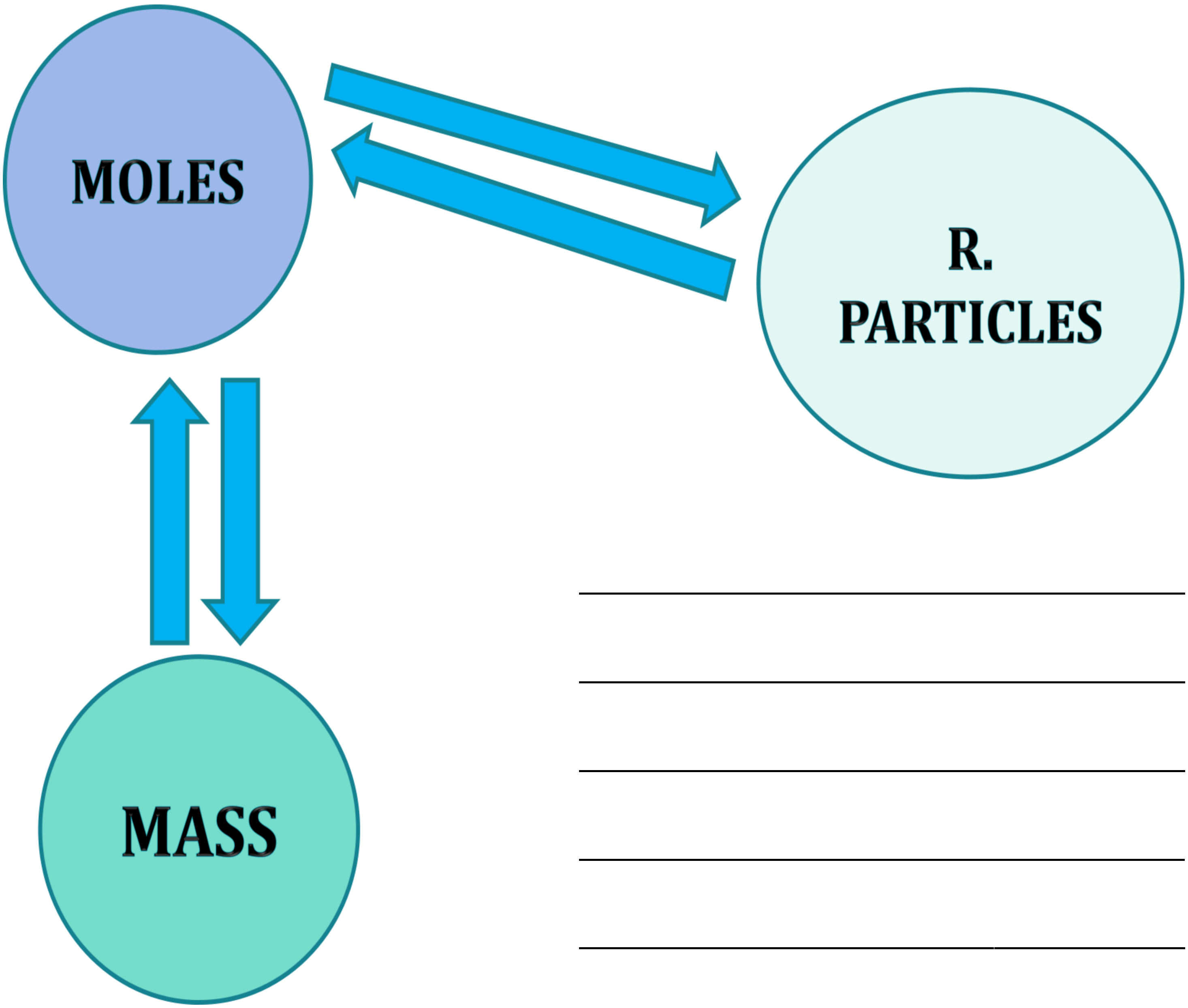
G = what you are given

W = what you want to find

C = cancel (diagonal)

The number of significant figures in the final answer is equal to the number of significant figures in the given quantity.

Mole Roadmap!



Mole-Mass-#Particles Conversions

Ex. 1:

Ex. 2:

Ex. 3:

Ex. 4:

Ex. 5:

Ex. 6:

Ex. 7:

Ex. 8:

Ex. 9:

Ex. 10:

Ex. 11:

Ex. 12:

Nuclear Chemistry

WHAT IS NUCLEAR CHEMISTRY!?

- The branch of chemistry dealing with ____

  ____.

NUCLEUS

- Located at the ____
  - Contains both ____
- Overall ____________________________ charge
  - Due to the presence of ____________________________
- ________________________ packed
  - Most ____________________ of an atom

NUCLEONS

- Parts of the ____________________________
- Refers to both the ____

NUCLIDE

- Refers to the nucleus of ____
    - **Isotope =** ____

      ____

- Notation: _________________________
    - Ex. Carbon-12 or $^{12}_{6}C$

- Has a specific number of __________________ and number of _______________ for a specific _______________________.
    - Ex. Carbon-12 $^{12}_{6}C$ → →

MASS DEFECT

- ____

  ____

  ____

- Ex. Carbon-12
    - _______ protons, _______ electrons, _______ neutrons

$^{12}_{6}C$ 12.0107 amu

6 protons: (6 x 1.007276 amu) = 6.043656 amu

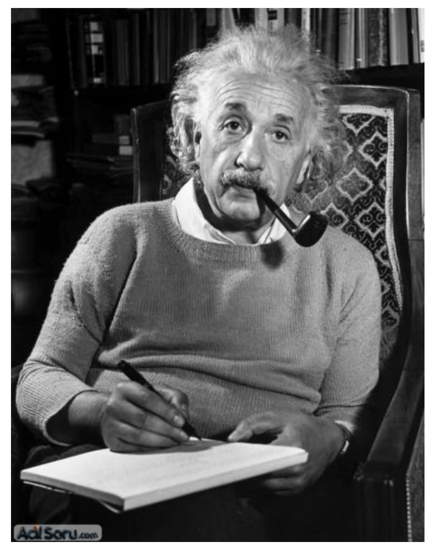
6 electrons: (6 x 0.0005486 amu) = 0.0032916 amu

6 neutrons: (6 x 1.008665 amu) = 6.0519 amu

12.0989 amu

Mass defect = 12.0989 amu – 12.0107 amu

= 0.0882 amu less



http://english.umuseke.rw/wp-content/uploads/2013/06/albert-einstein.jpg

- Lost mass is converted into______________________________

  ____

  ____.

  - Released energy is called

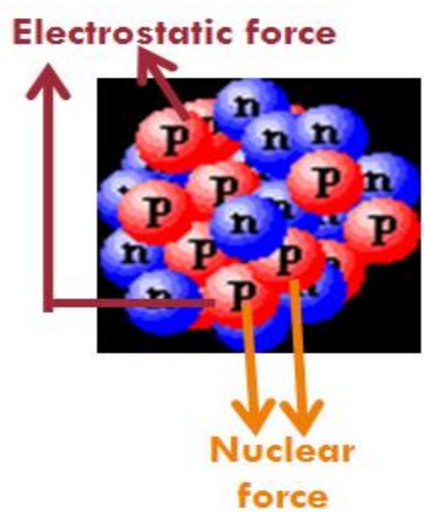
    ____.

- Nuclear binding energy can be determined using _________________________________

  ____.

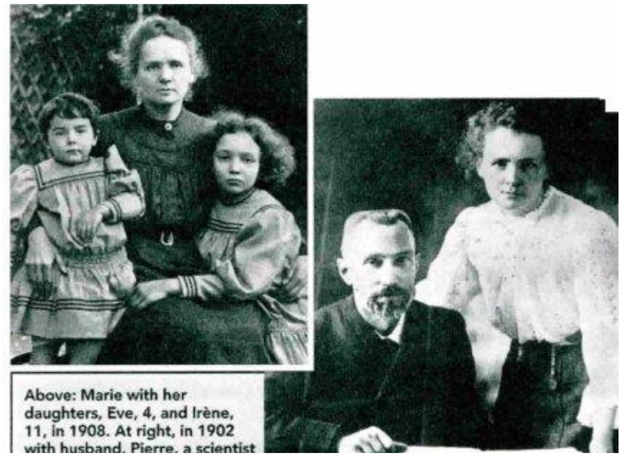
NUCLEAR STABILITY

- Determined by the ratio of ____
  ____.
- Isotope is ______________________ when:
  - 1 proton : 1 neutron ratio (small atoms - up to Ca)
  - 1 proton : 1.5 neutron ratio (large atoms – Ca to Pb)
- Isotope is ______________________ when:
  - Ratios not equivalent to the ones above
    - (atoms above ________)
- Protons repel each other in the nucleus due to
  ____.



- Protons close to one another attract each other due to
  ____.

RADIOACTIVITY



http://www.techcn.com.cn/uploads/200911/1258289166xFPbLtHi.jpg

- Process by which nuclei ______________________
  ____.
  - Named by ______________________________
- Occurs in isotopes
  with____.
  - Referred to as ____
- Must change the make-up of the nuclide by undergoing _______________________________
  ____.

NUCLEAR DECAY

- The spontaneous disintegration of a nucleus into_____________________________________
  ______________________; accompanied by ____
  ____.
  - Process of a radioactive nuclide breaking down to become ____________________.
- Results in the release of ____.
  - ____

NUCLEAR RADIATION

- Particles and/or electromagnetic radiation (energy) ______________________________

  ______________ (radioactive) during nuclear decay (______________________________)

- Types:
  - ____
  - ____
  - ____
  - ____

__________________________ PARTICLES

- _________________ nucleus
- Charge: __________________
  - (_______)
- Mass: _________ amu (largest)
- Example:

$$ {}^{238}_{92}\mathrm{U} \longrightarrow {}^{234}_{90}\mathrm{Th} + {}^{4}_{2}\alpha $$

_______________________ PARTICLES

- _______________________
- Charge: _________________
    - (_____)
- Mass: almost ____________
- Example:

$$^{14}_{6}C \longrightarrow \, ^{14}_{7}N + \, ^{0}_{-1}\beta$$

_______________________ RAYS

- ____
  ____
  ____.
    - All _______________
        - ONLY ______________
- Charge: _____________

- Mass: ________________

- Gamma radiation often occurs immediately following ______________________________

  ____.

__________________________ EMISSION

- _______________________________

- Charge: _______________________

  - (______)

- Mass: almost ___________

- Example:

$$^{15}_{8}O \longrightarrow ^{15}_{7}N + ^{0}_{1}\beta$$

HALF LIFE

- _____________ for half of a radioactive material to decay

  - Break down and give off radiation making it _______________

- Remember, if only __________ decays, the other _________ is STILL __________________

# of half-lives

Fraction Remaining

HALF LIFE EQUATION:

HALF LIFE: EXAMPLES

- The half life of thorium-227 is ____________ days. How many days are required for ______________________ of a given amount to decay?

- The half life of protactinium-234 is ____________ hours. What fraction of a given amount remains after _______________ hours?

- The half-life of polonium-210 is ____________ days. How many milligrams of polonium-210 remain after ____________days if you start with _________mg of the isotope?

- The half-life of cobalt-60 is _____________ minutes. How many milligrams of cobalt-60 remain after _____________ minutes if you start with ___________ mg?

NUCLEAR REACTIONS

- Equation that represents the ____

  ____.

- Must obey both the law of ____ and the law of ____.
  - Must be ___________________ for the _____________________ of the ____.

- Ex. 1: $^{187}_{75}\text{Re} + ^{A}_{Z}\text{X} \rightarrow ^{188}_{75}\text{Re} + ^{1}_{1}\text{H}$

- Ex. 2: $^{9}_{4}\text{Be} + ^{4}_{2}\alpha \rightarrow ^{A}_{Z}X + ^{1}_{0}\text{n}$

- Ex. 3: $^{22}_{11}\text{Na} + ^{A}_{Z}\text{X} \rightarrow ^{22}_{10}\text{Ne}$

- Ex. 4: ${}^{238}_{92}\text{U} \rightarrow {}^{A}_{Z}X + {}^{234}_{90}\text{Th}$

- Ex. 5: ${}^{37}_{18}\text{Ar} + {}^{A}_{Z}\text{X} \rightarrow {}^{37}_{17}\text{Cl}$

- Ex. 6: ${}^{253}_{99}\text{Es} + {}^{4}_{2}\alpha \rightarrow {}^{A}_{Z}X + {}^{1}_{0}\text{n}$

- Ex. 7: ${}^{38}_{19}\text{K} \rightarrow {}^{A}_{Z}X + {}^{38}_{18}\text{Ar}$

- Ex. 8: The parent nuclide of the thorium decay series is ${}^{232}_{90}\text{Th}$. The first four decays are as follows: alpha emission, beta emission, beta emission, and alpha emission. Write the nuclear equations for this series of emissions.

FISSION

- Breaking apart of ____ into __________________________ releasing large amounts of _______________.
  - Uses a _______________ and more _______________ are generated which react with other fissionable atoms which produce more _______________ which react with more fissionable atoms.
    - Creates a ____.
- Fission can be controlled so that ____ ____.
  - Occurs in ____.
  - A _________________________ is used to control the energy being released.

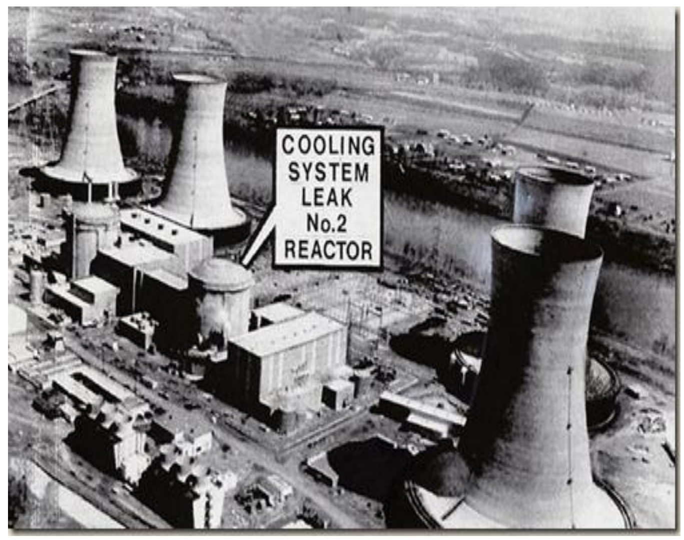
CHERNOBYL

- Located in __________________
- April 26, 1986
- The reactor temperature reached _________°F

http://inapcache.boston.com/universal/site_graphics/blogs/bigpicture/chernobyl_25th_anniversary/bp2.jpg

- _________ days to control the blaze
    - ___________________________________ dropped on fire
- Occurred when operators were ____.
- Reactor is now encased in ____.

THREE MILE ISLAND



http://pdxretro.com/2011/03/accident-at-three-mile-island-was-on-this-date-in-1979/

- Located in _________________________________
- March 28, 1979
- Power plant in operation for just ________________________
- _______________________ problem, led to an overheating (_________°F) and ____.
- _________% of the reactor core was melted down
- Three Mile Island crisis lasted _________days

FUSION

- Combining of ____ releasing large amounts of _________________________.
  - Generates ______________ energy than ______________________.
- Occurs at very ____.
- Occurs in __________________ (including the ___________).

UNITS

- ______________________________
  - Unit that measures nuclear radiation exposure to _____________________________
- ______________________________
  - Unit that measures nuclear radiation exposure to ____________________________

USES OF RADIOISOTOPES

- ___________________________________ of fossils
- Nuclear power plants producing _________________________

- ____

- _____________________________ of meat

- ____

  - __________________________ treatment

  - ___________________ (used to diagnose medical conditions)

Exam Date: ____

- **Atoms: The Building Blocks of Matter (Chapter 3)**
  - ✓ History of the Atom
  - ✓ Atomic Theory (Dalton's / Modern)
  - ✓ Law of Conservation of Mass / Law of Definite Proportions / Law of Multiple Proportions
  - ✓ Atomic Structure: protons / neutrons / electrons (what / where in atom / who found)
  - ✓ Mass Number / Atomic Number / Isotopes
  - ✓ Periodic table (atomic number / mass number / average atomic mass)
  - ✓ Mole / Avogadro's constant
  - ✓ Formula mass / Molar mass of elements
  - ✓ Mass (grams) to amount (moles) and # of particles (atoms) conversions
- **Nuclear Chemistry (Chapter 22)**
  - ✓ Focus on nucleus / nucleon / nuclide
  - ✓ Nuclear stability / radioactivity
  - ✓ Nuclear decay / nuclear radiation & types / half-life / units / uses
  - ✓ Nuclear reactions (set up & balance)
  - ✓ Fission / Fusion