Atoms

Ch 4

The Development of the Atomic Theory

Section 4.1

Key Ideas

- **Who** came up with the first theory of atoms?
- **What** did Dalton add to the atomic theory?
- **Who** did Thomson discover the electron?
- **What** is Rutherford's atomic model?

The Beginning of Atomic Theory

- *Who came up with the first theory of atoms?*
- In the fourth century BC, a Greek philosopher, _____, suggested that the universe was made of indivisible units called _____
- The word "_____" means unable to be _____
- _____ could explain some aspects of atoms, but could not get enough evidence to convince others

The Beginning of Atomic Theory

- As time progressed, people completed more experiments (with better equipment) and proposed more/new theories
- Remember… An atom is the smallest part of an element that still has the _____

  Ex. If you could divide a piece of gold down until you could not see it anymore, you would be left with tiny pieces (atoms) of gold

Dalton's Atomic Theory

- *Why did Dalton add to the Atomic Theory?*
- In the 1800s, _____ , an English scientist, was able to offer proof that _____ exist.
- He stated that _____ of a given element were _____, and atoms of _____ elements could join to form _____
- Dalton's model of the atom, a _____ was an early model of the atom.

Dalton's Atomic Theory

- Daltons used the law of definite proportions to support his theory
- The _____ states "A chemical compound always contains the same elements in exactly the same proportions by weight or mass. "
  - This means that no matter how many grams of a compound you have, you will have the same ratio of elements in the compound

Quick Lab

- Evidence of Atoms (page 114)
- Make sure to have "matching" cups
  - i.e. A and A, B and B,
  - Not A and B
- You have 15 minutes… Go

Dalton's Atomic Theory

- While Dalton's theory explained a lot, it did not fit all observations
- Over time, Dalton's (and Democritus's) theories have been built upon to create the theory we have today.

Thomson's Model of the Atom

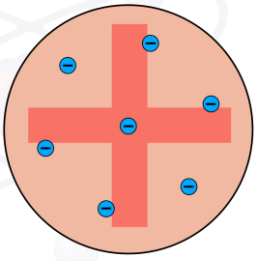
- *How did Thomson discover the electron?*
- Thomson used a _____ that suggested cathode rays were made of _____ charged particles that came from inside atoms!

Thomson's Model of the Atom

- Thomson discovered the _____ and came up with the _____ model for the atom.
- Using the cathode ray experiment, he discovered the charge of the _____ .
- An **electron** is _____
- Thomson's plum-pudding model stated electrons are spread throughout the atom

Thomson's Model of the Atom

- Here is what it looks like.
- Plums ( ) surrounded in pudding (a large _____ area)



Rutherford's Model of the Atom

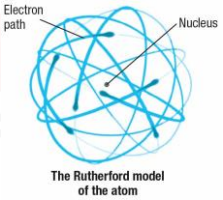
- *What is Rutherford's atomic model?*
- He thought most of the _____ of an atom was located in the _____
- He learned this by performing something called a _____ experiment

The Gold Foil Experiment

- He shot _____ at a very thin sheet of gold foil
- He expected them to go mostly straight threw with a few deviating a little because of (+) and (-) attraction
- Some _____
  - This meant they had to _____
  - They were hitting the _____ !
- The _____ is the central region of an atom that contains protons and neutrons.
  - Most of the _____ of the atom is also located here.

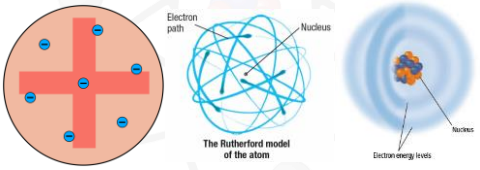
Rutherford's Model of the Atom

- Rutherford's model
  - Electrons in the _____
  - Protons and Neutrons located in the _____
- If the nucleus was a marble, the atom would be a _____



The Rutherford model of the atom

Comparison



Assignment

- Reading Toolbox on page 117
- 4.1 CR
- TON 4.2

The Structure of Atoms

Section 4.2

Key Ideas

- What is the difference between protons, neutrons, and electrons?
- What do atoms of an element have in common with other atoms of the same element?
- Why do isotopes of the same element have different atomic masses?
- What unit is used to express atomic mass?

What is an Atom?

- *What is the difference between protons, neutrons, and electrons?*

Particle	Charge	Mass (kg)	Location in the atom
Proton			
Neutron			
Electron			

What is an Atom?

- As stated last section, the nucleus contains _____ and _____
- The overall charge of a nucleus is _____ because protons are ( ) and neutrons are ( )
- The overall charge of an atom is _____ because the ( ) = the ( )
- The electric force holds the atom together.
  - Positive protons are attracted to negative electrons by the *electric force*.
  - This force holds the atom together.

What is and Atom?

- Protons and neutrons are = in size and mass while electrons are MUCH smaller and lighter
- **Protons** are _____
- **Neutrons** are _____
- **Electrons** are _____

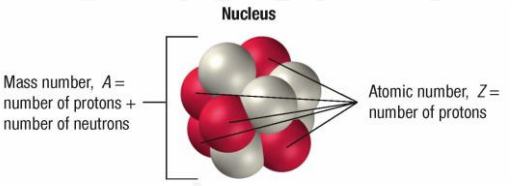
Atomic Number and Mass Number

- *What do atoms of an element have in common with other atoms of the same element*
- The number of protons tells you what type of atom you have and vice versa. For example, every carbon atom has six protons. Also, all atoms with six protons are carbon atoms.
- The number of protons in an atom is equal to a number called the _____ (Z)
- The atomic number for an element _____ changes.

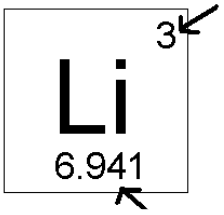
Atomic Number and Mass Number

- All atoms of an element had the _____ # of _____ but may have a different # of _____
- While the atomic number = the # of _____ , the _____ **#** is equal to the # of _____ plus the # of _____

Atomic Number and Mass Number



Element Box on Periodic Table



Quick Assignment

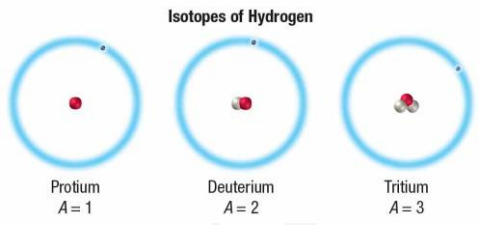
- Complete the "Reading Toolbox" on page 121
- You have 6 minutes… GO

Isotopes

- *Why do isotopes of the same element have different atomic masses?*
- They have a different number of _____ .

Isotopes

- What is different?



Isotopes

- Some isotopes are more common than other
  - _____ > _____ > _____
- Some isotopes are not stable, these are called _____
- These isotopes emit radiation, which turns them into a different _____

Atomic Masses

- *What unit is used to express atomic mass?*
- Since atoms have such a tiny mass, we express them in _____

Atomic Mass Unit (amu)

- The unit of measurement used for atomic particles is the _____ ( ).
- The mass of a _____ or a _____ is almost equal to _____ amu.
- The atomic mass unit is defined as one-twelfth the mass of a carbon atom containing six protons and six neutrons.
- 6 + 6 = 12
- 12 / 12 = 1 amu

Mass Number

- When trying to find the number of neutrons in an element you can round the atomic mass (according to rounding rules) and then find the number of neutrons

  <u>You have 3 minutes to answer the following question.</u>
- How many neutrons are in the following atoms?

Examples

- How many neutrons are there in _____ ?
- How many neutrons are there in _____ ?
- How many electrons are there in _____ ?
- How many protons are there in _____ ?

Average Atomic Mass

- The average atomic mass is a <u>weighted</u> _____
- This means you must take the _____ of each _____ into account.

Example

- What is the average atomic mass for the following "element"
  - 35% is X-56
  - 65% is X-59

Step 1: Turn the % into a decimal by /100

Step 2: Multiply the mass by the decimal

Step 3: Add the numbers together

Example

- Step 1
- Step 2
- Step 3

Practice

- A new element is found! There are 3 isotopes, Gk-67 (75%), Gk-68 (10%), and Gk-70(15%).

Average Atomic Mass

- The average atomic mass can also tell you which isotope is more common (when there are only 2 isotopes)
- Whichever isotope mass the average atomic mass is _____ too it the _____ common isotope

Example

- Which is more common?
  - X-56 or X- 57 (Average atomic mass is 56.8)
  - R-56 or R- 57 (Average atomic mass is 56.2)
  - Tb-5 or Tb- 6 (Average atomic mass is 6.55)
  - Wb-156 or Wb- 158 (Average atomic mass is 156.8)

The Mole!

- The mole is an SI base unit used to measure the amount of a substance
- Similar to a dozen = 12, the mole = 6.02×10^{23}.
- 6.02×10^{23}= 602000000000000000000000
  - So, it's a pretty big number
  - This is used to measure the number of atoms, particles, molecules, etc
    - Very small things
- Click me

The Mole

- _____ is also called **Avogadro's number**
- We will use this number to convert between the amount of a substance and the particles of that substance

Molar Mass

- The molar mass of an element is equal to its _____ .
- What is the molar mass for the following?
  - Carbon
  - Mercury
  - Hydrogen
  - Sulfur

Molar Mass

- The molar mass for a <u>compound</u> is the _____ of the atomic masses for each of the elements present in the compound.

Ex.

CO_2 ,There is…

1 Carbon = 1 * 12.01 = _____

2 Oxygen = 2 * 16 = _____

So, the molar mass for CO_2 is 32 + 12.01 = _____

Practice

- What is the molar mass for the following?
  - Water
  - O_2
  - NiO_2
  - $MgCl_2$
  - $C_{12}H_{22}O_{11}$
  - $Ca(OH)_2$

Moles to grams

- When converting moles to grams, you use Avogadro's number
- How many grams are in 2 moles of carbon?

$$\frac{2 \text{ moles C}}{1 \text{ mole C}} \times \frac{\text{g C}}{} = \_\_\_\_\_ \text{ g C}$$

Cross thingy!

Practice

- How many grams are in 3 moles of Al?
- How many grams are in 2.5 moles of Br?
- How many grams are in 3 moles of water?
- How many grams are in 3 moles of $C_{12}H_{22}O_{11}$?

Conversions

- Notice, there many be the same amount (moles) of a substance but the _____ is different
- This is why some substance are more or less dense than other substances

Grams to Moles

- When converting from grams to moles, you do the opposite
- How many moles are there in 67 grams of C?

$$\frac{67 \text{ g C}}{} \left| \frac{1 \text{ mole C}}{\text{g C}} \right. = \_\_\_\_\_ \textbf{ moles C}$$

Cross thingy!

Practice

- How many moles are in 345 grams of Al?
- How many moles are in 345 grams of Br?
- How many moles are in 55 grams of water?
- How many moles are in 5000 grams of $C_{12}H_{22}O_{11}$?

Particles to Moles

- When converting from grams to moles, you do the opposite
- How many moles are there in 2.02×10^{24} part C ?

$$\frac{2.02 \times 10^{24} \text{ part C}}{} \left| \frac{1 \text{ mole C}}{\text{part C}} \right. = \_\_\_\_ \textbf{ moles C}$$

Cross thingy!

Practice

- How many particles are in 34 moles of Al?
- How many particles are in 34 moles of Br?
- How many particles are in 55 moles of water?
- How many particles are in 5000 moles of $C_{12}H_{22}O_{11}$?

Assignment

- EOSQ (1,3,4,5ab,8ab,9-11)
- 4.2 wkst (In class tomorrow)

Modern Atomic Theory

4.3

Key Ideas

- What is the modern model of the atom?
- How are the NRG levels of an atom filled?
- What makes an electron jump to a new NRG level?

Modern Model

- *What is the modern model of atom?*
- In the modern atomic model, electrons can be found only in certain energy levels, not between levels. Furthermore, the location of electrons cannot be predicted precisely.

Modern Models of the Atom

- Niels Bohr determined that electrons can only be found in _____ NRG levels
- These electrons can move from _____ level to _____ level but require _____ to do so

- Example:
  - Electrons in a building
  - They can live on any floor but not in between them
  - Going up the elevator means they are gaining NRG while going down on the elevator means they are losing NRG

Modern Models of the Atom

- Bohr determined that electrons act more like _____ than _____
- Because they act like _____ , you _____ know exactly where an electron is
  - Like the blades on a propeller when it is moving
  - You know where it _____ , but not for sure

Modern Models of the Atom

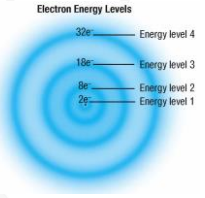
- Where you are likely to find an electron is called an _____ .
- An _____ is a region in an atom where there is a high probability of finding electrons
- Figure 2 on page 129

Electron NRG levels

- *How are the NRG levels of an atom filled?*
- The number of NRG levels filled in an atom depends on the number of _____ .
- Electrons fill from the _____ NRG level to the highest NRG level

Electron NRG levels

- So, electrons fill NRG level 1, the NRG level 2, etc.
- _____ **:** an electron that is found in the outermost shell of an atom and that determines the atom's chemical properties



Valence Electrons

- Atoms in the same _____ have the same number of _____ electrons
  - Examples on PT

The Role of Electrons

- There are 2 ways to remember this…
- Groups 1 and 2 = _____
- Groups 13-18 = _____
- OR

This is how I remember it…

Electron NRG Levels

- Each of orbital can hold a max of _____ electrons
- There are _____ types of orbitals
- There is 1 type of "___" orbital, 3 types of "___" orbitals, 5 types of "___" orbitals and 7 types of "___" orbitals
  – OR

Electron NRG

- So, if there are 3 p orbitals, this would mean the "p" orbitals can hold a total of 6 electrons
  – 2 electrons/orbital and 3 "p" orbitals
- How many _____ _____ can the d and f orbitals hold?

Electron Transitions

- *What makes an electron jump to a new NRG level?*
- Electrons jump between _____ levels when an atom gains or loses _____

Electron Transitions

- When an electron is at its lowest NRG states it is said to be in its _____ .
- When an electron gains NRG by absorbing a photon, it moves to an _____ .
- A _____ is a quantum (unit, pack) of light (NRG)
- The electron releases the _____ when it fall back to a lower _____ level

Analogy

- Building
  - When NRG is absorbed, it goes up floors
  - When NRG is released, it goes down floors
  - It take more NRG to move up more floors

Electron Transitions

- The a photon is released, it can emit _____ at a particular wavelength (_____)
- Each element releases a unique _____
  - Like a fingerprint for an atom

Assignment

- EOSQ (3,4,7)
- 4.3 CR