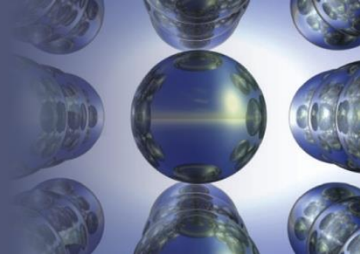
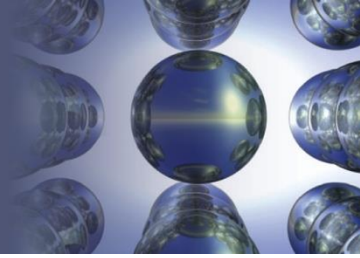


Three Important Laws

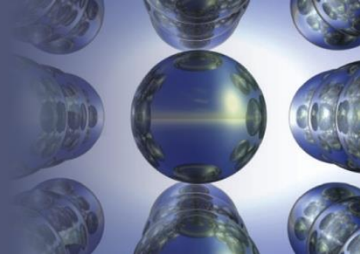
- Law of conservation of mass (Lavoisier):
  - Mass is neither created nor destroyed in a chemical reaction.

- Law of definite proportion (Proust):
  - A given compound always contains exactly the same proportion of elements by mass.



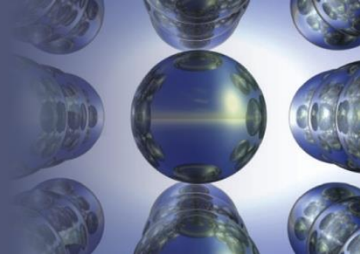
Three Important Laws (continued)

- Law of multiple proportions (Dalton):
  - When two elements form a series of compounds, the ratios of the masses of the second element that combine with 1 gram of the first element can always be reduced to small whole numbers.



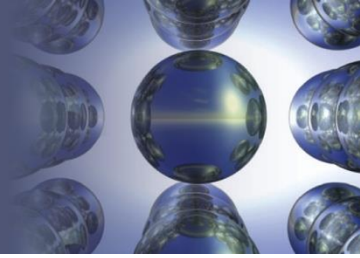
Dalton's Atomic Theory (1808)

- *Each element is made up of tiny particles called atoms.*



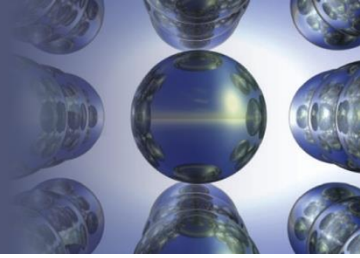
Dalton's Atomic Theory (continued)

- *The atoms of a given element are identical;* the atoms of different elements are different in some fundamental way or ways.



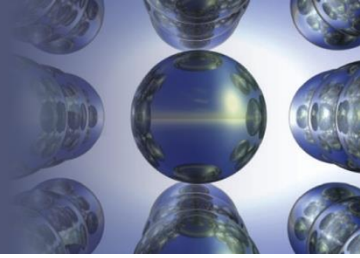
Dalton's Atomic Theory (continued)

- *Chemical compounds are formed when atoms of different elements combine with each other.* A given compound always has the same relative numbers and types of atoms.



Dalton's Atomic Theory (continued)

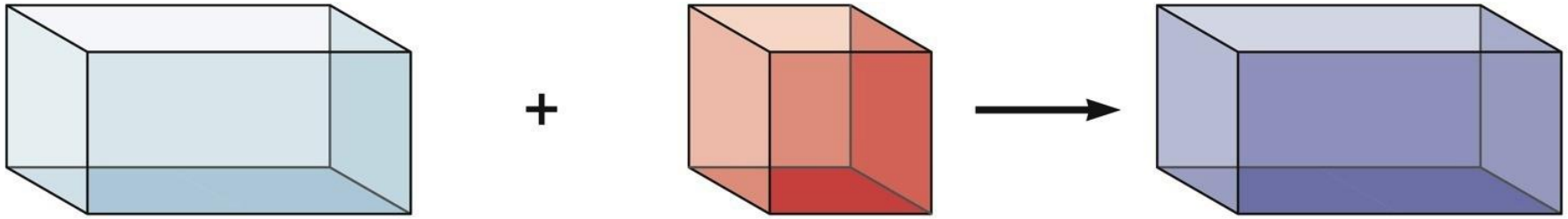
- *Chemical reactions involve reorganization of the atoms*—changes in the way they are bound together.
- The atoms themselves are not changed in a chemical reaction.



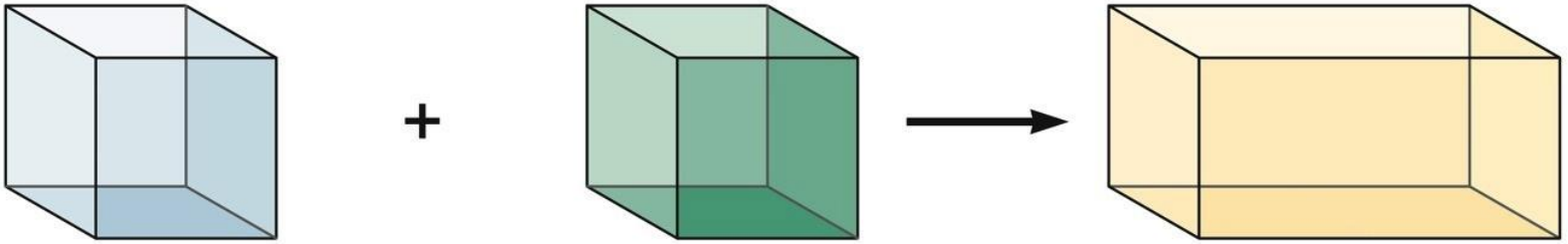
Gay-Lussac and Avogadro (1809—1811)

- Gay—Lussac
  - Measured (under same conditions of T and P) the volumes of gases that reacted with each other.
- Avogadro's Hypothesis
  - At the same T and P, equal volumes of different gases contain the same number of particles.
    - Volume of a gas is determined by the number, not the size, of molecules.

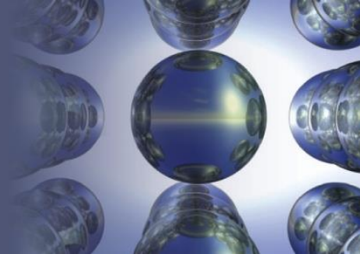
Representing Gay—Lussac's Results



Representing Gay—Lussac's Results

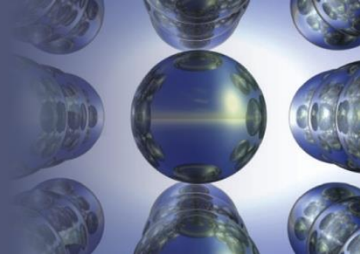


1 volume hydrogen combines with 1 volume chlorine to form 2 volumes hydrogen chloride



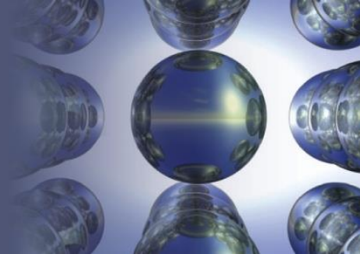
J. J. Thomson (1898—1903)

- Postulated the existence of negatively charged particles, that we now call electrons, using cathode-ray tubes.
- Determined the charge-to-mass ratio of an electron.
- The atom must also contain positive particles that balance exactly the negative charge carried by electrons.

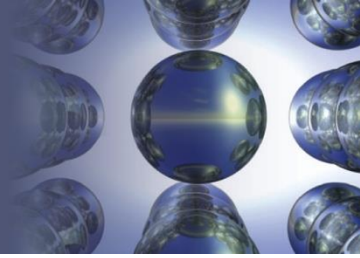


Robert Millikan (1909)

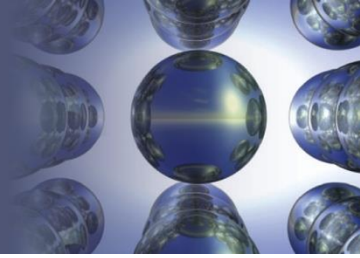
- Performed experiments involving charged oil drops.
- Determined the magnitude of the charge on a single electron.
- Calculated the mass of the electron
  - $(9.11 \times 10^{-31}$ kg).



- The atom contains:
  - *Electrons* – found outside the nucleus; negatively charged.
  - *Protons* – found in the nucleus; positive charge equal in magnitude to the electron's negative charge.
  - *Neutrons* – found in the nucleus; no charge; virtually same mass as a proton.



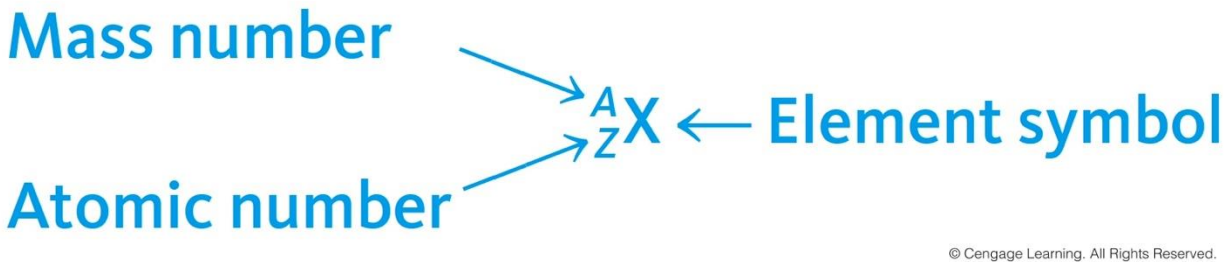
- The nucleus is:
  - Small compared with the overall size of the atom.
  - Extremely dense; accounts for almost all of the atom's mass.

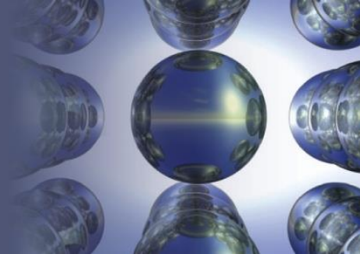


Isotopes

- Atoms with the same number of protons but different numbers of neutrons.
- Show almost identical chemical properties; chemistry of atom is due to its electrons.
- In nature most elements contain mixtures of isotopes.

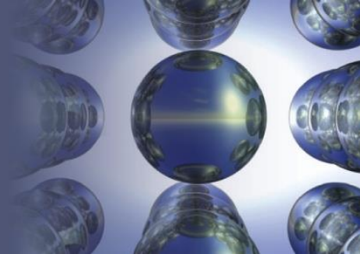
- Isotopes are identified by:
  - Atomic Number (Z) – number of protons
  - Mass Number (A) – number of protons plus number of neutrons





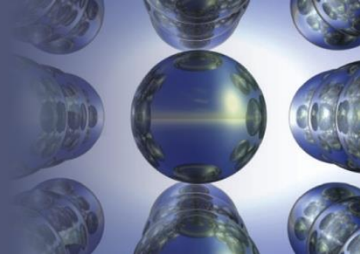
Chemical Bonds

- Covalent Bonds
  - Bonds form between atoms by sharing electrons.
  - Resulting collection of atoms is called a molecule.



Chemical Bonds

- Ionic Bonds
  - Bonds form due to force of attraction between oppositely charged ions.
  - *Ion* – atom or group of atoms that has a net positive or negative charge.
  - *Cation* – positive ion; lost electron(s).
  - *Anion* – negative ion; gained electron(s).



EXERCISE!

A certain isotope X^+ contains 54 electrons and 78 neutrons.

- What is the mass number of this isotope?

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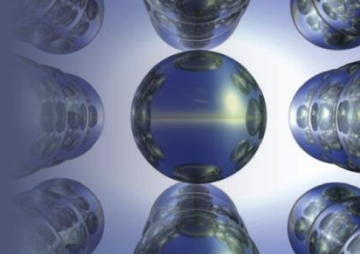

The Periodic Table

- *Metals vs. Nonmetals*
- *Groups or Families* – elements in the same vertical columns; have similar chemical properties
- *Periods* – horizontal rows of elements